

INTERNATIONAL STANDARD



**Adjustable speed electrical power drive systems –
Part 7-201: Generic interface and use of profiles for power drive systems –
Profile type 1 specification**



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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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CONTENTS

FOREWORD.....	17
INTRODUCTION.....	19
1 Scope.....	23
2 Normative references	23
3 Terms, definitions and abbreviated terms	23
3.1 Terms and definitions.....	23
3.2 Abbreviated terms.....	27
4 General	28
4.1 General considerations	28
4.2 Communication interface.....	29
4.3 Object dictionary	29
5 Data types	30
5.1 Standard data types.....	30
5.2 Record definitions	30
6 General object definitions	31
6.1 General.....	31
6.2 Communication parameter objects	31
6.3 Additional identification and information objects.....	32
6.3.1 Object 6402 _h : Motor type.....	32
6.3.2 Object 6403 _h : Motor catalogue number	33
6.3.3 Object 6404 _h : Motor manufacturer.....	34
6.3.4 Object 6405 _h : http motor catalogue address	35
6.3.5 Object 6406 _h : Motor calibration date	35
6.3.6 Object 6407 _h : Motor service period	36
6.3.7 Object 6503 _h : Drive catalogue number	36
6.3.8 Object 6505 _h : http drive catalogue address	37
7 Error codes and error behavior	37
7.1 Error codes.....	37
7.2 Error behavior.....	41
8 Controlling the power drive system	42
8.1 General.....	42
8.2 Finite state automaton	42
8.3 Modes of operation	45
8.4 Detailed object specifications	46
8.4.1 Object 6040 _h : Controlword	46
8.4.2 Object 6041 _h : Statusword.....	47
8.4.3 Object 603F _h : Error code.....	49
8.4.4 Object 6007 _h : Abort connection option code	50
8.4.5 Object 605A _h : Quick stop option code	51
8.4.6 Object 605B _h : Shutdown option code	51
8.4.7 Object 605C _h : Disable operation option code	52
8.4.8 Object 605D _h : Halt option code	53
8.4.9 Object 605E _h : Fault reaction option code	54
8.4.10 Object 6060 _h : Modes of operation	54
8.4.11 Object 6061 _h : Modes of operation display	56

8.4.12	Object 6502 _h : Supported drive modes	56
9	Factor group	57
9.1	General	57
9.2	Detailed object definitions	59
9.2.1	Object 608F _h : Position encoder resolution	59
9.2.2	Object 6090 _h : Velocity encoder resolution	60
9.2.3	Object 6091 _h : Gear ratio	62
9.2.4	Object 6092 _h : Feed constant	63
9.2.5	Object 6096 _h : Velocity factor	64
9.2.6	Object 6097 _h : Acceleration factor	64
9.2.7	Object 60A2 _h : Jerk factor	65
9.2.8	Object 607E _h : Polarity	66
9.2.9	Code table for device profile specific units	67
9.2.10	Object 60A8 _h : SI unit position	67
9.2.11	Object 60A9 _h : SI unit velocity	68
9.2.12	Object 60AA _h : SI unit acceleration	69
9.2.13	Object 60AB _h : SI unit jerk	70
10	Profile position mode	70
10.1	General information	70
10.2	Functional description	71
10.2.1	General	71
10.2.2	Single set-point	72
10.2.3	Set of set-points	73
10.2.4	Usage of halt bit in conjunction with new set-point bit	74
10.3	General definitions	75
10.4	Use of controlword and statusword	75
10.5	Detailed object definitions	76
10.5.1	Object 607A _h : Target position	76
10.5.2	Object 607B _h : Position range limit	77
10.5.3	Object 607D _h : Software position limit	78
10.5.4	Object 607F _h : Max profile velocity	80
10.5.5	Object 6080 _h : Max motor speed	81
10.5.6	Object 6081 _h : Profile velocity	81
10.5.7	Object 6082 _h : End velocity	82
10.5.8	Object 6083 _h : Profile acceleration	82
10.5.9	Object 6084 _h : Profile deceleration	83
10.5.10	Object 6085 _h : Quick stop deceleration	83
10.5.11	Object 6086 _h : Motion profile type	84
10.5.12	Object 60A3 _h : Profile jerk use	85
10.5.13	Object 60A4 _h : Profile jerk	85
10.5.14	Object 60C5 _h : Max acceleration	87
10.5.15	Object 60C6 _h : Max deceleration	88
11	Homing mode	89
11.1	General information	89
11.2	Functional description	89
11.3	General definitions	90
11.3.1	General	90
11.3.2	Method 1: Homing on negative limit switch and index pulse	90
11.3.3	Method 2: Homing on positive limit switch and index pulse	90

11.3.4	Method 3 and 4: Homing on positive home switch and index pulse	90
11.3.5	Method 5 and 6: Homing on negative home switch and index pulse	91
11.3.6	Method 7 to 14: Homing on home switch and index pulse	91
11.3.7	Method 15 and 16: Reserved	92
11.3.8	Method 17 to 30: Homing without index pulse	92
11.3.9	Method 31 and 32: Reserved	93
11.3.10	Method 33 and 34: Homing on index pulse	93
11.3.11	Method 35: Homing on ~~index pulse~~ current position (obsolete)	93
11.3.12	Method 36: ~~Homing with touch probe~~ Reserved for compatibility reasons	93
11.3.13	Method 37: Homing on current position	93
11.4	Use of controlword and statusword	94
11.5	Detailed object definitions	94
11.5.1	Object 607C _h : Home offset	94
11.5.2	Object 6098 _h : Homing method	95
11.5.3	Object 60E3 _h : Supported homing methods	96
11.5.4	Object 6099 _h : Homing speeds	97
11.5.5	Object 609A _h : Homing acceleration	98
12	Touch probe functionality	99
12.1	Object 60B8 _h : Touch probe function	99
12.2	Object 60B9 _h : Touch probe status	101
12.3	Object 60BA _h : Touch probe ~~pos1 pos value~~ 1 positive edge	102
12.4	Object 60BB _h : Touch probe ~~pos1 neg value~~ 1 negative edge	102
12.5	Object 60BC _h : Touch probe ~~pos2 pos value~~ 2 positive edge	103
12.6	Object 60BD _h : Touch probe ~~pos2 neg value~~ 2 negative edge	103
12.7	Object 60D0 _h : Touch probe source	104
12.8	Touch probe time stamp latch	105
12.8.1	General	105
12.8.2	Object 60D1 _h : Touch probe time stamp 1 positive value	106
12.8.3	Object 60D2 _h : Touch probe time stamp 1 negative value	106
12.8.4	Object 60D3 _h : Touch probe time stamp 2 positive value	107
12.8.5	Object 60D4 _h : Touch probe time stamp 2 negative value	107
12.9	Touch probe edge counter for continuous mode	108
12.9.1	General	108
12.9.2	Object 60D5 _h : Touch probe 1 positive edge counter	108
12.9.3	Object 60D6 _h : Touch probe 1 negative edge counter	108
12.9.4	Object 60D7 _h : Touch probe 2 positive edge counter	109
12.9.5	Object 60D8 _h : Touch probe 2 negative edge counter	110
12.10	Timing diagram for touch probe example	110
13	Position control function	112
13.1	General information	112
13.2	Functional description	112
13.3	Detailed object definitions	115
13.3.1	Object 6062 _h : Position demand value	115
13.3.2	Object 6063 _h : Position actual internal value	115
13.3.3	Object 6064 _h : Position actual value	116
13.3.4	Object 6065 _h : Following error window	116
13.3.5	Object 6066 _h : Following error time out	117
13.3.6	Object 6067 _h : Position window	118
13.3.7	Object 6068 _h : Position window time	118

13.3.8	Object 60F4 _h : Following error actual value	119
13.3.9	Object 60FA _h : Control effort	119
13.3.10	Object 60FC _h : Position demand internal value	120
13.3.11	Object 60F2 _h : Positioning option code	120
14	Interpolated position mode	124
14.1	General information	124
14.2	Functional description	125
14.2.1	General	125
14.2.2	Linear interpolated position mode with several axes	125
14.2.3	Buffer strategies for the interpolated position mode	127
14.2.4	Interpolated position mode FSA	128
14.3	General definitions	129
14.4	Use of controlword and statusword	129
14.5	Detailed object definitions	130
14.5.1	Object 60C0 _h : Interpolation sub mode select	130
14.5.2	Object 60C1 _h : Interpolation data record	131
14.5.3	Object 60C2 _h : Interpolation time period	132
14.5.4	Object 60C4 _h : Interpolation data configuration	133
15	Profile velocity mode	136
15.1	General information	136
15.2	Functional description	137
15.3	General definitions	137
15.4	Use of controlword and statusword	137
15.5	Detailed object definitions	138
15.5.1	Object 6069 _h : Velocity sensor actual value	138
15.5.2	Object 606A _h : Sensor selection code	139
15.5.3	Object 606B _h : Velocity demand value	139
15.5.4	Object 606C _h : Velocity actual value	140
15.5.5	Object 606D _h : Velocity window	140
15.5.6	Object 606E _h : Velocity window time	141
15.5.7	Object 606F _h : Velocity threshold	141
15.5.8	Object 6070 _h : Velocity threshold time	142
15.5.9	Object 60FF _h : Target velocity	142
15.5.10	Object 60F8 _h : Max slippage	143
16	Profile torque mode	144
16.1	General information	144
16.2	Functional description	144
16.3	General definitions	145
16.4	Use of controlword and statusword	145
16.5	Detailed object definitions	145
16.5.1	Object 6071 _h : Target torque	145
16.5.2	Object 6072 _h : Max torque	146
16.5.3	Object 60E0 _h : Positive torque limit value	146
16.5.4	Object 60E1 _h : Negative torque limit value	147
16.5.5	Object 6073 _h : Max current	148
16.5.6	Object 6074 _h : Torque demand	148
16.5.7	Object 6075 _h : Motor rated current	149
16.5.8	Object 6076 _h : Motor rated torque	149
16.5.9	Object 6077 _h : Torque actual value	150

16.5.10	Object 6078 _h : Current actual value	150
16.5.11	Object 6079 _h : DC link circuit voltage	151
16.5.12	Object 6087 _h : Torque slope	151
16.5.13	Object 6088 _h : Torque profile type	152
17	Velocity mode	152
17.1	General information	152
17.2	Functional description	153
~~17.2.1~~	~~Velocity limit function~~	~~153~~
17.2.1	Ramp function	153
17.2.2	Velocity control function	154
17.2.3	Factor function	154
17.3	General definitions	155
17.4	Use of controlword and statusword	155
17.5	Detailed object definitions	156
17.5.1	Object 6042 _h : vl target velocity	156
17.5.2	Object 6043 _h : vl velocity demand	156
17.5.3	Object 6044 _h : vl velocity actual value	157
17.5.4	Object 6046 _h : vl velocity min max amount	158
17.5.5	Object 6049 _h : vl velocity deceleration	159
17.5.6	Object 6048 _h : vl velocity acceleration	160
17.5.7	Object 604A _h : vl velocity quick stop	162
17.5.8	Object 604B _h : vl set-point factor	163
17.5.9	Object 604C _h : vl dimension factor	164
18	Cyclic synchronous position mode	166
18.1	General information	166
18.2	Functional description	166
18.3	Use of controlword and statusword	167
18.4	Detailed object definitions	168
18.4.1	Object 60B0 _h : Position offset	168
18.4.2	Object 60B1 _h : Velocity offset	168
18.4.3	Object 60B2 _h : Torque offset	169
19	Cyclic synchronous velocity mode	170
19.1	General information	170
19.2	General definitions	171
19.3	Functional description	171
19.4	Use of controlword and statusword	171
20	Cyclic synchronous torque mode	172
20.1	General information	172
20.2	General definitions	173
20.3	Functional description	173
20.4	Use of controlword and statusword	173
21	Cyclic synchronous torque mode with commutation angle (cstca)	174
21.1	General information	174
21.2	General definitions	175
21.3	Functional description	175
21.4	Use of controlword and statusword	176
21.5	Object 60EA _h : Commutation angle	177
22	Support of additional sensor interfaces	177

22.1	General.....	177
22.2	Object 60E4 _h : Additional position actual value	177
22.3	Object 60E5 _h : Additional velocity actual value	178
22.4	Object 60E6 _h : Additional position encoder resolution – encoder increments	179
22.5	Object 60EB _h : Additional position encoder resolution – motor revolutions.....	181
22.6	Object 60E7 _h : Additional velocity encoder resolution – encoder increments per second.....	182
22.7	Object 60EC _h : Additional velocity encoder resolution – motor revolutions per second.....	184
22.8	Object 60E8 _h : Additional gear ratio – motor shaft revolutions	185
22.9	Object 60ED _h : Additional gear ratio – driving shaft revolutions	186
22.10	Object 60E9 _h : Additional feed constant – feed	187
22.11	Object 60EE _h : Additional feed constant – driving shaft revolutions	188
23	Optional application FE	189
23.1	General.....	189
23.2	Object 60FD _h : Digital inputs	189
23.3	Object 60FE _h : Digital outputs	190
24	Device information.....	192
24.1	General.....	192
24.2	Object 67FE _h : Version number	192
	Bibliography.....	194
	Figure 1 – Structure of IEC 61800-7.....	22
	Figure 2 – Value definition	32
	Figure 3 – Remote and local control.....	42
	Figure 4 – Power drive system finite state automaton	43
	Figure 5 – Relation between different value parameters.....	46
	Figure 6 – Value definition	46
	Figure 7 – Value definition	48
	Figure 8 – Value definition.....	56
	Figure 9 – Position scaling concept.....	58
	Figure 10 – Value definition	67
	Figure 11 – Example for a position unit.....	68
	Figure 12 – Example for a velocity unit	69
	Figure 13 – Example for an acceleration unit	70
	Figure 14 – Example for a jerk unit	70
	Figure 15 – Trajectory generator and position control function	71
	Figure 16 – Trajectory generator for profile position mode	71
	Figure 17 – Set-point example	72
	Figure 18 – Handshaking procedure for the single set-point method	72
	Figure 19 – Handshaking procedure for the set of set-points method	73
	Figure 20 – Set-point handling for two set-points	74
	Figure 21 – Erase set-point.....	75
	Figure 22 – Controlword for profile position (pp) mode.....	75
	Figure 23 – Statusword for profile position (pp) mode	76
	Figure 24 – Software position limits	79

Figure 25 – Velocity/time diagram with jerk positions	86
Figure 26 – Homing mode function.....	89
Figure 27 – Homing on negative limit switch and index pulse	90
Figure 28 – Homing on positive limit switch and index pulse	90
Figure 29 – Homing on positive home switch and index pulse	91
Figure 30 – Homing on negative home switch and index pulse	91
Figure 31 – Homing on home switch and index pulse – positive initial motion	92
Figure 32 – Homing on home switch and index pulse – negative initial motion	92
Figure 33 – Homing on positive home switch	93
Figure 34 – Homing on index pulse	93
Figure 35 – Controlword for homing mode.....	94
Figure 36 – Statusword for homing mode.....	94
Figure 37 – Home offset definition	95
Figure 38 – Timing diagram for touch probe example.....	111
Figure 39 – Position control function	113
Figure 40 – Following error (functional overview)	113
Figure 41 – Position reached (functional overview)	114
Figure 42 – Position reached (definitions)	114
Figure 43 – Following error (definitions).....	115
Figure 44 – Object structure.....	121
Figure 45 – Rotary axis positioning example	122
Figure 46 – Example for absolute movement greater than modulo value	123
Figure 47 – Example for relative movement greater than modulo value	123
Figure 48 – Interpolation controller	125
Figure 49 – Interpolated position mode for two axes	126
Figure 50 – Linear interpolation for one axis	127
Figure 51 – Input buffer organization	128
Figure 52 – Input buffer examples.....	128
Figure 53 – Interpolated position mode FSA	129
Figure 54 – Controlword for interpolated position mode	129
Figure 55 – Statusword for interpolated position mode	130
Figure 56 – Profile velocity mode	137
Figure 57 – Controlword for profile velocity mode	137
Figure 58 – Statusword for profile velocity mode	138
Figure 59 – Structure of the profile torque mode	144
Figure 60 – Controlword for profile torque mode	145
Figure 61 – Statusword for profile torque mode.....	145
Figure 62 – Velocity mode with all objects	153
Figure 63 – Velocity mode with mandatory objects only	153
Figure 64 – Velocity profile	154
Figure 65 – Factor function	154
Figure 66 – Reverse factor function	154
Figure 67 – Controlword for profile velocity mode	155

Figure 68 – Usage of controlword bits in velocity mode	155
Figure 69 – Statusword for profile velocity mode	156
Figure 70 – Transfer characteristic of vl velocity min max amount	158
Figure 71 – Transfer characteristic of the velocity deceleration	159
Figure 72 – Transfer characteristic of the velocity acceleration	161
Figure 73 – Transfer characteristic of the quick stop deceleration	162
Figure 74 – Cyclic synchronous position mode overview	166
Figure 75 – Cyclic synchronous position control function	167
Figure 76 – Statusword for profile cyclic synchronous position mode	167
Figure 77 – Cyclic synchronous velocity mode overview	170
Figure 78 – Cyclic synchronous velocity control function	171
Figure 79 – Statusword for profile cyclic synchronous velocity mode	172
Figure 80 – Cyclic synchronous torque mode overview	173
Figure 81 – Cyclic synchronous torque control function	173
Figure 82 – Statusword for profile cyclic synchronous torque mode	174
Figure 83 – Cyclic synchronous torque mode with commutation angle overview	175
Figure 84 – Cyclic synchronous torque with commutation angle control function	176
Figure 85 – Statusword for cstca mode	176
Figure 86 – Object structure	190
Figure 87 – Object structure	191
Figure 88 – Structure of the standard version parameter	192
Table 1 – List of used data types	30
Table 2 – ~~Interpolated~~ Interpolation time period	31
Table 3 – ~~Interpolated~~ Interpolation data configuration	31
Table 4 – vl velocity acceleration/deceleration	31
Table 5 – Object description	32
Table 6 – Entry description	32
Table 7 – Value definition	33
Table 8 – Object description	33
Table 9 – Entry description	33
Table 10 – Object description	34
Table 11 – Entry description	34
Table 12 – Object description	34
Table 13 – Entry description	34
Table 14 – Object description	35
Table 15 – Entry description	35
Table 16 – Object description	35
Table 17 – Entry description	35
Table 18 – Object description	36
Table 19 – Entry description	36
Table 20 – Object description	36
Table 21 – Entry description	36

Table 22 – Object description	37
Table 23 – Entry description	37
Table 24 – Error codes	38
Table 25 – FSA states and supported functions	43
Table 26 – Transition events and actions	44
Table 27 – Command coding	47
Table 28 – Object description	47
Table 29 – Entry description	47
Table 30 – State coding	48
Table 31 – Object description	49
Table 32 – Entry description	49
Table 33 – Object description	49
Table 34 – Entry description	50
Table 35 – Value definition	50
Table 36 – Object description	50
Table 37 – Entry description	50
Table 38 – Value definition	51
Table 39 – Object description	51
Table 40 – Entry description	51
Table 41 – Value definition	52
Table 42 – Object description	52
Table 43 – Entry description	52
Table 44 – Value definition	52
Table 45 – Object description	53
Table 46 – Entry description	53
Table 47 – Value definition	53
Table 48 – Object description	53
Table 49 – Entry description	54
Table 50 – Value definition	54
Table 51 – Object description	54
Table 52 – Entry description	54
Table 53 – Value definition	55
Table 54 – Object description	55
Table 55 – Entry description	55
Table 56 – Object description	56
Table 57 – Entry description	56
Table 58 – Object description	57
Table 59 – Entry description	57
Table 60 – Object description	60
Table 61 – Entry description	60
Table 62 – Object description	61
Table 63 – Entry description	61
Table 64 – Object description	62

Table 65 – Entry description	62
Table 66 – Object description	63
Table 67 – Entry description	63
Table 68 – Object description	64
Table 69 – Entry description	64
Table 70 – Object description	65
Table 71 – Entry description	65
Table 72 – Object description	66
Table 73 – Entry description	66
Table 74 – Object description	67
Table 75 – Entry description	67
Table 76 – Device profile specific units	67
Table 77 – Object description	68
Table 78 – Entry description	68
Table 79 – Object description	68
Table 80 – Entry description	69
Table 81 – Object description	69
Table 82 – Entry description	69
Table 83 – Object description	70
Table 84 – Entry description	70
Table 85 – Definition of bit 4, bit 5, and bit 9	76
Table 86 – Definition of bit 6 and bit 8	76
Table 87 – Definition of bit 10, bit 12, and bit 13	76
Table 88 – Object description	77
Table 89 – Entry description	77
Table 90 – Object description	77
Table 91 – Entry description	78
Table 92 – Object description	79
Table 93 – Entry description	80
Table 94 – Object description	80
Table 95 – Entry description	81
Table 96 – Object description	81
Table 97 – Entry description	81
Table 98 – Object description	82
Table 99 – Entry description	82
Table 100 – Object description	82
Table 101 – Entry description	82
Table 102 – Object description	83
Table 103 – Entry description	83
Table 104 – Object description	83
Table 105 – Entry description	83
Table 106 – Object description	84
Table 107 – Entry description	84

Table 108 – Value definition.....	84
Table 109 – Object description.....	84
Table 110 – Entry description	85
Table 111 – Object description.....	85
Table 112 – Entry description	85
Table 113 – Value assignments	86
Table 114 – Object description.....	86
Table 115 – Entry description	87
Table 116 – Object description.....	88
Table 117 – Entry description	88
Table 118 – Object description.....	88
Table 119 – Entry description	88
Table 120 – Definition of bit 4 and bit 8.....	94
Table 121 – Definition of bit 10, bit 12, and bit 13	94
Table 122 – Object description.....	95
Table 123 – Entry description	95
Table 124 – Value definition.....	96
Table 125 – Object description.....	96
Table 126 – Entry description	96
Table 127 – Object description.....	96
Table 128 – Entry description	97
Table 129 – Object description.....	98
Table 130 – Entry description	98
Table 131 – Object description.....	99
Table 132 – Entry description	99
Table 133 – Value definition.....	100
Table 134 – Object description.....	100
Table 135 – Entry description	101
Table 136 – Value definition.....	101
Table 137 – Object description.....	101
Table 138 – Entry description	102
Table 139 – Object description.....	102
Table 140 – Entry description	102
Table 141 – Object description.....	102
Table 142 – Entry description	103
Table 143 – Object description.....	103
Table 144 – Entry description	103
Table 145 – Object description.....	103
Table 146 – Entry description	104
Table 147 – Value definition.....	104
Table 148 – Object description.....	104
Table 149 – Entry description	105
Table 150 – Object description.....	106

Table 151 – Entry description	106
Table 152 – Object description.....	106
Table 153 – Entry description	106
Table 154 – Object description.....	107
Table 155 – Entry description	107
Table 156 – Object description.....	107
Table 157 – Entry description	107
Table 158 – Object description.....	108
Table 159 – Entry description	108
Table 160 – Object description.....	109
Table 161 – Entry description	109
Table 162 – Object description.....	109
Table 163 – Entry description	109
Table 164 – Object description.....	110
Table 165 – Entry description	110
Table 166 – Explanation of the timing diagram.....	112
Table 167 – Object description.....	115
Table 168 – Entry description	115
Table 169 – Object description.....	116
Table 170 – Entry description	116
Table 171 – Object description.....	116
Table 172 – Entry description	116
Table 173 – Object description.....	117
Table 174 – Entry description	117
Table 175 – Object description.....	117
Table 176 – Entry description	117
Table 177 – Object description.....	118
Table 178 – Entry description	118
Table 179 – Object description.....	118
Table 180 – Entry description	119
Table 181 – Object description.....	119
Table 182 – Entry description	119
Table 183 – Object description.....	120
Table 184 – Entry description	120
Table 185 – Object description.....	120
Table 186 – Entry description	120
Table 187 – Value definition for bit 0 and bit 1	121
Table 188 – Value definition for bit 2 and bit 3	121
Table 189 – Value definition for bit 4 and bit 5	122
Table 190 – Value definition for bit 6 and bit 7	122
Table 191 – Object description.....	123
Table 192 – Entry description	124
Table 193 – Position calculation in interpolated position mode for several axes	126

Table 194 – FSA states and supported functions	129
Table 195 – Transition events and actions	129
Table 196 – Definition of bit 4 and bit 8	130
Table 197 – Definition of bit 10 and bit 12	130
Table 198 – Value definition	130
Table 199 – Object description	131
Table 200 – Entry description	131
Table 201 – Object description	131
Table 202 – Entry description	132
Table 203 – Object description	133
Table 204 – Entry description	133
Table 205 – Object description	134
Table 206 – Entry description	135
Table 207 – Definition of bit 8	138
Table 208 – Definition of bit 10, bit 12, and bit 13	138
Table 209 – Object description	138
Table 210 – Entry description	139
Table 211 – Value definition	139
Table 212 – Object description	139
Table 213 – Entry description	139
Table 214 – Object description	140
Table 215 – Entry description	140
Table 216 – Object description	140
Table 217 – Entry description	140
Table 218 – Object description	141
Table 219 – Entry description	141
Table 220 – Object description	141
Table 221 – Entry description	141
Table 222 – Object description	142
Table 223 – Entry description	142
Table 224 – Object description	142
Table 225 – Entry description	142
Table 226 – Object description	143
Table 227 – Entry description	143
Table 228 – Object description	143
Table 229 – Entry description	143
Table 230 – Definition of bit 8	145
Table 231 – Definition of bit 10	145
Table 232 – Object description	146
Table 233 – Entry description	146
Table 234 – Object description	146
Table 235 – Entry description	146
Table 236 – Object description	147

Table 237 – Entry description	147
Table 238 – Object description.....	147
Table 239 – Entry description	147
Table 240 – Object description.....	148
Table 241 – Entry description	148
Table 242 – Object description.....	148
Table 243 – Entry description	148
Table 244 – Object description.....	149
Table 245 – Entry description	149
Table 246 – Object description.....	149
Table 247 – Entry description	150
Table 248 – Object description.....	150
Table 249 – Entry description	150
Table 250 – Object description.....	150
Table 251 – Entry description	151
Table 252 – Object description.....	151
Table 253 – Entry description	151
Table 254 – Object description.....	151
Table 255 – Entry description	152
Table 256 – Value definition.....	152
Table 257 – Object description.....	152
Table 258 – Entry description	152
Table 259 – Definition of bit 4, bit 5, bit 6, and bit 8	155
Table 260 – Object description.....	156
Table 261 – Entry description	156
Table 262 – Object description.....	157
Table 263 – Entry description	157
Table 264 – Object description.....	157
Table 265 – Entry description	157
Table 266 – Object description.....	158
Table 267 – Entry description	159
Table 268 – Object description.....	160
Table 269 – Entry description	160
Table 270 – Object description.....	161
Table 271 – Entry description	162
Table 272 – Object description.....	163
Table 273 – Entry description	163
Table 274 – Object description.....	164
Table 275 – Entry description	164
Table 276 – Object description.....	165
Table 277 – Entry description	165
Table 278 – Definition of bit 10, bit 12, and bit 13	168
Table 279 – Object description.....	168

Table 280 – Entry description	168
Table 281 – Object description.....	169
Table 282 – Entry description	169
Table 283 – Object description.....	169
Table 284 – Entry description	170
Table 285 – Definition of bit 10, bit 12, and bit 13	172
Table 286 – Definition of bit 10, bit 12, and bit 13	174
Table 287 – Definition of bit 10, bit 12, and bit 13	176
Table 288 – Object description.....	177
Table 289 – Entry description	177
Table 290 – Object description.....	177
Table 291 – Entry description	178
Table 292 – Object description.....	179
Table 293 – Entry description	179
Table 294 – Object description.....	180
Table 295 – Entry description	180
Table 296 – Object description.....	181
Table 297 – Entry description	182
Table 298 – Object description.....	183
Table 299 – Entry description	183
Table 300 – Object description.....	184
Table 301 – Entry description	184
Table 302 – Object description.....	185
Table 303 – Entry description	186
Table 304 – Object description.....	186
Table 305 – Entry description	187
Table 306 – Object description.....	187
Table 307 – Entry description	188
Table 308 – Object description.....	188
Table 309 – Entry description	189
Table 310 – Value definition.....	190
Table 311 – Object description.....	190
Table 312 – Entry description	190
Table 313 – Value definition.....	191
Table 314 – Object description.....	191
Table 315 – Entry description	192
Table 316 – Object description.....	193
Table 317 – Entry description	193

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 7-201: Generic interface and use of profiles for power drive systems – Profile type 1 specification

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The International Standard IEC 61800-7-201 has been prepared by subcommittee SC 22G: Adjustable speed electric drive systems incorporating semiconductor power converters, of IEC technical committee TC 22: Power electronic systems and equipment.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- Updates, clarifications and enhancements.

The text of this standard is based on the following documents:

FDIS	Report on voting
22G/307/FDIS	22G/322/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61800 series, under the general title *Adjustable speed electrical power drive systems*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The IEC 61800 series is intended to provide a common set of specifications for adjustable speed electrical power drive systems.

IEC 61800-7 specifies profiles for power drive systems (PDS) and their mapping to existing communication systems by use of a generic interface model.

IEC 61800-7 describes a generic interface between control systems and power drive systems. This interface can be embedded in the control system. The control system itself can also be located in the drive (sometimes known as "smart drive" or "intelligent drive").

A variety of physical interfaces is available (analogue and digital inputs and outputs, serial and parallel interfaces, fieldbuses and networks). Profiles based on specific physical interfaces are already defined for some application areas (e.g. motion control) and some device classes (e.g. standard drives, positioner). The implementations of the associated drivers and application programmers interfaces are proprietary and vary widely.

IEC 61800-7 defines a set of common drive control functions, parameters, and state machines or description of sequences of operation to be mapped to the drive profiles.

IEC 61800-7 provides a way to access functions and data of a drive that is independent of the used drive profile and communication interface. The objective is a common drive model with generic functions and objects suitable to be mapped on different communication interfaces. This makes it possible to provide common implementations of motion control (or velocity control or drive control applications) in controllers without any specific knowledge of the drive implementation.

There are several reasons to define a generic interface:

For a drive device manufacturer

- less effort to support system integrators;
- less effort to describe drive functions because of common terminology;
- the selection of drives does not depend on availability of specific support;

For a control device manufacturer

- no influence of bus technology;
- easy device integration;
- independent of a drive supplier;

For a system integrator (~~builds modules, machines, plants etc.~~)

- less integration effort for devices;
- only one understandable way of modeling;
- independent of bus technology,

Much effort is needed to design a motion control application with several different drives and a specific control system. The tasks to implement the system software and to understand the functional description of the individual components may exhaust the project resources. In some cases, the drives do not share the same physical interface. Some control devices just support a single interface which will not be supported by a specific drive. On the other hand, the functions and data structures are often specified with incompatibilities. ~~It is up to This requires~~ the systems integrator to write special interfaces ~~to for the application software to handle that which~~ and this should not be his responsibility.

Some applications need device exchangeability or integration of new devices in an existing configuration. They are faced with different incompatible solutions. The efforts to ~~adopt~~ adapt a solution to a drive profile and to manufacturer-specific extensions may be unacceptable. This will reduce the degree of freedom to select a device best suited for this application to the selection of the unit which will be available for a specific physical interface and supported by the controller.

IEC 61800-7-1 is divided into a generic part and several annexes as shown in Figure 1. The drive profiles types for CiA® 402¹, CIP Motion™², PROFIdrive³ and SERCOS®-Interface™⁴ are mapped to the generic interface in the corresponding annex. The annexes have been submitted by open international network or fieldbus organizations which are responsible for the content of the related annex and use of the related trade marks.

This part of IEC 61800-7 specifies the profile type 1 (CiA® 402).

The profile types 2, 3 and 4 are specified in IEC 61800-7-202, IEC 61800-7-203 and IEC 61800-7-204.

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IEC 61800-7-301, IEC 61800-7-302, IEC 61800-7-303 and IEC 61800-7-304 specify how the profile types 1, 2, 3 and 4 are mapped to different network technologies (such as CANopen⁵, EtherCATTM, CC-Link IE[®] Field Network⁶, EPATM⁷, EtherCAT[®]⁸, Ethernet PowerlinkTM⁹, DeviceNetTM¹⁰, ControlNetTM¹¹, EtherNet/IPTM¹², PROFIBUS¹³, PROFINET¹⁴ and SERCOS[®] Interface).

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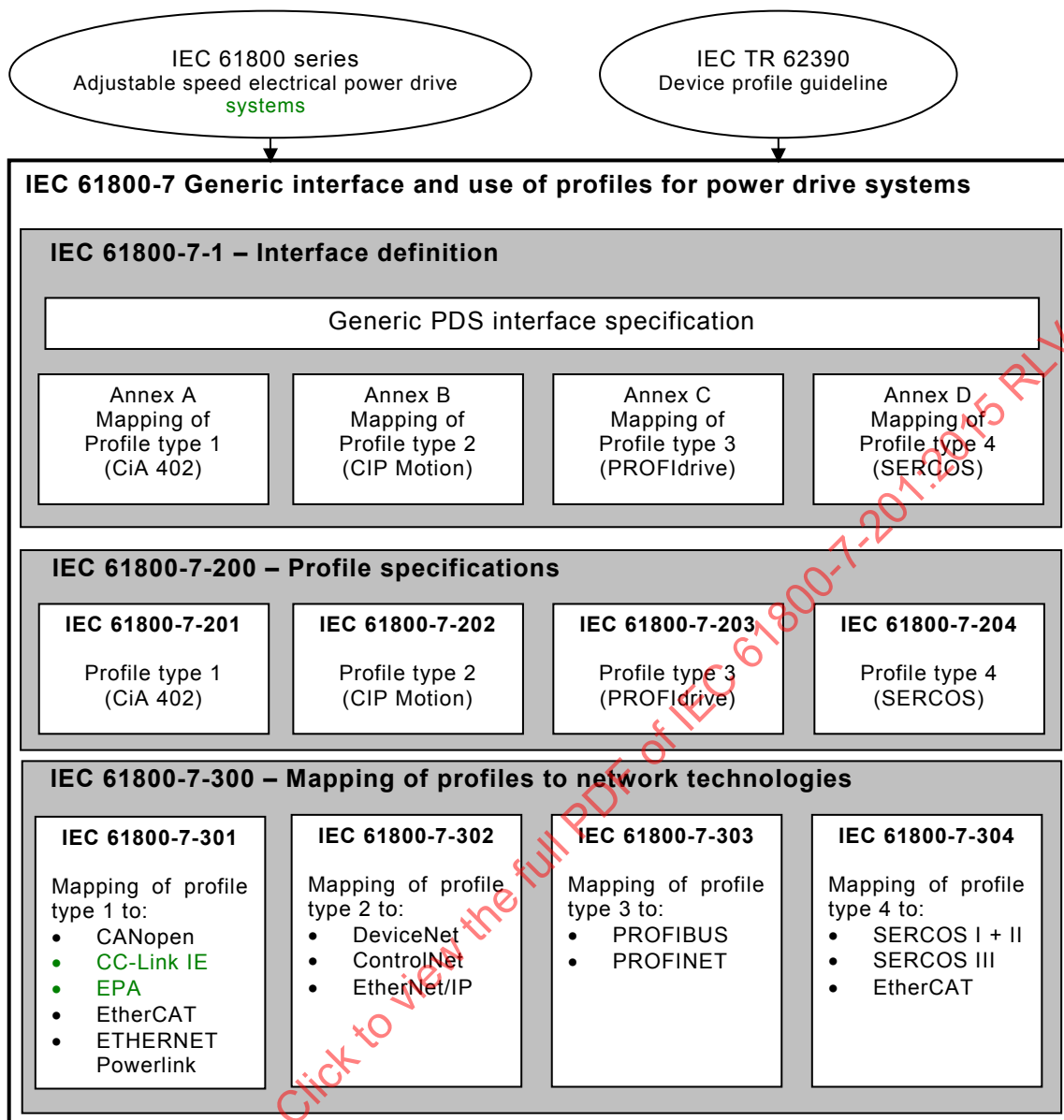


Figure 1 – Structure of IEC 61800-7

IEC

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 7-201: Generic interface and use of profiles for power drive systems – Profile type 1 specification

1 Scope

This part of IEC 61800 specifies profile type 1 for Power Drive Systems (PDS). Profile type 1 can be mapped onto different communication network technologies.

~~IEC 61800-7 specifies profiles for Power Drive Systems (PDS) and their mapping to existing communication systems by use of a generic interface model.~~

The functions specified in this part of IEC 61800 are not intended to ensure functional safety. This requires additional measures according to the relevant standards, agreements and laws.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 61800-7 (all parts), Adjustable speed electrical power drive systems – Generic interface and use of profiles for power drive systems~~

IEC 61800-7-301¹⁵, *Adjustable speed electrical power drive systems – Part 7-301: Generic interface and use of profiles for power drive systems – Mapping of profile type 1 to network technologies*

EN 50325-4, *Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces – Part 4: CANopen*

CiA 303-2:2012, *CANopen recommendation – Part 2: Representation of SI units and prefixes*¹⁶

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1

actual value

value of a variable **quantity** at a given instant

Note 1 to entry: Actual value ~~or actual variable are~~ is used in this document as input data of the application control program to monitor ~~feedback variables or other process~~ variables of the PDS (e.g. **feedback variables**).

¹⁵ To be published.

¹⁶ CiA 303-2 may be freely downloaded from www.can-cia.org. To avoid download misuse, the downloading person has to fill in a registration form, which does not arise some obligations to the specification user.

[SOURCE: ~~IEV 351-21-02~~ IEC 61800-7-1:2015, 3.3.1.1]

3.1.2 algorithm

completely determined finite sequence of operations by which the values of the output data can be calculated from the values of the input data

[SOURCE: ~~IEV 351-21-37~~ IEC 61800-7-1:2015, 3.2.1]

3.1.3 application

software functional element specific to the solution of a problem in industrial process measurement and control

Note 1 to entry: An application may be distributed among resources, and may communicate with other applications.

[SOURCE: ~~IEC/TR 62390:2005, 3.1.2, modified~~ IEC 61800-7-1:2015, 3.2.2]

3.1.4 application mode

type of application that can be requested from a PDS

Note 1 to entry: The different application modes reflect the control loop for torque control, velocity control, position control or other applications such as homing.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.2]

3.1.5 attribute

property or characteristic of an entity

[SOURCE: ~~IEC/TR 62390:2005, 3.1.3~~ IEC 61800-7-1:2015, 3.2.3]

3.1.6 class

description of a set of objects that share the same attributes, operations, methods, relationships, and semantics

[SOURCE: ~~ISO/IEC 19501, modified~~ IEC 61800-7-1:2015, 3.2.5]

3.1.7 commands

set of commands from the application control program to the PDS to control the behavior of the PDS or functional elements of the PDS

Note 1 to entry: The behavior is reflected by states or operating modes.

Note 2 to entry: The different commands may be represented by one bit each.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.3]

3.1.8 control

purposeful action on or in a process to meet specified objectives

[SOURCE: ~~IEV 351-21-29~~ IEC 61800-7-1:2015, 3.2.6]

3.1.9

control device

physical unit that contains – in a module/subassembly or device – an application program to control the PDS

[SOURCE: IEC 61800-7-1:2015, 3.2.7]

3.1.10

data type

set of values together with a set of permitted operations

[SOURCE: ~~ISO/IEC 2382-15:1999, 15.04.01, modified~~ IEC 61800-7-1:2015, 3.2.8]

3.1.11

device

field device

<function blocks> networked independent physical entity of an industrial automation system capable of performing specified functions in a particular context and delimited by its interfaces

[SOURCE: ~~IEC 61499-1:2005, 3.30, modified~~ IEC 61800-7-1:2015, 3.2.9]

~~entity that performs control, actuating and/or sensing functions and interfaces to other such entities within an automation system~~

~~[ISO 15745-1:2003, 3.11]~~

3.1.12

device profile

representation of a device in terms of its parameters, parameter assemblies and behaviour according to a device model that describes the data and behaviour of the device as viewed through a network, independent from any network technology

~~NOTE This is a definition from IEC/TS 61915 which is extended by the addition of the device functional structure.~~

[SOURCE: ~~IEC/TR 62390:2005, 3.19, modified~~ IEC 61800-7-1:2015, 3.2.11]

3.1.13

feedback variable

variable quantity, which represents the controlled variable and is returned to the comparing element

~~[IEV 351-27-03]~~

[SOURCE: IEC 61800-7-1:2015, 3.2.12]

3.1.14

functional element

entity of software or software combined with hardware, capable of accomplishing a specified function of a device

Note 1 to entry: A functional element has an interface, associations to other functional elements and functions.

Note 2 to entry: A functional element can be made out of function block(s), object(s) or parameter list(s).

[SOURCE: ~~IEC/TR 62390:2005, 3.1.12~~ IEC 61800-7-1:2015, 3.2.13]

3.1.15

high-level power

main electric power supply of the drive device

3.1.16

input data

data transferred from an external source into a device, resource or functional element

[SOURCE: ~~IEC/TR 62390:2005, 3.1.14~~ IEC 61800-7-1:2015, 3.2.14]

3.1.17

interface

shared boundary between two entities defined by functional characteristics, signal characteristics, or other characteristics as appropriate

[SOURCE: ~~IEV 351-21-35, modified~~ IEC 61800-7-1:2015, 3.2.15]

3.1.18

logical power drive system

model which includes PDS and communication network accessible through the generic PDS interface

[SOURCE: IEC 61800-7-1:2015, 3.2.16]

3.1.19

low-level power

electrical power supply for the control section of the drive device

3.1.20

model

mathematical or physical representation of a system or a process, based with sufficient precision upon known laws, identification or specified suppositions

[SOURCE: ~~IEV 351-21-36~~ IEC 61800-7-1:2015, 3.2.17]

3.1.21

operating mode

characterization of the way and the extent to which the human operator intervenes in the control equipment

[SOURCE: ~~IEV 351-31-04~~ IEC 61800-7-1:2015, 3.2.18]

3.1.22

output data

data originating in a device, resource or functional element and transferred from them to external systems

[SOURCE: ~~IEC/TR 62390:2005, 3.1.21~~ IEC 61800-7-1:2015, 3.2.19]

3.1.23

parameter

data element that represents device information that can be read from or written to a device, for example through the network or a local HMI

~~Note 1 — Adapted from IEC/TS 61915.~~

Note 1 to entry: A parameter is typically characterised by a parameter name, data type and access direction.

[SOURCE: ~~IEC/TR 62390:2005, 3.1.22, modified~~ IEC 61800-7-1:2015, 3.2.20]

3.1.24

profile

representation of a PDS interface in terms of its parameters, parameter assemblies and behavior according to a communication profile and a device profile

[SOURCE: IEC 61800-7-1:2015, 3.2.21, modified — Note 1 to entry is deleted.]

3.1.25

reference variable

input variable to a comparing element in a controlling system which sets the desired value of the controlled variable and is deducted from the command variable

[SOURCE: ~~IEV 351-27-02~~ IEC 61800-7-1:2015, 3.2.22]

3.1.26

set-point

value or variable used as output data of the application control program to control the PDS

[SOURCE: IEC 61800-7-1:2015, 3.3.1.5]

3.1.27

status

set of information from the PDS to the application control program reflecting the state or mode of the PDS or a functional element of the PDS

Note 1 to entry: The different status information may be coded with one bit each.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.6]

3.1.28

type

hardware or software element which specifies the common attributes shared by all instances of the type

[SOURCE: ~~IEC/TR 62390:2005, 3.1.25~~ IEC 61800-7-1:2015, 3.2.23]

3.1.29

use case

class specification of a sequence of actions, including variants, that a system (or other entity) can perform, interacting with actors of the system

[SOURCE: ~~IEC/TR 62390:2005, 3.1.26~~ IEC 61800-7-1:2015, 3.2.24]

3.1.30

variable

software entity that may take different values, one at a time

Note 1 to entry: The values of a variable as well as of a parameter are usually restricted to a certain data type.

[SOURCE: ~~IEC/TR 62390:2005, 3.1.27~~ IEC 61800-7-1:2015, 3.2.25]

3.2 Abbreviated terms

AC	alternating current
BL	brush-less
c	constant
CiA	CAN in Automation
COB	communication object

csp	cyclic synchronous profile mode
cst	cyclic synchronous torque mode
cstca	cyclic synchronous torque mode with commutation angle
csv	cyclic synchronous velocity mode
DC	direct current
DIV	divisor
FC	frequency converter
FE	functional element
FIFO	first In, first out
FSA	finite state automaton
hm	homing mode
HMI	human machine interface
I/O	input/output
ip	interpolated position mode
LSB	less significant bit/byte
MSB	most significant bit/byte
MUL	multiplication
NMT	network management
PDO	process data object
PDS	power drive system
PM	permanent magnet
pp	profile position mode
pv	profile velocity mode
r	reserved
r.m.s.	root mean square
ro	read-only
rw	read-write
tq	torque mode
vl	velocity mode

4 General

4.1 General considerations

This part of the IEC 61800-7 series specifies the bus-independent CiA 402 device profile for power drive systems such as frequency converters, servo controllers, or stepper motor controllers. It includes the definition of real-time control objects as well as of configuration, adjustment, identification and network management objects. The PDS finite state automaton (FSA) is also defined, which may be controlled externally by a control device communicating via a communication system to the drive device.

The device profile defines several modes of operation. They include profile position mode, homing mode, interpolated position mode, profile velocity mode, profile torque mode, velocity mode, cyclic synchronous position mode, cyclic synchronous velocity mode, and cyclic synchronous torque mode.

4.2 Communication interface

The communication system connects the drive device to the control device and other field devices. Via the communication system the control device uses communication services to exchange with the drive device:

- non real-time data (configuration, identification, adjustment, diagnostic, etc.);
- process data such as target values and actual values.

These services are defined in the IEC 61800-7-301. The process data are exchanged by real-time data messages. These messages may be configured by means of configuration services provided by the communication system.

The communication system shall provide services to transmit and receive communication objects (COB). The following COBs shall be supported:

- COB for real-time data transmission;
- COB for emergency information transmission;
- COB for network management purposes.

Additionally, the communication system may provide the following COBs:

- COB for configuration data transmission;
- COB for synchronization purposes;
- COB for system time distribution.

The COBs are defined in detail in IEC 61800-7-301.

4.3 Object dictionary

All objects in this part of the IEC 61800-7 series are grouped in the object dictionary, and defined by attributes as defined in EN 50325-4. All objects shall be accessible via the network in an ordered pre-defined fashion by means of COB for configuration data transmission. Each object within the dictionary shall be addressed uniquely by using a 16-bit index and an 8-bit sub-index. The communication-related objects are defined in detail in [EN 50325-4](#) and IEC 61800-7-301.

The standardized device profile area at indices 6000_h through 9FFF_h shall contain all application objects common to this device profile specification. The following object indices shall be reserved for compatibility reasons: 6045_h, 6047_h, 604D_h, 604E_h, 604F_h, 6052_h, 6053_h, 6054_h, 6055_h, 6056_h, 6057_h, 6058_h, 6059_h, 6089_h, 608A_h, 608B_h, 608C_h, 608D_h, 608E_h, 6093_h, 6094_h, 6095_h, 6096_h, 6097_h, 60A0_h, 60A1_h, 60A2_h, 60F6_h, 60F7_h, 60F9_h, 60FB_h, 6410_h, 6504_h, and 6510_h. The following object indices range shall be reserved for compatibility reasons with other standards: from 6200_h to 62FF_h and from 6600_h to 67EF_h.

The objects may be read respectively written via the network. Within this range of objects, up to 8 axes may be realized. Additionally, it is possible to implement other device profiles (e. g. generic I/O module or encoder) within the drive device. These other device profiles may be implemented instead of one or several axes.

For multi axes devices, the object range 6000_h to 67FF_h shall be shifted as follows:

- 6000_h to 67FF_h: axis 0
- 6800_h to 6FFF_h: axis 1
- 7000_h to 77FF_h: axis 2
- 7800_h to 7FFF_h: axis 3
- 8000_h to 87FF_h: axis 4

- 8800_h to 8FFF_h: axis 5
- 9000_h to 97FF_h: axis 6
- 9800_h to 9FFF_h: axis 7

The category and entry category attributes of an object indicate if the object shall be implemented (mandatory) or may be implemented (optional).

The object code and data type attributes are defined in detail in EN 50325-4 or in other network technology specifications. The used data type attributes are given in Clause 5. In the entry description, the access attribute indicating if an application object is read only (ro), read/write (rw) or write only (wo) or constant (c) is defined. Read only indicates that this shall not be written via the bus; read/write allows to read and to write this object; and write only means that this application object shall be not read via the bus.

The PDO mapping attribute shall indicate if this object shall be or may be or shall not be mapped into COB for real-time data transmission. The detailed definition of these attributes is given in IEC 61800-7-301.

The default value attribute defines the value of an object with access attribute of the value 'rw' and 'c' after power-on or application reset.

5 Data types

5.1 Standard data types

The data types used in this profile are listed in Table 1.

Table 1 – List of used data types

Data type	Reference
Unsigned8	EN 50325-4
Unsigned16	EN 50325-4
Unsigned32	EN 50325-4
Integer8	EN 50325-4
Integer16	EN 50325-4
Integer32	EN 50325-4
Visible string	EN 50325-4
Time of day	EN 50325-4
Interpolated Interpolation time period	See Table 2
Interpolated Interpolation data configuration	See Table 3
vl velocity acceleration/deceleration	See Table 4

5.2 Record definitions

Table 2, Table 3, and Table 4 define the records used in this part of the IEC 61800-7 series.

Table 2 – ~~Interpolated~~ Interpolation time period

Index	Sub-index	Description	Data type
0080 _h	00 _h	Highest ~~sub~~ -index supported	Unsigned8
	01 _h	Interpolation time units	Unsigned8
	02 _h	Interpolation time index	Integer8

Table 3 – ~~Interpolated~~ Interpolation data configuration

Index	Sub-index	Description	Data type
0081 _h	00 _h	Highest ~~sub~~ -index supported	Unsigned8
	01 _h	Maximum buffer size	Unsigned32
	02 _h	Actual buffer size	Unsigned32
	03 _h	Buffer organisation	Unsigned8
	04 _h	Buffer position	Unsigned16
	05 _h	Size of data record	Unsigned8
	06 _h	Buffer clear	Unsigned8

Table 4 – vl velocity acceleration/deceleration

Index	Sub-index	Description	Data type
0082 _h	00 _h	Highest ~~sub~~ -index supported	Unsigned8
	01 _h	Delta speed	Unsigned32
	02 _h	Delta time	Integer16

6 General object definitions

6.1 General

In the following subclauses, the communication parameter objects, the additional identification and the information objects are defined.

6.2 Communication parameter objects

There are three communication parameter objects that shall be implemented:

- Device type object 1000_h
- Error register object 1001_h
- Identity object 1018_h

They are defined in EN 50325-4 and the following definitions shall also apply.

The device type object shall define the device type, the device's functionality, and the mapping variant.

For multi device modules, the additional information parameter shall contain 0FFF_h and the device profile number referenced by object 1000_h is the device profile of the first device in the object dictionary. All other devices of a multiple device module shall identify their profiles at object 67FF_h + x × 800_h with x = internal number of the device (0 to 7). For details, see EN 50325-4. Figure 2 specifies the structure and the values of the device type object, Table 5 specifies the object description, and Table 6 specifies the entry description.

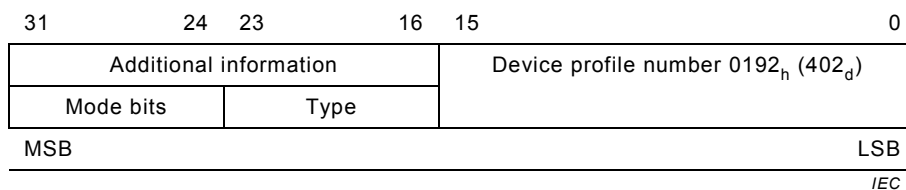


Figure 2 – Value definition

Mode bits and type in the additional information are defined in IEC 61800-7-301.

Table 5 – Object description

Attribute	Value
Index	1000 _h
Name	Device type
Object code	See EN 50325-4
Data type	See EN 50325-4
Category	Mandatory

Table 6 – Entry description

Attribute	Value
Sub-index	00 _h
Access	c
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	Manufacturer-specific

The device-profile specific bit in the error register object (1001_h) shall be used to indicate that the error code in the Emergency message is defined in this part of the IEC 61800-7 series.

NOTE The corresponding error code ~~may be read~~ is readable in object 1003_h (see EN 50325-4) or object 603F_h.

6.3 Additional identification and information objects

6.3.1 Object 6402_h: Motor type

This object shall indicate the type of motor attached to and driven by the drive device. Table 7 specifies the value definition, Table 8 specifies the object description, and Table 9 specifies the entry description.

Table 7 – Value definition

Value	CANopen name	Other names
0000 _h	Non-standard motor	–
0001 _h	Phase modulated DC motor	–
0002 _h	Frequency controlled DC motor	–
0003 _h	PM synchronous motor	–
0004 _h	FC synchronous motor	AC synchronous sinewave wound field
0005 _h	Switched reluctance motor	AC synchronous reluctance switched
0006 _h	Wound rotor induction motor	AC asynchronous induction polyphase wound rotor
0007 _h	Squirrel cage induction motor	AC asynchronous induction squirrel cage
0008 _h	Stepper motor	AC synchronous step
0009 _h	Micro-step stepper motor	–
000A _h	Sinusoidal PM BL motor	AC synchronous sinusoidal PM
000B _h	Trapezoidal PM BL motor	AC synchronous brushless PM trapezoidal
000C _h	AC synchronous reluctance sync	–
000D _h	DC commutator PM	–
000E _h	DC commutator wound field series	–
000F _h	DC commutator wound field shunt	–
0010 _h	DC commutator wound field compound	–
0011 _h to 7FFE _h	Reserved	–
7FFF _h	No motor type assigned	–
8000 _h to FFFF _h	Manufacturer-specific	–

Table 8 – Object description

Attribute	Value
Index	6402 _h
Name	Motor type
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 9 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 7
Default value	Manufacturer-specific

6.3.2 Object 6403_h: Motor catalogue number

This object shall indicate the motor catalogue number (nameplate number) provided by the motor manufacturer. If the number is not assigned yet, this object shall indicate this by /0

(empty string). Table 10 specifies the object description, and Table 11 specifies the entry description.

Table 10 – Object description

Attribute	Value
Index	6403 _h
Name	Motor catalogue number
Object code	Variable
Data type	Visible string
Category	Optional

Table 11 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Visible string
Default value	Manufacturer-specific

6.3.3 Object 6404_h: Motor manufacturer

This object shall indicate the name of the motor manufacturer. If the name is not assigned yet, this object shall indicate this by /0 (empty string). Table 12 specifies the object description, and Table 13 specifies the entry description.

Table 12 – Object description

Attribute	Value
Index	6404 _h
Name	Motor manufacturer
Object code	Variable
Data type	Visible string
Category	Optional

Table 13 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Visible string
Default value	Manufacturer-specific

6.3.4 Object 6405_h: http motor catalogue address

This object shall indicate the assigned web-address of the motor catalogue. If the address is not assigned yet, this object shall indicate this by /0 (empty string). Table 14 specifies the object description, and Table 15 specifies the entry description.

Table 14 – Object description

Attribute	Value
Index	6405 _h
Name	http motor catalogue address
Object code	Variable
Data type	Visible string
Category	Optional

Table 15 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Visible string
Default value	Manufacturer-specific

6.3.5 Object 6406_h: Motor calibration date

This object shall indicate the assigned date of the last motor inspection. If the date is not assigned yet, this object shall indicate this by a value of 0. Table 16 specifies the object description, and Table 17 specifies the entry description.

Table 16 – Object description

Attribute	Value
Index	6406 _h
Name	Motor calibration date
Object code	Variable
Data type	Time of day
Category	Optional

Table 17 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	0 _d or Time of day
Default value	Manufacturer-specific

6.3.6 Object 6407_h: Motor service period

This object shall indicate the assigned motor service period. If the period is not assigned yet, this object shall indicate this by 0000 0000_h. The value shall be given in multiples of hours. Table 18 specifies the object description, and Table 19 specifies the entry description.

Table 18 – Object description

Attribute	Value
Index	6407 _h
Name	Motor service period
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 19 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

6.3.7 Object 6503_h: Drive catalogue number

This object shall indicate the assigned manufacturer's drive catalogue number (nameplate number). Table 20 specifies the object description, and Table 21 specifies the entry description.

Table 20 – Object description

Attribute	Value
Index	6503 _h
Name	Drive catalogue number
Object code	Variable
Data type	Visible string
Category	Optional

Table 21 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	No
Default value	/0 (empty string) Manufacturer-specific

6.3.8 Object 6505_h: http drive catalogue address

This object shall indicate the assigned web address of the drive manufacturer. If the address is not assigned yet, this object shall indicate this by /0 (empty string). Table 22 specifies the object description, and Table 23 specifies the entry description.

Table 22 – Object description

Attribute	Value
Index	6505 _h
Name	http drive catalogue address
Object code	Variable
Data type	Visible string
Category	Optional

Table 23 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	No
Default value	Manufacturer-specific

7 Error codes and error behavior

7.1 Error codes

Emergency messages are triggered by internal errors and severe warnings detected within the drive device. They are defined in detail in the IEC 61800-7-301. They shall contain the 16-bit error code. Error codes from xx00_h to xx7F_h are defined in EN 50325-4 or in Table 24. Error codes between xx80_h and xxFF_h are used manufacturer-specific.

Table 24 – Error codes

Error code	Meaning
2110 _h	Short circuit/earth leakage (input)
2120 _h	Earth leakage (input)
2121 _h	Earth leakage phase L1
2122 _h	Earth leakage phase L2
2123 _h	Earth leakage phase L3
2130 _h	Short circuit (input)
2131 _h	Short circuit phases L1-L2
2132 _h	Short circuit phases L2-L3
2133 _h	Short circuit phases L3-L1
2211 _h	Internal current no.1
2212 _h	Internal current no.2
2213 _h	Over-current in ramp function
2214 _h	Over-current in the sequence
2220 _h	Continuous over current (device internal)
2221 _h	Continuous over current no.1
2222 _h	Continuous over current no.2
2230 _h	Short circuit/earth leakage (device internal)
2240 _h	Earth leakage (device internal)
2250 _h	Short circuit (device internal)
2310 _h	Continuous over current (device output side)
2311 _h	Continuous over current no.1
2312 _h	Continuous over current no.2
2320 _h	Short circuit/earth leakage (motor-side)
2330 _h	Earth leakage (motor-side)
2331 _h	Earth leakage phase U
2332 _h	Earth leakage phase V
2333 _h	Earth leakage phase W
2340 _h	Short circuit (motor-side)
2341 _h	Short circuit phases U-V
2342 _h	Earth leakage phase V-W
2343 _h	Earth leakage phase W-U
2350 _h	Load level fault (I ² t, thermal state)
2351 _h	Load level warning (I ² t, thermal state)
3110 _h	Mains over-voltage
3111 _h	Mains over-voltage phase L1
3112 _h	Mains over-voltage phase L2
3113 _h	Mains over-voltage phase L3
3120 _h	Mains under-voltage
3121 _h	Mains under-voltage phase L1
3122 _h	Mains under-voltage phase L2
3123 _h	Mains under-voltage phase L3
3130 _h	Phase failure
3131 _h	Phase failure L1

Error code	Meaning
3132 _h	Phase failure L2
3133 _h	Phase failure L3
3134 _h	Phase sequence
3140 _h	Mains frequency
3141 _h	Mains frequency too great
3142 _h	Mains frequency too small
3210 _h	DC link over-voltage
3211 _h	Over-voltage no. 1
3212 _h	Over voltage no. 2
3220 _h	DC link under-voltage
3221 _h	Under-voltage no. 1
3222 _h	Under-voltage no. 2
3230 _h	Load error
3310 _h	Output over-voltage
3311 _h	Output over-voltage phase U
3312 _h	Output over-voltage phase V
3313 _h	Output over-voltage phase W
3320 _h	Armature circuit
3321 _h	Armature circuit interrupted
3330 _h	Field circuit
3331 _h	Field circuit interrupted
4110 _h	Excess ambient temperature
4120 _h	Too low ambient temperature
4130 _h	Temperature supply air
4140 _h	Temperature air outlet
4210 _h	Excess temperature device
4220 _h	Too low temperature device
4300 _h	Temperature drive
4310 _h	Excess temperature drive
4320 _h	Too low temperature drive
4400 _h	Temperature supply
4410 _h	Excess temperature supply
4420 _h	Too low temperature supply
5100 _h	Supply device hardware
5110 _h	Supply low voltage
5111 _h	U1 = supply ±15V
5112 _h	U2 = supply +24 V
5113 _h	U3 = supply +5 V
5114 _h	U4 = manufacturer-specific
5115 _h	U5 = manufacturer-specific
5116 _h	U6 = manufacturer-specific
5117 _h	U7 = manufacturer-specific
5118 _h	U8 = manufacturer-specific
5119 _h	U9 = manufacturer-specific

Error code	Meaning
5120 _h	Supply intermediate circuit
5200 _h	Control
5210 _h	Measurement circuit
5220 _h	Computing circuit
5300 _h	Operating unit
5400 _h	Power section
5410 _h	Output stages
5420 _h	Chopper
5430 _h	Input stages
5440 _h	Contacts
5441 _h	Contact 1 = manufacturer-specific
5442 _h	Contact 2 = manufacturer-specific
5443 _h	Contact 3 = manufacturer-specific
5444 _h	Contact 4 = manufacturer-specific
5445 _h	Contact 5 = manufacturer-specific
5450 _h	Fuses
5451 _h	S1 = I1
5452 _h	S2 = I2
5453 _h	S3 = I3
5454 _h	S4 = manufacturer-specific
5455 _h	S5 = manufacturer-specific
5456 _h	S6 = manufacturer-specific
5457 _h	S7 = manufacturer-specific
5458 _h	S8 = manufacturer-specific
5459 _h	S9 = manufacturer-specific
5500 _h	Hardware memory
5510 _h	RAM
5520 _h	ROM/EPROM
5530 _h	EEPROM
6010 _h	Software reset (watchdog)
6301 _h to 630F _h	Data record no. 1 to no. 15
6310 _h	Loss of parameters
6320 _h	Parameter error
7100 _h	Power additional modules
7110 _h	Brake chopper
7111 _h	Failure brake chopper
7112 _h	Over current brake chopper
7113 _h	Protective circuit brake chopper
7120 _h	Motor
7121 _h	Motor blocked
7122 _h	Motor error or commutation malfunc.
7123 _h	Motor tilted
7200 _h	Measurement circuit
7300 _h	Sensor

Error code	Meaning
7301 _h	Tacho fault
7302 _h	Tacho wrong polarity
7303 _h	Resolver 1 fault
7304 _h	Resolver 2 fault
7305 _h	Incremental sensor 1 fault
7306 _h	Incremental sensor 2 fault
7307 _h	Incremental sensor 3 fault
7310 _h	Speed
7320 _h	Position
7400 _h	Computation circuit
7500 _h	Communication
7510 _h	Serial interface no. 1
7520 _h	Serial interface no. 2
7600 _h	Data storage (external)
8300 _h	Torque control
8311 _h	Excess torque
8312 _h	Difficult start up
8313 _h	Standstill torque
8321 _h	Insufficient torque
8331 _h	Torque fault
8400 _h	Velocity speed controller
8500 _h	Position controller
8600 _h	Positioning controller
8611 _h	Following error
8612 _h	Reference limit
8613 _h	Homing Error
8700 _h	Sync controller
8800 _h	Winding controller
8900 _h	Process data monitoring
8A00 _h	Control monitoring
F001 _h	Deceleration
F002 _h	Sub-synchronous run
F003 _h	Stroke operation
F004 _h	Control additional functions
FF00 _h to FFFF _h	Manufacturer-specific

7.2 Error behavior

The communication system may support an object specifying to which network management state the drive device shall transit, when a communication error or a severe device-internal error is detected. When the PDS FSA transits into error (fault or fault reaction active) state, this shall be regarded as a severe device-internal failure.

8 Controlling the power drive system

8.1 General

The PDS FSA is an abstraction to define the behavior of a black box as a control device experiences the PDS. It defines the application behavior of the PDS. Due to the requirement that a PDS provides local control even when the communication network is not working properly, the communication FSA as defined in the communication system mapping specifications and the PDS FSA are only loosely coupled.

Figure 3 specifies how the PDS may be operated locally or via the network remotely. The PDS is operated by local signals (not in the scope of this part of IEC 61800) and by the controlword sent by the control device via the network. The state of the PDS is reported by the statusword produced by the drive device. The FSA is also controlled by error detection signals.

The PDS FSA defines the PDS status and the possible control sequence of the PDS. A single state represents a special internal or external behavior. The state of the PDS also determines which commands are accepted. For example, it is only possible to start a point-to-point move when the drive is in the operation enabled state.

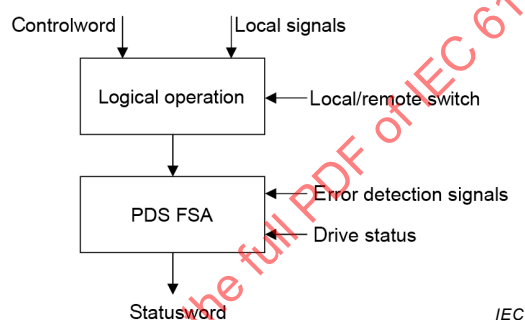


Figure 3 – Remote and local control

8.2 Finite state automaton

Figure 4 specifies the PDS FSA with respect to control of the power electronics as a result of user commands and internal drive faults.

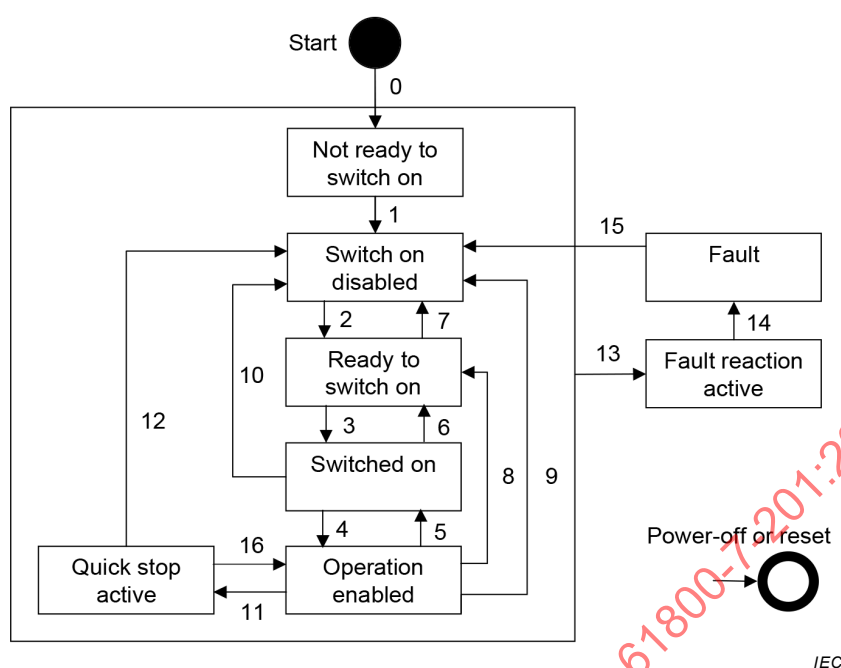


Figure 4 – Power drive system finite state automaton

The FSA states shall support the functions as shown in Table 25. The start state shall be a pseudo state indicating the start when the FSA is activated during the start-up sequence of the device drive's application software.

Table 25 – FSA states and supported functions

Function	FSA states							
	Not ready to switch on	Switch on disabled	Ready to switch on	Switched on	Operation enabled	Quick stop active	Fault reaction active	Fault
Brake applied, if present	Yes	Yes	Yes	Yes	Yes/No	Yes/No	Yes/No	Yes
Low-level power applied	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
High-level power applied	Yes/No	Yes/No	Yes/No	Yes	Yes	Yes	Yes	Yes/No
Drive function enabled	No	No	No	No	Yes	Yes	Yes	No
Configuration allowed	Yes	Yes	Yes	Yes	Yes/No	Yes/No	Yes/No	Yes

If in the quick stop active state the quick stop option code is set to 5, 6, 7 or 8, the drive device shall not leave this state, but it may transit to the operation enabled state with the enable operation command.

The drive device shall support the transitions and actions as given in Table 26. The events shall initiate the transition. The transition shall be terminated after the action has been performed.

Table 26 – Transition events and actions

Transition	Event(s)	Action(s)
0	Automatic transition after power-on or reset application	Drive device self-test and/or self initialization shall be performed.
1	Automatic transition	Communication shall be activated.
2	Shutdown command from control device or local signal	None
3	Switch on command received from control device or local signal	The high-level power shall be switched on, if possible.
4	Enable operation command received from control device or local signal	The drive function shall be enabled and all internal set-points cleared.
5	Disable operation command received from control device or local signal	The drive function shall be disabled.
6	Shutdown command received from control device or local signal	The high-level power shall be switched off, if possible.
7	Quick stop or disable voltage command from control device or local signal	None
8	Shutdown command from control device or local signal	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
9	Disable voltage command from control device or local signal	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
10	Disable voltage or quick stop command from control device or local signal	The high-level power shall be switched off, if possible.
11	Quick stop command from control device or local signal	The quick stop function shall be started.
12	Automatic transition when the quick stop function is completed and quick stop option code is 1, 2, 3 or 4, or disable voltage command received from control device (depends on the quick stop option code)	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
13	Fault signal (see also IEC 61800-7-301)	The configured fault reaction function shall be executed.
14	Automatic transition	The drive function shall be disabled; the high-level power shall be switched off, if possible.
15	Fault reset command from control device or local signal	A reset of the fault condition is carried out, if no fault exists currently on the drive device; after leaving the fault state, the fault reset bit in the controlword shall be cleared by the control device.
16	Enable operation command from control device, if the quick stop option code is 5, 6, 7, or 8	The drive function shall be enabled.
NOTE It is not recommended to support transition 16.		

If a state transition is requested, the related actions shall be processed completely before transitioning to the new state. Example: In operation enabled state, when the disable operation command is received, the drive device shall stay in the operation enabled state until the disable operation function (see object 605C_h) is completed.

Drive devices able to control the contactor for the mains may switch the high-level power. If the high-level power is switched-off, the motor shall be free to rotate if not braked.

Drive function is disabled implies no energy shall be supplied to the motor. Target or set-point values (e.g. torque, velocity, position) shall be not processed.

Drive function is enabled implies that energy may be supplied to the motor. Target or set-point values shall be processed.

If a fault is detected in the drive device, there shall be a transition to the fault reaction active state. In this state, the PDS shall execute a special fault reaction. After the execution of this fault reaction, the drive device shall switch automatically to the fault state. This state shall only be left by the fault reset command, but only if the fault is not active any more.

In case of fatal error, the drive device is not longer able to control the motor, so that an immediate switch-off of the drive device is necessary.

The behavior of drive disabling, quick stop, halt, and fault reaction functions is configurable by means of configuration objects defined in 8.4.

NOTE If a brake is present, the high-level power is switched off after a delay time in order to apply the brake.

8.3 Modes of operation

The PDS behavior depends on the activated mode of operation. The PDS may implement several modes of operation. Since it is not possible to operate the modes in parallel, the user is able to activate the required function by selecting a mode of operation.

The control device writes to the modes of operation object in order to select the operation mode. The drive device provides the modes of operation display object to indicate the actual activated operation mode. Controlword, statusword, and set-points are used mode-specific. This implies the responsibility of the control device to avoid inconsistencies and erroneous behavior. The switching between the modes of operation implies no automatic reconfiguration of COBs for real-time data transmission.

Therefore, the PDS may limit mode switching in one or some PDS FSA state(s). Mode switching may also be limited to the 'local control' function; this means it is not possible to select the operation mode via the network.

The following modes of operation are described in this part of the IEC 61800-7 series:

- profile position mode;
- homing mode;
- interpolated position mode;
- profile velocity mode (e.g. servo drives);
- torque profile mode;
- velocity mode (e.g. frequency converter);
- cyclic sync position mode;
- cyclic sync velocity mode;
- cyclic sync torque mode.

With the exception of the homing mode, the listed modes of operation deal with set-points. In addition to this, manufacturer-specific modes of operation may also be implemented. These are not limited to set-points.

Figure 5 shows the general relations between target, reference, effort, and actual values.



8.4.1 Object 6040_h: Controlword

This object shall indicate the received command controlling the PDS FSA. It shall be structured as defined in Figure 6. The bits 7, 3, 2, 1, and 0 shall be supported. The ~~other~~ bits 0 to 9 ~~may~~ shall be supported according to the mode of operation. If the related functionality is not available, an appropriate emergency message shall be generated. The manufacturer-specific (ms) bits may be supported. The commands shall be coded as given in Table 27. All implemented bits of the controlword are valid independent of the PDS FSA state. Starting of any movement is operation mode specific and is described in the related clause.

Key	
ms	manufacturer-specific
r	reserved
oms	operation mode specific
h	halt
fr	fault reset
eo	enable operation
qs	quick stop
ev	enable voltage
so	switch on

Figure 6 – Value definition

Table 27 – Command coding

Command	Bits of the controlword					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 (NOTE)
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset		X	X	X	X	15
NOTE Automatic transition to enable operation state after executing switched on state functionality.						

Bits 9, 6, 5, and 4 of the controlword are operation mode specific. The halt function (bit 8) behavior is operation mode specific. If the bit is 1, the commanded motion shall be interrupted, the PDS shall behave as defined in the halt option code. After releasing the halt function, the commanded motion shall be continued if possible.

The bit 10 is reserved for further use; it shall be set to 0. The bits 11, 12, 13, 14, and 15 are manufacturer-specific.

Table 28 specifies the object description, and Table 29 specifies the entry description.

Table 28 – Object description

Attribute	Value
Index	6040 _h
Name	Controlword
Object code	Variable
Data type	Unsigned16
Category	Mandatory

Table 29 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 27
Default value	Device and operation mode specific

8.4.2 Object 6041_h: Statusword

This object shall provide the status of the PDS FSA. The object shall be structured as defined in Figure 7. The bits 10, 9, and 6 to 0 shall be supported. The ~~other~~ ~~oms~~ bits ~~may~~ shall be supported if the mode of operation is supported. If the related functionality of the oms bits is

not available, the corresponding bit shall be 0_b. The manufacturer-specific (ms) bits may be supported. The bit combinations defined in Table 30 shall code the PDS FSA states. All implemented bits of the status word are valid independent of the PDS FSA state.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ms	oms		ila	tr	rm	ms	w	sod	qs	ve	f	oe	so	rtso	
MSB														LSB	
IEC															

Key:

ms	manufacturer-specific
oms	operation mode specific
ila	internal limit active
tr	target reached
rm	remote
w	warning
sod	switch on disabled
qs	quick stop
ve	voltage enabled
f	fault
oe	operation enabled
so	switched on
rtso	ready to switch on

Figure 7 – Value definition

Table 30 – State coding

Statusword	PDS FSA state
xxxx xxxx x0xx 0000 _b	Not ready to switch on
xxxx xxxx x1xx 0000 _b	Switch on disabled
xxxx xxxx x01x 0001 _b	Ready to switch on
xxxx xxxx x01x 0011 _b	Switched on
xxxx xxxx x01x 0111 _b	Operation enabled
xxxx xxxx x00x 0111 _b	Quick stop active
xxxx xxxx x0xx 1111 _b	Fault reaction active
xxxx xxxx x0xx 1000 _b	Fault

If bit 4 (voltage enabled) of the statusword is 1, this shall indicate that high voltage is applied to the PDS.

If bit 5 (quick stop) of the statusword is 0, this shall indicate that the PDS is reacting on a quick stop request.

If bit 7 (warning) of the statusword is 1, this shall indicate the presence of a warning condition. Warning is not an error or fault (examples: temperature limit exceeded, job refused). The status of the PDS FSA shall not be changed. The cause of the warning may be given in the fault code parameter object (603F_h).

If bit 9 (remote) of the statusword is 1, this shall indicate that the controlword is processed. If it is 0 (local), this shall indicate that the controlword is not processed. Nevertheless, the PDS may provide actual values, and the PDS may accept COB for configuration data transmission for other parameter objects.

If bit 10 (target reached) of the statusword is 1, this shall indicate that the PDS has reached the set-point. The set-point is operation mode specific and is defined in detail in the corresponding clauses of this part of the IEC 61800-7 series. Bit 10 shall also be set to 1, if the operation mode has been changed. The change of a target value by software shall alter this bit. If quick stop option code is 5, 6, 7 or 8, bit 10 shall be set to 1, when the quick stop

operation is finished and the PDS is halted. If halt occurred and the PDS has halted then bit 10 shall be set to 1, too. **If the same internal value is commanded then bit 10 shall not alter, if bit 10 is supported.**

If bit 11 (internal limit active) of the statusword is 1, this shall indicate that an internal limit is active (example: position range limit). The internal limits are manufacturer-specific.

Bit 13 and bit 12 of the statusword are operation mode specific.

Bit 14 and bit 15 are manufacturer-specific.

Table 31 specifies the object description, and Table 32 specifies the entry description.

Table 31 – Object description

Attribute	Value
Index	6041 _h
Name	Statusword
Object code	Variable
Data type	Unsigned16
Category	Mandatory

Table 32 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 30
Default value	No

8.4.3 Object 603F_h: Error code

This object shall provide the error code of the last error which occurred in the drive device. Table 24 specifies the value definition, Table 33 specifies the object description, and Table 34 specifies the entry description.

NOTE In CANopen networks, this object provides the same information as the lower 16-bit of sub-index 01_h of the pre-defined error field (1003_h).

Table 33 – Object description

Attribute	Value
Index	603F _h
Name	Error code
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 34 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 24
Default value	No

8.4.4 Object 6007_h: Abort connection option code

This object shall indicate what action shall be performed when one of the following events occurs: bus-off, heartbeat, life guarding, NMT stopped state entered, reset application, and reset communication. Table 35 specifies the value definition, Table 36 specifies the object description, and Table 37 specifies the entry description.

NOTE If the drive is switched in the LSS configuration state the reaction of the drive is manufacturer-specific.

Table 35 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	No action
+1	Fault signal
+2	Disable voltage command
+3	Quick stop command
+4 to +32 767	Reserved

Table 36 – Object description

Attribute	Value
Index	6007 _h
Name	Abort connection option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 37 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 35
Default value	+1

8.4.5 Object 605A_h: Quick stop option code

This object shall indicate what action is performed when the quick stop function is executed. The slow down ramp is the deceleration value of the used mode of operations. Table 38 specifies the value definition, Table 39 specifies the object description, and Table 40 specifies the entry description.

Table 38 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function
+1	Slow down on slow down ramp and transit into switch on disabled
+2	Slow down on quick stop ramp and transit into switch on disabled
+3	Slow down on current limit and transit into switch on disabled
+4	Slow down on voltage limit and transit into switch on disabled
+5	Slow down on slow down ramp and stay in quick stop active
+6	Slow down on quick stop ramp and stay in quick stop active
+7	Slow down on current limit and stay in quick stop active
+8	Slow down on voltage limit and stay in quick stop active
+9 to +32 767	Reserved

Table 39 – Object description

Attribute	Value
Index	605A _h
Name	Quick stop option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 40 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 38
Default value	+2

8.4.6 Object 605B_h: Shutdown option code

This object shall indicate what action is performed if there is a transition from operation enabled state to ready to switch on state. The slow down ramp is the deceleration value of the used mode of operations. Table 41 specifies the value definition, Table 42 specifies the object description, and Table 43 specifies the entry description.

Table 41 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function (switch-off the drive power stage)
+1	Slow down with slow down ramp; disable of the drive function
+2 to +32 767	Reserved

Table 42 – Object description

Attribute	Value
Index	605B _h
Name	Shutdown option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 43 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 41
Default value	0

8.4.7 Object 605C_h: Disable operation option code

This object shall indicate what action is performed if there is a transition from operation enabled state to switched on state. The slow down ramp is the deceleration value of the used mode of operations. Table 44 specifies the value definition, Table 45 specifies the object description, and Table 46 specifies the entry description.

Table 44 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function (switch-off the drive power stage)
+1	Slow down with slow down ramp; disable of the drive function
+2 to +32 767	reserved

Table 45 – Object description

Attribute	Value
Index	605C _h
Name	Disable operation option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 46 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 44
Default value	+1

8.4.8 Object 605D_h: Halt option code

This object shall indicate what action is performed when the halt function is executed. The slow down ramp is the deceleration value of the used mode of operations. Table 47 specifies the value definition, Table 48 specifies the object description, and Table 49 specifies the entry description.

Table 47 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Reserved
+1	Slow down on slow down ramp and stay in operation enabled
+2	Slow down on quick stop ramp and stay in operation enabled
+3	Slow down on current limit and stay in operation enabled
+4	Slow down on voltage limit and stay in operation enabled
+5 to +32 767	Reserved

Table 48 – Object description

Attribute	Value
Index	605D _h
Name	Halt option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 49 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 47
Default value	+1

8.4.9 Object 605E_h: Fault reaction option code

This object shall indicate what action is performed when fault is detected in the PDS. The slow down ramp is the deceleration value of the used mode of operations. Table 50 specifies the value definition, Table 51 specifies the object description, and Table 52 specifies the entry description.

Table 50 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function, motor is free to rotate
+1	Slow down on slow down ramp
+2	Slow down on quick stop ramp
+3	Slow down on current limit
+4	Slow down on voltage limit
+5 to +32 767	Reserved

Table 51 – Object description

Attribute	Value
Index	605E _h
Name	Fault reaction option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 52 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 50
Default value	+2

8.4.10 Object 6060_h: Modes of operation

This object shall indicate the requested operation mode.

Table 53 specifies the value definition, Table 54 specifies the object description, and Table 55 specifies the entry description.

NOTE 1 This object shows only the value of the requested operation mode, the actual operation mode of the PDS is reflected in the object modes of operation display.

NOTE 2 The behavior of the drive in mode of operation 0 is manufacturer-specific.

NOTE 3 If mode of operation is changed, the behavior of the drive is manufacturer-specific.

Table 53 – Value definition

Value	Definition
-128 to -1	Manufacturer-specific operation modes
0	No mode change/no mode assigned
+1	Profile position mode
+2	Velocity mode
+3	Profile velocity mode
+4	Torque profile mode
+5	Reserved
+6	Homing mode
+7	Interpolated position mode
+8	Cyclic sync position mode
+9	Cyclic sync velocity mode
+10	Cyclic sync torque mode
+11	Cyclic sync torque mode with commutation angle
+12 to +127	Reserved

Table 54 – Object description

Attribute	Value
Index	6060 _h
Name	Modes of operation
Object code	Variable
Data type	Integer8
Category	Optional Conditional: mandatory, if more than one mode of operation is supported

Table 55 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 53
Default value	0 Manufacturer-specific

8.4.11 Object 6061_h: Modes of operation display

This object shall provide the actual operation mode.

Table 53 specifies the value definition, Table 56 specifies the object description, and Table 57 specifies the entry description.

Table 56 – Object description

Attribute	Value
Index	6061 _h
Name	Modes of operation display
Object code	Variable
Data type	Integer8
Category	Optional Conditional: mandatory, if more than one mode of operation is supported

Table 57 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 53
Default value	No

8.4.12 Object 6502_h: Supported drive modes

This object shall provide information on the supported drive modes. Figure 8 specifies the value definition, Table 58 specifies the object description, and Table 59 specifies the entry description.

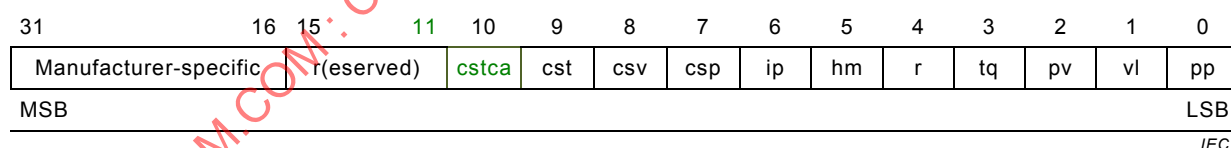


Figure 8 – Value definition

The following value definitions shall apply:

cstca, cst, csv, csp, ip, hm, tq, p_v, v_l, and pp bits:

1 = mode is supported 0 = mode is not supported

manufacturer-specific bits:

1 = function is supported 0 = function is not supported

r(eserved) bits: 0

Table 58 – Object description

Attribute	Value
Index	6502 _h
Name	Supported drive modes
Object code	Variable
Data type	Unsigned32
Category	Mandatory

Table 59 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Figure 8
Default value	~~No~~ Manufacturer-specific

9 Factor group

9.1 General

In some drive device applications several sensor resolution values and ratio values are needed. They may be presented by the objects defined in this clause.

The user-defined units as defined in this specification are used in the corresponding objects representing position, velocity, acceleration, or jerk values.

The user-defined units are specified by the SI unit objects (object 60A8_h, 60A9_h, 60AA_h, and 60AB_h). For the calculation of the respective values (and their physical units) see the following formulas. If some of the objects in the formulas are not implemented, the default values defined in the respective objects shall be used. Objects, whose values are not dependent on the factor group have fixed units specified within the objects. Figure 9 explains the scaling concept in more detail.

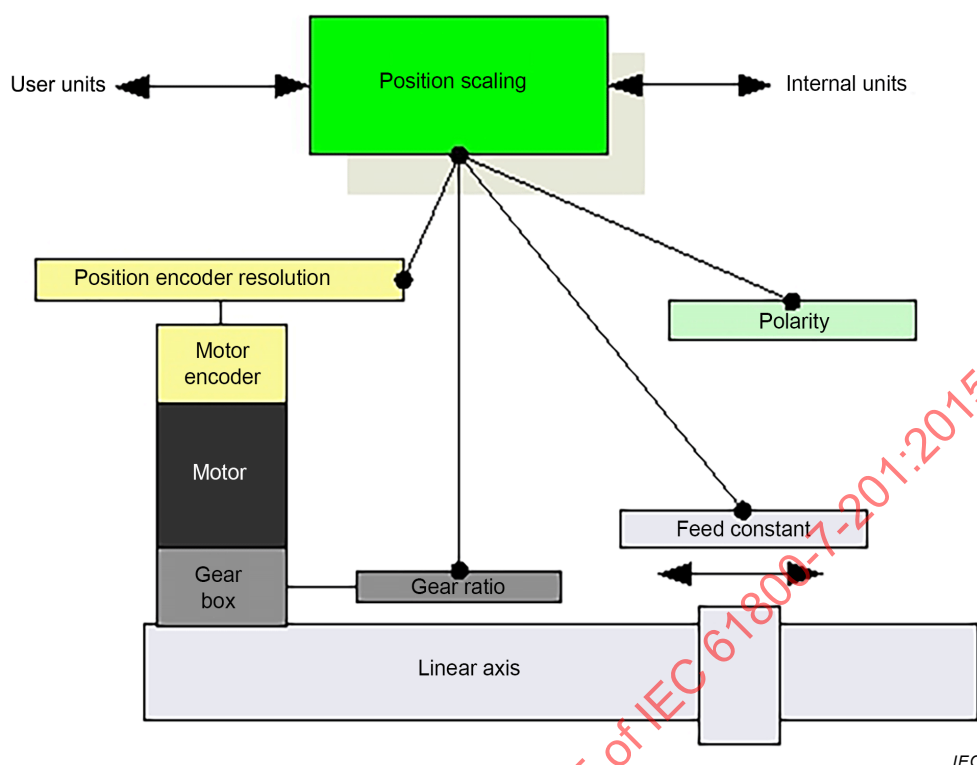


Figure 9 – Position scaling concept

Position units

~~The relation between the user-defined units and the internal units is calculated by the following equation:~~

The calculation of the position values is done by the following formula:

$$\text{position value} = \frac{\text{position internal value} \cdot \text{feed constant}}{\text{position encoder resolution} \cdot \text{gear ratio}}$$

The position value represents the objects containing values in user-defined position units, specified in the SI unit position (object 60A8_n). The factors in the formula shall be adjusted in a way that the SI unit position fits the mechanical conditions.

The position internal value is given in internal units, e.g. encoder increments. For calculation of the position internal values from the target position values the formula is transposed to:

$$\text{position internal value} = \frac{\text{position value} \cdot \text{position encoder resolution} \cdot \text{gear ratio}}{\text{feed constant}}$$

Velocity units

In case the velocity encoder resolution (object 6090_n) is implemented, the velocity values are calculated by:

$$\text{velocity value} = \frac{\text{velocity internal value} \cdot \text{feed constant}}{\text{velocity encoder resolution} \cdot \text{gear ratio}} \cdot \text{velocity factor}$$

The velocity internal value is taken from the separate encoder (object 606A_h, sensor selection code = 1), or by position internal value(s) (object 606A_h, sensor selection code = 0)

If object 6090_h is not implemented, the position encoder resolution is used for calculation:

$$\text{velocity value} = \frac{\text{velocity internal value} \cdot \text{feed constant}}{\text{position encoder resolution} \cdot \text{gear ratio}} \cdot \text{velocity factor}$$

or:

$$\text{velocity value} = \frac{\text{position value}}{s} \cdot \text{velocity factor}$$

The velocity value represents the objects containing values in user-defined velocity units, specified in the SI unit velocity (object 60A9_h). If object 60A9_h is not implemented, the user-defined velocity unit shall be the user-defined position unit/s.

The factors in the formulas shall be adjusted in a way that the SI unit velocity fits the mechanical conditions.

Acceleration units

$$\text{acceleration value} = \frac{\text{velocity value}}{s} \cdot \text{acceleration factor}$$

The acceleration value represents the objects containing values in user-defined acceleration units, specified in the SI unit acceleration (object 60AA_h). If object 60AA_h is not implemented, the user-defined acceleration unit shall be the user-defined velocity unit/s.

The factors in the formula shall be adjusted in a way that the SI unit acceleration fits the mechanical conditions.

Jerk units

$$\text{jerk value} = \frac{\text{acceleration value}}{s} \cdot \text{jerk factor}$$

The jerk value represents the objects containing values in user-defined jerk units, specified in the SI unit jerk (object 60AB_h). If object 60AB_h is not implemented the user-defined jerk unit shall be the user-defined velocity unit/s².

The factors in the formula shall be adjusted in a way that the SI unit jerk fits the mechanical conditions.

9.2 Detailed object definitions

9.2.1 Object 608F_h: Position encoder resolution

This object shall indicate the configured encoder increments and the number of motor revolutions. The position encoder resolution shall be calculated by the following formula:

$$\text{position encoder resolution} = \frac{\text{encoder increments}}{\text{motor revolutions}}$$

All values shall be dimensionless. Table 60 specifies the object description, and Table 61 specifies the entry description.

Table 60 – Object description

Attribute	Value
Index	608F _h
Name	Position encoder resolution
Object code	Array
Data type	Unsigned32
Category	Optional

Table 61 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	01 _h
Description	Encoder increments
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	Motor revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific (but not equal to 0)

9.2.2 Object 6090_h: Velocity encoder resolution

This object shall indicate the configured encoder increments per second and the motor revolutions per second. The velocity encoder resolution shall be calculated by the following formula:

$$\text{velocity encoder resolution} = \frac{\text{encoder} \frac{\text{increments}}{\text{second}}}{\text{motor} \frac{\text{revolutions}}{\text{second}}}$$

All values shall be dimensionless. Table 62 specifies the object description, and Table 63 specifies the entry description.

Table 62 – Object description

Attribute	Value
Index	6090 _h
Name	Velocity encoder resolution
Object code	Array
Data type	Unsigned32
Category	Optional

Table 63 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	~~Manufacturer-specific (but not equal to 0)~~ 02 _h
Sub-index	01 _h
Description	Encoder increments per second
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	Motor revolutions per second
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific (but not equal to 0)

9.2.3 Object 6091_h: Gear ratio

This object shall indicate the configured number of motor shaft revolutions and the number of driving shaft revolutions. The gear ratio shall be calculated by the following formula:

$$\text{gear ratio} = \frac{\text{motor shaft revolutions}}{\text{driving shaft revolutions}}$$

All values shall be dimensionless. Table 64 specifies the object description, and Table 65 specifies the entry description.

Table 64 – Object description

Attribute	Value
Index	6091 _h
Name	Gear ratio
Object code	Array
Data type	Unsigned32
Category	Optional

Table 65 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	Manufacturer-specific (but not equal to 0) 02 _h
Sub-index	01 _h
Description	Motor shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	Driving shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

9.2.4 Object 6092_h: Feed constant

This object shall indicate the configured feed constant, which is the measurement distance per one revolution of the output shaft of the gearbox. The feed constant shall be calculated by the following formula:

$$\text{feed constant} = \frac{\text{feed}}{\text{driving shaft revolutions}}$$

The feed shall be given in user-defined position units, and the driving shaft revolutions value shall be dimensionless. Table 66 specifies the object description, and Table 67 specifies the entry description.

Table 66 – Object description

Attribute	Value
Index	6092 _h
Name	Feed constant
Object code	Array
Data type	Unsigned32
Category	Optional

Table 67 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	Manufacturer-specific (but not equal to 0) 02 _h
Sub-index	01 _h
Description	Feed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	Shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

9.2.5 Object 6096_h: Velocity factor

This object can be used to match the velocity units to the user-defined velocity units. Table 68 specifies the object description, and Table 69 specifies the entry description.

Table 68 – Object description

Attribute	Value
Index	6096 _h
Name	Velocity factor
Object code	Array
Data type	Unsigned32
Category	Optional

Table 69 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to 2 ³² – 1
Default value	1
Sub-index	02 _h
Description	Divisor
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to 2 ³² – 1
Default value	1

9.2.6 Object 6097_h: Acceleration factor

This object can be used to match the acceleration units to the user-defined acceleration units. Table 70 specifies the object description, and Table 71 specifies the entry description.

Table 70 – Object description

Attribute	Value
Index	6097 _h
Name	Acceleration factor
Object code	Array
Data type	Unsigned32
Category	Optional

Table 71 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to $2^{32} - 1$
Default value	1
Sub-index	02 _h
Description	Divisor
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to $2^{32} - 1$
Default value	1

9.2.7 Object 60A2_h: Jerk factor

This object can be used to match the jerk units to the user-defined jerk units. Table 72 specifies the object description, and Table 73 specifies the entry description.

Table 72 – Object description

Attribute	Value
Index	60A2 _h
Name	Jerk factor
Object code	Array
Data type	Unsigned32
Category	Optional

Table 73 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to $2^{32} - 1$
Default value	1
Sub-index	02 _h
Description	Divisor
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to $2^{32} - 1$
Default value	1

9.2.8 Object 607E_h: Polarity

This object shall indicate if the position demand value shall be multiplied by 1 or by –1. The polarity flag shall have no influence on the homing mode. The position polarity bit shall be used only for profile position (pp) mode and cyclic sync position mode (csp). The velocity polarity bit shall be used only for profile velocity (pv) mode and cyclic sync velocity mode (csv). Figure 10 specifies the value definition, Table 74 specifies the object description, and Table 75 specifies the entry description.

7	6	5	0
Position polarity	Velocity polarity	reserved (0)	
MSB			LSB

IEC

Figure 10 – Value definition

The polarity bits shall be coded as follows: 0_b = multiply by 1 and 1_b = multiply by -1

Table 74 – Object description

Attribute	Value
Index	607E _h
Name	Polarity
Object code	Variable
Data type	Unsigned8
Category	Optional

Table 75 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Figure 10
Default value	00 _h

9.2.9 Code table for device profile specific units

Table 76 specifies the representation of the additional specific units used in this profile.

Table 76 – Device profile specific units

Name of unit	International symbol	Notation index
Cubic second	s ³	A0 _h
Reserved	–	A1 _h to AB _h , AD _h to B3 _h , B6 _h to BF _h
Manufacturer-specific	–	C0 _h to FF _h
Revolution	none	B4 _h
Inc	none	B5 _h
Step	none	AC _h

9.2.10 Object 60A8_h: SI unit position

This object shall indicate the user-defined position units. The object structure is defined in Figure 1 in CiA 303-2:2012. The representation of the SI units and prefixes is given in CiA 303-2. The representation of the additional profile-specific units is defined in Table 76. The profile-specific field (bit 0 to bit 7) of this object is reserved (00_h).

The scaling from the real position increments to the position value in user-defined units is done using the objects 608F_h, 6091_h and 6092_h. Table 77 specifies the object description, and Table 78 specifies the entry description.

Table 77 – Object description

Attribute	Value
Index	60A8 _h
Name	SI unit position
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 78 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

Figure 11 shows an example for the object configuration in mm.

31	24	23	16	15	8	7	0
FD _h (means 10 ⁻³)		01 _h (means m)		00 _h		reserved (00 _h)	
MSB				LSB			

IEC

Figure 11 – Example for a position unit

9.2.11 Object 60A9_h: SI unit velocity

This object shall indicate the user-defined velocity units. If this object is not implemented, the user-defined velocity unit shall be the user-defined position unit/s. The object structure is defined in Figure 1 in CiA 303-2:2012. The representation of the SI units and prefixes is given in CiA 303-2. The representation of the additional profile-specific units is defined in Table 76. The profile-specific field (bit 0 to bit 7) of this object is reserved (00_h).

This object is taken as a definition for the user-defined velocity units, if the object 6090_h (velocity encoder resolution) is implemented. If the object 6090_h is not implemented, a calculation based on the position-related values has to be done. Table 79 specifies the object description, and Table 80 specifies the entry description.

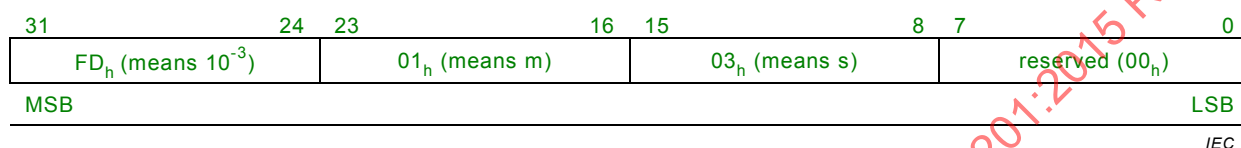
Table 79 – Object description

Attribute	Value
Index	60A9 _h
Name	SI unit velocity
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 80 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

Figure 12 shows an example for the object configuration in mm/s.

**Figure 12 – Example for a velocity unit**

9.2.12 Object 60AA_h: SI unit acceleration

This object shall indicate the user-defined acceleration units. If this object is not implemented, the user-defined acceleration unit shall be the user-defined velocity unit/s. The object structure is defined in Figure 1 in CiA 303-2:2012. The representation of the SI units and prefixes is given in CiA 303-2. The representation of the additional profile-specific units is defined in Table 76. The profile-specific field (bit 0 to bit 7) of this object is reserved (00_h).

To match the acceleration value to the user-defined units, a calculation based on the velocity value has to be done. Table 81 specifies the object description, and Table 82 specifies the entry description.

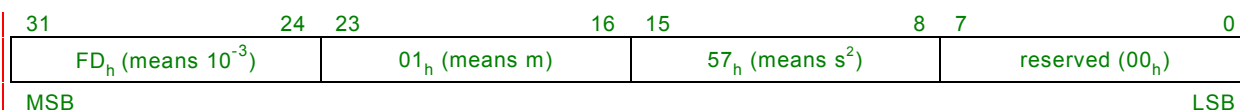
Table 81 – Object description

Attribute	Value
Index	60AA _h
Name	SI unit acceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 82 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

Figure 13 shows an example for the object configuration in mm/s².



IEC

Figure 13 – Example for an acceleration unit

9.2.13 Object 60AB_h: SI unit jerk

This object shall indicate the user-defined jerk units. If this object is not implemented, the user-defined jerk unit shall be the user-defined velocity unit/s². The object structure is defined in Figure 1 in CiA 303-2:2012. The representation of the SI units and prefixes is given in CiA 303-2. The representation of the additional profile-specific units is defined in Table 76. The profile-specific field (bit 0 to bit 7) of this object is reserved (00_h).

Table 83 specifies the object description, and Table 84 specifies the entry description.

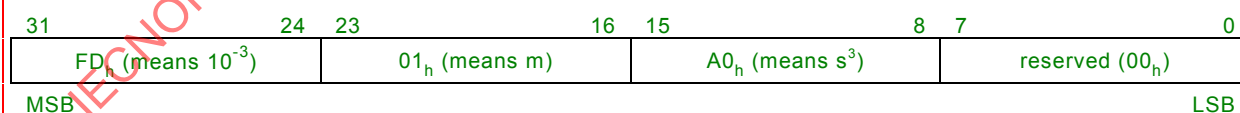
Table 83 – Object description

Attribute	Value
Index	60AB _h
Name	SI unit jerk
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 84 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

Figure 14 shows an example for the object configuration in mm/s³.



IEC

Figure 14 – Example for a jerk unit

10 Profile position mode

10.1 General information

The overall structure for this mode is shown in Figure 15. A target position is applied to the trajectory generator. It is generating a position demand value for the position control loop described in the position control function (see 13.3.1). These two function blocks are optionally controlled by individual parameter sets.

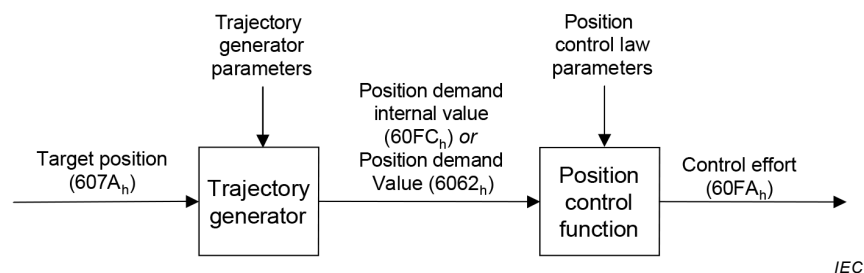


Figure 15 – Trajectory generator and position control function

At the input to the trajectory generator, parameters may have optional limits applied before being normalized to internal units. The simplest form of a trajectory generator is just to pass through a target position and to transform it to a position demand internal value with internal units (increments) only. Figure 16 defines the detailed structure of the trajectory generator.

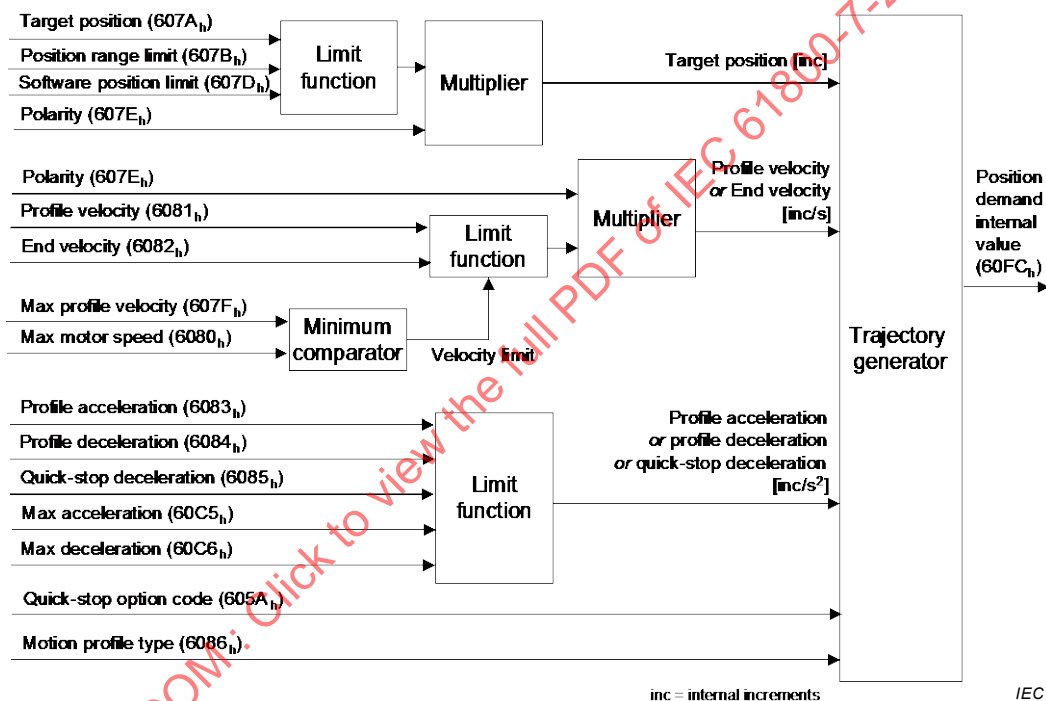


Figure 16 – Trajectory generator for profile position mode

10.2 Functional description

10.2.1 General

The setting of set-points is controlled by the timing of the new set-point bit and the change set immediately bit in the controlword as well as the set-point acknowledge bit in the statusword.

If the change set immediately bit of the controlword is set to 1, a single set-point is expected by the drive device. If the change set immediately bit of the controlword is set to 0, a set of set-points is expected by the drive device.

After a set-point is applied to the drive device, the control device signals that the set-point is valid by a rising edge of the new set-point bit in the controlword. The drive device sets the set-point acknowledge bit in the statusword to 1, and afterwards, the drive device signals with the set-point acknowledge bit set to 0 its ability to accept new set-points. An example is shown in Figure 17.

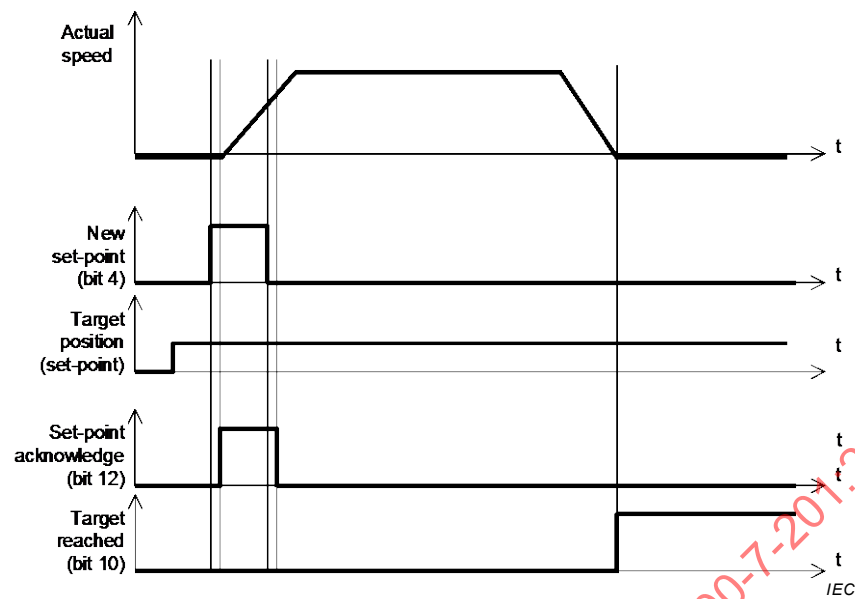


Figure 17 – Set-point example

If one set-point is still in progress and a new one is validated, two methods of handling are supported: single set-point (change set immediately bit of controlword is 1) and set of set-points (change set immediately bit of controlword is 0).

10.2.2 Single set-point

When a set-point is in progress and a new set-point is validated by the new set-point (bit 4) in the controlword, the new set-point shall be processed immediately. The handshaking procedure shown in Figure 18 is used for the single set-point method.

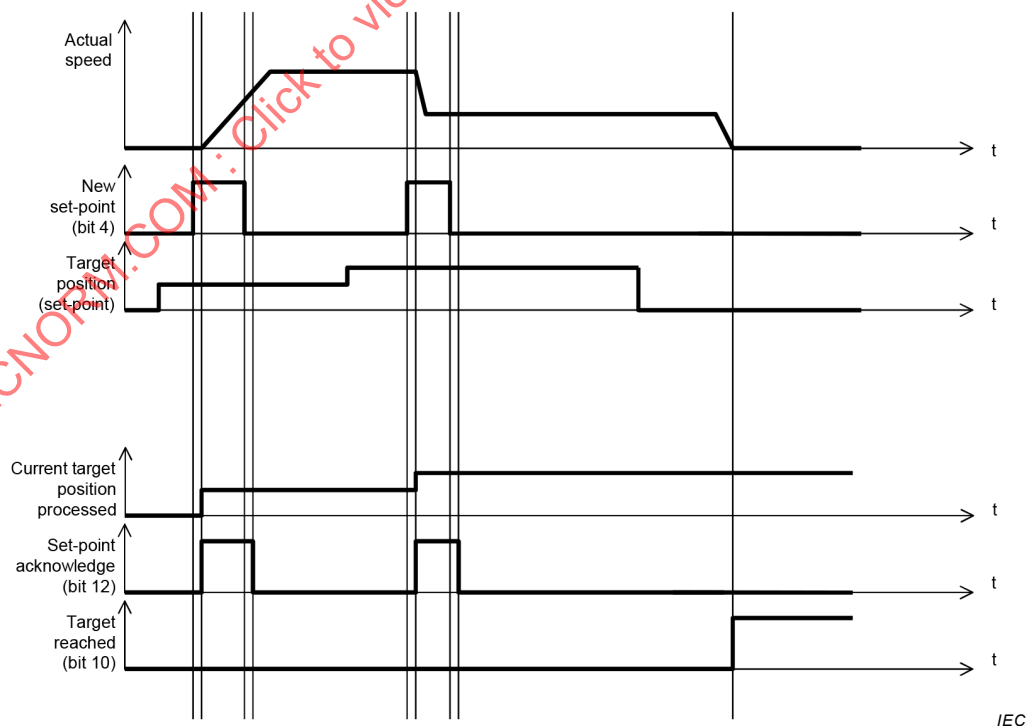


Figure 18 – Handshaking procedure for the single set-point method

10.2.3 Set of set-points

When a set-point is in progress and a new set-point is validated by the new set-point (bit 4) in the controlword, the new set-point shall be processed only after the previous has been reached. The handshaking procedure shown in Figure 19 is used for the set of set-points method. The additional grey line segment in the graph 'actual speed' shows the actual speed if the change of set-point bit (bit 9) is set to 1.

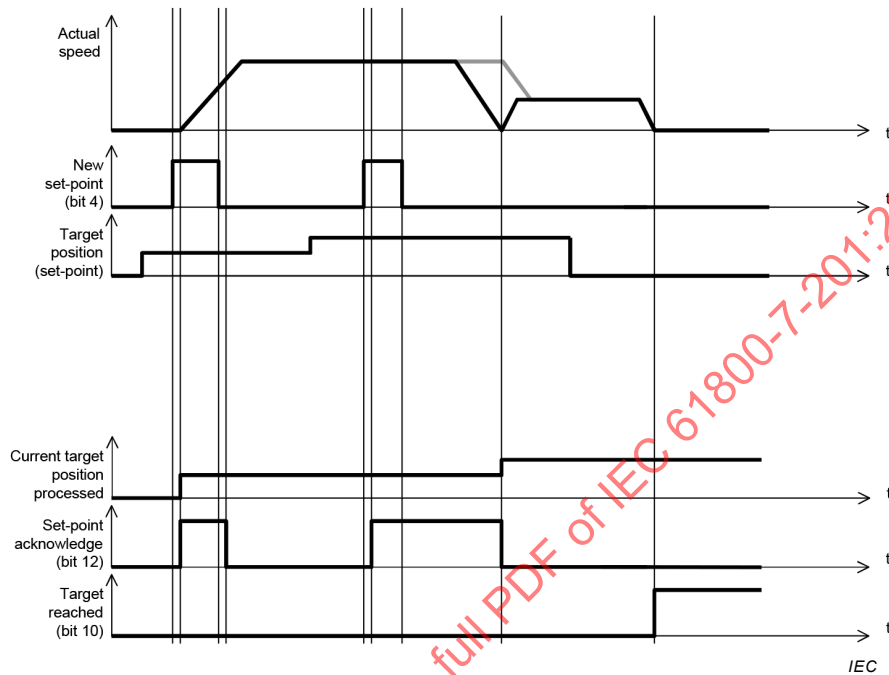


Figure 19 – Handshaking procedure for the set of set-points method

If a drive device supports set of set-points, a minimum of two set-points are available, a set-point that is currently been processed and a buffered set-point. The set-points are handled as shown in Figure 20.

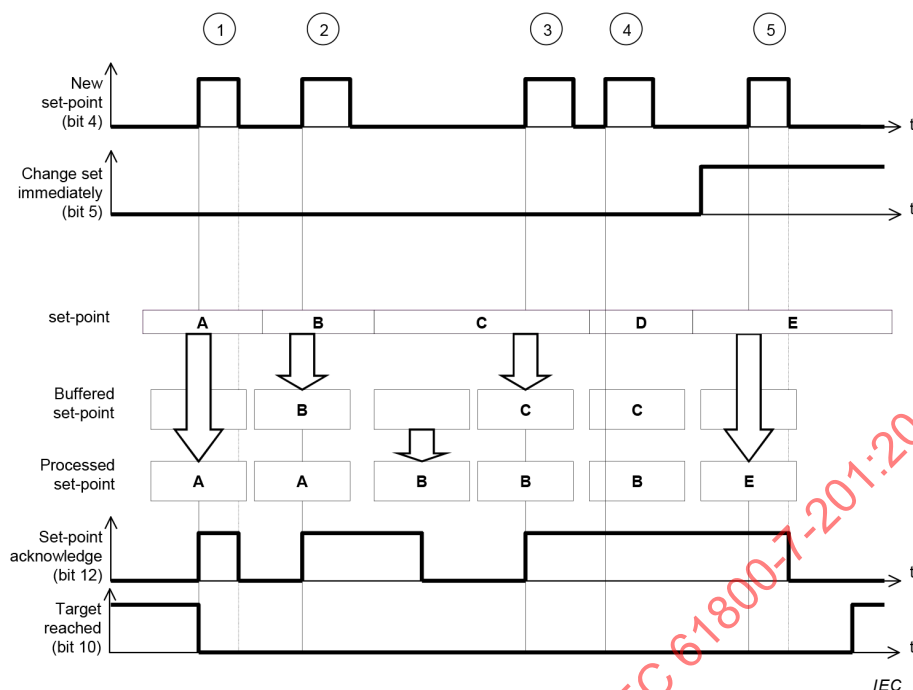


Figure 20 – Set-point handling for two set-points

New set-points are buffered in the set-point list as long as free set-points are available in the drive device. If no set-point is in progress, the new set-point shall become active immediately (1). If a set-point is in progress, the new set-point shall be stored in the first set-point buffer that is free (2 + 3).

If all set-point buffers are busy (set-point acknowledge bit is 1), the reaction depends on the change set immediately bit. If the change set immediately bit is set to 1, the new set-point shall be processed immediately as single set-point. All previously loaded set-points shall be discarded (5).

The target reached bit shall remain 0 until all set-points are processed.

10.2.4 Usage of halt bit in conjunction with new set-point bit

The halt bit can be used to halt, set a new set-point and in combination with the new set-point bit to interrupt an actual movement which is described in this section.

If a drive is processing a set-point the halt bit (bit 8 of the controlword) can be used to stop the motor and keep it in position control. After releasing the halt bit the processing of the actual set-point is continued. Figure 21 describes a mechanism how to erase the processed set-point and set the actual position as a new set-point for that the drive remains at the current position in position control even after releasing the halt bit.

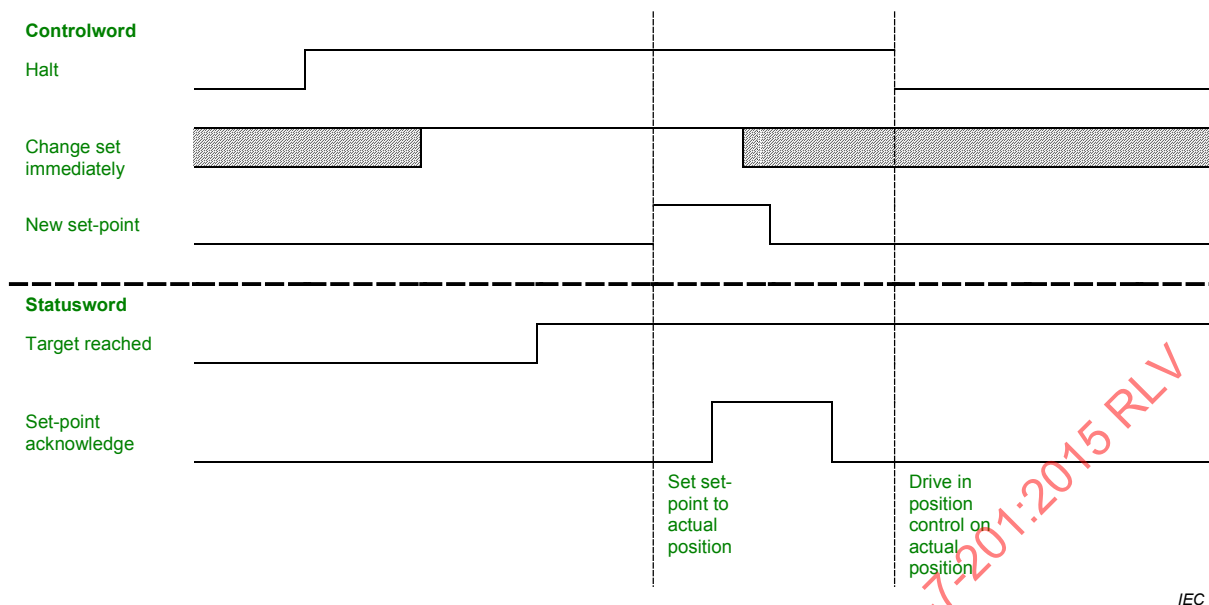


Figure 21 – Erase set-point

The actual drive position shall be captured after a complete stand still of the motor. Therefore bit 8 (halt) of the controlword (6040_h) and bit 10 (target reached) of the statusword (6041_h) have to be equal to 1. Additional information on this bit combination can be found in Table 87.

To define the slowdown ramp which is applied during the halt command object 605D_h (halt option code) can be used.

10.3 General definitions

The internal software limits shall not be exceeded by external settings configured by the user.

10.4 Use of controlword and statusword

The profile position mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 22 shows the structure of the controlword. If no positioning is in progress, the rising edge of bit 4 shall start the positioning of the axis. In case a positioning is in progress, the definitions given in Table 85 shall be used. Table 86 defines the values for bit 6 and 8 of the controlword.

NOTE It is assumed that the target position is edge-triggered 0->1 otherwise the drive could set immediately new values, which leads to unexpected behavior.

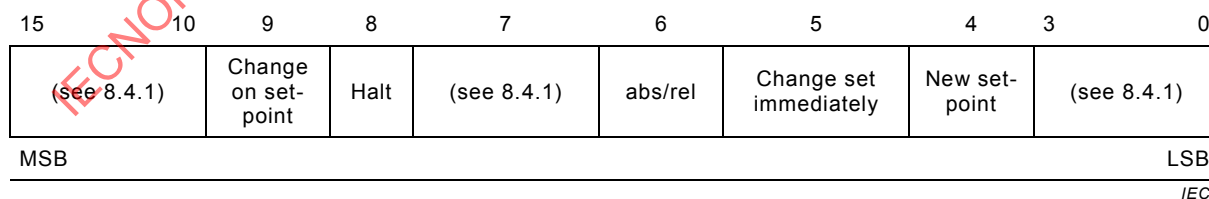


Figure 22 – Controlword for profile position (pp) mode

Table 85 – Definition of bit 4, bit 5, and bit 9

Bit 9	Bit 5	Bit 4	Definition
0	0	0 -> 1	Positioning shall be completed (target reached) before the next one gets started (see Figure 17 and Figure 19)
X	1	0 -> 1	Next positioning shall be started immediately (see Figure 17 and Figure 18)
1	0	0 -> 1	Positioning with the current profile velocity up to the current set-point shall be proceeded and then next positioning (see Figure 17 and Figure 19) shall be applied

Table 86 – Definition of bit 6 and bit 8

Bit	Value	Definition
6	0	Target position shall be an absolute value
	1	Target position shall be a relative value (depending on object 60F2 _h)
8	0	Positioning shall be executed or continued
	1	Axis shall be stopped accordingly to halt option code (605D _h)

Figure 23 shows the structure of the statusword. Table 87 defines the values for bit 10, bit 12, and bit 13.

15	14	13	12	11	10	9	0
(see 8.4.2)	Following error	Set-point acknowledge	(see 8.4.2)	Target reached	(see 8.4.2)		
MSB							LSB

IEC

Figure 23 – Statusword for profile position (pp) mode

Table 87 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Halt (bit 8 in controlword) = 0: Target position not reached Halt (bit 8 in controlword) = 1: Axis decelerates
	1	Halt (bit 8 in controlword) = 0: Target position reached Halt (bit 8 in controlword) = 1: Velocity of axis is 0
12	0	Previous set-point already processed, waiting for new set-point
	1	Previous set-point still in process, set-point overwriting shall be accepted
13	0	No following error
	1	Following error

10.5 Detailed object definitions

10.5.1 Object 607A_h: Target position

This object shall indicate the commanded position that the drive should move to in position profile mode using the current settings of motion control parameters such as velocity, acceleration, deceleration, motion profile type etc. The value of this object shall be interpreted as absolute or relative depending on the abs/rel flag in the controlword. It shall be given in user-defined position units and shall be converted to position increments. Table 88 specifies the object description, and Table 89 specifies the entry description.

Table 88 – Object description

Attribute	Value
Index	607A _h
Name	Target position
Object code	Variable
Data type	Integer32
Category	Optional; mandatory if pp, pc or csp is supported

Table 89 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

10.5.2 Object 607B_h: Position range limit

This object shall indicate the configured maximal and minimal position range limits. It shall limit the numerical range of the input value. On reaching or exceeding these limits, the input value shall wrap automatically to the other end of the range. Wrap-around of the input value may be prevented by setting software position limits as defined in software position limit object (607D_h). To disable the position range limits the min position range limit (sub-index 01_h) and max position range limit (sub-index 02_h) shall be set to 0. The values shall be given in user-defined position units. Table 90 specifies the object description, and Table 91 specifies the entry description.

Table 90 – Object description

Attribute	Value
Index	607B _h
Name	Position range limit
Object code	Array
Data type	Integer32
Category	Optional

Table 91 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	Manufacturer-specific 02 _h
Sub-index	01 _h
Description	Min position range limit
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Max position range limit
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

10.5.3 Object 607D_h: Software position limit

This object shall indicate the configured maximal and minimal software position limits. These parameters shall define the absolute position limits for the position demand value and the position actual value as specified in Figure 24. Every new target position shall be checked against these limits. ~~The limit positions shall be always relative to the machine home position. Before being compared with the target position, they shall be corrected internally by the home offset as follows:~~

~~corrected min position limit = min position limit — home offset~~

~~corrected max position limit = max position limit — home offset~~

~~This calculation needs only be performed when home offset or software position limit is changed.~~

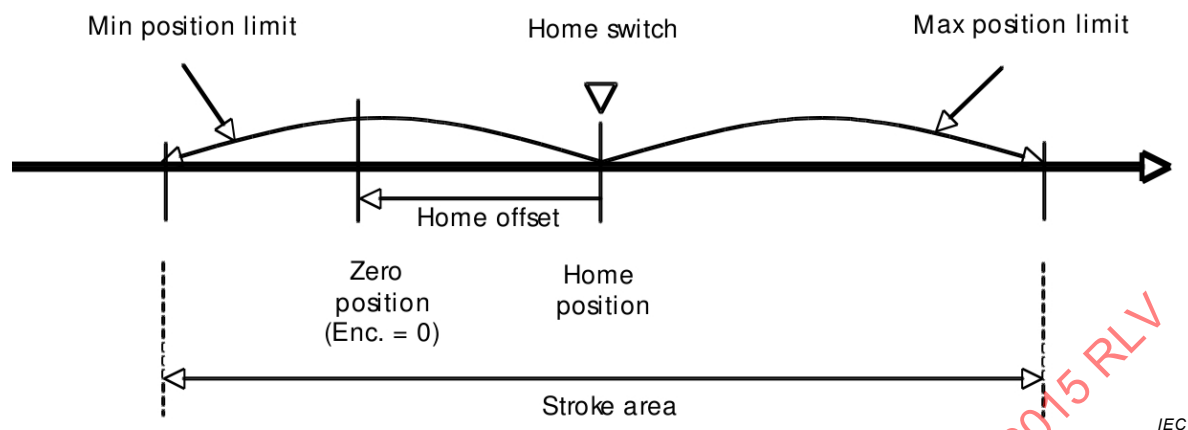


Figure 24 – Software position limits

The limit positions shall be given in user-defined position units (same as target position). Table 92 specifies the object description, and Table 93 specifies the entry description.

Supervision of software position limits requires a defined home position.

Table 92 – Object description

Attribute	Value
Index	607D _h
Name	Software position limit
Object code	Array
Data type	Integer32
Category	Optional

Table 93 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	Manufacturer-specific 02 _h
Sub-index	01 _h
Description	Min position limit
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Max position limit
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

10.5.4 Object 607F_h: Max profile velocity

This object shall indicate the configured maximal allowed velocity in either direction during a profiled motion. The value shall be given in the very same physical unit as the profile velocity object (6081_h). Table 94 specifies the object description, and Table 95 specifies the entry description.

Table 94 – Object description

Attribute	Value
Index	607F _h
Name	Max profile velocity
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 95 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.5 Object 6080_h: Max motor speed

This object shall indicate the configured maximal allowed speed for the motor in either direction. It is used to protect the motor and is taken from the motor data sheet. The value shall be given in rotations per minute (~~rpm~~ r/min) or user-defined velocity units. Table 96 specifies the object description, and Table 97 specifies the entry description.

Table 96 – Object description

Attribute	Value
Index	6080 _h
Name	Max motor speed
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 97 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.6 Object 6081_h: Profile velocity

This object shall indicate the configured velocity normally attained at the end of the acceleration ramp during a profiled motion and shall be valid for both directions of motion. ~~allowed velocity in either direction during a profiled motion.~~ The value shall be given in user-defined ~~speed~~ velocity units. ~~It shall be converted to position increments per second using the velocity encoder factor object.~~ The velocity units can depend on the user-defined position units (position units per second). The calculation of the user-defined position units is done via the factor group (see Clause 9). Table 98 specifies the object description, and Table 99 specifies the entry description.

Table 98 – Object description

Attribute	Value
Index	6081 _h
Name	Profile velocity
Object code	Variable
Data type	Unsigned32
Category	Conditional: mandatory if pp is supported

Table 99 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.7 Object 6082_h: End velocity

This object shall indicate the configured velocity, which the drive shall have on reaching the target position. Normally, the drive stops at the target position, i.e. the end velocity is 0. The value shall be given in the same physical units as the profile velocity object (6081_h). Table 100 specifies the object description, and Table 101 specifies the entry description.

Table 100 – Object description

Attribute	Value
Index	6082 _h
Name	End velocity
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 101 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	0000 0000 _h

10.5.8 Object 6083_h: Profile acceleration

This object shall indicate the configured acceleration. The value shall be given in user-defined acceleration units; ~~it shall be converted to position increments per square second (s²) using the normalising factors (see Clause).~~ Table 102 specifies the object description, and Table 103 specifies the entry description.

Table 102 – Object description

Attribute	Value
Index	6083 _h
Name	Profile acceleration
Object code	Variable
Data type	Unsigned32
Category	Conditional: mandatory if pp or pv is supported

Table 103 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.9 Object 6084_h: Profile deceleration

This object shall indicate the configured deceleration. If this parameter is not supported, then the profile acceleration object (6083_h) value shall be used for deceleration, too. The value shall be given in the same physical units as profile acceleration object (6083_h). Table 104 specifies the object description, and Table 105 specifies the entry description.

Table 104 – Object description

Attribute	Value
Index	6084 _h
Name	Profile deceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 105 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.10 Object 6085_h: Quick stop deceleration

This object shall indicate the configured deceleration used to stop the motor when the quick stop function is activated and the quick stop code object (605A_h) is set to 2 or 6. The quick stop deceleration is also used if the fault reaction code object (605E_h) is 2 and the halt option code object (605D_h) is 2. The value shall be given in the same physical unit as profile

acceleration object (6083_h). Table 106 specifies the object description, and Table 107 specifies the entry description.

Table 106 – Object description

Attribute	Value
Index	6085 _h
Name	Quick stop deceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 107 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.11 Object 6086_h: Motion profile type

This object shall indicate the configured type of motion profile used to perform a profiled motion. Table 108 specifies the value definition, Table 109 specifies the object description, and Table 110 specifies the entry description.

Table 108 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Linear ramp (trapezoidal profile)
+1	Sin ² ramp
+2	Jerk-free ramp
+3	Jerk-limited ramp
+4 to +32 767	Reserved

Table 109 – Object description

Attribute	Value
Index	6086 _h
Name	Motion profile type
Object code	Variable
Data type	Integer16
Category	Optional

Table 110 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0

10.5.12 Object 60A3_h: Profile jerk use

This object shall indicate the configured number of sub-indices used in the profile jerk object (60A4_h) for the jerk profile movement. If this object is not implemented, the profile jerk object shall be used as it is implemented. The value shall be dimensionless, the value of FF_h shall indicate that the profile jerk use is not configured. Table 111 specifies the object description, and Table 112 specifies the entry description.

Table 111 – Object description

Attribute	Value
Index	60A3 _h
Name	Profile jerk use
Object code	Variable
Data type	Unsigned8
Category	Optional

Table 112 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	01 _h to 06 _h and FF _h
Default value	Manufacturer-specific

10.5.13 Object 60A4_h: Profile jerk

This object shall indicate the configured set of jerk parameters that shall be used during the profile movement. Figure 25 shows the defined jerks (A, B, C, D, E, and F). The values shall be given in user-defined jerk units. Table 113 specifies the value assignment to jerks depending of the value of profile jerk use object (60A3_h). If object 60A3_h is not implemented, the sub-index 00_h shall be used to assign the values given in the other sub-indices to the jerks. Table 114 specifies the object description, and Table 115 specifies the entry description.

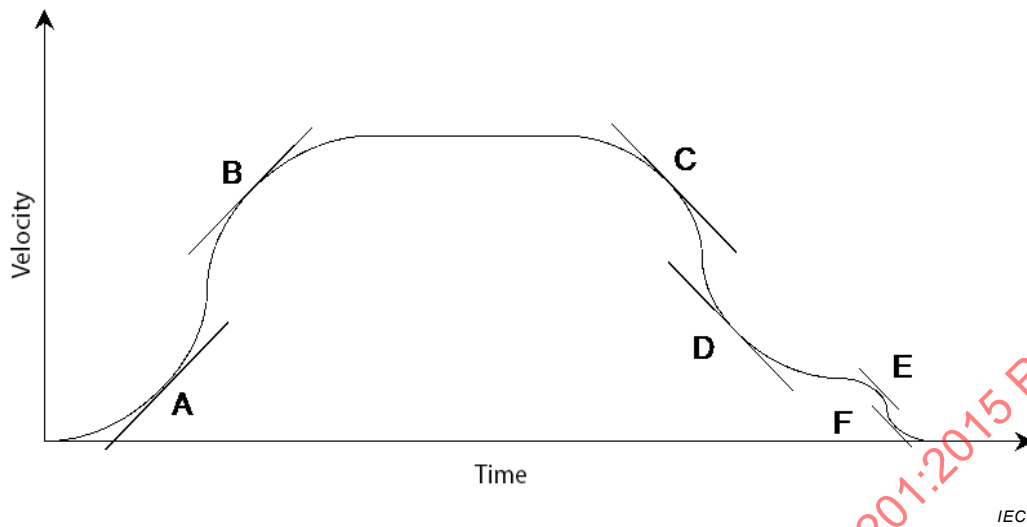


Figure 25 – Velocity/time diagram with jerk positions

Table 113 – Value assignments

Value in 60A3 _h or sub-index 00 _h of 60A4 _h if 60A3 _h is not implemented	Value assignment to jerks					
	A	B	C	D	E	F
01 _h	01 _h	01 _h	01 _h	01 _h	–	–
02 _h	01 _h	01 _h	02 _h	02 _h	–	–
04 _h	01 _h	03 _h	02 _h	04 _h	–	–
06 _h	01 _h	03 _h	02 _h	04 _h	05 _h	06 _h

Table 114 – Object description

Attribute	Value
Index	60A4 _h
Name	Profile jerk
Object code	Array
Data type	Unsigned32
Category	Optional

Table 115 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h , 02 _h , 04 _h , or 06 _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	Profile jerk 1
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Profile jerk 2
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	06 _h
Description	Profile jerk 6
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.14 Object 60C5_h: Max acceleration

This object shall indicate the configured maximal acceleration. It is used to limit the acceleration to an acceptable value in order to prevent the motor and the moved mechanics from being destroyed. The value shall be given in user-defined acceleration physical units. Table 116 specifies the object description, and Table 117 specifies the entry description.

Table 116 – Object description

Attribute	Value
Index	60C5 _h
Name	Max acceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 117 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.15 Object 60C6_h: Max deceleration

This object shall indicate the configured maximal deceleration. It is used to limit the acceleration to an acceptable value in order to prevent the motor and the moved mechanics from being destroyed. The value shall be given in the same physical unit as the max acceleration object (60C5_h). Table 118 specifies the object description, and Table 119 specifies the entry description.

Table 118 – Object description

Attribute	Value
Index	60C6 _h
Name	Max deceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 119 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

11 Homing mode

11.1 General information

This clause describes the method by which a drive seeks the home position (also called, the datum, reference point or zero point). There are various methods of achieving this using limit switches at the ends of travel or a home switch (zero point switch) in mid-travel, most of the methods also use the index (zero) pulse train from an incremental encoder.

11.2 Functional description

Figure 26 shows the defined input objects as well as the output objects. The user may specify the speeds, acceleration and the method of homing. There is a further object home offset, which allows the user to displace zero in the user's coordinate system from the home position.

There is no output data except for those bits in the statusword, which return the status or result of the homing process and the demand to the position control loops.

There are two homing speeds; in a typical cycle, the faster speed is used to find the home switch and the slower speed is used to find the index pulse. The manufacturer is allowed some discretion in the use of these speeds as the response to the signals may be dependent upon the hardware used.

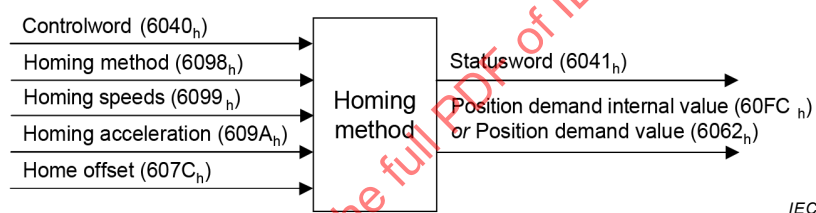


Figure 26 – Homing mode function

By choosing a homing method, the following behavior is determined: The homing signal (positive limit switch, negative limit switch, home switch), the direction of actuation and where appropriate, the position of the index pulse.

The home position and the zero position are offset by the home offset; see the definition of home offset for how this offset is used.

An encircled number in the figures Figure 27 to Figure 34 indicates the code for selection of this homing position. The direction of movement is also indicated.

There are four sources of homing signal available: These are the negative and positive limit switches, the home switch and the index pulse from an encoder. In case, that a limit switch has reached the drive shall move in the other direction to leave the position.

In the diagrams of homing sequences shown below, the encoder count increases as the axis's position moves to the right, in other words, the left is the minimum position and the right is the maximum position.

For the operation of positioning drives, an exact knowledge of the absolute position is normally required. Since, for cost reasons, drives often do not have an absolute encoder, a homing operation is necessary. There are several, application-specific methods. The homing method is used for selection.

The exact sequence of the homing operation is clearly described by the method. In some circumstances, a drive device has several methods to choose from, using the homing method.

11.3 General definitions

11.3.1 General

The homing modes are working on logical values of the limit- and homing-switches (object 60FD_h).

11.3.2 Method 1: Homing on negative limit switch and index pulse

Using this method as shown in Figure 27, the initial direction of movement shall be leftward if the negative limit switch is inactive (here: low). The home position shall be at the first index pulse to the right of the position where the negative limit switch becomes inactive.

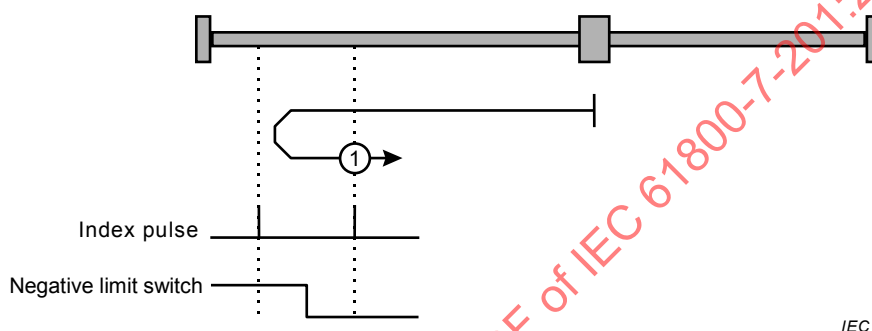


Figure 27 – Homing on negative limit switch and index pulse

11.3.3 Method 2: Homing on positive limit switch and index pulse

Using this method as shown in Figure 28, the initial direction of movement shall be rightward if the positive limit switch is inactive (here: low). The position of home shall be at the first index pulse to the left of the position where the positive limit switch becomes inactive.

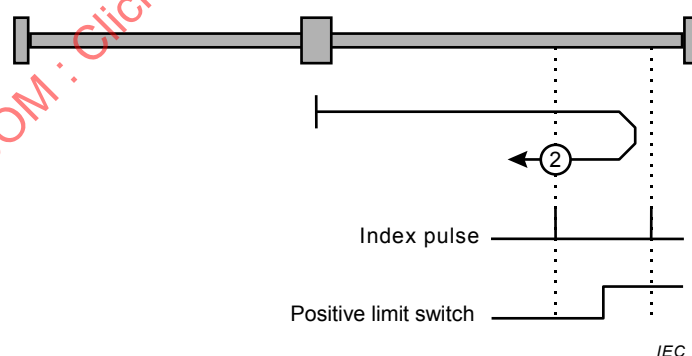


Figure 28 – Homing on positive limit switch and index pulse

11.3.4 Method 3 and 4: Homing on positive home switch and index pulse

Using these methods as shown in Figure 29, the initial direction of movement shall be dependent on the state of the home switch. The home position shall be at the index pulse to either to the left or the right of the point where the home switch changes state. If the initial position is situated so that the direction of movement shall reverse during homing, the point at which the reversal takes place is anywhere after a change of state of the home switch.

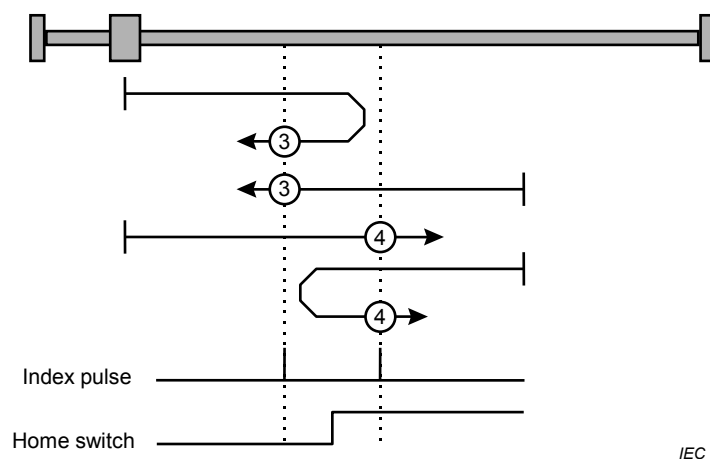


Figure 29 – Homing on positive home switch and index pulse

11.3.5 Method 5 and 6: Homing on negative home switch and index pulse

Using these methods as shown in Figure 30, the initial direction of movement shall be dependent on the state of the home switch. The home position shall be at the index pulse to either to the left or the right of the point where the home switch changes state. If the initial position is situated so that the direction of movement shall reverse during homing, the point at which the reversal takes place is anywhere after a change of state of the home switch.

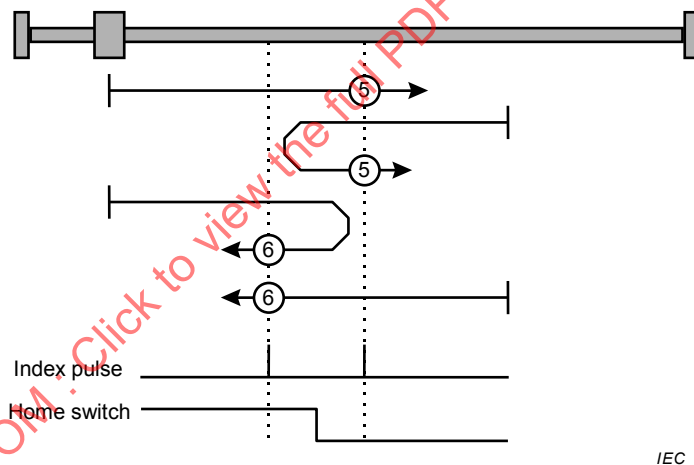


Figure 30 – Homing on negative home switch and index pulse

11.3.6 Method 7 to 14: Homing on home switch and index pulse

These methods use a home switch, which is active over only a portion of the travel, in effect the switch has a 'momentary' action as the axis's position sweeps past the switch. Using the methods 7 to 10, the initial direction of movement shall be to the right, and using methods 11 to 14, the initial direction of movement shall be to the left except if the home switch is active at the start of the motion. In this case, the initial direction of motion shall be dependent on the edge being sought. The home position shall be at the index pulse on either side of the rising or falling edges of the home switch, as shown in Figure 31 and Figure 32. If the initial direction of movement leads away from the home switch, the drive shall reverse on encountering the relevant limit switch.

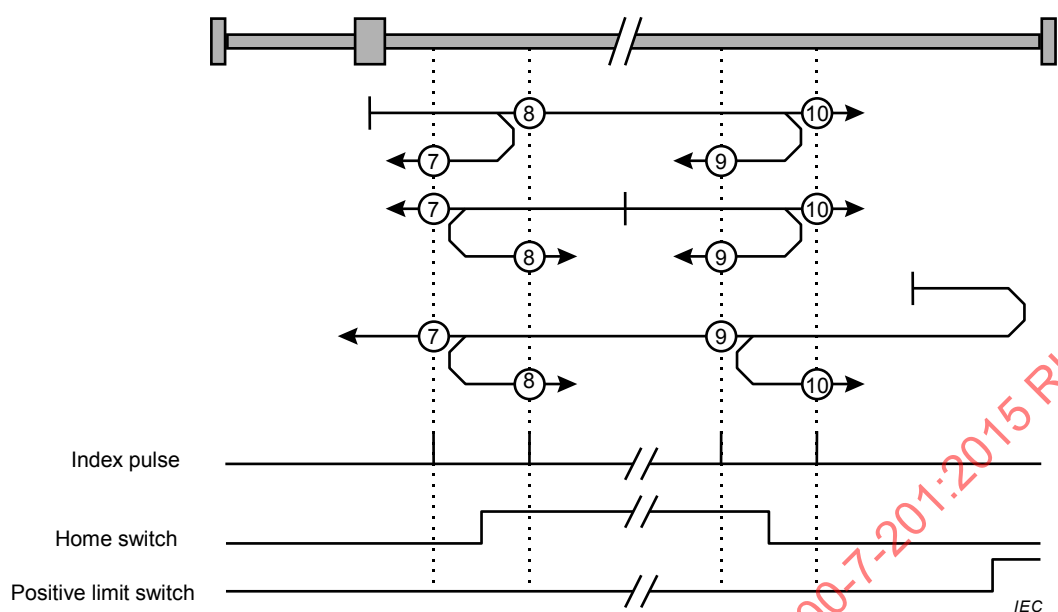


Figure 31 – Homing on home switch and index pulse – positive initial motion

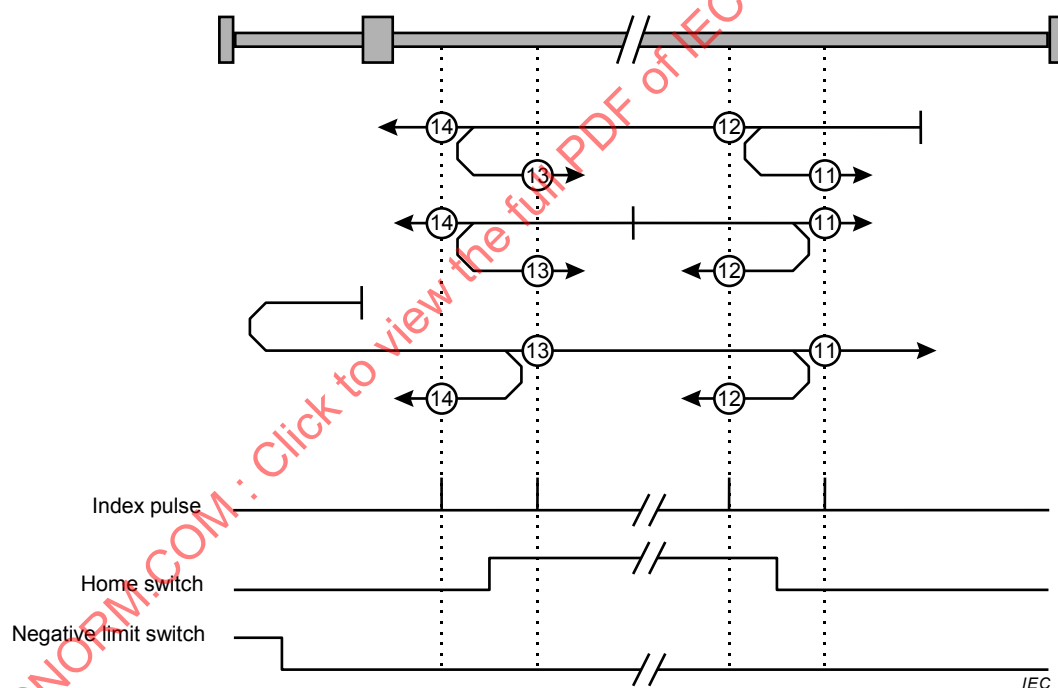


Figure 32 – Homing on home switch and index pulse – negative initial motion

11.3.7 Method 15 and 16: Reserved

These methods are reserved.

11.3.8 Method 17 to 30: Homing without index pulse

These methods are similar to methods 1 to 14 except that the home position is not dependent on the index pulse but only dependent on the relevant home or limit switch transitions. For example methods 19 and 20 are similar to methods 3 and 4 as shown in Figure 33.

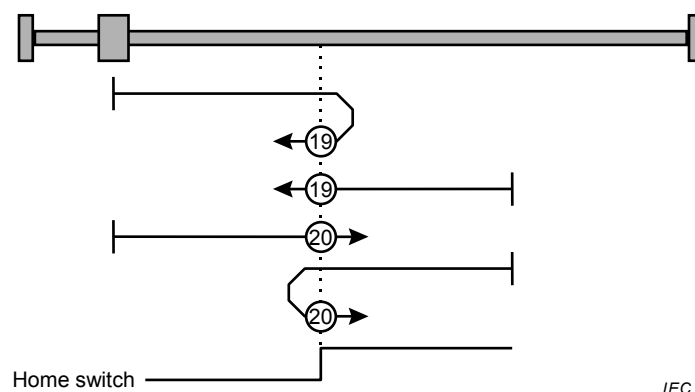


Figure 33 – Homing on positive home switch

11.3.9 Method 31 and 32: Reserved

These methods are reserved.

11.3.10 Method 33 and 34: Homing on index pulse

Using these methods, the direction of homing is negative or positive respectively. The home position shall be at the index pulse found in the selected direction as shown in Figure 34.

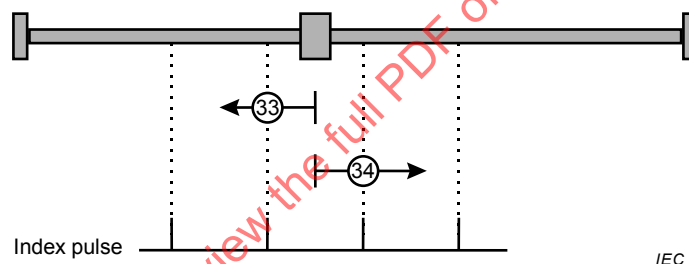


Figure 34 – Homing on index pulse

11.3.11 Method 35: Homing on ~~index pulse~~ current position (obsolete)

In this method, the current position shall be taken to be the home position. This method does not require the drive device to be in operation ~~at~~ enabled state.

NOTE This method is obsolete because of compatibility reasons.

11.3.12 Method 36: ~~Homing with touch probe~~ Reserved for compatibility reasons

~~In this method, the position is not sampled by the control device, but by the drive device itself. When the switch is triggered, the corresponding actual position together with the switch signal shall be reported.~~

11.3.13 Method 37: Homing on current position

In this method, the position sensor information (converted in user-defined position units) shall be taken to be the home position. This method does not require the drive device to be in operation enabled state.

At the home position (i.e. after the homing process) the position actual value (6064_h) is calculated as follows:

Position actual value (6064_h) = Home offset ($607C_h$)

EXAMPLE: The control device can set the operation mode and runs the drive to the home position. At the home position the control device switches the operation mode to the homing mode, method 37. The drive takes the current mechanical position as the machine home position. Then the control device switches back to operation mode.

11.4 Use of controlword and statusword

The homing mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 35 shows the structure of the controlword. Table 120 defines the values for bit 4 and 8 of the controlword.

15	9	8	7	6	5	4	3	0
(see 8.4.1)	Halt	(see 8.4.1)	reserved (0)	Homing operation start	(see 8.4.1)			
MSB								LSB

Figure 35 – Controlword for homing mode

Table 120 – Definition of bit 4 and bit 8

Bit	Value	Definition
4	0	Do not start homing procedure
	1	Start or continue homing procedure
8	0	Enable bit 4
	1	Stop axis according to halt option code (605D _h)

Figure 36 shows the structure of the statusword. Table 121 defines the values for bit 10, bit 12, and bit 13. Bit 12 shall provide the actual homing status. Bit 12 may be used to observe whether homing is attained without executing the homing procedure.

15	14	13	12	11	10	9	0
(see 8.4.2)	Homing error	Homing attained	(see 8.4.2)	Target reached	(see 8.4.2)		
MSB							LSB

Figure 36 – Statusword for homing mode

Table 121 – Definition of bit 10, bit 12, and bit 13

Bit 13	Bit 12	Bit 10	Definition
0	0	0	Homing procedure is in progress
0	0	1	Homing procedure is interrupted or not started
0	1	0	Homing is attained, but target is not reached
0	1	1	Homing procedure is completed successfully
1	0	0	Homing error occurred, velocity is not 0
1	0	1	Homing error occurred, velocity is 0
1	1	X	Reserved

11.5 Detailed object definitions

11.5.1 Object 607C_h: Home offset

This object shall indicate the configured difference between the zero position for the application and the machine home position (found during homing). During homing, the

machine home position is found and once the homing is completed, the zero position is offset from the home position by adding the home offset to the home position.

The zero position is calculated by following equation:

$$\text{zero position} = \text{home position} + \text{home offset}$$

All subsequent absolute moves shall be taken relative to this new zero position. This is illustrated in Figure 37. If this object is not implemented, then the home offset shall be regarded as zero. The value of this object shall be given in user-defined position units. Negative values shall indicate the opposite direction.

The activation of a new value of the object home offset is manufacturer-specific. It is recommended to apply the new value only while the drive is in homing mode.



Figure 37 – Home offset definition

Table 122 specifies the object description, and Table 123 specifies the entry description.

Table 122 – Object description

Attribute	Value
Index	607C _h
Name	Home offset
Object code	Variable
Data type	Integer32
Category	Optional

Table 123 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	0 _d

11.5.2 Object 6098_h: Homing method

This object shall indicate the configured homing method that shall be used. Table 124 specifies the value definition, Table 125 specifies the object description, and Table 126 specifies the entry description.

Table 124 – Value definition

Value	Definition
-128_d to -1_d	Manufacturer-specific
0_d	No homing method assigned
$+1_d$	Method 1 shall be used
to	
$+35\ 37_d$	Method ~~35~~ 37 shall be used
$+36_d$	~~Method 36 shall be used~~
$+37\ 38_d$ to $+127_d$	Reserved

Table 125 – Object description

Attribute	Value
Index	6098_h
Name	Homing method
Object code	Variable
Data type	Integer8
Category	Conditional: mandatory if hm is supported

Table 126 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 124
Default value	Manufacturer-specific

11.5.3 Object 60E3_h: Supported homing methods

This object shall provide the supported homing methods of the drive. Table 124 specifies the value definition, Table 127 specifies the object description, and Table 128 specifies the entry description.

Table 127 – Object description

Attribute	Value
Index	$60E3_h$
Name	Supported homing methods
Object code	Array
Data type	Integer8
Category	Optional

Table 128 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st supported homing method
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	See Table 124
Default value	+37 _d
Sub-index	02 _h
Description	2nd supported homing method
Entry category	Optional
Access	c
PDO mapping	See IEC 61800-7-301
Value range	See Table 124
Default value	Manufacturer-specific
to	
Sub-index	FE _h
Description	254th supported homing method
Entry category	Optional
Access	c
PDO mapping	See IEC 61800-7-301
Value range	See Table 124
Default value	Manufacturer-specific

11.5.4 Object 6099_h: Homing speeds

This object shall indicate the configured speeds used during homing procedure. The values shall be given in user-defined velocity units. Table 129 specifies the object description, and Table 130 specifies the entry description.

Table 129 – Object description

Attribute	Value
Index	6099 _h
Name	Homing speeds
Object code	Array
Data type	Unsigned32
Category	Conditional: mandatory if hm is supported

Table 130 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Speed during search for switch
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Speed during search for zero
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

11.5.5 Object 609A_h: Homing acceleration

This object shall indicate the configured acceleration and deceleration to be used during homing operation. The value shall be given in user-defined acceleration units. Table 131 specifies the object description, and Table 132 specifies the entry description.

Table 131 – Object description

Attribute	Value
Index	609A _h
Name	Homing acceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 132 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

12 Touch probe functionality

12.1 Object 60B8_h: Touch probe function

This object shall indicate the configured function of the touch probe. Table 133 specifies the value definition, Table 134 specifies the object description, and Table 135 specifies the entry description.

Table 133 – Value definition

Bit	Value	Definition
0	0	Switch off touch probe 1
	1	Enable touch probe 1
1	0	Trigger first event
	1	continuous
~~2~~ 3,2	~~0~~ 00 _b	Trigger with touch probe 1 input
	~~4~~ 01 _b	Trigger with zero impulse signal or position encoder
	10 _b	Touch probe source as defined in object 60D0 _h , sub-index 01 _h
	~~0~~ 11 _b	Reserved
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1
6, 7	–	User-defined (e.g. for testing)
8	0	Switch off touch probe 2
	1	Enable touch probe 2
9	0	Trigger first event
	1	Continuous
~~10~~ 11,10	~~0~~ 00 _b	Trigger with touch probe 2 input
	~~4~~ 01 _b	Trigger with zero impulse signal or position encoder
	10 _b	Touch probe source as defined in object 60D0 _h , sub-index 02 _h
	~~0~~ 11 _b	Reserved
12	0	Switch off sampling at positive edge of touch probe 2
	1	Enable sampling at positive edge of touch probe 2
13	0	Switch off sampling at negative edge of touch probe 2
	1	Enable sampling at negative edge of touch probe 2
14, 15	–	User-defined (e.g. for testing)

Table 134 – Object description

Attribute	Value
Index	60B8 _h
Name	Touch probe function
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 135 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 133
Default value	Manufacturer-specific

12.2 Object 60B9_h: Touch probe status

This object shall provide the status of the touch probe. Table 136 specifies the value, Table 137 specifies the object description, and Table 138 specifies the entry description.

Table 136 – Value definition

Bit	Value	Definition
0	0	Touch probe 1 is switched off
	1	Touch probe 1 is enabled
1	0	Touch probe 1 no positive edge value stored
	1	Touch probe 1 negative edge position stored
2	0	Touch probe 1 no negative edge value stored
	1	Touch probe 1 positive edge position stored
3 to 5	0	Reserved
6, 7	–	User-defined (e.g. for testing)
8	0	Touch probe 2 is switched off
	1	Touch probe 2 is enabled
9	0	Touch probe 2 no positive edge value stored
	1	Touch probe 2 negative edge position stored
10	0	Touch probe 2 no negative edge value stored
	1	Touch probe 2 positive edge position stored
11 to 13	0	Reserved
14, 15	–	User-defined (e.g. for testing)

NOTE Bit 1 and bit 2 are set to 0_b when touch probe 1 is switched off (object 60B8_h bit 0 is 0_b). Bit 9 and 10 are set to 0_b when touch probe 2 is switched off (object 60B8_h bit 8 is 0_b).

Table 137 – Object description

Attribute	Value
Index	60B9 _h
Name	Touch probe status
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 138 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 136
Default value	No

12.3 Object 60BA_h: Touch probe ~~pos1 pos-value~~ 1 positive edge

This object shall provide the position value of the touch probe 1 at positive edge. The value shall be given in user-defined position units. Table 139 specifies the object description, and Table 140 specifies the entry description.

Table 139 – Object description

Attribute	Value
Index	60BA _h
Name	Touch probe ~~pos1 pos-value~~ 1 positive edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 140 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

12.4 Object 60BB_h: Touch probe ~~pos1 neg-value~~ 1 negative edge

This object shall provide the position value of the touch probe 1 at negative edge. The value shall be given in user-defined position units. Table 141 specifies the object description, and Table 142 specifies the entry description.

Table 141 – Object description

Attribute	Value
Index	60BB _h
Name	Touch probe ~~pos1 neg-value~~ 1 negative edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 142 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

12.5 Object 60BC_h: Touch probe ~~pos2 pos-value~~ 2 positive edge

This object shall provide the position value of the touch probe 2 at positive edge. The value shall be given in user-defined position units. Table 143 specifies the object description, and Table 144 specifies the entry description.

Table 143 – Object description

Attribute	Value
Index	60BC _h
Name	Touch probe ~~pos2 pos-value~~ 2 positive edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 144 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

12.6 Object 60BD_h: Touch probe ~~pos2 neg-value~~ 2 negative edge

This object shall provide the position value of the touch probe 2 at negative edge. The value shall be given in user-defined position units. Table 145 specifies the object description, and Table 146 specifies the entry description.

Table 145 – Object description

Attribute	Value
Index	60BD _h
Name	Touch probe ~~pos2 neg-value~~ 2 negative edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 146 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

12.7 Object 60D0_h: Touch probe source

This object shall provide the source of the touch probe functions. Table 147 specifies the value definition.

Table 148 specifies the object description, and Table 149 specifies the entry description.

Table 147 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Reserved
+1	Touch probe 1 input
+2	Touch probe 2 input
+3	Touch probe 3 input
+4	Touch probe 4 input
+5	Hardware zero impulse signal of position encoder
+6	Software zero impulse signal of position encoder
+7 to +32 767	Reserved

Table 148 – Object description

Attribute	Value
Index	60D0 _h
Name	Touch probe source
Object code	Array
Data type	Integer16
Category	Optional

Table 149 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	No
Sub-index	01 _h
Description	Touch probe 1 source
Entry category	Mandatory
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 147
Default value	No
Sub-index	02 _h
Description	Touch probe 2 source
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 147
Default value	No
to	
Sub-index	FE _h
Description	Touch probe 254 source
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 147
Default value	No

12.8 Touch probe time stamp latch

12.8.1 General

In addition to the position values (objects 60BA_h, 60BB_h, 60BC_h and 60BD_h) the current time stamp may be latched by the device. The objects 60D1_h, 60D2_h, 60D3_h and 60D4_h provide the corresponding time stamp for touch probe 1 and 2. The control device may use several process values with the same time stamp to calculate new set-points.

12.8.2 Object 60D1_h: Touch probe time stamp 1 positive value

This object shall provide the time stamp value of the touch probe 1 at positive edge. The value shall be given in nanoseconds. Table 150 specifies the object description, and Table 151 specifies the entry description.

Table 150 – Object description

Attribute	Value
Index	60D1 _h
Name	Touch probe time stamp 1 positive value
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 151 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

12.8.3 Object 60D2_h: Touch probe time stamp 1 negative value

This object shall provide the time stamp value of the touch probe 1 at negative edge. The value shall be given in nanoseconds. Table 152 specifies the object description, and Table 153 specifies the entry description.

Table 152 – Object description

Attribute	Value
Index	60D2 _h
Name	Touch probe time stamp 1 negative value
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 153 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

12.8.4 Object 60D3_h: Touch probe time stamp 2 positive value

This object shall provide the time stamp value of the touch probe 2 at positive edge. The value shall be given in nanoseconds. Table 154 specifies the object description, and Table 155 specifies the entry description.

Table 154 – Object description

Attribute	Value
Index	60D3 _h
Name	Touch probe time stamp 2 positive value
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 155 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

12.8.5 Object 60D4_h: Touch probe time stamp 2 negative value

This object shall provide the time stamp value of the touch probe 2 at negative edge. The value shall be given in nanoseconds. Table 156 specifies the object description, and Table 157 specifies the entry description.

Table 156 – Object description

Attribute	Value
Index	60D4 _h
Name	Touch probe time stamp 2 negative value
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 157 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

12.9 Touch probe edge counter for continuous mode

12.9.1 General

For continuous touch probe mode (60B8_h, bit 1 = 1_b or 60B8_h, bit 9 = 1_b) a counter per touch probe channel is incremented on each touch probe event. Thus, the control device may check how many touch probe events happen between the control cycles. Per touch probe and per edge a counter object (objects 60D5_h, 60D6_h, 60D7_h and 60D8_h) is defined.

12.9.2 Object 60D5_h: Touch probe 1 positive edge counter

This object shall provide a continuous counter that is incremented with each positive edge at touch probe 1. The counter is only valid if the touch probe input is enabled (60B8_h, bit 0 = 1_b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.

Table 158 specifies the object description, and Table 159 specifies the entry description.

Table 158 – Object description

Attribute	Value
Index	60D5 _h
Name	Touch probe 1 positive edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 159 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	No

12.9.3 Object 60D6_h: Touch probe 1 negative edge counter

This object shall provide a continuous counter that is incremented with each negative edge at touch probe 1. The counter is only valid if the touch probe input is enabled (60B8_h, bit 0 = 1_b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.

Table 160 specifies the object description, and Table 161 specifies the entry description.

Table 160 – Object description

Attribute	Value
Index	60D6 _h
Name	Touch probe 1 negative edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 161 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	No

12.9.4 Object 60D7_h: Touch probe 2 positive edge counter

This object shall provide a continuous counter that is incremented with each positive edge at touch probe 2. The counter is only valid if the touch probe input is enabled (60B8_h, bit 8 = 1_b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.

Table 162 specifies the object description, and Table 163 specifies the entry description.

Table 162 – Object description

Attribute	Value
Index	60D7 _h
Name	Touch probe 2 positive edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 163 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	No

12.9.5 Object 60D8_h: Touch probe 2 negative edge counter

This object shall provide a continuous counter that is incremented with each negative edge at touch probe 2. The counter is only valid if the touch probe input is enabled (60B8_h, bit 8 = 1_b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.

Table 164 specifies the object description, and Table 165 specifies the entry description.

Table 164 – Object description

Attribute	Value
Index	60D8 _h
Name	Touch probe 2 negative edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 165 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	No

12.10 Timing diagram for touch probe example

Figure 38 shows a timing diagram for an example touch probe configuration and the corresponding behavior. Table 166 explains the timing diagram.

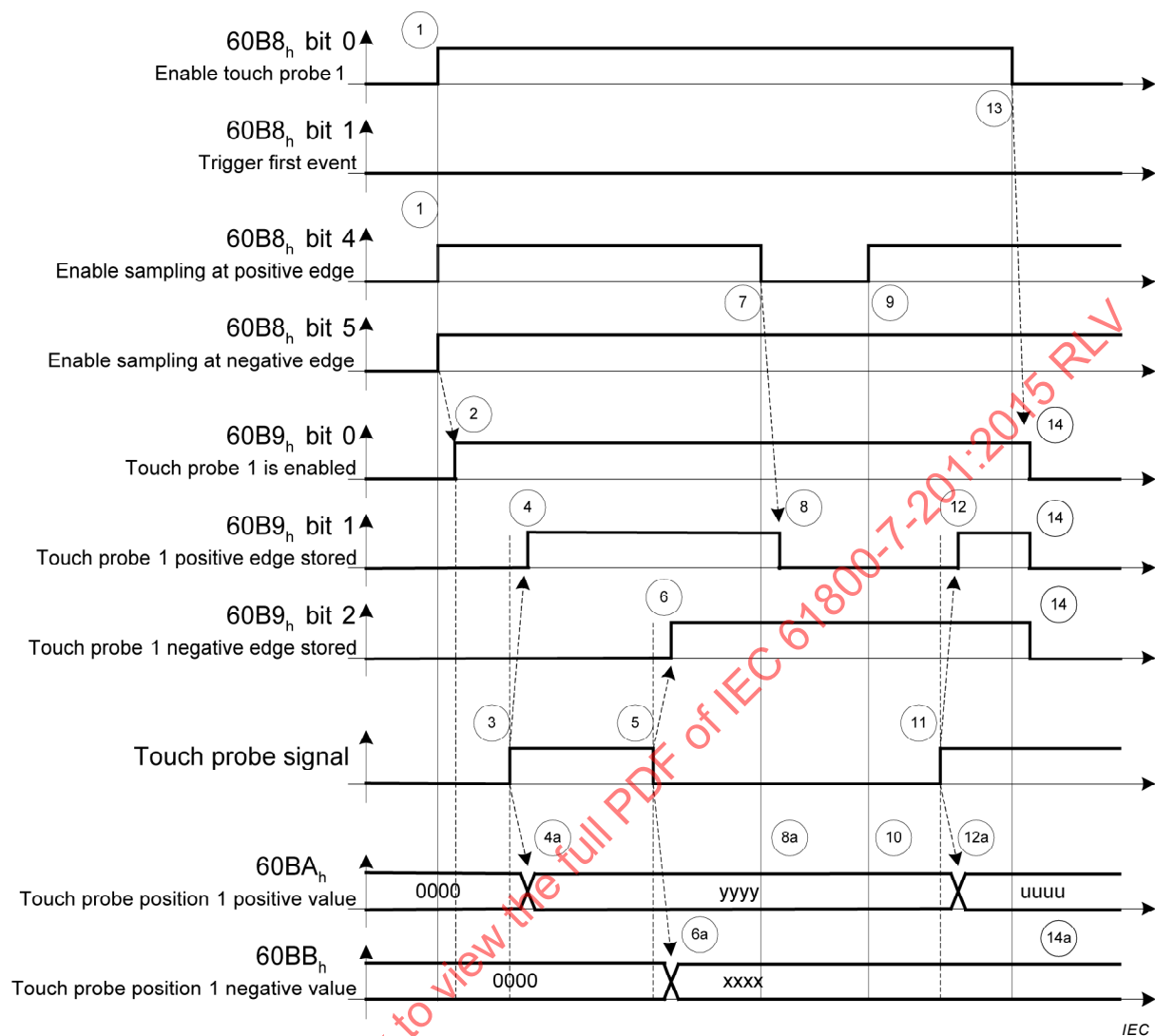


Figure 38 – Timing diagram for touch probe example

Table 166 – Explanation of the timing diagram

Number	Touch probe behavior
(1)	60B8 _h , bit 0 = 1 _b Enable touch probe 1 60B8 _h , bit 1, 4, 5 Configure and enable touch probe 1 positive and negative edge
(2)	→ 60B9 _h , bit 0 = 1 _b Status “Touch probe 1 enabled” is set
(3)	External touch probe signal has positive edge
(4)	→ 60B9 _h , bit 1 = 1 _b Status “Touch probe 1 positive edge stored” is set
(4a)	→ 60BA _h Touch probe position 1 positive value is stored
(5)	External touch probe signal has negative edge
(6)	→ 60B9 _h , bit 2 = 1 _b Status “Touch probe 1 negative edge stored” is set
(6a)	→ 60BB _h Touch probe position 1 negative value is stored
(7)	60B8 _h , bit 4 = 0 _b Sample positive edge is disabled
(8)	→ 60B9 _h , bit 0 = 0 _b Status “Touch probe 1 positive edge stored” is reset
(8a)	→ 60BA _h Touch probe position 1 positive value is not changed
(9)	60B8 _h , bit 4 = 1 _b Sample positive edge is enabled
(10)	→ 60BA _h Touch probe position 1 positive value is not changed
(11)	External touch probe signal has positive edge
(12)	→ 60B9 _h , bit 1 = 1 _b Status “Touch probe 1 positive edge stored” is set
(12a)	→ 60BA _h Touch probe position 1 positive value is stored
(13)	60B8 _h , bit 0 = 0 _b Touch probe 1 is disabled
(14)	→ 60B9 _h , bit 0, 1, 2 = 0 _b Status bits are reset
(14a)	→ 60BA _h , 60BB _h Touch probe position 1 positive/negative value are not changed

13 Position control function

13.1 General information

For closed-loop position, the position demand value (as one of the outputs of the trajectory generator) and the output of the position detection unit (position actual value) such as a resolver or encoder are used input parameters. The behavior of the closed-loop control is influenced by control parameters, which are externally applicable. To keep the loop stable, a relative limitation of the output using the previous control effort is optional. In order not to exceed the physical limits of a drive, an absolute limit function may be implemented for the control effort.

13.2 Functional description

Figure 39 shows the inputs and outputs of the position control function. The control effort may be a velocity demand value, a position demand value or any other output value, depending on the modes of operation implemented in the drive device. Especially in cascaded control structures, where a position control is followed by a torque control, for example the control effort of the position control loop is used as an input for a further calculation.

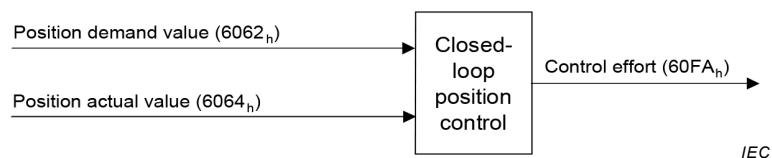


Figure 39 – Position control function

All values are transformed – if necessary – from user-defined units to normalized units such as increments.

A position actual value outside the allowed range of the following error window around a position demand value for longer than the following error time out shall result in setting bit 13 (following error) in the statusword to 1. This is shown in detail in Figure 40. Depending on the supported modes of operation (pp, hm, or ip) and on the capabilities of different categories of drives, only some of the mentioned input parameters may be necessary.

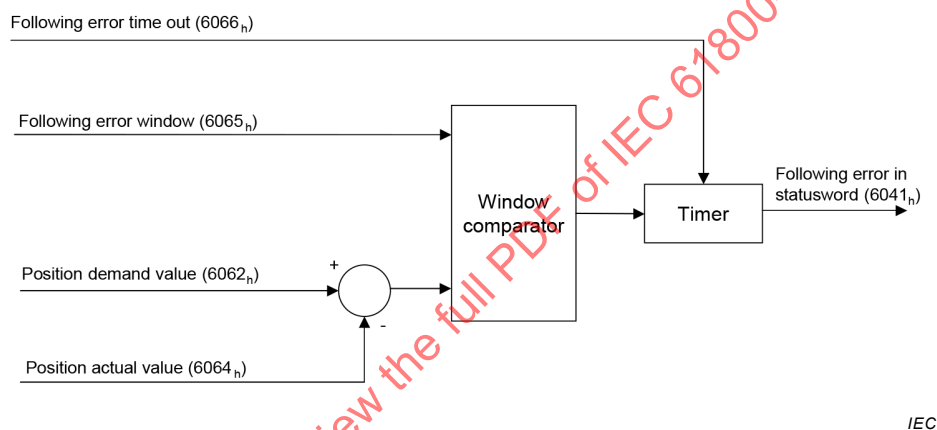
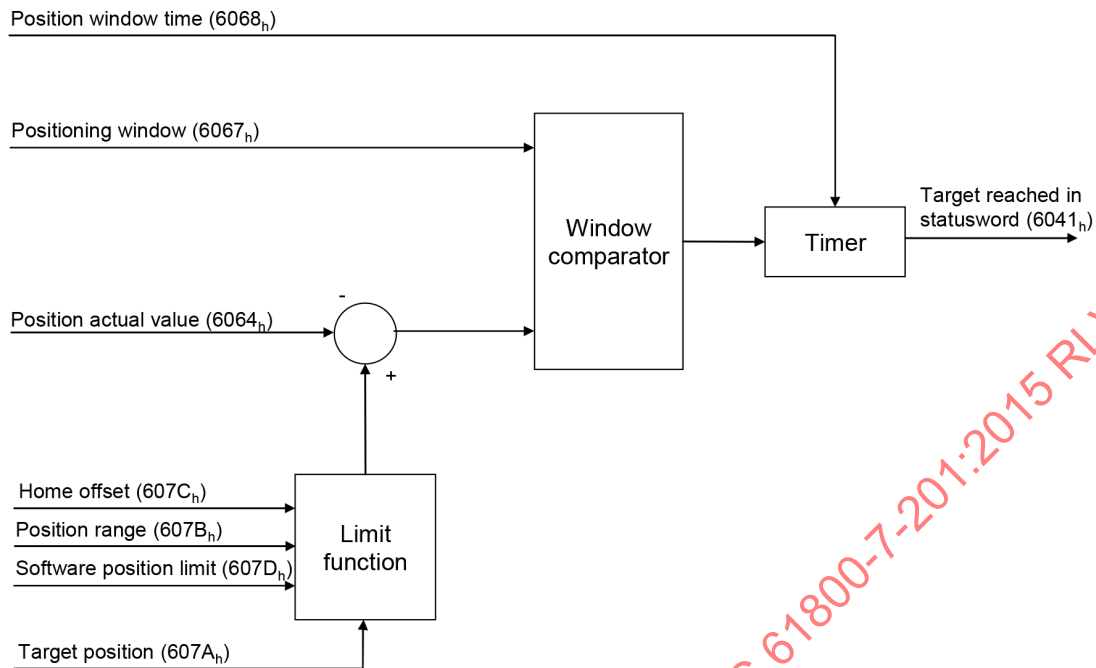


Figure 40 – Following error (functional overview)

The position reached function as shown in Figure 41 offers the possibility to define a position range around a position demand value to be regarded as valid. If a drive's position is within this area for a specified time – the position window time – the related control bit 10 target reached in the statusword shall be set to 1.

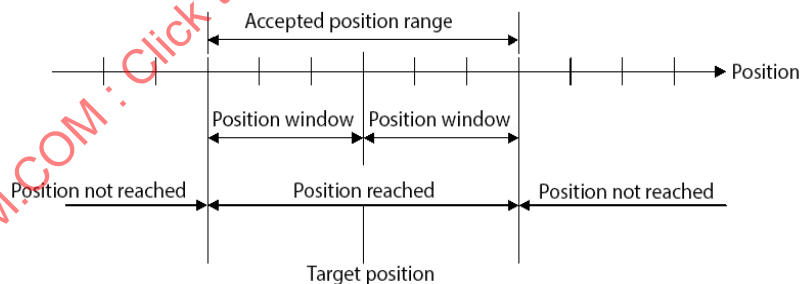


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Figure 41 – Position reached (functional overview)

The control functions following error and position reached have direct access to the statusword and shall give immediate notification to the user if their results change.

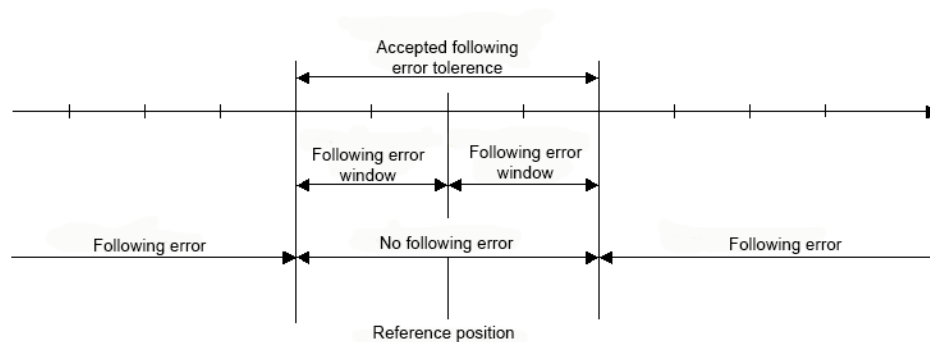
Figure 42 shows the definitions of the sub-function position reached. A window is defined for the accepted position range symmetrically around the target position. If a drive is situated in the accepted position range over the time position window time, the bit target reached (bit 10) in the statusword shall be set to 1.



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Figure 42 – Position reached (definitions)

Figure 43 shows the definitions of the sub-function following error in the profile position mode. A window is defined for the accepted following error tolerance symmetrically around the reference position. If a drive is situated out of the accepted position range for more than following error time out time, the bit following error (bit 13) in the statusword shall be set to 1.



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Figure 43 – Following error (definitions)

13.3 Detailed object definitions

13.3.1 Object 6062_h: Position demand value

This object shall provide the demanded position value. The value shall be given in user-defined position units. Table 167 specifies the object description, and Table 168 specifies the entry description.

Table 167 – Object description

Attribute	Value
Index	6062 _h
Name	Position demand value
Object code	Variable
Data type	Integer32
Category	Optional

Table 168 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.2 Object 6063_h: Position actual internal value

This object shall provide the actual value of the position measurement device, which shall be one of the two input values of the closed-loop position control. If necessary, the data unit may be transformed from user-defined units to increments. The value shall be given in internal units. Table 169 specifies the object description, and Table 170 specifies the entry description.

Table 169 – Object description

Attribute	Value
Index	6063 _h
Name	Position actual internal value
Object code	Variable
Data type	Integer32
Category	Optional

Table 170 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.3 Object 6064_h: Position actual value

This object shall provide the actual value of the position measurement device. The value shall be given in user-defined position units. Table 171 specifies the object description, and Table 172 specifies the entry description.

Table 171 – Object description

Attribute	Value
Index	6064 _h
Name	Position actual value
Object code	Variable
Data type	Integer32
Category	Mandatory if pp, ip or csp is supported

Table 172 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.4 Object 6065_h: Following error window

This object shall indicate the configured range of tolerated position values symmetrically to the position demand value. If the position actual value is out of the following error window, a following error occurs. A following error may occur when a drive is blocked, unreachable profile velocity occurs, or at wrong closed-loop coefficients. The value shall be given in user-defined position units. If the value of the following error window is FFFF FFFF_h, the following

control shall be switched off. Table 173 specifies the object description, and Table 174 specifies the entry description.

Table 173 – Object description

Attribute	Value
Index	6065 _h
Name	Following error window
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 174 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

13.3.5 Object 6066_h: Following error time out

This object shall indicate the configured time for a following error condition, after that the bit 13 of the statusword shall be set to 1. The reaction of the drive when a following error occurs is manufacturer-specific. The value shall be given in ms. Table 175 specifies the object description, and Table 176 specifies the entry description.

Table 175 – Object description

Attribute	Value
Index	6066 _h
Name	Following error time out
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 176 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

13.3.6 Object 6067_h: Position window

This object shall indicate the configured symmetrical range of accepted positions relative to the target position. If the actual value of the position encoder is within the position window, this target position shall be regarded as having been reached. As the user mostly prefers to specify the position window in his application in user-defined units, the value is transformed into increments. The target position shall be handled in the same manner as in the trajectory generator concerning limiting functions and transformation into internal machine units before it may be used with this function. The value shall be given in user-defined position units. If the value of the position window is FFFF FFFF_h, the position window control shall be switched off. Table 177 specifies the object description, and Table 178 specifies the entry description.

Table 177 – Object description

Attribute	Value
Index	6067 _h
Name	Position window
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 178 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

13.3.7 Object 6068_h: Position window time

This object shall indicate the configured time, during which the actual position within the position window is measured. The value shall be given in ms. Table 179 specifies the object description, and Table 180 specifies the entry description.

Table 179 – Object description

Attribute	Value
Index	6068 _h
Name	Position window time
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 180 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

13.3.8 Object 60F4_h: Following error actual value

This object shall provide the actual value of the following error. The value shall be given in user-defined position units. Table 181 specifies the object description, and Table 182 specifies the entry description.

Table 181 – Object description

Attribute	Value
Index	60F4 _h
Name	Following error actual value
Object code	Variable
Data type	Integer32
Category	Optional

Table 182 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.9 Object 60FA_h: Control effort

This object shall provide the control effort as the output of the position control loop. It is particular to the position control function that the notation of the control effort is mode-dependent and therefore not specified. The value shall be given in user-defined velocity units. Table 183 specifies the object description, and Table 184 specifies the entry description.

Table 183 – Object description

Attribute	Value
Index	60FA _h
Name	Control effort
Object code	Variable
Data type	Integer32
Category	Optional

Table 184 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.10 Object 60FC_h: Position demand internal value

This object shall provide the output of the trajectory generator in profile position mode. This value shall be given in increments of the position encoder. Table 185 specifies the object description, and Table 186 specifies the entry description.

Table 185 – Object description

Attribute	Value
Index	60FC _h
Name	Position demand internal value
Object code	Variable
Data type	Integer32
Category	Optional

Table 186 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.11 Object 60F2_h: Positioning option code

This object shall indicate the configured positioning behavior as described by the profile positioning mode or the interpolated positioning mode. Figure 44 shows the defined object structure.



Key

ms	manufacturer-specific
rro	request-response option
cio	change immediately option
rado	rotary axis direction option

Figure 44 – Object structure

The relative option bits shall control the behavior of positioning tasks in detail when the abs/rel bit (bit 6) of the controlword is set to 1 in pp mode. Table 187 shows the bit value definitions.

Table 187 – Value definition for bit 0 and bit 1

Bit 1	Bit 0	Definition
0	0	Positioning moves shall be performed relative to the preceding (internal absolute) target position (rsp. relative to 0 if there is no preceding target position) as described in 10.2
0	1	Positioning moves shall be performed relative to the actual position demand value (object 60FC _n) – output of the trajectory generator
1	0	Positioning moves shall be performed relative to the position actual value (object 6064 _n)
1	1	Reserved

The change immediately option bits shall control the behavior of positioning tasks in detail when the change set immediately bit (bit 5) of the controlword is set to 1 in pp mode. Table 188 shows the bit value definitions.

Table 188 – Value definition for bit 2 and bit 3

Bit 3	Bit 2	Definition
0	0	The drive device shall readapt the actual motion to the new target position (considering potentially changed profile velocity and accelerations etc.) immediately as described in 10.2
0	1	The actually performed positioning task shall be continued (without attempting to stop on target position) and blended to the newly commanded task (considering potentially changed profile velocity and accelerations etc.) when target position is touched
1	0	Reserved
1	1	Reserved

The request-response option bits shall allow the drive device to release the new set-point bit (bit 4) of the controlword internally in order to avoid the need of setting this bit to 0 by the control device in pp mode. After internally releasing the new set-point bit, the drive device shall indicate the action to the control device by setting the set-point acknowledge bit (bit 12) in the statusword to 0. Table 189 shows the bit value definitions.

Table 189 – Value definition for bit 4 and bit 5

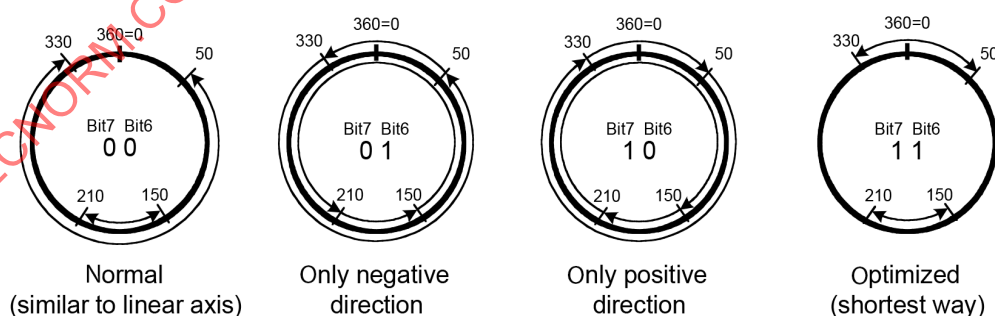
Bit 5	Bit 4	Definition
0	0	The handshake as described in 10.2 shall be performed
0	1	The drive device shall release autonomously the new set-point bit as soon as target is reached
1	0	The drive shall release autonomously the new set-point bit as soon as able to accept new set-point data
1	1	Reserved

Controlled rotary axes are needed for rotary tables and conveyor belts. It is also needed for cases where the host controller position limits are wider than the position range limits available in the drive. In these cases the software position limits (object 607D_h) are out of the position range limits (object 607B_h). To disable the position range limits the min position range limit (607B_h, sub-index 01_h) and max position range limit (607B_h, sub-index 02_h) shall be set to 0. Depending on the application, there are different rotary axis movements possible, which are coded by bit 6 and 7. Table 190 shows the bit value definitions.

Table 190 – Value definition for bit 6 and bit 7

Bit 7	Bit 6	Definition
0	0	Normal positioning similar to linear axis; If reaching or exceeding the position range limits (607B _h) the input value shall wrap automatically to the other end of the range. Positioning can be relative or absolute. Only with this bit combination, the movement greater than a modulo value is possible.
0	1	Positioning only in negative direction; if target position is higher than actual position, axis moves over the min position limit (607D _h , sub-index 01 _h) to the target position.
1	0	Positioning only in positive direction; if target position is lower than actual position, axis moves over the max position limit (607D _h , sub-index 02 _h) to the target position.
1	1	Positioning with the shortest way to the target position. NOTE If the difference between actual value and target position in a 360° system is 180°, the axis moves in positive direction.

Figure 45 shows movement examples depending on settings of the bits 6 and 7. Here the min position range limit (607B_h, sub-index 01_h) is 0° and the max position range limit (607B_h, sub-index 02_h) is 360°.



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Figure 45 – Rotary axis positioning example

A movement greater than a modulo value with more than 360° (bit 6 and 7 in this object are set to 0) on a rotary axis can be done with relative and absolute values depending on the bit 6 in the controlword. In addition the relative option bits (bit 0 and 1 in this object) are valid. There are positive and negative values possible.

Figure 46 shows an example for absolute positioning in a 360° system. The actual position is 90° and absolute target position is 630°. The axis will move in positive direction one time via the max position limit to 270°. To move in negative direction, the negative sign for target position shall be used.

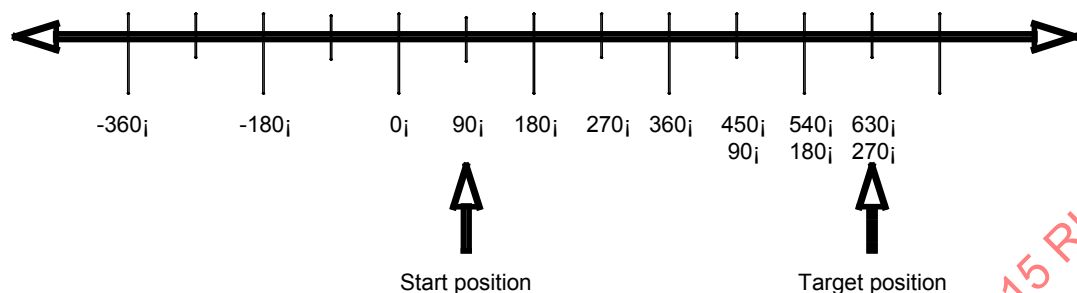


Figure 46 – Example for absolute movement greater than modulo value

Figure 47 shows an example for relative positioning in a 360° system. The actual position is 300° and relative target position is 500°. The axis will move in positive direction two times via the max position limit to 80°. To move in negative direction, the negative sign for target position shall be used. The difference between min and max position range limits (see object 607B_h) shall be representable in multiples of encoder increments.

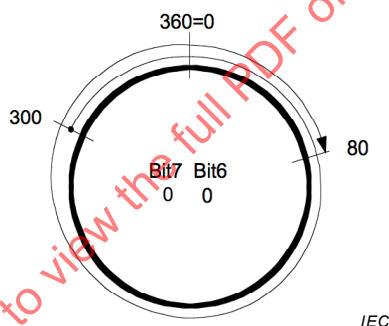


Figure 47 – Example for relative movement greater than modulo value

The ip option bits are reserved for defining the interpolated position mode. When the manufacturer-specific bit is set to 0, the function shall be not enabled; if it is set to 1, the manufacturer-specific function shall be enabled. The other reserved bits shall be set to 0.

Table 191 specifies the object description, and Table 192 specifies the entry description.

Table 191 – Object description

Attribute	Value
Index	60F2 _h
Name	Positioning option code
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 192 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 187, Table 188, Table 189
Default value	0000 _h

14 Interpolated position mode

14.1 General information

The interpolated position mode is used to control multiple coordinated axes or a single axis with the need for time-interpolation of set-point data. The interpolated position mode normally uses time synchronization mechanisms for a time coordination of the related drive units.

The interpolation data record contains the interpolation data; the data type of the sub-indices of this structure are manufacturer-specific.

For synchronous operation, the interpolation cycle time is defined by the object interpolation time period. Time synchronization may be done by network dependent mechanisms. Each synchronization cycle actuates the next data record if a valid data record is available.

For asynchronous operation, the interpolation time (for each time slice), may be included in the interpolation data record. If this is so, then the units for the interpolation time are still specified by the interpolation time index as for synchronous operation. The next data record shall be actuated as soon as the interpolation time expires and a valid data record is available.

The interpolated position mode allows the control device to transmit a stream of interpolation data with either an implicit or explicit time reference to a drive unit. If the drive supports an input buffer, the interpolation data may be sent in bursts rather than continuously in real time. The maximum size of the input buffer may be read by the control device using the interpolation data configuration. The actual buffer size may be both written and read by the control device using the interpolation data configuration. The buffer size is the number of interpolation data records which may be sent to a drive to fill the input buffer and it is not the size in bytes. Drive devices without input buffer capabilities shall accept at least one interpolation data item.

The interpolation data buffer may be implemented as a FIFO or a ring. The definition of a valid data record for each type of buffer shall be as follows:

- for the FIFO implementation, a valid data record is one that has not been actuated yet;
- for the ring implementation, all data records within the actual buffer size are treated as valid data records, so interpolation data will continue to be actuated while ip enable is true.

The interpolation algorithm is defined in the interpolation sub mode select (object 60C0h). Linear interpolation is the default interpolation method. This requires only one interpolation data item to be buffered for the calculation of the next demand value. For each interpolation cycle, the drive shall calculate a position demand value by interpolating positions over a period of time.

Optionally the common limit functions for speed, acceleration and deceleration may be applied to the interpolation data.

The placement of the scaling and limiting of the interpolation data record in Figure 48 is for indication only. These functions may be performed during the input of the interpolation data record.

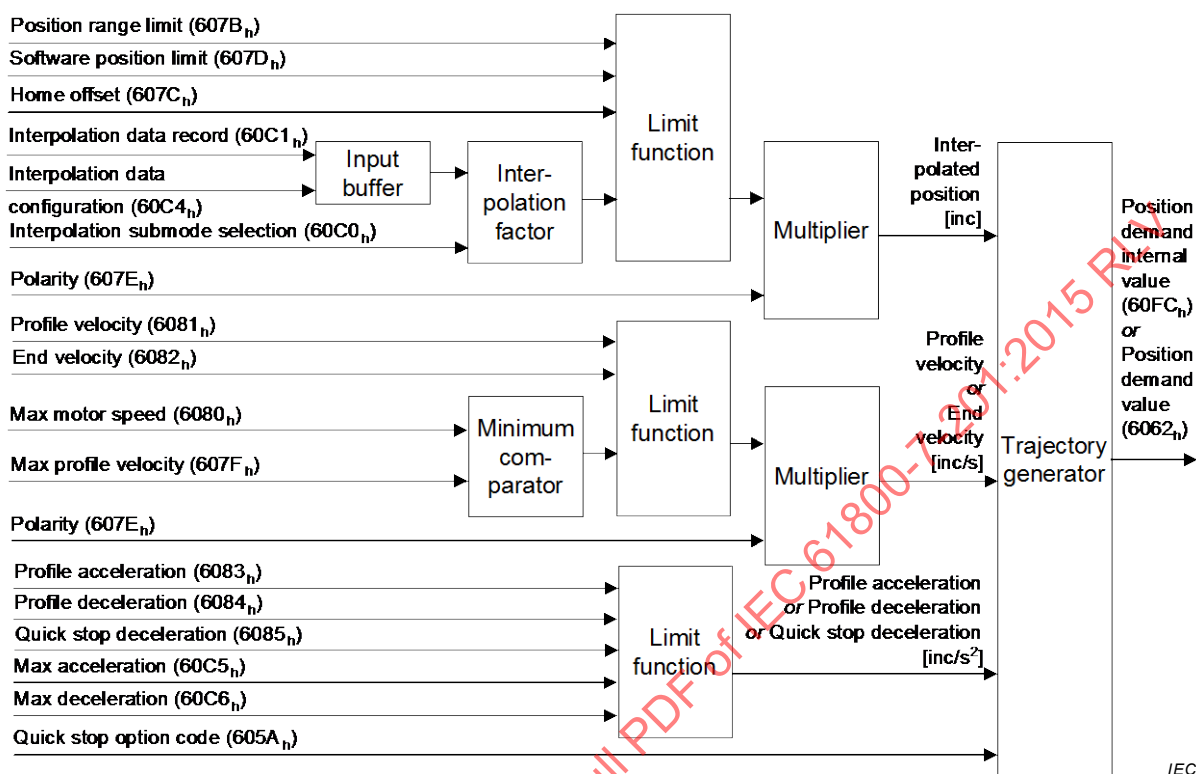


Figure 48 – Interpolation controller

14.2 Functional description

14.2.1 General

The manufacturer specifies the way the drive device handles the next valid interpolation data record. This may be in a way corresponding to the standard position mode, or might be a more complex algorithm. The standard method is to apply the new data immediately, after the next synchronization signal in synchronous mode or after the previous interpolation time has expired in asynchronous mode.

An input buffer for interpolation data records eases the data exchange between control device and drive device. The real-time requirements to the network as well as to the drive device decrease in this case, because an input buffer decouples the data processing in the drive device from the data transmission on the network.

14.2.2 Linear interpolated position mode with several axes

In order to follow a two- or more-dimensional curve through the space with a defined speed, the control device calculates the different positions P_i for each set of coordinates which shall be reached at specified times t_i .

For each set-point P_i the control device shall calculate x_i , y_i and t_i . Each axis gets a set of interpolation data records, which each axis shall process internally independent from the other axes according to the chosen interpolation mode. This is shown in Figure 49.

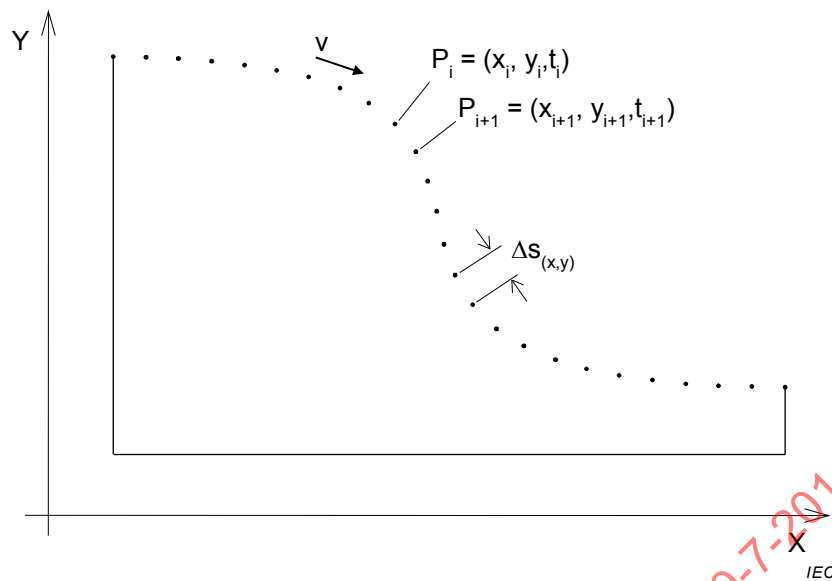


Figure 49 – Interpolated position mode for two axes

In a centralized drive system with a remote motion device doing the interpolation calculation, a central clocking scheme for synchronization of the different axes. This results in a movement depending on the calculation cycle time of the interpolation controller. The velocity becomes more or less a fixed value for each axis. This is detailed in Table 193.

Table 193 – Position calculation in interpolated position mode for several axes

Calculated positions	ip data records for		
	x-axis	y-axis	z-axis
P_i	x_i, t_i	y_i, t_i	z_i, t_i
$P_i + 1$	$x_i + 1, t_i + 1$	$y_i + 1, t_i + 1$	$z_i + 1, t_i + 1$
$P_i + 2$	$x_i + 2, t_i + 2$	$y_i + 2, t_i + 2$	$z_i + 2, t_i + 2$
...	...	...	...
$P_i + n$	$x_i + n, t_i + n$	$y_i + n, t_i + n$	$z_i + n, t_i + n$

In decentralized motion systems, the control device starts all relevant axes by changing the mode-internal state to interpolation active after preparing and sending one or more interpolation data records to all axes and synchronizes them. Each axis calculates internally and independently the necessary speed and acceleration needed to move from one position to the next. This may be done by calculating a linear or any other move between two given position set-points. Along this track, every axis controls the movement between the set-points independently from the other axes. The axes may continue their movement, as long as there is enough data to continue the calculations. Therefore it is easy to use the input buffer to give data records ahead.

With this information, each axis may act as shown in Figure 50.

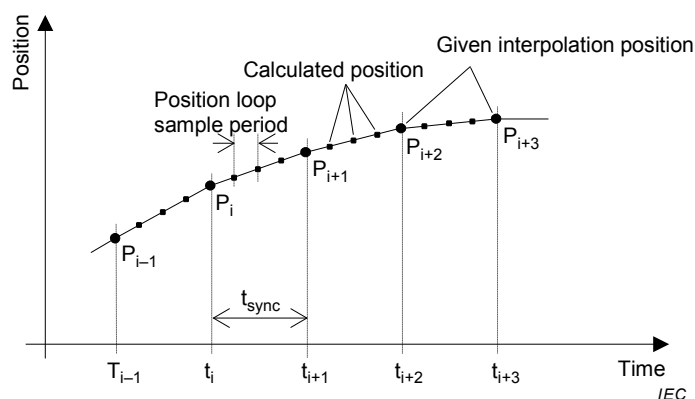


Figure 50 – Linear interpolation for one axis

NOTE In CANopen synchronous mode, the interpolation time is normally the same as the nominal period for the sync signal.

14.2.3 Buffer strategies for the interpolated position mode

If a drive device provides an input buffer for interpolation data records, its size may be organized by the control device using the interpolation data configuration. The control device splits the available buffer capacity into pages which have the size of one interpolation data record each. This is done by size of data record. If one page remains, which does not keep one complete data record, it may not be used. After the reorganization of the input buffer, all previous stored data will be lost. All devices supporting the interpolated position mode shall implement an input buffer, which at least may keep one interpolation data record. The input buffer organization is specified in Figure 51.

The content of the buffer items may only be accessed via the interpolation data record.

Commonly, first-in-first-out (FIFO) structures or ring buffers are used as input buffers.

FIFO: If the buffer is organized as FIFO, every new received interpolation data record is placed at the end of the queue, and the device takes the next data record from the top of the queue. When the last item of a data record is stored, the buffer pointer is incremented in order to point to the next buffer position. For this buffer principle, the object buffer position does not have any influence.

Ring buffer: If the buffer is structured as a ring, the control device may place an interpolation data record into any valid position in the ring by changing the pointer defined in buffer position. Without changing the buffer position, all data records will be written at the same location. The drive reads the next entry out of the buffer by an internal ring pointer. It is set to the first data record with a clear buffer, and after the reorganization of the input buffer.

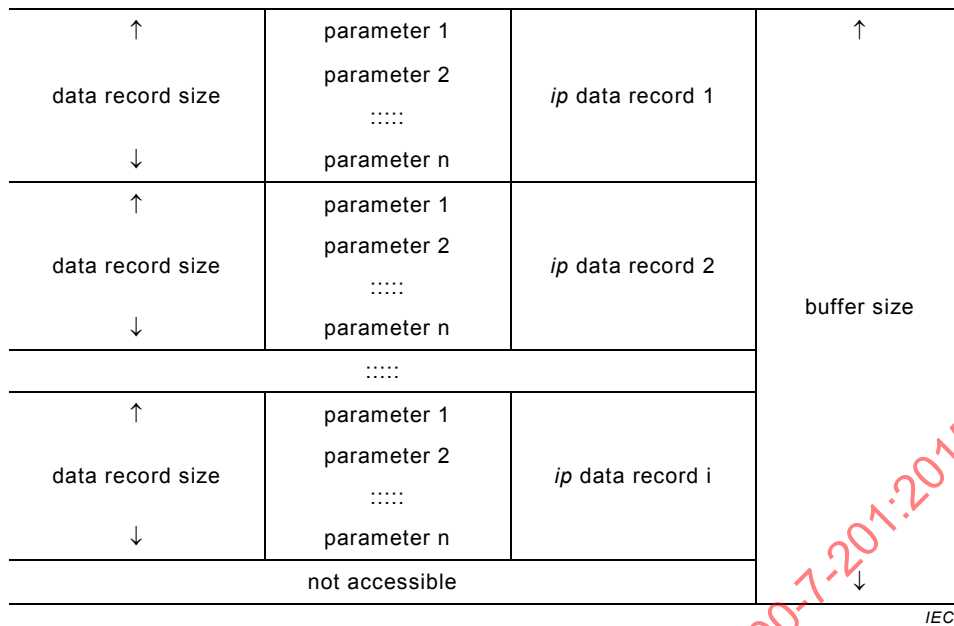
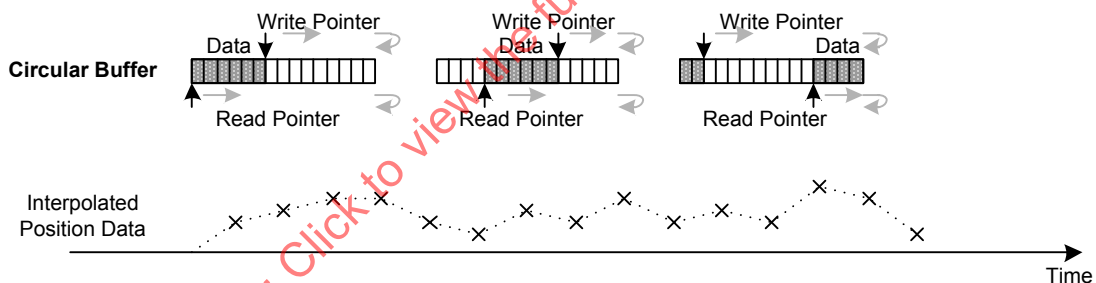


Figure 51 – Input buffer organization

Figure 52 shows the difference between a FIFO buffer and a ring buffer. The ring buffer may be used to achieve a periodic motion and all data records in the actual data buffer are considered to be valid. If no new data is written to the FIFO, then the motion shall halt and interpolation should become inactive at the last valid data point.

FIFO



Ring

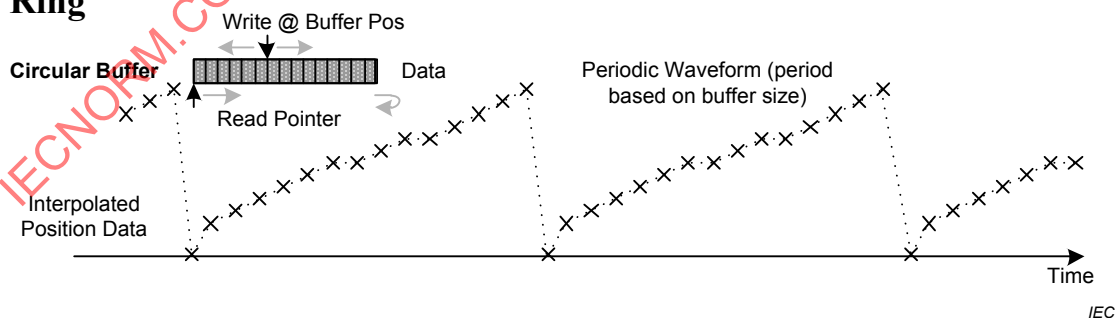
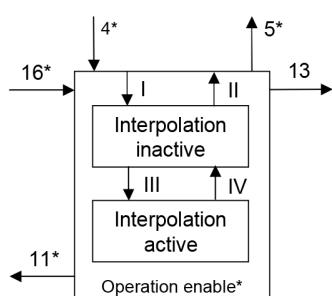


Figure 52 – Input buffer examples

14.2.4 Interpolated position mode FSA

Figure 53 specifies the interpolated position mode FSA. It is a sub FSA of the operation enabled state as shown in Figure 4.



* See power drive system FSA

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Figure 53 – Interpolated position mode FSA

The FSA states shall support the functions as shown in Table 194.

Table 194 – FSA states and supported functions

FSA state	Function
Interpolation inactive	The drive device will accept input data and will buffer it for interpolation calculations, but it does not move the axis.
Interpolation active	The drive unit will accept input data and it moves the axis.

The drive device supporting the ip mode shall support the transitions and actions as given in Table 195. The events shall initiate the transitions. The transition shall be terminated, after the action has been performed.

Table 195 – Transition events and actions

Transition	Event(s)	Action(s)
I	ip mode selected (see object 6060 _h)	None
II	ip mode not selected (see object 6060 _h)	None
III	Enable interpolation (bit 4 of the controlword is 1)	None
IV	Disable interpolation (bit 4 of the controlword is 0)	None

14.3 General definitions

The output values provided by the interpolated position mode depend on the number and type of interpolation functions implemented. For the predefined linear time interpolation, the output is a position demand internal value.

14.4 Use of controlword and statusword

The interpolated position mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 54 shows the structure of the controlword. Table 196 defines the values for bit 4 and bit 8 of the controlword.

15	9	8	7	6	5	4	3	0
(see 8.4.1)	Halt	(see 8.4.1)	reserved (0)	Enable interpolation	(see 8.4.1)			
MSB								LSB

IEC

Figure 54 – Controlword for interpolated position mode

Table 196 – Definition of bit 4 and bit 8

Bit	Value	Definition
4	0	Disable interpolation
	1	Enable interpolation
8	0	Execute instruction of bit 4
	1	Axis shall be stopped accordingly to halt option code (605D _h), and bit 12 in the statusword shall be set to 0

Figure 55 shows the structure of the statusword. Table 197 defines the values for bit 10 and bit 12 of the statusword. The target position reached bit shall remain 0 until all set-points are processed.

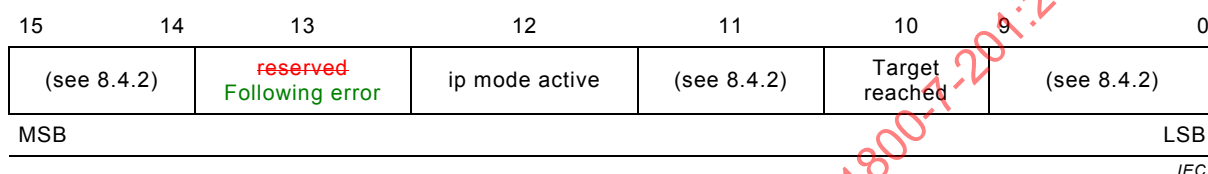


Figure 55 – Statusword for interpolated position mode

Table 197 – Definition of bit 10 and bit 12

Bit	Value	Definition
10	0	Target position not (yet) reached (if Halt bit in last controlword was 0) or axle decelerates (if Halt bit in last controlword was 1)
	1	Target position reached (if Halt bit in last controlword was 0) or axle has velocity 0 (if halt bit in last controlword was 1)
12	0	Interpolation inactive
	1	Interpolation active
13	0	No following error
	1	Following error

14.5 Detailed object definitions

14.5.1 Object 60C0_h: Interpolation sub mode select

This object shall indicate the actually chosen interpolation mode. If linear interpolation is the only algorithm available, then it is not necessary to implement this object. If a manufacturer-specific interpolation mode is selected, the corresponding interpolation data record shall be implemented in the manufacturer-specific profile area of the object dictionary. If the linear interpolation mode is selected, the interpolation data given in object 60C1_h shall be used. Table 198 specifies the value definition, Table 199 specifies the object description, and Table 200 specifies the entry description.

Table 198 – Value definition

Value	Definition
–32 768 to –1	Manufacturer-specific
0	Linear interpolation
+1 to +32 767	Reserved

Table 199 – Object description

Attribute	Value
Index	60C0 _h
Name	Interpolation sub mode select
Object code	Variable
Data type	Integer16
Category	Optional

Table 200 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 198
Default value	0

14.5.2 Object 60C1_h: Interpolation data record

This object shall indicate data words, which are necessary to perform the interpolation algorithm. The number N of data words in the record is defined by interpolation data configuration. The interpretation of the data words in interpolation data record may vary with the different possible interpolation modes as set by the interpolation sub mode select.

For the linear interpolation mode, each interpolation data record simply is regarded as a new position set-point. To describe a cubic spline interpolation, four or more data words are needed for the spline coefficients, and further interpolation parameters.

After the last item of an interpolation data record is written to the drive device's input buffer, the pointer of the buffer shall be automatically incremented to the next buffer position.

Table 201 specifies the object description, and Table 202 specifies the entry description.

Table 201 – Object description

Attribute	Value
Index	60C1 _h
Name	~~Interpolated~~ Interpolation data record
Object code	Array
Data type	Integer32
Category	Optional

Table 202 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	~~No~~ Manufacturer-specific
Sub-index	01 _h
Description	1st set-point
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	2nd set-point
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific
to	
Sub-index	FE _h
Description	254th set-point
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

14.5.3 Object 60C2_h: Interpolation time period

This object shall indicate the configured interpolation cycle time. The interpolation time period (sub-index 01_h) value shall be given in 10^(interpolation time index) s(econd). The interpolation time index (sub-index 02_h) shall be dimensionless.

Table 203 specifies the object description, and Table 204 specifies the entry description.

Table 203 – Object description

Attribute	Value
Index	60C2 _h
Name	Interpolation time period
Object code	Record
Data type	Interpolation time period record (0080 _h)
Category	Conditional: mandatory if ip, csp, csv or cst mode is supported

Table 204 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Interpolation time period value
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned8
Default value	01 _h
Sub-index	02 _h
Description	Interpolation time index
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	–128 to +63
Default value	–3

14.5.4 Object 60C4_h: Interpolation data configuration

This object shall provide the maximum buffer size, shall indicate the configured buffer organization of interpolation data, and shall provide objects to define the size of the data record and to clear the buffers. This object is used to enable the drive device to receive the needed data in advance. It also is used to store the positions and further data sent by the control device.

The value of sub-index 01_h shall be given in numbers of interpolation data records.

The value of sub-index 02_h shall be given in numbers of interpolation data records.

If sub-index 03_h is 00_h this shall indicate a FIFO buffer organization, if it is 01_h this shall indicate a ring buffer organization. All other values are reserved.

The value of sub-index 04_h shall be dimensionless indicating the next free buffer entry point.

The value of sub-index 05_h shall be given in bytes.

If 00_h is written to sub-index 06_h this shall clear the buffer inputs, shall disable the access, and shall clear all ip data records. If 01_h is written to sub-index 06_h, this enables access to the input buffers. All other values are reserved.

Table 205 specifies the object description, and Table 206 specifies the entry description.

Table 205 – Object description

Attribute	Value
Index	60C4 _h
Name	Interpolation data configuration
Object code	Record
Data type	Interpolation data configuration record (for data type of the sub-indices see record 0081 _h)
Category	Optional

Table 206 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	07 06 _h
Default value	07 06 _h
Sub-index	01 _h
Description	Maximum buffer size
Entry category	Mandatory
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No
Sub-index	02 _h
Description	Actual buffer size
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	0000 0000 _h
Attribute	Value
Sub-index	03 _h
Description	Buffer organisation
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	00 _h or 01 _h
Default value	00 _h
Sub-index	04 _h
Description	Buffer position
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	0000 _h

Sub-index	05 _h
Description	Size of data record
Entry category	Mandatory
Access	wo
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	01 _h
Sub-index	06 _h
Description	Buffer clear
Entry category	Mandatory
Access	wo
PDO mapping	See IEC 61800-7-301
Value range	00 _h or 01 _h
Default value	00 _h

15 Profile velocity mode

15.1 General information

The profile velocity mode covers the following sub-functions:

- demand value input via trajectory generator;
- velocity capture using position sensor or velocity sensor;
- velocity control function with appropriate input and output signals;
- monitoring of the profile velocity using a window-function;
- monitoring of velocity actual value using a threshold.

The operation of the reference value generator and the following input parameters are described in Clause 10:

- profile velocity;
- profile acceleration;
- profile deceleration;
- ~~Emergency~~ quick stop ~~deceleration~~;
- motion profile type.

Various sensors may be used for velocity capture. In particular, the aim is that costs are reduced and the drive power system is simplified by evaluating position and velocity using a common sensor, such as is optional using a resolver or an encoder.

The velocity control function is not specified more precisely at this point, as it is highly manufacturer-specific, ~~but the format and maximum number of control coefficients are established.~~

Monitoring functions for the velocity actual value provide status information for super-ordinated systems.

15.2 Functional description

Figure 56 shows the defined structure of the profile velocity mode. The actual velocity may be obtained through differentiation from the position encoder and is represented in position encoder increments.

The target reached bit (bit 10) shall be set to 1 in the statusword when the difference between the target velocity and the velocity actual value is within the velocity window longer than the velocity window time.

As soon as the velocity actual value exceeds the velocity threshold longer than the velocity threshold time, then bit 12 shall be set to 0 in the statusword. Below this threshold, the bit shall be set to 1 and shall indicate that the axis is stationary.

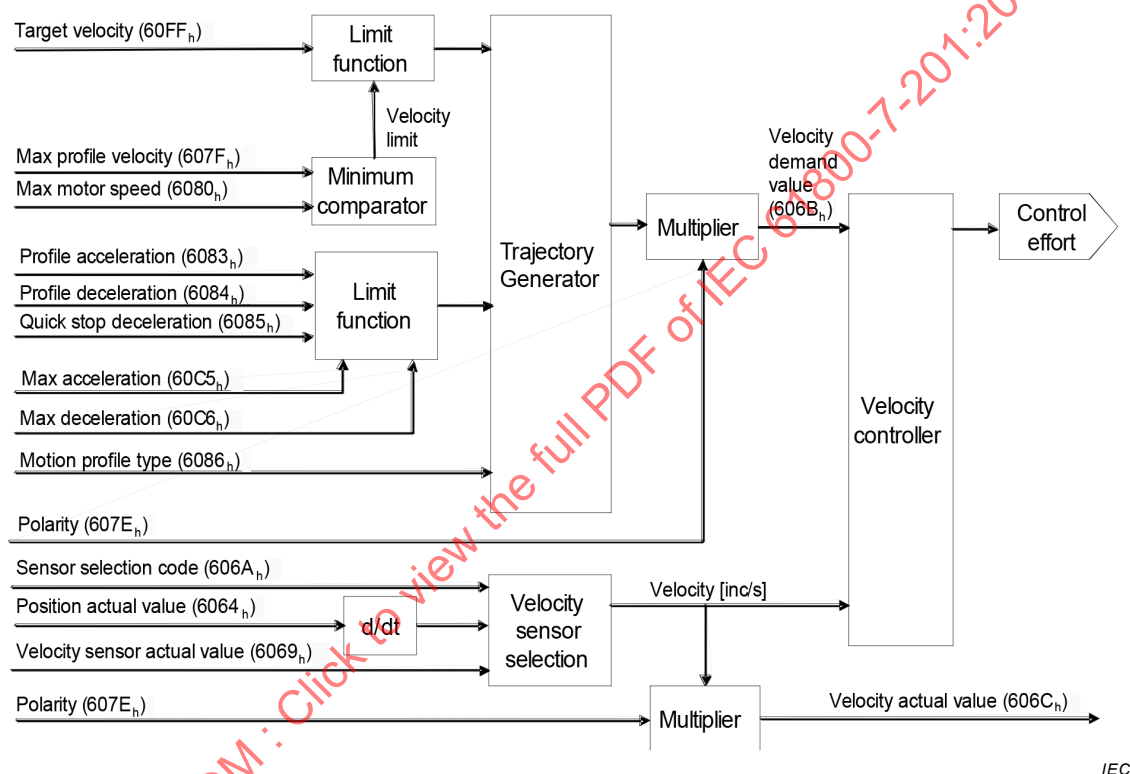


Figure 56 – Profile velocity mode

15.3 General definitions

The factors necessary for scaling have a linear relationship and therefore they are described in the factor group. The polarity is described in the factor group as well.

15.4 Use of controlword and statusword

The profile velocity mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 57 shows the structure of the controlword. Table 207 defines the values for bit 8 of the controlword.

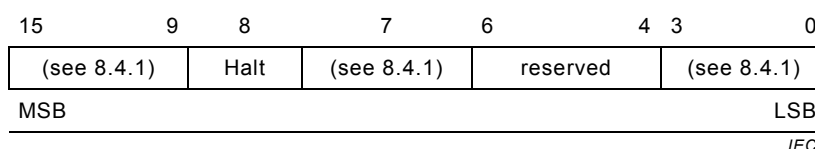


Figure 57 – Controlword for profile velocity mode

Table 207 – Definition of bit 8

Bit	Value	Definition
8	0	The motion shall be executed or continued
	1	Axis shall be stopped according to the halt option code (605D _h)

Figure 58 shows the structure of the statusword. Table 208 defines the values for bit 10, 12, and 13 of the statusword.

15	14	13	12	11	10	9	0
(see 8.4.2)	Max slippage error	Speed	(see 8.4.2)	Target reached	(see 8.4.2)		
MSB						LSB	

IEC

Figure 58 – Statusword for profile velocity mode

Table 208 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Halt (bit 8 in controlword) = 0: Target not reached Halt (bit 8 in controlword) = 1: Axis decelerates
	1	Halt (bit 8 in controlword) = 0: Target reached Halt (bit 8 in controlword) = 1: Velocity of axis is 0
12	0	Speed is not equal 0
	1	Speed is equal 0
13	0	Maximum slippage not reached
	1	Maximum slippage reached

15.5 Detailed object definitions

15.5.1 Object 6069_h: Velocity sensor actual value

This object shall provide the value read from a velocity sensor. The value shall be given in increments per second. Table 209 specifies the object description, and Table 210 specifies the entry description.

Table 209 – Object description

Attribute	Value
Index	6069 _h
Name	Velocity sensor actual value
Object code	Variable
Data type	Integer32
Category	Optional

Table 210 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

15.5.2 Object 606A_h: Sensor selection code

This object shall provide the source of the velocity sensor actual value. It determines whether a differentiated position signal or the signal from a separate velocity sensor is evaluated. Table 211 specifies the value definition, Table 212 specifies the object description, and Table 213 specifies the entry description.

Table 211 – Value definition

Value	Definition
0000 _h	Actual velocity value from position encoder
0001 _h	Actual velocity value from velocity encoder
0002 _h to 7FFF _h	Reserved
8000 _h to FFFF _h	Manufacturer-specific

Table 212 – Object description

Attribute	Value
Index	606A _h
Name	Sensor selection code
Object code	Variable
Data type	Integer16
Category	Optional

Table 213 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 211
Default value	Manufacturer-specific

15.5.3 Object 606B_h: Velocity demand value

This object shall provide the output value of the trajectory generator. The value shall be given in the user-defined velocity units. Table 214 specifies the object description, and Table 215 specifies the entry description.

Table 214 – Object description

Attribute	Value
Index	606B _h
Name	Velocity demand value
Object code	Variable
Data type	Integer32
Category	Optional

Table 215 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

15.5.4 Object 606C_h: Velocity actual value

This object shall provide the actual velocity value derived either from the velocity sensor or the position sensor. The value shall be given in user-defined velocity units. Table 216 specifies the object description, and Table 217 specifies the entry description.

Table 216 – Object description

Attribute	Value
Index	606C _h
Name	Velocity actual value
Object code	Variable
Data type	Integer32
Category	Conditional: mandatory if pv or csv is supported

Table 217 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

15.5.5 Object 606D_h: Velocity window

This object shall indicate the configured velocity window. The value shall be given in user-defined velocity units. Table 218 specifies the object description, and Table 219 specifies the entry description.

Table 218 – Object description

Attribute	Value
Index	606D _h
Name	Velocity window
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 219 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

15.5.6 Object 606E_h: Velocity window time

This object shall indicate the configured velocity window time. The value shall be given in milliseconds. Table 220 specifies the object description, and Table 221 specifies the entry description.

Table 220 – Object description

Attribute	Value
Index	606E _h
Name	Velocity window time
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 221 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	0000 _h

15.5.7 Object 606F_h: Velocity threshold

This object shall indicate the configured velocity threshold. The value shall be given in user-defined velocity units. Table 222 specifies the object description, and Table 223 specifies the entry description.

Table 222 – Object description

Attribute	Value
Index	606F _h
Name	Velocity threshold
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 223 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

15.5.8 Object 6070_h: Velocity threshold time

This object shall indicate the configured velocity threshold time. The value shall be given in milliseconds. Table 224 specifies the object description, and Table 225 specifies the entry description.

Table 224 – Object description

Attribute	Value
Index	6070 _h
Name	Velocity threshold time
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 225 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

15.5.9 Object 60FF_h: Target velocity

This object shall indicate the configured target velocity and shall be used as input for the trajectory generator. The value shall be given in user-defined velocity units. Table 226 specifies the object description, and Table 227 specifies the entry description.

Table 226 – Object description

Attribute	Value
Index	60FF _h
Name	Target velocity
Object code	Variable
Data type	Integer32
Category	Conditional: mandatory if pv or csv is supported

Table 227 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

15.5.10 Object 60F8_h: Max slippage

This object shall indicate the configured maximal slippage of an asynchronous motor. When the max slippage has been reached, the corresponding bit 13 max slippage error in the statusword shall be set to 1. The reaction of the drive device, when the max slippage error occurs, is manufacturer-specific. This value shall be given in user-defined units. Table 228 specifies the object description, and Table 229 specifies the entry description.

Table 228 – Object description

Attribute	Value
Index	60F8 _h
Name	Max slippage
Object code	Variable
Data type	Integer32
Category	Optional

Table 229 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

16 Profile torque mode

16.1 General information

The profile torque mode allows control device (i.e. closed-loop speed controller, open-loop transmission force controller) to transmit the target torque value, which is processed via the trajectory generator. The torque slope and torque profile type parameters are required.

16.2 Functional description

If the control device switches the controlword bit 8 (halt) from 0 to 1 or from 1 to 0, than the trajectory generator ramps its control effort output down to zero, respectively up to the target torque. In both cases, the trajectory generator takes the torque slope and torque profile type into consideration.

All definitions refer to rotating motors. Using linear motors instead requires that all "torque" objects refer to a "force" instead. For the sake of simplicity, the objects are not duplicated and their names are not modified. As an example, the linear motor target force is transmitted using the target torque object. Refer to the object descriptions for additional information.

The manufacturer-specific torque control and power-stage functions are not described as they fall beyond the scope of this drive profile specification. They are only mentioned for showing how some parameters affect them. As an example, the closed-loop torque control coefficients (if any) are to be defined and described by the manufacturer.

The torque control parameters, power stage parameters and motor parameters are defined as objects in order that they may be handled (i.e. downloaded) in a standard way. Their detailed data definition is manufacturer-specific.

The torque demand, torque actual value, current actual value and DC link voltage are available to the user as parameters, if they are monitored.

Figure 59 shows the defined structure of the profile torque mode.

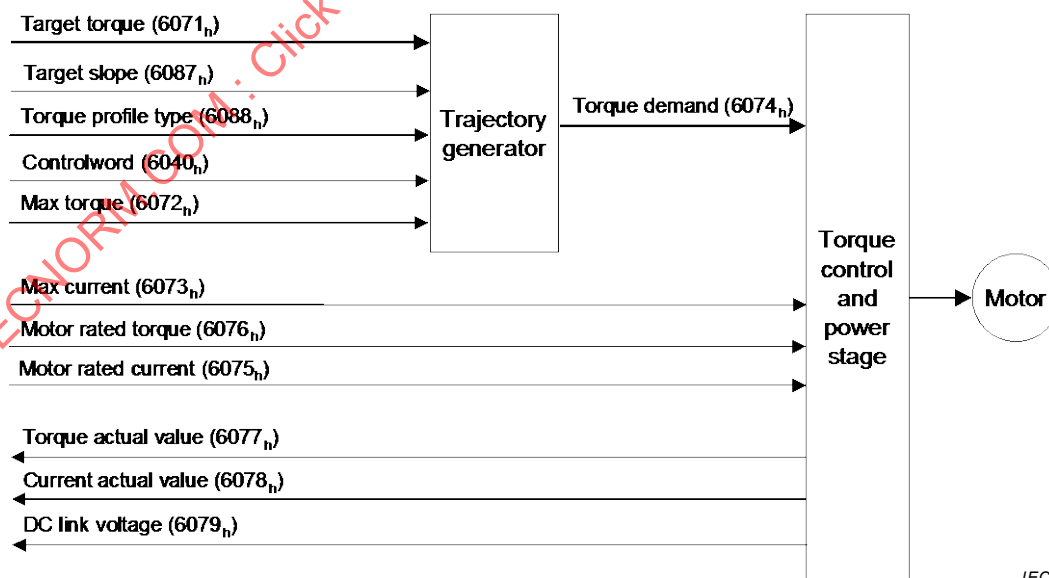


Figure 59 – Structure of the profile torque mode

16.3 General definitions

There are no general definitions given for the profile torque mode.

16.4 Use of controlword and statusword

The profile torque mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 60 shows the structure of the controlword. Table 230 defines the values for bit 8 of the controlword.

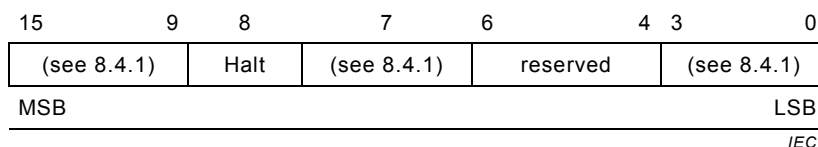


Figure 60 – Controlword for profile torque mode

Table 230 – Definition of bit 8

Bit	Value	Definition
8	0	The motion shall be executed or continued
	1	Axis shall be stopped according to the halt option code (605D _h)

Figure 61 shows the structure of the statusword. Table 231 defines the values for bit 10 of the statusword. **Target torque reached is defined by a manufacturer-specific time or window object.**

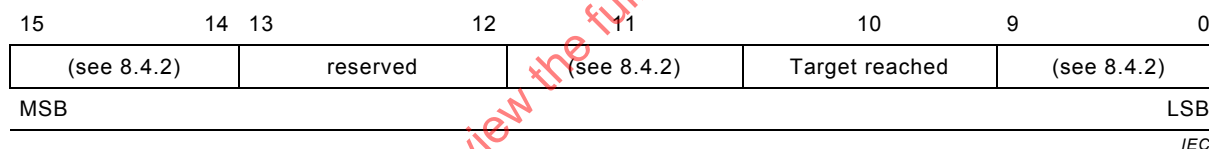


Figure 61 – Statusword for profile torque mode

Table 231 – Definition of bit 10

Bit	Value	Definition
10	0	Halt (bit 8 in controlword) = 0: Target torque not reached Halt (bit 8 in controlword) = 1: Axis decelerates
	1	Halt (bit 8 in controlword) = 0: Target torque reached Halt (bit 8 in controlword) = 1: Velocity of axis is 0

NOTE Target torque reached is defined by a manufacturer-specific time or window object.

16.5 Detailed object definitions

16.5.1 Object 6071_h: Target torque

This object shall indicate the configured input value for the torque controller in profile torque mode. The value shall be given per thousand of rated torque. Table 232 specifies the object description, and Table 233 specifies the entry description.

Table 232 – Object description

Attribute	Value
Index	6071 _h
Name	Target torque
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if tq or cst is supported

Table 233 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0000 _h

16.5.2 Object 6072_h: Max torque

This object shall indicate the configured maximum permissible torque in the motor. The value shall be given per thousand of rated torque. Table 234 specifies the object description, and Table 235 specifies the entry description.

Table 234 – Object description

Attribute	Value
Index	6072 _h
Name	Max torque
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 235 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

16.5.3 Object 60E0_h: Positive torque limit value

This object shall indicate the configured maximum positive torque in the motor. The value shall be given per thousand of rated torque. Positive torque takes effect in the case of motive operation is positive velocity or regenerative operation is negative velocity.

Table 236 specifies the object description, and Table 237 specifies the entry description.

Table 236 – Object description

Attribute	Value
Index	60E0 _h
Name	Positive torque limit value
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 237 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

16.5.4 Object 60E1_h: Negative torque limit value

This object shall indicate the configured maximum negative torque in the motor. The value shall be given per thousand of rated torque. Negative torque takes effect in the case of motive operation is negative velocity or regenerative operation is positive velocity.

Table 238 specifies the object description, and Table 239 specifies the entry description.

Table 238 – Object description

Attribute	Value
Index	60E1 _h
Name	Negative torque limit value
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 239 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

16.5.5 Object 6073_h: Max current

This object shall indicate the configured maximum permissible torque creating current in the motor. The value shall be given per thousand of rated current. Table 240 specifies the object description, and Table 241 specifies the entry description.

Table 240 – Object description

Attribute	Value
Index	6073 _h
Name	Max current
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 241 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

16.5.6 Object 6074_h: Torque demand

This object shall provide the output value of the trajectory generator. The value shall be given in 1/1 000 per thousand of rated torque. Table 242 specifies the object description, and Table 243 specifies the entry description.

Table 242 – Object description

Attribute	Value
Index	6074 _h
Name	Torque demand
Object code	Variable
Data type	Integer16
Category	Optional

Table 243 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

16.5.7 Object 6075_h: Motor rated current

This object shall indicate the configured motor rated current. It is taken from the motor's name-plate. Depending on the motor and drive technology, this current is DC, peak or r.m.s. (root-mean-square) current. All relative current data refers to this value. The value shall be given in mA. Table 244 specifies the object description, and Table 245 specifies the entry description.

Table 244 – Object description

Attribute	Value
Index	6075 _h
Name	Motor rated current
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 245 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

16.5.8 Object 6076_h: Motor rated torque

This object shall indicate the configured motor rated torque. It is taken from the motor's name-plate. All relative torque data shall refer to this value. For linear motors, the object name is not changed, but the motor rated force value shall be entered as multiples of mN (milli Newton). The value shall be given in mNm (milli Newton metre). Table 246 specifies the object description, and Table 247 specifies the entry description.

Table 246 – Object description

Attribute	Value
Index	6076 _h
Name	Motor rated torque
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 247 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

16.5.9 Object 6077_h: Torque actual value

This object shall provide the actual value of the torque. It shall correspond to the instantaneous torque in the motor. The value shall be given per thousand of rated torque. Table 248 specifies the object description, and Table 249 specifies the entry description.

Table 248 – Object description

Attribute	Value
Index	6077 _h
Name	Torque actual value
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if cst is supported

Table 249 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

16.5.10 Object 6078_h: Current actual value

This object shall provide the actual value of the current. It shall correspond to the current in the motor. The value shall be given per thousand of rated current. Table 250 specifies the object description, and Table 251 specifies the entry description.

Table 250 – Object description

Attribute	Value
Index	6078 _h
Name	Current actual value
Object code	Variable
Data type	Integer16
Category	Optional

Table 251 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

16.5.11 Object 6079_h: DC link circuit voltage

This object shall provide the instantaneous DC link current voltage at the drive device. The value shall be given in mV. Table 252 specifies the object description, and Table 253 specifies the entry description.

Table 252 – Object description

Attribute	Value
Index	6079 _h
Name	DC link circuit voltage
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 253 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

16.5.12 Object 6087_h: Torque slope

This object shall indicate the configured rate of change of torque. The value shall be given in units of per thousand of rated torque per second. Table 254 specifies the object description, and Table 255 specifies the entry description.

Table 254 – Object description

Attribute	Value
Index	6087 _h
Name	Torque slope
Object code	Variable
Data type	Unsigned32
Category	Conditional: mandatory if tq is supported

Table 255 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

16.5.13 Object 6088_h: Torque profile type

This object shall indicate the configured type of profile used to perform a torque change. Table 256 specifies the value definition, Table 257 specifies the object description, and Table 258 specifies the entry description.

Table 256 – Value definition

Value	Definition
0000 _h	Linear ramp (trapezoidal profile)
0001 _h	sin ² ramp
0002 _h to 7FFF _h	Reserved
8000 _h to FFFF _h	Manufacturer-specific

Table 257 – Object description

Attribute	Value
Index	6088 _h
Name	Torque profile type
Object code	Variable
Data type	Integer16
Category	Optional

Table 258 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0000 _h

17 Velocity mode

17.1 General information

This mode is used by frequency inverters, but not limited to this kind of drive device. Most applications use a velocity set-point and a controlword for switching the drive device on and off.

Figure 62 shows the overall structure of the velocity mode. The possible torque control function is not in the scope of this part of the IEC 61800-7 series, it may use the target torque and torque actual value objects defined in 16.5.1 or respectively in 16.5.9.

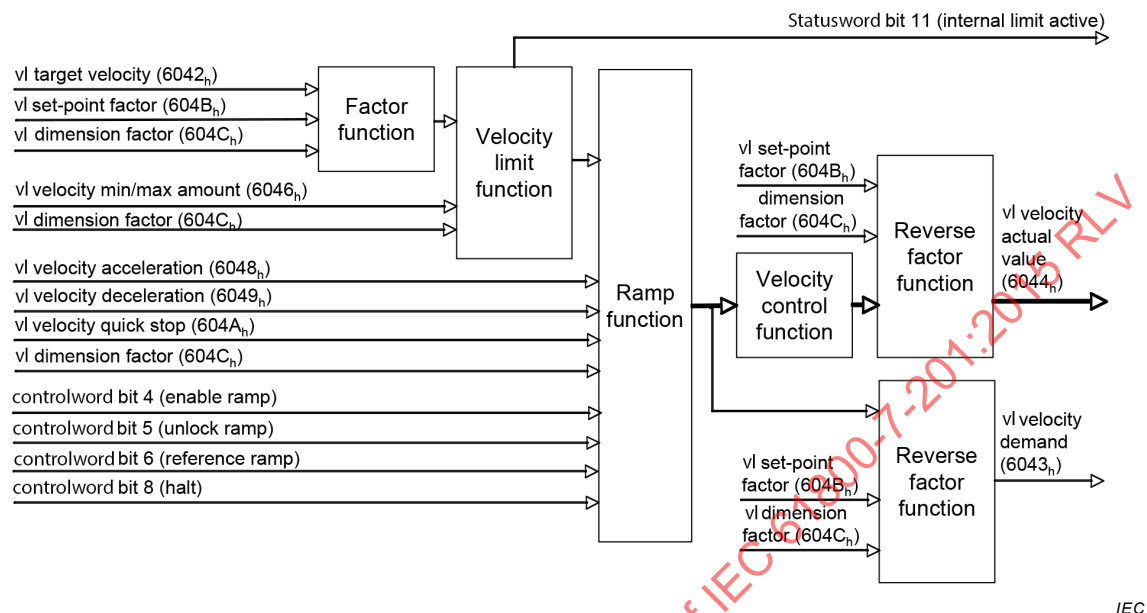


Figure 62 – Velocity mode with all objects

All drive devices using this profile and supporting the velocity mode shall implement the mandatory objects and their functionality as shown in Figure 63.

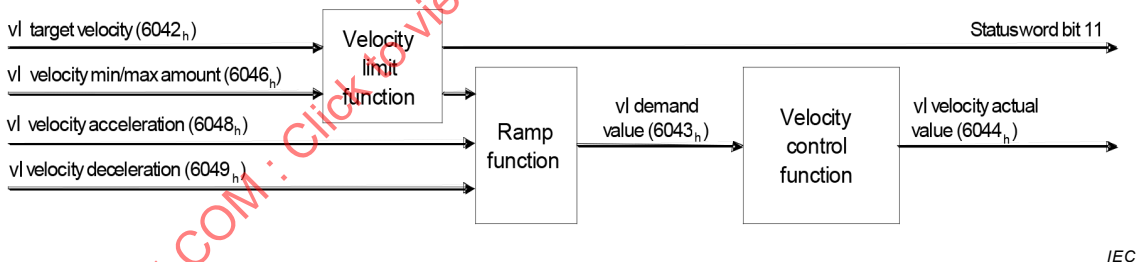


Figure 63 – Velocity mode with mandatory objects only

17.2 Functional description

17.2.1 Velocity limit function

The limits in the velocity limit function may be given in user-specific units by including the vl dimension factor in the velocity limit or in rotations per minute (rpm). The limit value message is generated if the input value of the speed limit results in a value outside the speed limit's operating range. The limit value message is mapped as one bit in the statusword.

17.2.1 Ramp function

Figure 64 shows the velocity profile that is used to limit the increase and decrease of velocity. The velocity output is equal to the input as long as the changes are below as defined in vl velocity acceleration, vl velocity deceleration, and vl velocity quickstop.

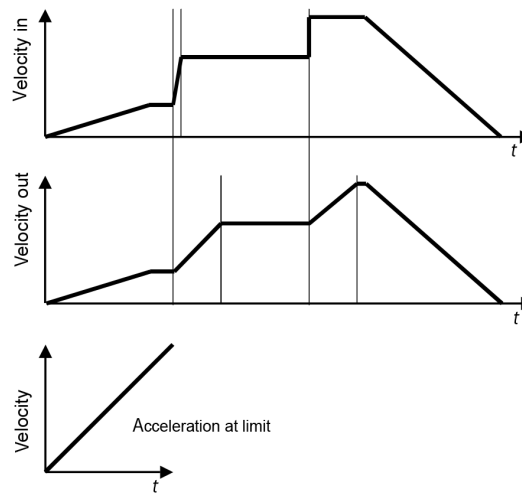


Figure 64 – Velocity profile

17.2.2 Velocity control function

On the basis of the vl velocity demand, the velocity control function provides the vl-control-effort actual value.

17.2.3 Factor function

The factor function multiplies the input variables by the assigned factors. The factor shall have a value of 1, if it is not implemented.

Figure 65 shows the structure of the factor function; the factor function for two factors is built of two functions in series connection.

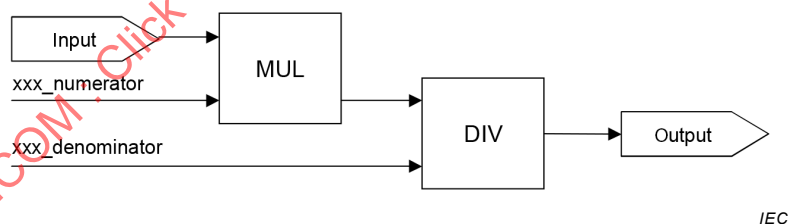


Figure 65 – Factor function

Figure 66 shows the structure of the reverse factor function. The reverse factor function divides the input variables by the assigned factors.

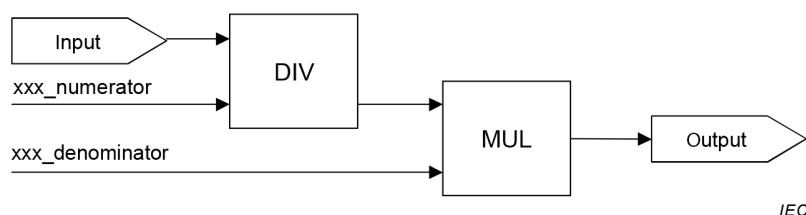


Figure 66 – Reverse factor function

17.3 General definitions

All objects defined in 17.5 are used only for the velocity mode.

17.4 Use of controlword and statusword

The velocity mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 67 shows the structure of the controlword. Table 259 and Figure 68 define the values for bit 4, bit 5, bit 6, and bit 8 of the controlword. These bits are optional.

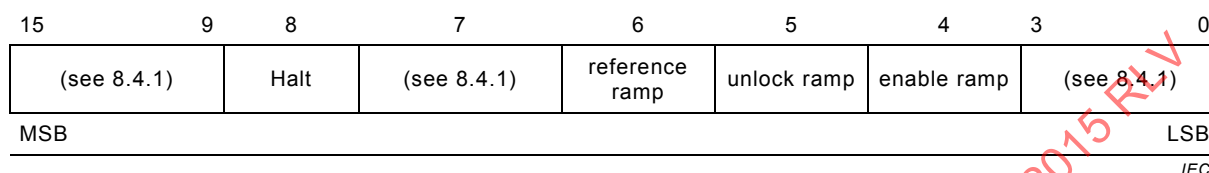


Figure 67 – Controlword for profile velocity mode

Table 259 – Definition of bit 4, bit 5, bit 6, and bit 8

Bit	Value	Definition
4	0	Velocity demand value shall be controlled in any other (manufacturer-specific) way, for example by a test function generator or manufacturer-specific halt function
	1	Velocity demand value shall accord with ramp output value
5	0	Ramp output value shall be locked to current output value
	1	Ramp output value shall follow ramp input value
6	0	Ramp input value shall be set to zero
	1	Ramp input value shall accord with ramp reference
8	0	No command
	1	Motor shall be stopped

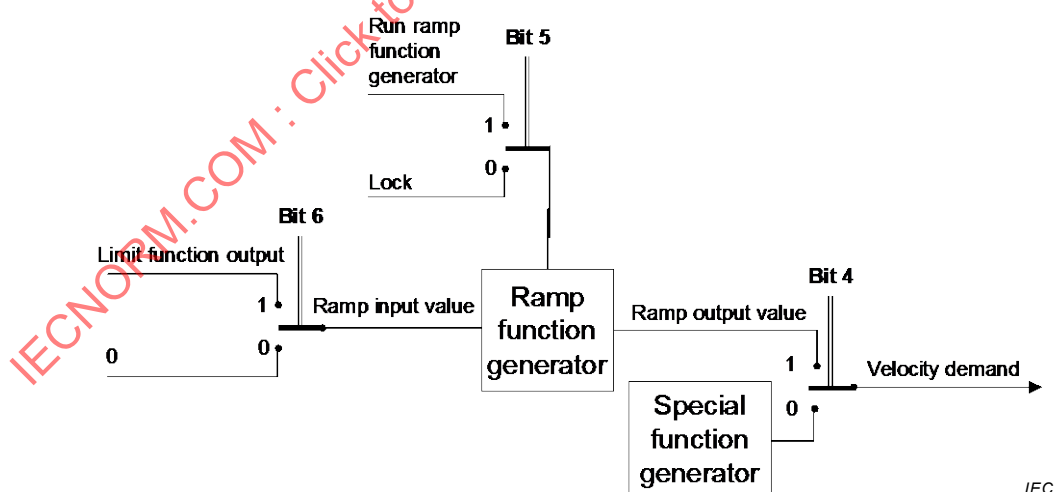


Figure 68 – Usage of controlword bits in velocity mode

Figure 69 shows the structure of the statusword.

15	14	13	12	11	10	9	0
(see 8.4.2)	reserved (0)		(see 8.4.2)	reserved (0)		(see 8.4.2)	
MSB							LSB

IEC

Figure 69 – Statusword for profile velocity mode

17.5 Detailed object definitions

17.5.1 Object 6042_h: vl target velocity

This object shall indicate the required velocity of the system. It shall be multiplied by the vl dimension factor and the vl set-point factor, if these are implemented. The value shall be given in user-defined velocity units or in revolutions per minute (~~rpm~~ r/min), if the vl dimension factor and the vl set-point factor are not implemented or have the value 1. Positive values shall indicate forward direction and negative values shall indicate reverse direction. Table 260 specifies the object description, and Table 261 specifies the entry description.

Table 260 – Object description

Attribute	Value
Index	6042 _h
Name	vl target velocity
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if vl is supported

Table 261 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0000 _h

17.5.2 Object 6043_h: vl velocity demand

This object shall provide the instantaneous velocity generated by the ramp function. It is an internal object of the drive device. The value shall be given in the very same unit as the vl target velocity. Positive values shall indicate forward direction and negative values shall indicate reverse direction. Table 262 specifies the object description, and Table 263 specifies the entry description.

Table 262 – Object description

Attribute	Value
Index	6043 _h
Name	vl velocity demand
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if vl is supported

Table 263 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

17.5.3 Object 6044_h: vl velocity actual value

This object shall provide the velocity at the motor spindle or load. Depending on the implementation (simple drive device, without sensor, with sensor, etc.), the drive shall provide the appropriate image of the actual velocity ~~(velocity demand, velocity control effort, calculated velocity, measured velocity)~~ derived for example from velocity demand or a sensor signal.

The value shall be given in the very same unit as the vl target velocity. Positive values shall indicate forward direction and negative values shall indicate reverse direction. Table 264 specifies the object description, and Table 265 specifies the entry description.

Table 264 – Object description

Attribute	Value
Index	6044 _h
Name	vl velocity actual value
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory, if vl is supported

Table 265 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

17.5.4 Object 6046_n: vl velocity min max amount

This object shall indicate the configured minimum and maximum amount of velocity. The vl velocity max amount sub-object shall be mapped internally to the vl velocity max pos and vl velocity max neg values. The vl velocity min amount sub-object shall be mapped internally to the vl velocity min pos and vl velocity min neg values.

This transfer characteristic is shown in Figure 70.

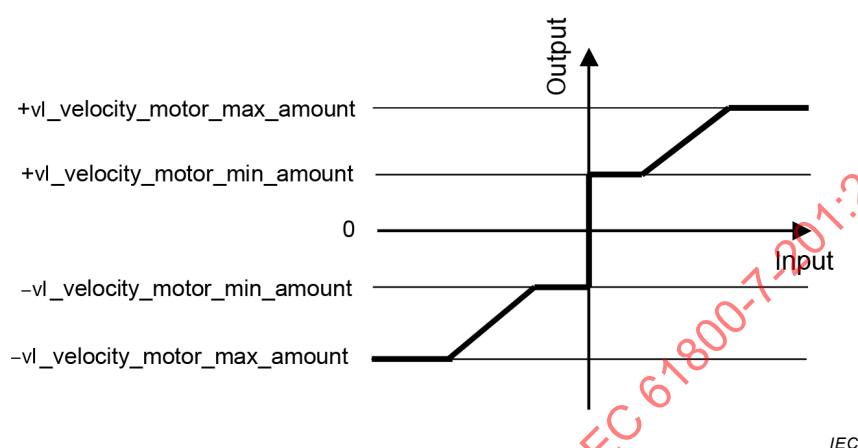


Figure 70 – Transfer characteristic of vl velocity min max amount

The values shall be given in rotations per minute (~~rpm~~ r/min) or in user-defined velocity units if the vl dimension factor object is implemented and is not set to 1. Table 266 specifies the object description, and Table 267 specifies the entry description.

Table 266 – Object description

Attribute	Value
Index	6046 _n
Name	vl velocity min max amount
Object code	Array
Data type	Unsigned32
Category	Conditional: mandatory if vl mode is supported

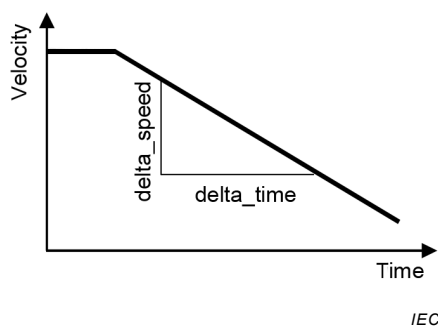
Table 267 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	vl velocity min amount
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	vl velocity max amount
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

17.5.5 Object 6049_h: vl velocity deceleration

This object shall indicate the configured delta speed and delta time of the slope of the deceleration ramp as shown in Figure 71.

$$\text{vl velocity deceleration} = \frac{\text{delta speed}}{\text{delta time}}$$

**Figure 71 – Transfer characteristic of the velocity deceleration**

The value of delta speed shall be given in rotations per minute (~~rpm~~ r/min) or in user-defined velocity units if the vl dimension factor object is implemented and is not set to 1. The value of delta time shall be given in s. Table 268 specifies the object description, and Table 269 specifies the entry description. If this object is not implemented, the value in object 6048_h shall be used for vl velocity deceleration.

Table 268 – Object description

Attribute	Value
Index	6049 _h
Name	vl velocity deceleration
Object code	Record
Data type	vl velocity acceleration deceleration (for data type of the sub-indices see record 0082 _h)
Category	Conditional: ~~optional~~ mandatory in vl mode

Table 269 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Delta speed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Delta time
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

17.5.6 Object 6048_h: vl velocity acceleration

This object shall indicate the configured delta speed and delta time of the slope of the acceleration ramp as shown in Figure 72.

~~Example: If you ramp to 1 500 rpm in 3,7 s, the delta speed equals to 15 000 rpm and delta time equals to 37 s.~~

$$v_l \text{ velocity acceleration} = \frac{\text{delta speed}}{\text{delta time}}$$

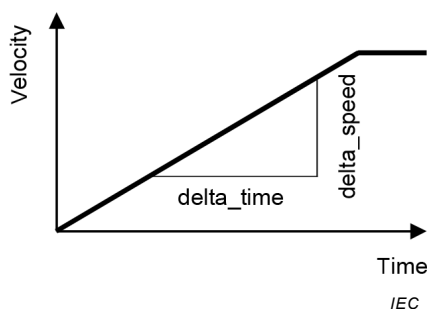


Figure 72 – Transfer characteristic of the velocity acceleration

The value of delta speed shall be given in rotations per minute (~~rpm~~ r/min) or in user-defined velocity units if the v_l dimension factor object is implemented and is not set to 1. The value of delta time shall be given in s. **Example: If you ramp to 1 500 r/min in 3,7 s, the delta speed equals to 15 000 (r/min) and delta time equals to 37 s.**

Table 270 specifies the object description, and Table 271 specifies the entry description.

Table 270 – Object description

Attribute	Value
Index	6048 _h
Name	v_l velocity acceleration
Object code	Record
Data type	v_l velocity acceleration deceleration (for data type of the sub-indices see record 0082 _h)
Category	Conditional: mandatory if v_l is supported

Table 271 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Delta speed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Delta time
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

17.5.7 Object 604A_h: vl-velocity quick stop

This object shall indicate the configured delta speed and delta time of the slope of the deceleration ramp for quick stop as shown in Figure 73.

$$\text{velocityquick stop} = \frac{\text{delta speed}}{\text{delta time}}$$

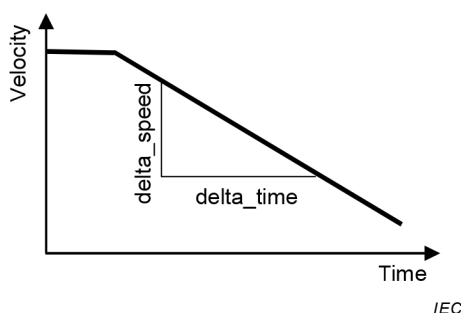


Figure 73 – Transfer characteristic of the quick stop deceleration

The value of delta speed shall be given in rotations per minute (~~rpm~~ r/min) or in user-defined velocity units if the vl dimension factor object is implemented and is not set to 1. The value of delta time shall be given in s. Table 272 specifies the object description, and Table 273 specifies the entry description.

Table 272 – Object description

Attribute	Value
Index	604A _h
Name	vl velocity quick stop
Object code	Record
Data type	vl velocity acceleration deceleration (for data type of the sub-indices see record 0082 _h)
Category	~~Conditional~~ : Optional

Table 273 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Delta speed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Delta time
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

17.5.8 Object 604B_h: vl set-point factor

This object shall indicate the configured numerator and denominator of the vl set-point factor. The vl set-point factor serves to modify the resolution or directing range of the specified set-point. It is also included in calculation of the vl velocity demand, and vl velocity actual value. It does not influence the velocity limit function and the ramp function. The value shall ~~have no~~

~~physical unit~~ be dimensionless and shall be given in the range from –32 768 to +32 767, but the value of 0 shall not be used. Table 274 specifies the object description, and Table 275 specifies the entry description.

Table 274 – Object description

Attribute	Value
Index	604B _h
Name	vl set-point factor
Object code	Array
Data type	Integer16
Category	Optional

Table 275 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	vl set-point factor numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	+1
Sub-index	02 _h
Description	vl set-point factor denominator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	+1

17.5.9 Object 604C_h: vl dimension factor

This object shall indicate the configured numerator and denominator of the vl dimension factor. The vl dimension factor serves to include gearing in calculation or serves to scale the frequencies or specific units of the user. It influences the vl target velocity, vl velocity demand, vl velocity actual value as well as the velocity limit function and the ramp function.

Calculating the vl dimension factor: Every user-specific velocity consists of specific units referred to specific units of time (e.g. 1/s, bottles/min, m/s, etc.). The purpose of the vl dimension factor is to convert the specific **velocity** units to the revolutions/minute ~~unit~~.

Velocity [user-defined units] × vl dimension factor [~~rpm~~ r/min/user-defined units] = Velocity [~~rpm~~ r/min]

The values shall be in the range of –2 147 483 648 to +2 147 483 647, but the value of 0 shall be not used ~~specifies the object description, and specifies the entry description~~.

Example: If the target unit is 0,1 Hz the numerator is 120 and the denominator is the pole number.

Table 276 specifies the object description, and Table 277 specifies the entry description.

Table 276 – Object description

Attribute	Value
Index	604C _h
Name	vl dimension factor
Object code	Array
Data type	Integer32
Category	Optional

Table 277 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	vl dimension factor numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	+1
Sub-index	02 _h
Description	vl dimension factor denominator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	+1

18 Cyclic synchronous position mode

18.1 General information

The overall structure for this mode is shown in Figure 74. With this mode, the trajectory generator is located in the control device, not in the drive device. In cyclic synchronous manner, it provides a target position to the drive device, which performs position control, velocity control and torque control. Optionally, additive velocity and torque values can be provided by the control system in order to allow for velocity and/or torque feedforward. Measured by sensors, the drive device may provide actual values for position, velocity and torque to the control device.

The behavior of the control function is influenced by control parameters such as limit functions, which are externally applicable. The drive internal control function is not specified more precisely in this part of the IEC 618700-7 series as it is highly manufacturer specific, but the format and content of the control parameters are provided.

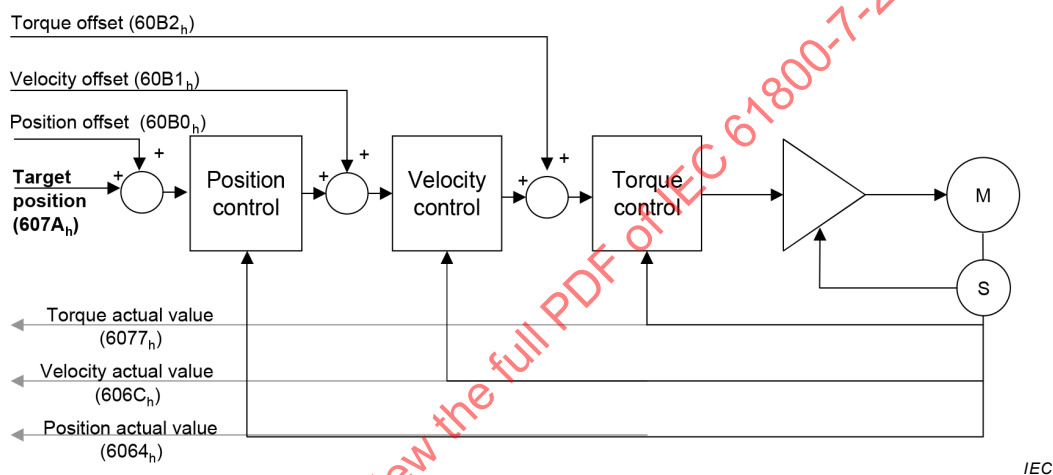


Figure 74 – Cyclic synchronous position mode overview

18.2 Functional description

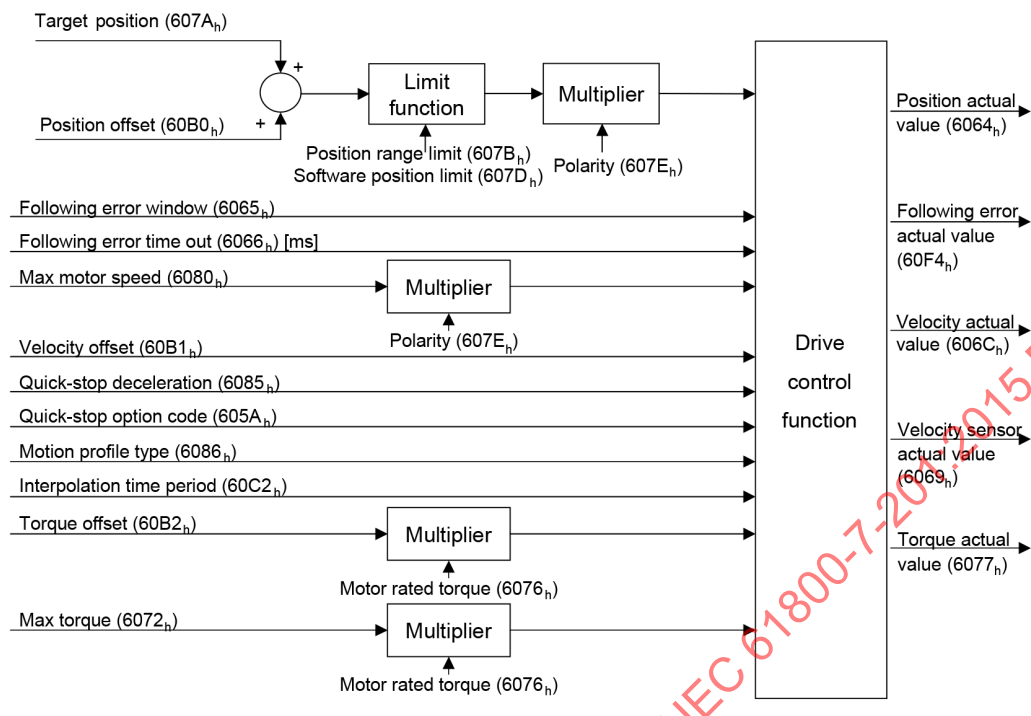
Figure 75 shows the inputs and outputs of the drive control function. The input values (from the control function point of view) are the target position and optionally a position offset (to be added to the target position to allow two instances to set up the position) as well as an optional velocity offset and an optional torque offset used for feedforward control. Especially in cascaded control structures, where a position control is followed by a velocity or torque control, the output of the position control loop is used as an input for a further calculation in the drive device. Limit functions may be used to restrict the range of values to avoid unintended positions.

The drive device monitors the following error. Other features specified in this mode are limitation of motor speed and a quick stop function for emergency reasons. The torque may be limited as well.

The interpolation time period defines the time period between two updates of the target position and/or additive position and shall be used for intercycle interpolation.

The target position shall be interpreted as absolute value.

The position actual value is used as mandatory output to the control device. Further outputs may be the velocity actual value, torque actual value and the velocity sensor actual value. The following error actual value may be used as an additional parameter.



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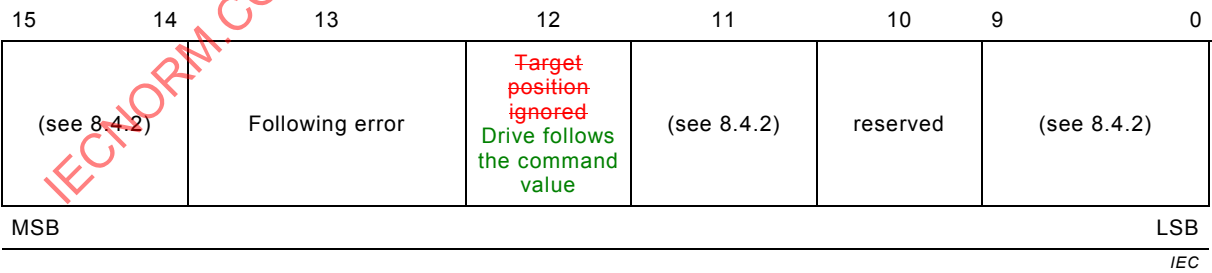
Figure 75 – Cyclic synchronous position control function

All values are transformed – if necessary – from user-defined units to normalized units such as increments using the functions as specified in Clause 9.

A target position value or position offset outside the allowed range of the following error window around a position demand value for longer than the following error time out shall result in setting bit 13 (following error) in the statusword to 1.

18.3 Use of controlword and statusword

The cyclic synchronous position mode uses no mode-specific bits of the controlword and three bits of the statusword for mode-specific purposes. Figure 76 shows the structure of the statusword. Table 278 defines the values for bit 10, 12, and 13 of the statusword.



IEC

Figure 76 – Statusword for profile cyclic synchronous position mode

Table 278 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Reserved
	1	Reserved
12	0	Drive does not follow the command value – Target position ignored
	1	Drive follows the command value – Target position ~~shall be~~ used as input to position control loop
13	0	No following error
	1	Following error

18.4 Detailed object definitions

18.4.1 Object 60B0_h: Position offset

This object shall provide the offset of the target position. The offset shall be given in user-defined position units.

NOTE The value itself is absolute and thus independent of how often it is transmitted over the communication system, for example, transmitted twice does not mean double value. Since the additive position value represents an offset to the target position, it can be also used to control the drive with relative values with regard to the target position.

Table 279 specifies the object description, and Table 280 specifies the entry description.

Table 279 – Object description

Attribute	Value
Index	60B0 _h
Name	Position offset
Object code	Variable
Data type	Integer32
Category	Optional

Table 280 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	0

18.4.2 Object 60B1_h: Velocity offset

This object shall provide the offset for the velocity value. The offset shall be given in user-defined velocity units. In cyclic synchronous position mode, this object contains the input value for velocity feed forward. In cyclic synchronous velocity mode (see Clause 19), it contains the commanded offset of the drive device.

NOTE The value itself is absolute and thus independent of how often it is transmitted over the communication system, for example transmitted twice does not mean double value. Since the additive velocity value represents an

offset to the target velocity, it can be also used to control the drive with relative values with regard to the target velocity.

Table 281 specifies the object description, and Table 282 specifies the entry description.

Table 281 – Object description

Attribute	Value
Index	60B1 _h
Name	Velocity offset
Object code	Variable
Data type	Integer32
Category	Optional

Table 282 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	0

18.4.3 Object 60B2_h: Torque offset

This object shall provide the offset for the torque value. The offset shall be given in per thousand rated torque. In cyclic synchronous position mode and cyclic synchronous velocity mode (see Clause 20), this object contains the input value for torque feed forward. In cyclic synchronous torque mode (see Clause 20) it contains the commanded additive torque of the drive, which is added to the target torque value.

NOTE The value itself is absolute and thus independent of how often it is transmitted over the communication system, for example transmitted twice does not mean double value.

Table 283 specifies the object description, and Table 284 specifies the entry description.

Table 283 – Object description

Attribute	Value
Index	60B2 _h
Name	Torque offset
Object code	Variable
Data type	Integer16
Category	Optional

Table 284 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0

19 Cyclic synchronous velocity mode

19.1 General information

The overall structure for this mode is shown in Figure 77. With this mode, the trajectory generator is located in the control device, not in the drive device. In cyclic synchronous manner, it provides a target velocity to the drive device, which performs velocity control and torque control. If desired, the position control loop may be closed over the communication system. Optionally, additive velocity and torque values may be provided by the control system in order to allow a second source for velocity and/or a torque feed forward. Measured by sensors, the drive device may provide actual values for position, velocity and torque to the control device.

The cyclic synchronous velocity mode covers the following sub-functions:

- demand value input;
- velocity capture using position sensor or velocity sensor;
- velocity control function with appropriate input and output signals;
- limitation of torque demand.

Various sensors may be used for velocity capture. In particular, the aim is that costs are reduced and the drive power system is simplified by evaluating position and velocity using a common sensor, such as is optional using a resolver or an encoder.

The behavior of the control function is influenced by control parameters such as limit functions, which are externally applicable. The drive internal control function is not specified more precisely in this part of the IEC 61800-7 series, as it is highly manufacturer-specific, but the format and content of the control parameters are provided.

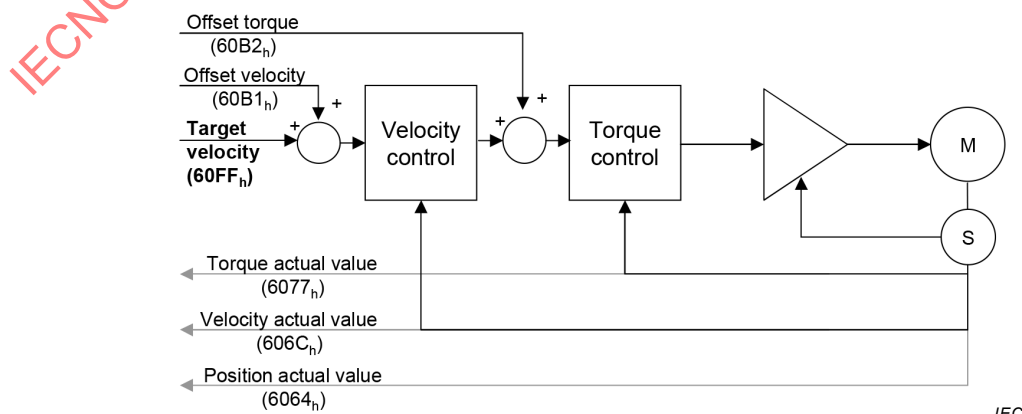


Figure 77 – Cyclic synchronous velocity mode overview

19.2 General definitions

The factors necessary for scaling have a linear relationship and therefore they are described in the factor group. The polarity is described in the factor group as well.

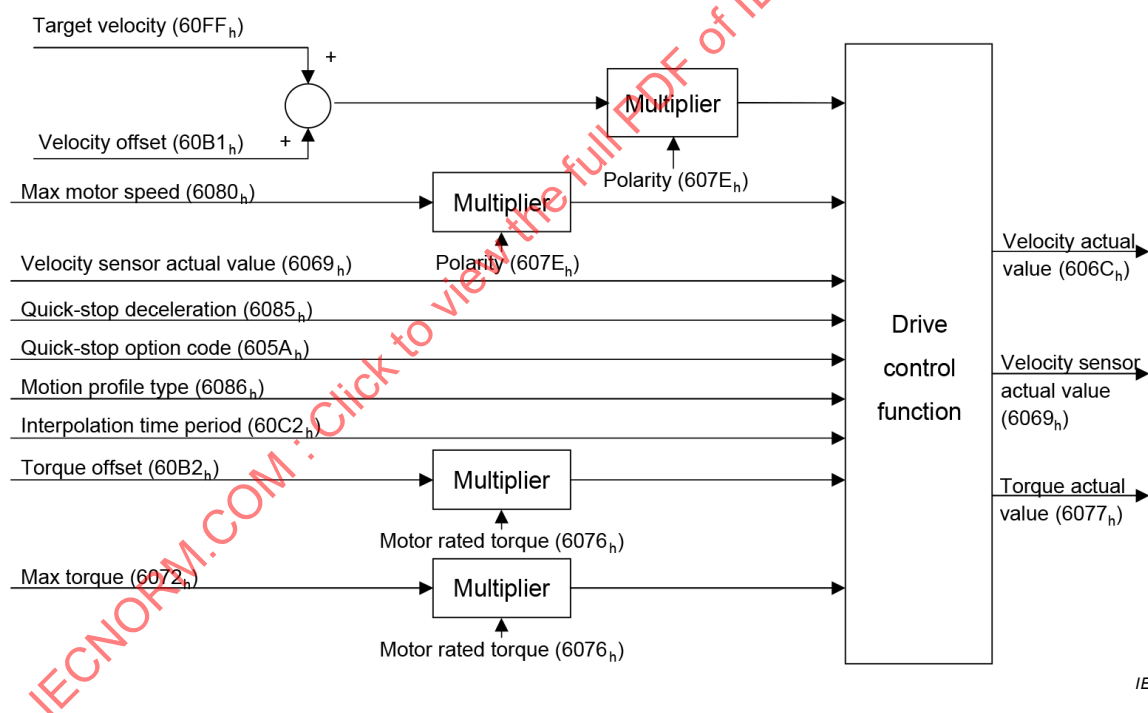
19.3 Functional description

Figure 78 shows the inputs and outputs of the drive control function. The input (from the control device point of view) are the target velocity and optionally, a velocity offset (to be added to the target velocity to allow two instances to set up the velocity) as well as a torque offset. Especially in cascaded control structures, where a velocity control is followed by a torque control, the output of the velocity control loop is used as an input for a further calculation in the drive device.

The drive device may support limitation of motor speed and a quick stop function for emergency reasons. The torque may be limited as well.

The interpolation time period defines the time period between two updates of the target velocity and/or additive velocity and shall be used for intercycle interpolation.

The velocity actual value is used as mandatory output to the control device. Further outputs may be the torque actual value and the velocity sensor actual value.



IEC

Figure 78 – Cyclic synchronous velocity control function

All values are transformed – if necessary – from user-defined units to normalized units such as increments using the functions as specified in Clause 9.

19.4 Use of controlword and statusword

The cyclic synchronous velocity mode uses no mode-specific bits of the controlword and some bits of the statusword for mode-specific purposes. Figure 79 shows the structure of the statusword. Table 285 defines the values for bit 10, 12, and 13 of the statusword.

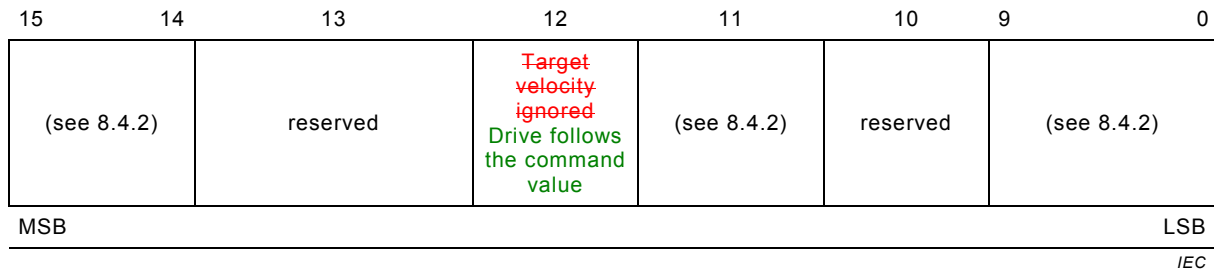


Figure 79 – Statusword for profile cyclic synchronous velocity mode

Table 285 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Reserved
	1	Reserved
12	0	Drive does not follow the command value – Target velocity ignored
	1	Drive follows the command value – Target velocity ~~shall be~~ used as input to velocity control loop
13	0	Reserved
	1	Reserved

20 Cyclic synchronous torque mode

20.1 General information

The overall structure for this mode is shown in Figure 80. With this mode, the trajectory generator is located in the control device, not in the drive device. In cyclic synchronous manner, it provides a target torque to the drive device, which performs torque control. Optionally, an additive torque value can be provided by the control system in order to allow two instances to set up the torque. Measured by sensors, the drive device may provide actual values for position, velocity and torque to the control device.

The cyclic synchronous torque mode covers the following sub-functions:

- demand value input;
- torque capture;
- torque control function with appropriate input and output signals;
- limitation of torque demand.

The drive internal control function is not specified more precisely in this part of the IEC 61800-7 series as it is highly manufacturer-specific, but the format and content of the control parameters are provided.

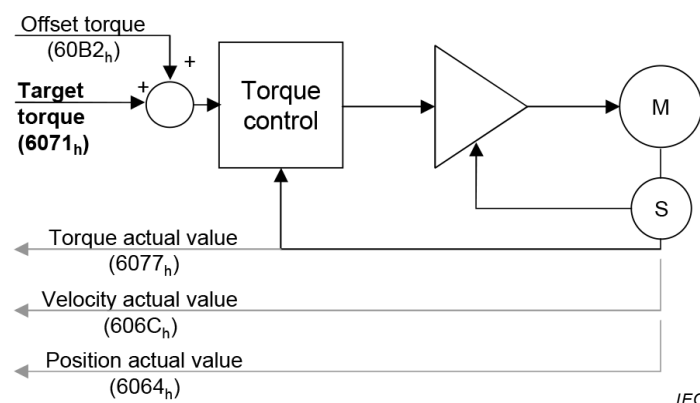


Figure 80 – Cyclic synchronous torque mode overview

20.2 General definitions

The factors necessary for scaling have a linear relationship and therefore they are described in the factor group. The polarity is described in the factor group as well.

20.3 Functional description

Figure 81 shows the inputs and outputs of the torque control function. The input (from the control function point of view) are the target torque and optionally a torque offset (to be added to the target torque to allow two instances to set up the torque).

The drive device can have features for limitation of motor speed. The torque can be limited as well.

The interpolation time period defines the time period between two updates of the target velocity and/or additive velocity and shall be used for intercycle interpolation.

The torque actual value is used as mandatory output to the control device.

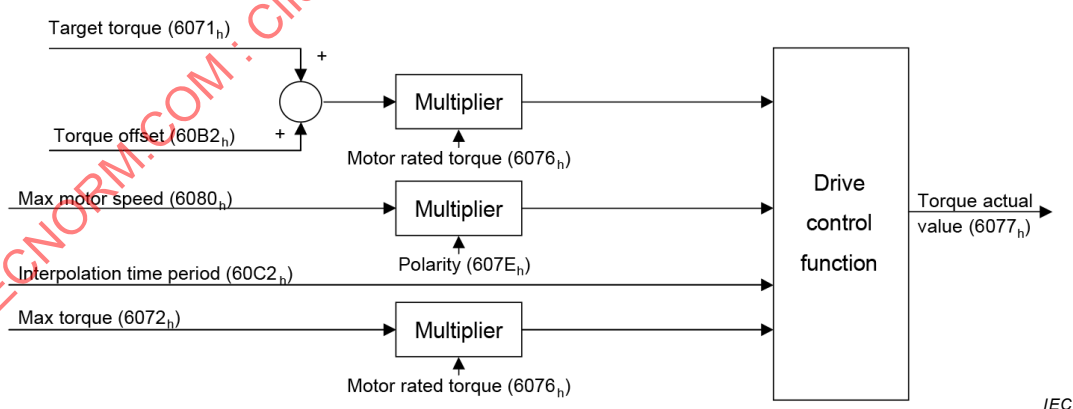


Figure 81 – Cyclic synchronous torque control function

20.4 Use of controlword and statusword

The cyclic synchronous torque mode uses no mode-specific bits of the controlword and some bits of the statusword for mode-specific purposes. Figure 82 shows the structure of the statusword. Table 286 defines the values for bit 10, 12, and 13 of the statusword.

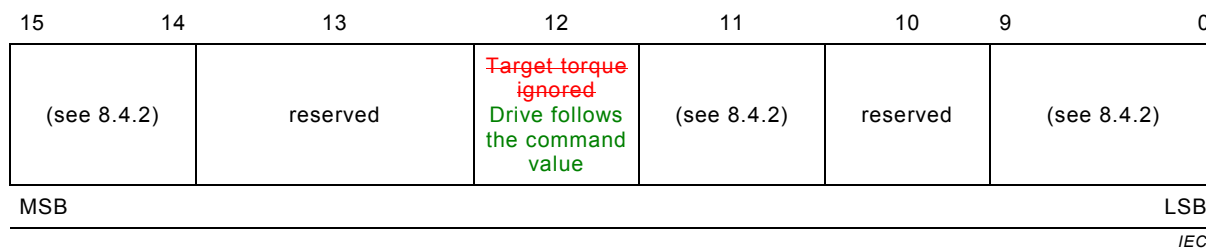


Figure 82 – Statusword for profile cyclic synchronous torque mode

Table 286 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Reserved
	1	Reserved
12	0	Drive does not follow the command value – Target torque ignored
	1	Drive follows the command value – Target torque shall be used as input to torque control loop
13	0	Reserved
	1	Reserved

21 Cyclic synchronous torque mode with commutation angle (cstca)

21.1 General information

The overall structure for this mode is shown in Figure 83. With this mode, the trajectory generator is located in the control device, not in the drive device. In cyclic synchronous manner, it provides a commutation angle and a target torque to the drive device, which performs current control and space vector modulation. Optionally, an additive torque value can be provided by the control system in order to allow two instances to set up the torque. Measured by sensors, the drive device could provide actual values for position or may provide velocity and torque to the control device.

This mode can be used for example:

- to find the commutation angle during commissioning;
- to check the function (increments, zero signal) and direction of the sensor.

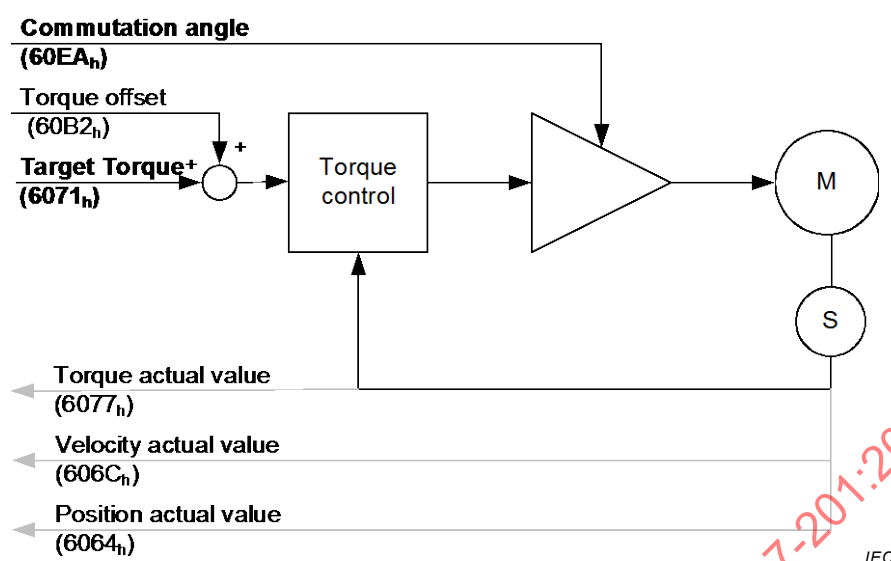


Figure 83 – Cyclic synchronous torque mode with commutation angle overview

21.2 General definitions

The factors necessary for scaling have a linear relationship and therefore they are described in the factor group. The polarity is described in the factor group as well.

21.3 Functional description

Figure 84 shows the inputs and outputs of the torque control function with commutation angle. The inputs (from the control function point of view) are the commutation angle and the target torque and optionally a torque offset (to be added to the target torque to allow two instances to set up the torque).

The drive device can have features for limitation of motor speed. The torque can be limited as well.

The interpolation time period defines the time period between two updates of the target velocity and/or additive velocity and shall be used for intercycle interpolation.

The torque actual value can be used as output to the control device. The objects marked bold in Figure 84 are used for cstca.

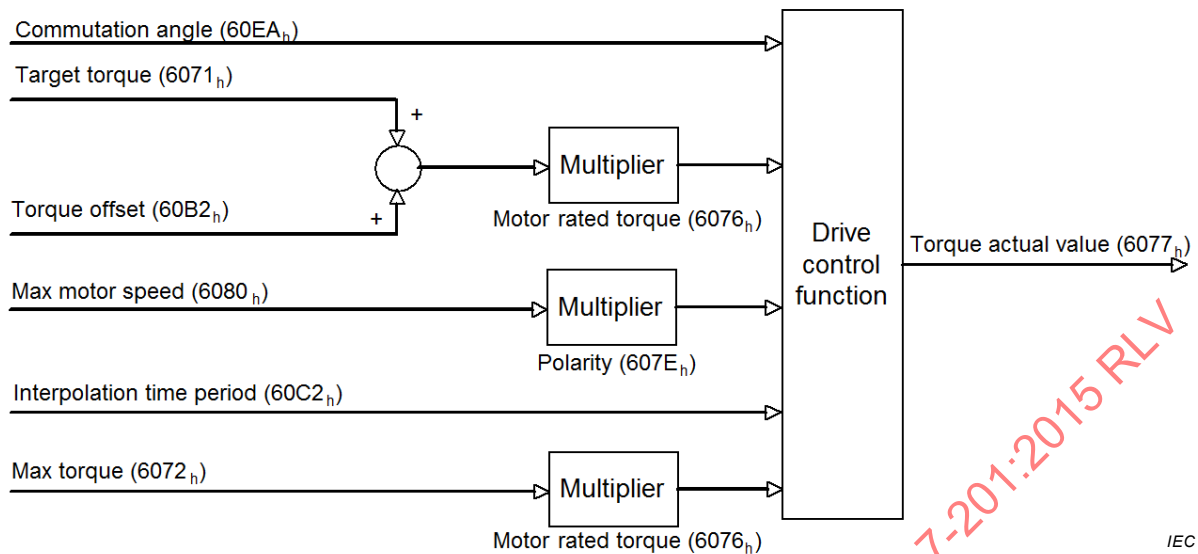


Figure 84 – Cyclic synchronous torque with commutation angle control function

21.4 Use of controlword and statusword

The operation mode specific bits (bit 4 to 6, bit 9) and the halt bit (bit 8) in the controlword shall be ignored by the drive. In the cstca mode the bit 8 shall be ignored because the halt function is controlled by the control device.

Figure 85 shows the structure of the statusword.

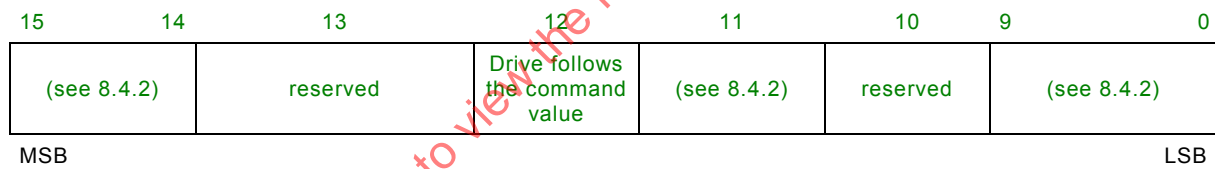


Figure 85 – Statusword for cstca mode

The bit 12 is mandatory. The value of the bit 12 shall be 0_b if the drive does not follow the target torque value because of local reasons (internal set-point settings). The bit 12 shall be set to 1_b if the drive is in operation enabled state and follows the target and set-point values of the control device. In all other cases it shall be 0_b. Table 287 defines the values of bit 10, bit 12 and bit 13.

Table 287 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Reserved
	1	Reserved
12	0	Drive does not follow the command value – Target torque ignored
	1	Drive follows the command value – Target torque used as input to torque control loop
13	0	Reserved
	1	Reserved

21.5 Object 60EA_h: Commutation angle

This object shall indicate the electrical commutation angle for the space vector modulation. The value shall be given in multiples of $360^\circ/2^{16}$, whereby the electrical angle is used. Table 288 specifies the object description, and Table 289 specifies the entry description.

Table 288 – Object description

Attribute	Value
Index	60EA _h
Name	Commutation angle
Object code	Variable
Data type	Unsigned16
Category	Mandatory if cstca is supported

Table 289 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	0000 _h

22 Support of additional sensor interfaces

22.1 General

A drive may support several sensor interfaces. This clause specifies the objects required for use of additional sensor interfaces.

22.2 Object 60E4_h: Additional position actual value

This object provides the additional position actual values. The value shall be given in user-defined position units. Table 290 specifies the object description, and Table 291 specifies the entry description.

Table 290 – Object description

Attribute	Value
Index	60E4 _h
Name	Additional position actual value
Object code	Array
Data type	Integer32
Category	Optional

Table 291 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional position actual value
Entry category	Mandatory
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No
Sub-index	02 _h
Description	2nd additional position actual value
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No
to	
Sub-index	FE _h
Description	254th additional position actual value
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

22.3 Object 60E5_h: Additional velocity actual value

This object provides the additional velocity actual values. The value shall be given in user-defined velocity units. Table 292 specifies the object description, and Table 293 specifies the entry description.

Table 292 – Object description

Attribute	Value
Index	60E5 _h
Name	Additional velocity actual value
Object code	Array
Data type	Integer32
Category	Optional

Table 293 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional velocity actual value
Entry category	Mandatory
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No
Sub-index	02 _h
Description	2nd additional velocity actual value
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No
to	
Sub-index	FE _h
Description	254th additional velocity actual value
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

22.4 Object 60E6_h: Additional position encoder resolution – encoder increments

This object provides the encoder increments for the additional position encoder resolution. This object shall be used with the corresponding sub-index of the object 60EB_h (motor revolutions for the additional position encoder resolution).

The additional position encoder resolution value is calculated by the formula as given in the object 608F_h. Table 294 specifies the object description, and Table 295 specifies the entry description.

Table 294 – Object description

Attribute	Value
Index	60E6 _h
Name	Additional position encoder resolution – encoder increments
Object code	Array
Data type	Unsigned32
Category	Optional

Table 295 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional position encoder resolution – encoder increments
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific
Sub-index	02 _h
Description	2nd additional position encoder resolution – encoder increments
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific
to	
Sub-index	FE _h
Description	254th additional position encoder resolution – encoder increments
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific

22.5 Object 60EB_h: Additional position encoder resolution – motor revolutions

This object provides the motor revolutions for the additional position encoder resolution. This object shall be used with the corresponding sub-index of the object 60E6_h (encoder increments for the additional position encoder resolution). The additional position encoder resolution value is calculated by the formula as given in the object 608F_h. Table 296 specifies the object description, and Table 297 specifies the entry description.

Table 296 – Object description

Attribute	Value
Index	60EB _h
Name	Additional position encoder resolution – motor revolutions
Object code	Array
Data type	Unsigned32
Category	Conditional: if object 60E6 _h is supported

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Table 297 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional position encoder resolution – motor revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific
Sub-index	02 _h
Description	2nd additional position encoder resolution – motor revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific
to	
Sub-index	FE _h
Description	254th additional position encoder resolution – motor revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific

22.6 Object 60E7_h: Additional velocity encoder resolution – encoder increments per second

This object provides the encoder increments per second for the additional velocity encoder resolution. This object shall be used with the corresponding sub-index of the object 60EC_h (motor revolutions per second for the additional velocity encoder resolution). The additional velocity encoder resolution value is calculated by the formula as given in the object 6090_h. Table 298 specifies the object description, and Table 299 specifies the entry description.

Table 298 – Object description

Attribute	Value
Index	60E7 _h
Name	Additional velocity encoder resolution – encoder increments per second
Object code	Array
Data type	Unsigned32
Category	Conditional if 60EC _h is supported

Table 299 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional velocity encoder resolution – encoder increments per second
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional velocity encoder resolution – encoder increments per second
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional velocity encoder resolution – encoder increments per second
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.7 Object 60EC_h: Additional velocity encoder resolution – motor revolutions per second

This object provides the motor revolutions per second for the additional velocity encoder resolution. This object shall be used with the corresponding sub-index of the object 60E7_h (encoder increments per second for the additional velocity encoder resolution). The additional velocity encoder resolution value is calculated by the formula as given in the object 6090_h. Table 300 specifies the object description, and Table 301 specifies the entry description.

Table 300 – Object description

Attribute	Value
Index	60EC _h
Name	Additional velocity encoder resolution – motor revolutions per second
Object code	Array
Data type	Unsigned32
Category	Conditional: if object 60E7 _h is supported

Table 301 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional velocity encoder resolution – motor revolutions per second
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional velocity encoder resolution – motor revolutions per second
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional velocity encoder resolution – motor revolutions per second
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301

Attribute	Value
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.8 Object 60E8_h: Additional gear ratio – motor shaft revolutions

This object provides the motor shaft revolutions for the additional gear ratio calculation. This object shall be used with the corresponding sub-index of the object 60ED_h (driving shaft revolutions for the additional gear ratio calculation). The additional gear ratio value is calculated by the formula as given in the object 6091_h. Table 302 specifies the object description, and Table 303 specifies the entry description.

Table 302 – Object description

Attribute	Value
Index	60E8 _h
Name	Additional gear ratio – motor shaft revolutions
Object code	Array
Data type	Unsigned32
Category	Conditional if 60ED _h is supported

Table 303 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional gear ratio – motor shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional gear ratio – motor shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	FE _h
Description	254th additional gear ratio – motor shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.9 Object 60ED_h: Additional gear ratio – driving shaft revolutions

This object provides the driving shaft revolutions for the additional gear ratio calculation. This object shall be used with the corresponding sub-index of the object 60E8_h (motor shaft revolutions for the additional gear ratio calculation). The additional gear ratio value is calculated by the formula as given in the object 6091_h. Table 304 specifies the object description, and Table 305 specifies the entry description.

Table 304 – Object description

Attribute	Value
Index	60ED _h
Name	Additional gear ratio – driving shaft revolutions
Object code	Array
Data type	Unsigned32
Category	Conditional: if object 60E8 _h is supported

Table 305 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional gear ratio – driving shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional gear ratio – driving shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional gear ratio – driving shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.10 Object 60E9_h: Additional feed constant – feed

This object provides the feed for the additional feed constant calculation. This object shall be used with the corresponding sub-index of the object 60EE_h (driving shaft revolutions for the additional feed constant calculation). The additional feed constant value is calculated by the formula as given in the object 6092_h. Table 306 specifies the object description, and Table 307 specifies the entry description.

Table 306 – Object description

Attribute	Value
Index	60E9 _h
Name	Additional feed constant – feed
Object code	Array
Data type	Unsigned32
Category	Conditional if 60EE _h is supported

Table 307 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional feed constant – feed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional feed constant – feed
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional feed constant – feed
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.11 Object 60EE_h: Additional feed constant – driving shaft revolutions

This object provides the driving shaft revolutions for the additional feed constant calculation. This object shall be used with the corresponding sub-index of the object 60E9_h (feed for the additional feed constant calculation). The additional feed constant value is calculated by the formula as given in the object 6092_h. Table 308 specifies the object description, and Table 309 specifies the entry description.

Table 308 – Object description

Attribute	Value
Index	60EE _h
Name	Additional feed constant – driving shaft revolutions
Object code	Array
Data type	Unsigned32
Category	Conditional: if object 60E9 _h is supported

Table 309 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional feed constant – driving shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional feed constant – driving shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional feed constant – driving shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

23 Optional Application FE

23.1 General

The objects defined in this clause are used for the optional generic input/output FE.

23.2 Object 60FD_h: Digital inputs

This object shall provide digital inputs. Figure 86 specifies the object structure. This object represents the physical input levels. If a certain input function is supported the pin assignment shall be as defined in Figure 86.

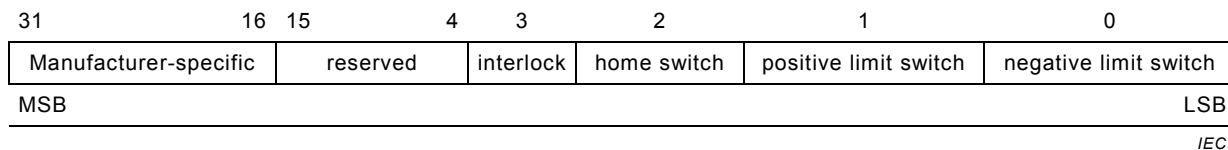


Figure 86 – Object structure

The conversion from external physical values into internal logical values is manufacturer-specific.

Bit 3 (interlock) displays the state of the interlock input. If the logical input signal changes to not activated, the drive has to enter the switch on disabled or fault reaction active state. This means the power stage of the drive is disabled and locked against switching on.

Table 310 specifies the values.

Table 310 – Value definition

Value	Definition
0 _b	Switched off (0 V)
1 _b	Switched on (supply voltage [V _{dc}])

Table 311 specifies the object description, Table 312 specifies the entry description.

Table 311 – Object description

Attribute	Value
Index	60FD _h
Name	Digital inputs
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 312 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	0000-0000 _h no

23.3 Object 60FE_h: Digital outputs

This object shall command simple digital outputs. This object represents the physical output levels. If a certain output function is supported the pin assignment shall be as defined in Figure 87.

Figure 87 specifies the object structure.

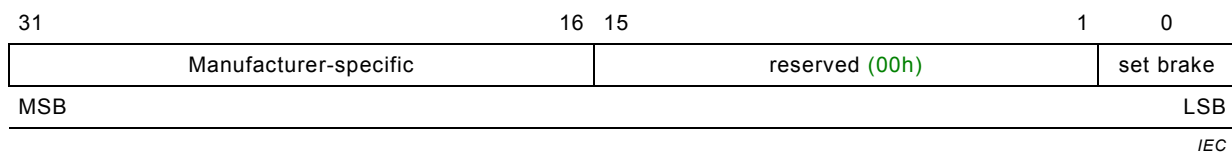
**Figure 87 – Object structure**

Table 313 specifies the values.

Table 313 – Value definition

Value	Definition for ~~sub-index 01_h~~ bit 0	Definition for ~~sub-index 02_h~~ bit 16 to 31
0 _b	Switch off/don't set brake	Disable output
1 _b	Switch on/set brake	Enable output

Table 314 specifies the object description, Table 315 specifies the entry description.

Table 314 – Object description

Attribute	Value
Index	60FE _h
Name	Digital output
Object Code	Array
Data Type	Unsigned32
Category	Optional

Table 315 – Entry description

Attribute	Value
Sub-Index	00 _h
Description	Highest sub-index supported
Entry Category	Mandatory
Access	c
PDO Mapping	See IEC 61800-7-301
Value Range	02 01 _h or 02 _h
Default Value	Manufacturer-specific
Sub-Index	01 _h
Description	Physical outputs
Entry Category	Mandatory
Access	rw
PDO Mapping	See IEC 61800-7-301
Value Range	Unsigned32
Default Value	0000 0000 _h
Sub-Index	02 _h
Description	Bit mask
Entry Category	Optional
Access	rw
PDO Mapping	See IEC 61800-7-301
Value Range	Unsigned32
Default Value	0000 0000 _h

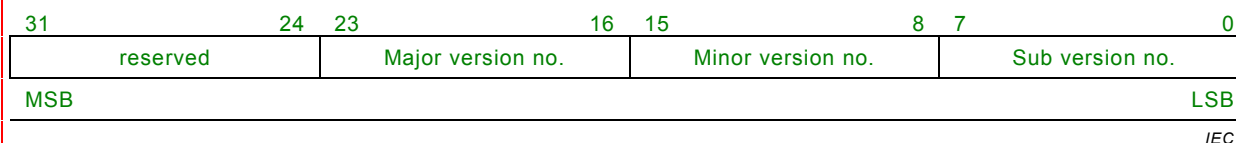
24 Device information

24.1 General

The objects defined in this clause provide general device information.

24.2 Object 67FE_h: Version number

This object shall provide the version number of the CiA 402 profile which is used to build up the device. Object 67FE_h shall be applied as well for single and multi axis devices. The version number consists out of three figures. For this international standard the number 3.1.0 shall be used.



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Figure 88 – Structure of the standard version parameter

Table 316 specifies the object description, and Table 317 specifies the entry description.

Table 316 – Object description

Attribute	Value
Index	67FE _h
Name	Version number
Object code	Variable
Data type	Unsigned32
Category	Mandatory

Table 317 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Figure 88
Default value	Manufacturer-specific

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¹⁷ See also the IEC Multilingual Dictionary – Electricity, Electronics and Telecommunications.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Adjustable speed electrical power drive systems –
Part 7-201: Generic interface and use of profiles for power drive systems –
Profile type 1 specification**

**Entraînements électriques de puissance à vitesse variable –
Partie 7-201: Interface générique et utilisation de profils pour les entraînements
électriques de puissance – Spécification de profil de type 1**

CONTENTS

FOREWORD	17
INTRODUCTION	19
1 Scope	23
2 Normative references	23
3 Terms, definitions and abbreviated terms	23
3.1 Terms and definitions	23
3.2 Abbreviated terms	27
4 General	28
4.1 General considerations	28
4.2 Communication interface	28
4.3 Object dictionary	29
5 Data types	30
5.1 Standard data types	30
5.2 Record definitions	30
6 General object definitions	31
6.1 General	31
6.2 Communication parameter objects	31
6.3 Additional identification and information objects	32
6.3.1 Object 6402 _h : Motor type	32
6.3.2 Object 6403 _h : Motor catalogue number	33
6.3.3 Object 6404 _h : Motor manufacturer	34
6.3.4 Object 6405 _h : http motor catalogue address	35
6.3.5 Object 6406 _h : Motor calibration date	35
6.3.6 Object 6407 _h : Motor service period	36
6.3.7 Object 6503 _h : Drive catalogue number	36
6.3.8 Object 6505 _h : http drive catalogue address	37
7 Error codes and error behavior	37
7.1 Error codes	37
7.2 Error behavior	41
8 Controlling the power drive system	42
8.1 General	42
8.2 Finite state automaton	42
8.3 Modes of operation	45
8.4 Detailed object specifications	46
8.4.1 Object 6040 _h : Controlword	46
8.4.2 Object 6041 _h : Statusword	47
8.4.3 Object 603F _h : Error code	49
8.4.4 Object 6007 _h : Abort connection option code	50
8.4.5 Object 605A _h : Quick stop option code	51
8.4.6 Object 605B _h : Shutdown option code	51
8.4.7 Object 605C _h : Disable operation option code	52
8.4.8 Object 605D _h : Halt option code	53
8.4.9 Object 605E _h : Fault reaction option code	54
8.4.10 Object 6060 _h : Modes of operation	54
8.4.11 Object 6061 _h : Modes of operation display	56

8.4.12	Object 6502 _h : Supported drive modes	56
9	Factor group	57
9.1	General	57
9.2	Detailed object definitions	59
9.2.1	Object 608F _h : Position encoder resolution	59
9.2.2	Object 6090 _h : Velocity encoder resolution	60
9.2.3	Object 6091 _h : Gear ratio	61
9.2.4	Object 6092 _h : Feed constant	62
9.2.5	Object 6096 _h : Velocity factor	64
9.2.6	Object 6097 _h : Acceleration factor	64
9.2.7	Object 60A2 _h : Jerk factor	65
9.2.8	Object 607E _h : Polarity	66
9.2.9	Code table for device profile specific units	67
9.2.10	Object 60A8 _h : SI unit position	67
9.2.11	Object 60A9 _h : SI unit velocity	68
9.2.12	Object 60AA _h : SI unit acceleration	69
9.2.13	Object 60AB _h : SI unit jerk	70
10	Profile position mode	70
10.1	General information	70
10.2	Functional description	71
10.2.1	General	71
10.2.2	Single set-point	72
10.2.3	Set of set-points	73
10.2.4	Usage of halt bit in conjunction with new set-point bit	74
10.3	General definitions	75
10.4	Use of controlword and statusword	75
10.5	Detailed object definitions	76
10.5.1	Object 607A _h : Target position	76
10.5.2	Object 607B _h : Position range limit	77
10.5.3	Object 607D _h : Software position limit	78
10.5.4	Object 607F _h : Max profile velocity	80
10.5.5	Object 6080 _h : Max motor speed	81
10.5.6	Object 6081 _h : Profile velocity	81
10.5.7	Object 6082 _h : End velocity	82
10.5.8	Object 6083 _h : Profile acceleration	82
10.5.9	Object 6084 _h : Profile deceleration	83
10.5.10	Object 6085 _h : Quick stop deceleration	83
10.5.11	Object 6086 _h : Motion profile type	84
10.5.12	Object 60A3 _h : Profile jerk use	85
10.5.13	Object 60A4 _h : Profile jerk	85
10.5.14	Object 60C5 _h : Max acceleration	87
10.5.15	Object 60C6 _h : Max deceleration	88
11	Homing mode	89
11.1	General information	89
11.2	Functional description	89
11.3	General definitions	90
11.3.1	General	90
11.3.2	Method 1: Homing on negative limit switch and index pulse	90
11.3.3	Method 2: Homing on positive limit switch and index pulse	90

11.3.4	Method 3 and 4: Homing on positive home switch and index pulse	90
11.3.5	Method 5 and 6: Homing on negative home switch and index pulse	91
11.3.6	Method 7 to 14: Homing on home switch and index pulse	91
11.3.7	Method 15 and 16: Reserved	92
11.3.8	Method 17 to 30: Homing without index pulse	92
11.3.9	Method 31 and 32: Reserved	93
11.3.10	Method 33 and 34: Homing on index pulse	93
11.3.11	Method 35: Homing on current position (obsolete)	93
11.3.12	Method 36: Reserved for compatibility reasons	93
11.3.13	Method 37: Homing on current position	93
11.4	Use of controlword and statusword	94
11.5	Detailed object definitions	94
11.5.1	Object 607C _h : Home offset	94
11.5.2	Object 6098 _h : Homing method	95
11.5.3	Object 60E3 _h : Supported homing methods	96
11.5.4	Object 6099 _h : Homing speeds	97
11.5.5	Object 609A _h : Homing acceleration	98
12	Touch probe functionality	99
12.1	Object 60B8 _h : Touch probe function	99
12.2	Object 60B9 _h : Touch probe status	101
12.3	Object 60BA _h : Touch probe 1 positive edge	102
12.4	Object 60BB _h : Touch probe 1 negative edge	102
12.5	Object 60BC _h : Touch probe 2 positive edge	103
12.6	Object 60BD _h : Touch probe 2 negative edge	103
12.7	Object 60D0 _h : Touch probe source	104
12.8	Touch probe time stamp latch	105
12.8.1	General	105
12.8.2	Object 60D1 _h : Touch probe time stamp 1 positive value	106
12.8.3	Object 60D2 _h : Touch probe time stamp 1 negative value	106
12.8.4	Object 60D3 _h : Touch probe time stamp 2 positive value	107
12.8.5	Object 60D4 _h : Touch probe time stamp 2 negative value	107
12.9	Touch probe edge counter for continuous mode	108
12.9.1	General	108
12.9.2	Object 60D5 _h : Touch probe 1 positive edge counter	108
12.9.3	Object 60D6 _h : Touch probe 1 negative edge counter	108
12.9.4	Object 60D7 _h : Touch probe 2 positive edge counter	109
12.9.5	Object 60D8 _h : Touch probe 2 negative edge counter	110
12.10	Timing diagram for touch probe example	110
13	Position control function	112
13.1	General information	112
13.2	Functional description	112
13.3	Detailed object definitions	114
13.3.1	Object 6062 _h : Position demand value	114
13.3.2	Object 6063 _h : Position actual internal value	115
13.3.3	Object 6064 _h : Position actual value	115
13.3.4	Object 6065 _h : Following error window	116
13.3.5	Object 6066 _h : Following error time out	117
13.3.6	Object 6067 _h : Position window	117
13.3.7	Object 6068 _h : Position window time	118

13.3.8	Object 60F4 _h : Following error actual value	118
13.3.9	Object 60FA _h : Control effort	119
13.3.10	Object 60FC _h : Position demand internal value	119
13.3.11	Object 60F2 _h : Positioning option code	120
14	Interpolated position mode	123
14.1	General information	123
14.2	Functional description	125
14.2.1	General	125
14.2.2	Linear interpolated position mode with several axes	125
14.2.3	Buffer strategies for the interpolated position mode	127
14.2.4	Interpolated position mode FSA	128
14.3	General definitions	129
14.4	Use of controlword and statusword	129
14.5	Detailed object definitions	130
14.5.1	Object 60C0 _h : Interpolation sub mode select	130
14.5.2	Object 60C1 _h : Interpolation data record	131
14.5.3	Object 60C2 _h : Interpolation time period	132
14.5.4	Object 60C4 _h : Interpolation data configuration	133
15	Profile velocity mode	136
15.1	General information	136
15.2	Functional description	136
15.3	General definitions	137
15.4	Use of controlword and statusword	137
15.5	Detailed object definitions	138
15.5.1	Object 6069 _h : Velocity sensor actual value	138
15.5.2	Object 606A _h : Sensor selection code	139
15.5.3	Object 606B _h : Velocity demand value	139
15.5.4	Object 606C _h : Velocity actual value	140
15.5.5	Object 606D _h : Velocity window	140
15.5.6	Object 606E _h : Velocity window time	141
15.5.7	Object 606F _h : Velocity threshold	141
15.5.8	Object 6070 _h : Velocity threshold time	142
15.5.9	Object 60FF _h : Target velocity	142
15.5.10	Object 60F8 _h : Max slippage	143
16	Profile torque mode	144
16.1	General information	144
16.2	Functional description	144
16.3	General definitions	145
16.4	Use of controlword and statusword	145
16.5	Detailed object definitions	145
16.5.1	Object 6071 _h : Target torque	145
16.5.2	Object 6072 _h : Max torque	146
16.5.3	Object 60E0 _h : Positive torque limit value	146
16.5.4	Object 60E1 _h : Negative torque limit value	147
16.5.5	Object 6073 _h : Max current	148
16.5.6	Object 6074 _h : Torque demand	148
16.5.7	Object 6075 _h : Motor rated current	149
16.5.8	Object 6076 _h : Motor rated torque	149
16.5.9	Object 6077 _h : Torque actual value	150

16.5.10	Object 6078 _h : Current actual value	150
16.5.11	Object 6079 _h : DC link circuit voltage	151
16.5.12	Object 6087 _h : Torque slope	151
16.5.13	Object 6088 _h : Torque profile type	152
17	Velocity mode	152
17.1	General information	152
17.2	Functional description	153
17.2.1	Ramp function	153
17.2.2	Velocity control function	154
17.2.3	Factor function	154
17.3	General definitions	155
17.4	Use of controlword and statusword	155
17.5	Detailed object definitions	156
17.5.1	Object 6042 _h : vl target velocity	156
17.5.2	Object 6043 _h : vl velocity demand	156
17.5.3	Object 6044 _h : vl velocity actual value	157
17.5.4	Object 6046 _h : vl velocity min max amount	158
17.5.5	Object 6049 _h : vl velocity deceleration	159
17.5.6	Object 6048 _h : vl velocity acceleration	160
17.5.7	Object 604A _h : vl velocity quick stop	162
17.5.8	Object 604B _h : vl set-point factor	163
17.5.9	Object 604C _h : vl dimension factor	164
18	Cyclic synchronous position mode	166
18.1	General information	166
18.2	Functional description	166
18.3	Use of controlword and statusword	167
18.4	Detailed object definitions	168
18.4.1	Object 60B0 _h : Position offset	168
18.4.2	Object 60B1 _h : Velocity offset	168
18.4.3	Object 60B2 _h : Torque offset	169
19	Cyclic synchronous velocity mode	170
19.1	General information	170
19.2	General definitions	171
19.3	Functional description	171
19.4	Use of controlword and statusword	171
20	Cyclic synchronous torque mode	172
20.1	General information	172
20.2	General definitions	173
20.3	Functional description	173
20.4	Use of controlword and statusword	173
21	Cyclic synchronous torque mode with commutation angle (cstca)	174
21.1	General information	174
21.2	General definitions	175
21.3	Functional description	175
21.4	Use of controlword and statusword	175
21.5	Object 60EA _h : Commutation angle	176
22	Support of additional sensor interfaces	176
22.1	General	176

22.2	Object 60E4 _h : Additional position actual value	177
22.3	Object 60E5 _h : Additional velocity actual value	178
22.4	Object 60E6 _h : Additional position encoder resolution – encoder increments	179
22.5	Object 60EB _h : Additional position encoder resolution – motor revolutions	180
22.6	Object 60E7 _h : Additional velocity encoder resolution – encoder increments per second	182
22.7	Object 60EC _h : Additional velocity encoder resolution – motor revolutions per second	183
22.8	Object 60E8 _h : Additional gear ratio – motor shaft revolutions	185
22.9	Object 60ED _h : Additional gear ratio – driving shaft revolutions	186
22.10	Object 60E9 _h : Additional feed constant – feed	186
22.11	Object 60EE _h : Additional feed constant – driving shaft revolutions	188
23	Optional application FE	189
23.1	General	189
23.2	Object 60FD _h : Digital inputs	189
23.3	Object 60FE _h : Digital outputs	190
24	Device information	191
24.1	General	191
24.2	Object 67FE _h : Version number	191
	Bibliography	193
	Figure 1 – Structure of IEC 61800-7	22
	Figure 2 – Value definition	31
	Figure 3 – Remote and local control	42
	Figure 4 – Power drive system finite state automaton	43
	Figure 5 – Relation between different value parameters	46
	Figure 6 – Value definition	46
	Figure 7 – Value definition	48
	Figure 8 – Value definition	56
	Figure 9 – Position scaling concept	58
	Figure 10 – Value definition	67
	Figure 11 – Example for a position unit	68
	Figure 12 – Example for a velocity unit	69
	Figure 13 – Example for an acceleration unit	70
	Figure 14 – Example for a jerk unit	70
	Figure 15 – Trajectory generator and position control function	71
	Figure 16 – Trajectory generator for profile position mode	71
	Figure 17 – Set-point example	72
	Figure 18 – Handshaking procedure for the single set-point method	72
	Figure 19 – Handshaking procedure for the set of set-points method	73
	Figure 20 – Set-point handling for two set-points	74
	Figure 21 – Erase set-point	75
	Figure 22 – Controlword for profile position (pp) mode	75
	Figure 23 – Statusword for profile position (pp) mode	76
	Figure 24 – Software position limits	79
	Figure 25 – Velocity/time diagram with jerk positions	86

Figure 26 – Homing mode function.....	89
Figure 27 – Homing on negative limit switch and index pulse	90
Figure 28 – Homing on positive limit switch and index pulse	90
Figure 29 – Homing on positive home switch and index pulse	91
Figure 30 – Homing on negative home switch and index pulse	91
Figure 31 – Homing on home switch and index pulse – positive initial motion	92
Figure 32 – Homing on home switch and index pulse – negative initial motion	92
Figure 33 – Homing on positive home switch	93
Figure 34 – Homing on index pulse	93
Figure 35 – Controlword for homing mode.....	94
Figure 36 – Statusword for homing mode	94
Figure 37 – Home offset definition	95
Figure 38 – Timing diagram for touch probe example.....	111
Figure 39 – Position control function	112
Figure 40 – Following error (functional overview)	113
Figure 41 – Position reached (functional overview)	113
Figure 42 – Position reached (definitions)	114
Figure 43 – Following error (definitions)	114
Figure 44 – Object structure.....	120
Figure 45 – Rotary axis positioning example	122
Figure 46 – Example for absolute movement greater than modulo value	122
Figure 47 – Example for relative movement greater than modulo value	123
Figure 48 – Interpolation controller	125
Figure 49 – Interpolated position mode for two axes	126
Figure 50 – Linear interpolation for one axis	127
Figure 51 – Input buffer organization	128
Figure 52 – Input buffer examples.....	128
Figure 53 – Interpolated position mode FSA	129
Figure 54 – Controlword for interpolated position mode	129
Figure 55 – Statusword for interpolated position mode	130
Figure 56 – Profile velocity mode	137
Figure 57 – Controlword for profile velocity mode	137
Figure 58 – Statusword for profile velocity mode	138
Figure 59 – Structure of the profile torque mode	144
Figure 60 – Controlword for profile torque mode	145
Figure 61 – Statusword for profile torque mode.....	145
Figure 62 – Velocity mode with all objects	153
Figure 63 – Velocity mode with mandatory objects only	153
Figure 64 – Velocity profile	154
Figure 65 – Factor function	154
Figure 66 – Reverse factor function	154
Figure 67 – Controlword for profile velocity mode	155
Figure 68 – Usage of controlword bits in velocity mode.....	155

Figure 69 – Statusword for profile velocity mode	156
Figure 70 – Transfer characteristic of vl velocity min max amount	158
Figure 71 – Transfer characteristic of the velocity deceleration	159
Figure 72 – Transfer characteristic of the velocity acceleration	161
Figure 73 – Transfer characteristic of the quick stop deceleration	162
Figure 74 – Cyclic synchronous position mode overview	166
Figure 75 – Cyclic synchronous position control function	167
Figure 76 – Statusword for profile cyclic synchronous position mode	167
Figure 77 – Cyclic synchronous velocity mode overview	170
Figure 78 – Cyclic synchronous velocity control function	171
Figure 79 – Statusword for profile cyclic synchronous velocity mode	172
Figure 80 – Cyclic synchronous torque mode overview	173
Figure 81 – Cyclic synchronous torque control function	173
Figure 82 – Statusword for profile cyclic synchronous torque mode	174
Figure 83 – Cyclic synchronous torque mode with commutation angle overview	174
Figure 84 – Cyclic synchronous torque with commutation angle control function	175
Figure 85 – Statusword for cstca mode	175
Figure 86 – Object structure	189
Figure 87 – Object structure	190
Figure 88 – Structure of the standard version parameter	191
Table 1 – List of used data types	30
Table 2 – Interpolation time period	30
Table 3 – Interpolation data configuration	31
Table 4 – vl velocity acceleration/deceleration	31
Table 5 – Object description	32
Table 6 – Entry description	32
Table 7 – Value definition	33
Table 8 – Object description	33
Table 9 – Entry description	33
Table 10 – Object description	34
Table 11 – Entry description	34
Table 12 – Object description	34
Table 13 – Entry description	34
Table 14 – Object description	35
Table 15 – Entry description	35
Table 16 – Object description	35
Table 17 – Entry description	35
Table 18 – Object description	36
Table 19 – Entry description	36
Table 20 – Object description	36
Table 21 – Entry description	36
Table 22 – Object description	37

Table 23 – Entry description	37
Table 24 – Error codes	38
Table 25 – FSA states and supported functions	43
Table 26 – Transition events and actions	44
Table 27 – Command coding	47
Table 28 – Object description	47
Table 29 – Entry description	47
Table 30 – State coding	48
Table 31 – Object description	49
Table 32 – Entry description	49
Table 33 – Object description	49
Table 34 – Entry description	50
Table 35 – Value definition	50
Table 36 – Object description	50
Table 37 – Entry description	50
Table 38 – Value definition	51
Table 39 – Object description	51
Table 40 – Entry description	51
Table 41 – Value definition	52
Table 42 – Object description	52
Table 43 – Entry description	52
Table 44 – Value definition	52
Table 45 – Object description	53
Table 46 – Entry description	53
Table 47 – Value definition	53
Table 48 – Object description	53
Table 49 – Entry description	54
Table 50 – Value definition	54
Table 51 – Object description	54
Table 52 – Entry description	54
Table 53 – Value definition	55
Table 54 – Object description	55
Table 55 – Entry description	55
Table 56 – Object description	56
Table 57 – Entry description	56
Table 58 – Object description	57
Table 59 – Entry description	57
Table 60 – Object description	60
Table 61 – Entry description	60
Table 62 – Object description	61
Table 63 – Entry description	61
Table 64 – Object description	62
Table 65 – Entry description	62

Table 66 – Object description	63
Table 67 – Entry description	63
Table 68 – Object description	64
Table 69 – Entry description	64
Table 70 – Object description	65
Table 71 – Entry description	65
Table 72 – Object description	66
Table 73 – Entry description	66
Table 74 – Object description	67
Table 75 – Entry description	67
Table 76 – Device profile specific units	67
Table 77 – Object description	68
Table 78 – Entry description	68
Table 79 – Object description	68
Table 80 – Entry description	69
Table 81 – Object description	69
Table 82 – Entry description	69
Table 83 – Object description	70
Table 84 – Entry description	70
Table 85 – Definition of bit 4, bit 5, and bit 9	76
Table 86 – Definition of bit 6 and bit 8	76
Table 87 – Definition of bit 10, bit 12, and bit 13	76
Table 88 – Object description	77
Table 89 – Entry description	77
Table 90 – Object description	77
Table 91 – Entry description	78
Table 92 – Object description	79
Table 93 – Entry description	80
Table 94 – Object description	80
Table 95 – Entry description	81
Table 96 – Object description	81
Table 97 – Entry description	81
Table 98 – Object description	82
Table 99 – Entry description	82
Table 100 – Object description	82
Table 101 – Entry description	82
Table 102 – Object description	83
Table 103 – Entry description	83
Table 104 – Object description	83
Table 105 – Entry description	83
Table 106 – Object description	84
Table 107 – Entry description	84
Table 108 – Value definition	84

Table 109 – Object description.....	84
Table 110 – Entry description	85
Table 111 – Object description.....	85
Table 112 – Entry description	85
Table 113 – Value assignments	86
Table 114 – Object description.....	86
Table 115 – Entry description	87
Table 116 – Object description.....	88
Table 117 – Entry description	88
Table 118 – Object description.....	88
Table 119 – Entry description	88
Table 120 – Definition of bit 4 and bit 8.....	94
Table 121 – Definition of bit 10, bit 12, and bit 13	94
Table 122 – Object description.....	95
Table 123 – Entry description	95
Table 124 – Value definition.....	96
Table 125 – Object description.....	96
Table 126 – Entry description	96
Table 127 – Object description.....	96
Table 128 – Entry description	97
Table 129 – Object description.....	98
Table 130 – Entry description	98
Table 131 – Object description.....	99
Table 132 – Entry description	99
Table 133 – Value definition.....	100
Table 134 – Object description.....	100
Table 135 – Entry description	101
Table 136 – Value definition.....	101
Table 137 – Object description.....	101
Table 138 – Entry description	102
Table 139 – Object description.....	102
Table 140 – Entry description	102
Table 141 – Object description.....	102
Table 142 – Entry description	103
Table 143 – Object description.....	103
Table 144 – Entry description	103
Table 145 – Object description.....	103
Table 146 – Entry description	104
Table 147 – Value definition.....	104
Table 148 – Object description.....	104
Table 149 – Entry description	105
Table 150 – Object description.....	106
Table 151 – Entry description	106

Table 152 – Object description.....	106
Table 153 – Entry description	106
Table 154 – Object description.....	107
Table 155 – Entry description	107
Table 156 – Object description.....	107
Table 157 – Entry description	107
Table 158 – Object description.....	108
Table 159 – Entry description	108
Table 160 – Object description.....	109
Table 161 – Entry description	109
Table 162 – Object description.....	109
Table 163 – Entry description	109
Table 164 – Object description.....	110
Table 165 – Entry description	110
Table 166 – Explanation of the timing diagram.....	112
Table 167 – Object description.....	115
Table 168 – Entry description	115
Table 169 – Object description.....	115
Table 170 – Entry description	115
Table 171 – Object description.....	116
Table 172 – Entry description	116
Table 173 – Object description.....	116
Table 174 – Entry description	116
Table 175 – Object description.....	117
Table 176 – Entry description	117
Table 177 – Object description.....	117
Table 178 – Entry description	118
Table 179 – Object description.....	118
Table 180 – Entry description	118
Table 181 – Object description.....	118
Table 182 – Entry description	119
Table 183 – Object description.....	119
Table 184 – Entry description	119
Table 185 – Object description.....	120
Table 186 – Entry description	120
Table 187 – Value definition for bit 0 and bit 1	120
Table 188 – Value definition for bit 2 and bit 3	121
Table 189 – Value definition for bit 4 and bit 5	121
Table 190 – Value definition for bit 6 and bit 7	121
Table 191 – Object description.....	123
Table 192 – Entry description	123
Table 193 – Position calculation in interpolated position mode for several axes	126
Table 194 – FSA states and supported functions	129

Table 195 – Transition events and actions	129
Table 196 – Definition of bit 4 and bit 8	130
Table 197 – Definition of bit 10 and bit 12	130
Table 198 – Value definition	130
Table 199 – Object description	131
Table 200 – Entry description	131
Table 201 – Object description	131
Table 202 – Entry description	132
Table 203 – Object description	133
Table 204 – Entry description	133
Table 205 – Object description	134
Table 206 – Entry description	135
Table 207 – Definition of bit 8	138
Table 208 – Definition of bit 10, bit 12, and bit 13	138
Table 209 – Object description	138
Table 210 – Entry description	139
Table 211 – Value definition	139
Table 212 – Object description	139
Table 213 – Entry description	139
Table 214 – Object description	140
Table 215 – Entry description	140
Table 216 – Object description	140
Table 217 – Entry description	140
Table 218 – Object description	141
Table 219 – Entry description	141
Table 220 – Object description	141
Table 221 – Entry description	141
Table 222 – Object description	142
Table 223 – Entry description	142
Table 224 – Object description	142
Table 225 – Entry description	142
Table 226 – Object description	143
Table 227 – Entry description	143
Table 228 – Object description	143
Table 229 – Entry description	143
Table 230 – Definition of bit 8	145
Table 231 – Definition of bit 10	145
Table 232 – Object description	146
Table 233 – Entry description	146
Table 234 – Object description	146
Table 235 – Entry description	146
Table 236 – Object description	147
Table 237 – Entry description	147

Table 238 – Object description.....	147
Table 239 – Entry description	147
Table 240 – Object description.....	148
Table 241 – Entry description	148
Table 242 – Object description.....	148
Table 243 – Entry description	148
Table 244 – Object description.....	149
Table 245 – Entry description	149
Table 246 – Object description.....	149
Table 247 – Entry description	150
Table 248 – Object description.....	150
Table 249 – Entry description	150
Table 250 – Object description.....	150
Table 251 – Entry description	151
Table 252 – Object description.....	151
Table 253 – Entry description	151
Table 254 – Object description.....	151
Table 255 – Entry description	152
Table 256 – Value definition.....	152
Table 257 – Object description.....	152
Table 258 – Entry description	152
Table 259 – Definition of bit 4, bit 5, bit 6, and bit 8	155
Table 260 – Object description.....	156
Table 261 – Entry description	156
Table 262 – Object description.....	157
Table 263 – Entry description	157
Table 264 – Object description.....	157
Table 265 – Entry description	157
Table 266 – Object description.....	158
Table 267 – Entry description	159
Table 268 – Object description.....	160
Table 269 – Entry description	160
Table 270 – Object description.....	161
Table 271 – Entry description	162
Table 272 – Object description.....	163
Table 273 – Entry description	163
Table 274 – Object description.....	164
Table 275 – Entry description	164
Table 276 – Object description.....	165
Table 277 – Entry description	165
Table 278 – Definition of bit 10, bit 12, and bit 13	168
Table 279 – Object description.....	168
Table 280 – Entry description	168

Table 281 – Object description.....	169
Table 282 – Entry description	169
Table 283 – Object description.....	169
Table 284 – Entry description	170
Table 285 – Definition of bit 10, bit 12, and bit 13	172
Table 286 – Definition of bit 10, bit 12, and bit 13	174
Table 287 – Definition of bit 10, bit 12, and bit 13	176
Table 288 – Object description.....	176
Table 289 – Entry description	176
Table 290 – Object description.....	177
Table 291 – Entry description	178
Table 292 – Object description.....	179
Table 293 – Entry description	179
Table 294 – Object description.....	180
Table 295 – Entry description	180
Table 296 – Object description.....	181
Table 297 – Entry description	181
Table 298 – Object description.....	182
Table 299 – Entry description	183
Table 300 – Object description.....	184
Table 301 – Entry description	184
Table 302 – Object description.....	185
Table 303 – Entry description	185
Table 304 – Object description.....	186
Table 305 – Entry description	186
Table 306 – Object description.....	187
Table 307 – Entry description	187
Table 308 – Object description.....	188
Table 309 – Entry description	188
Table 310 – Value definition.....	189
Table 311 – Object description.....	189
Table 312 – Entry description	190
Table 313 – Value definition.....	190
Table 314 – Object description.....	190
Table 315 – Entry description	191
Table 316 – Object description.....	192
Table 317 – Entry description	192

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –**Part 7-201: Generic interface and use of profiles
for power drive systems – Profile type 1 specification**

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The International Standard IEC 61800-7-201 has been prepared by subcommittee SC 22G: Adjustable speed electric drive systems incorporating semiconductor power converters, of IEC technical committee TC 22: Power electronic systems and equipment.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- Updates, clarifications and enhancements.

The text of this standard is based on the following documents:

FDIS	Report on voting
22G/307/FDIS	22G/322/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61800 series, under the general title *Adjustable speed electrical power drive systems*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The IEC 61800 series is intended to provide a common set of specifications for adjustable speed electrical power drive systems.

IEC 61800-7 specifies profiles for power drive systems (PDS) and their mapping to existing communication systems by use of a generic interface model.

IEC 61800-7 describes a generic interface between control systems and power drive systems. This interface can be embedded in the control system. The control system itself can also be located in the drive (sometimes known as "smart drive" or "intelligent drive").

A variety of physical interfaces is available (analogue and digital inputs and outputs, serial and parallel interfaces, fieldbuses and networks). Profiles based on specific physical interfaces are already defined for some application areas (e.g. motion control) and some device classes (e.g. standard drives, positioner). The implementations of the associated drivers and application programmers interfaces are proprietary and vary widely.

IEC 61800-7 defines a set of common drive control functions, parameters, and state machines or description of sequences of operation to be mapped to the drive profiles.

IEC 61800-7 provides a way to access functions and data of a drive that is independent of the used drive profile and communication interface. The objective is a common drive model with generic functions and objects suitable to be mapped on different communication interfaces. This makes it possible to provide common implementations of motion control (or velocity control or drive control applications) in controllers without any specific knowledge of the drive implementation.

There are several reasons to define a generic interface:

For a drive device manufacturer

- less effort to support system integrators;
- less effort to describe drive functions because of common terminology;
- the selection of drives does not depend on availability of specific support;

For a control device manufacturer

- no influence of bus technology;
- easy device integration;
- independent of a drive supplier;

For a system integrator

- less integration effort for devices;
- only one understandable way of modeling;
- independent of bus technology,

Much effort is needed to design a motion control application with several different drives and a specific control system. The tasks to implement the system software and to understand the functional description of the individual components may exhaust the project resources. In some cases, the drives do not share the same physical interface. Some control devices just support a single interface which will not be supported by a specific drive. On the other hand, the functions and data structures are often specified with incompatibilities. This requires the system integrator to write special interfaces for the application software and this should not be his responsibility.

Some applications need device exchangeability or integration of new devices in an existing configuration. They are faced with different incompatible solutions. The efforts to adapt a solution to a drive profile and to manufacturer-specific extensions may be unacceptable. This will reduce the degree of freedom to select a device best suited for this application to the selection of the unit which will be available for a specific physical interface and supported by the controller.

IEC 61800-7-1 is divided into a generic part and several annexes as shown in Figure 1. The drive profiles types for CiA® 402¹, CIP Motion™², PROFIdrive³ and SERCOS®⁴ are mapped to the generic interface in the corresponding annex. The annexes have been submitted by open international network or fieldbus organizations which are responsible for the content of the related annex and use of the related trade marks.

This part of IEC 61800-7 specifies the profile type 1 (CiA® 402).

The profile types 2, 3 and 4 are specified in IEC 61800-7-202, IEC 61800-7-203 and IEC 61800-7-204.

-
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IEC 61800-7-301, IEC 61800-7-302, IEC 61800-7-303 and IEC 61800-7-304 specify how the profile types 1, 2, 3 and 4 are mapped to different network technologies (such as CANopen®⁵, CC-Link IE® Field Network⁶, EPA™⁷, EtherCAT®⁸, Ethernet Powerlink™⁹, DeviceNet™¹⁰, ControlNet™¹¹, EtherNet/IP™¹², PROFIBUS¹³, PROFINET¹⁴ and SERCOS®).

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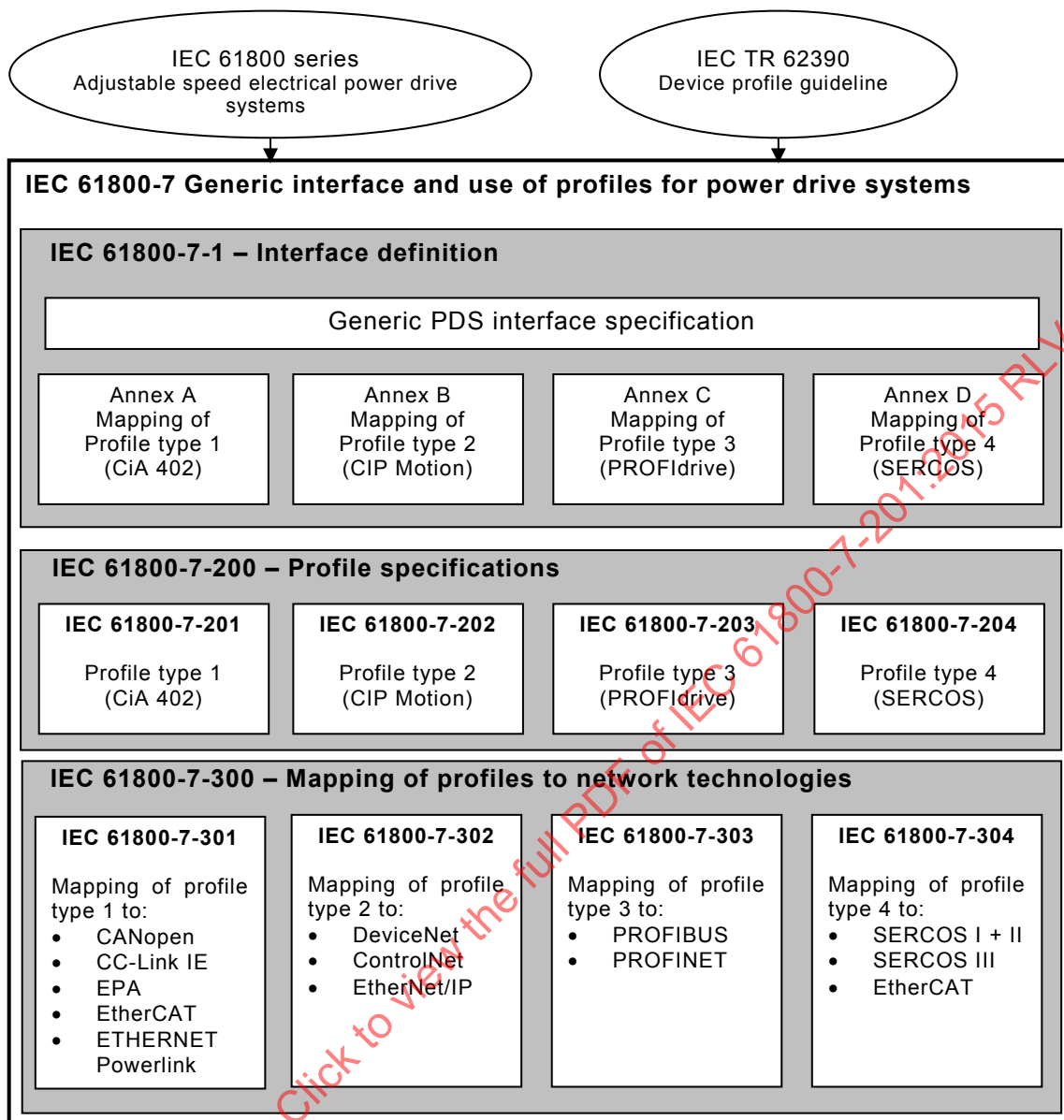


Figure 1 – Structure of IEC 61800-7

IEC

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 7-201: Generic interface and use of profiles for power drive systems – Profile type 1 specification

1 Scope

This part of IEC 61800 specifies profile type 1 for power drive systems (PDS). Profile type 1 can be mapped onto different communication network technologies.

The functions specified in this part of IEC 61800 are not intended to ensure functional safety. This requires additional measures according to the relevant standards, agreements and laws.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61800-7-301¹⁵, *Adjustable speed electrical power drive systems – Part 7-301: Generic interface and use of profiles for power drive systems – Mapping of profile type 1 to network technologies*

EN 50325-4, *Industrial communications subsystem based on ISO 11898 (CAN) for controller-device interfaces – Part 4: CANopen*

CiA 303-2:2012, *CANopen recommendation – Part 2: Representation of SI units and prefixes*¹⁶

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1

actual value

value of a variable quantity at a given instant

Note 1 to entry: Actual value is used in this document as input data of the application control program to monitor variables of the PDS (e.g. feedback variables).

[SOURCE: IEC 61800-7-1:2015, 3.3.1.1]

¹⁵ To be published.

¹⁶ CiA 303-2 may be freely downloaded from www.can-cia.org. To avoid download misuse, the downloading person has to fill in a registration form, which does not arise some obligations to the specification user.

3.1.2

algorithm

completely determined finite sequence of operations by which the values of the output data can be calculated from the values of the input data

[SOURCE: IEC 61800-7-1:2015, 3.2.1]

3.1.3

application

software functional element specific to the solution of a problem in industrial-process measurement and control

Note 1 to entry: An application may be distributed among resources, and may communicate with other applications.

[SOURCE: IEC 61800-7-1:2015, 3.2.2]

3.1.4

application mode

type of application that can be requested from a PDS

Note 1 to entry: The different application modes reflect the control loop for torque control, velocity control, position control or other applications such as homing.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.2]

3.1.5

attribute

property or characteristic of an entity

[SOURCE: IEC 61800-7-1:2015, 3.2.3]

3.1.6

class

description of a set of objects that share the same attributes, operations, methods, relationships, and semantics

[SOURCE: IEC 61800-7-1:2015, 3.2.5]

3.1.7

commands

set of commands from the application control program to the PDS to control the behavior of the PDS or functional elements of the PDS

Note 1 to entry: The behavior is reflected by states or operating modes.

Note 2 to entry: The different commands may be represented by one bit each.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.3]

3.1.8

control

purposeful action on or in a process to meet specified objectives

[SOURCE: IEC 61800-7-1:2015, 3.2.6]

3.1.9**control device**

physical unit that contains – in a module/subassembly or device – an application program to control the PDS

[SOURCE: IEC 61800-7-1:2015, 3.2.7]

3.1.10**data type**

set of values together with a set of permitted operations

[SOURCE: IEC 61800-7-1:2015, 3.2.8]

3.1.11**device**

field device

<function blocks> networked independent physical entity of an industrial automation system capable of performing specified functions in a particular context and delimited by its interfaces

[SOURCE: IEC 61800-7-1:2015, 3.2.9]

3.1.12**device profile**

representation of a device in terms of its parameters, parameter assemblies and behaviour according to a device model that describes the data and behaviour of the device as viewed through a network, independent from any network technology

[SOURCE: IEC 61800-7-1:2015, 3.2.11]

3.1.13**feedback variable**

variable quantity, which represents the controlled variable and is returned to the comparing element

[SOURCE: IEC 61800-7-1:2015, 3.2.12]

3.1.14**functional element**

entity of software or software combined with hardware, capable of accomplishing a specified function of a device

Note 1 to entry: A functional element has an interface, associations to other functional elements and functions.

Note 2 to entry: A functional element can be made out of function block(s), object(s) or parameter list(s).

[SOURCE: IEC 61800-7-1:2015, 3.2.13]

3.1.15**high-level power**

main electric power supply of the drive device

3.1.16**input data**

data transferred from an external source into a device, resource or functional element

[SOURCE: IEC 61800-7-1:2015, 3.2.14]

3.1.17

interface

shared boundary between two entities defined by functional characteristics, signal characteristics, or other characteristics as appropriate

[SOURCE: IEC 61800-7-1:2015, 3.2.15]

3.1.18

logical power drive system

model which includes PDS and communication network accessible through the generic PDS interface

[SOURCE: IEC 61800-7-1:2015, 3.2.16]

3.1.19

low-level power

electrical power supply for the control section of the drive device

3.1.20

model

mathematical or physical representation of a system or a process, based with sufficient precision upon known laws, identification or specified suppositions

[SOURCE: IEC 61800-7-1:2015, 3.2.17]

3.1.21

operating mode

characterization of the way and the extent to which the human operator intervenes in the control equipment

[SOURCE: IEC 61800-7-1:2015, 3.2.18]

3.1.22

output data

data originating in a device, resource or functional element and transferred from them to external systems

[SOURCE: IEC 61800-7-1:2015, 3.2.19]

3.1.23

parameter

data element that represents device information that can be read from or written to a device, for example through the network or a local HMI

Note 1 to entry: A parameter is typically characterized by a parameter name, data type and access direction.

[SOURCE: IEC 61800-7-1:2015, 3.2.20]

3.1.24

profile

representation of a PDS interface in terms of its parameters, parameter assemblies and behavior according to a communication profile and a device profile

[SOURCE: IEC 61800-7-1:2015, 3.2.21, modified — Note 1 to entry is deleted.]

3.1.25**reference variable**

input variable to a comparing element in a controlling system which sets the desired value of the controlled variable and is deducted from the command variable

[SOURCE: IEC 61800-7-1:2015, 3.2.22]

3.1.26**set-point**

value or variable used as output data of the application control program to control the PDS

[SOURCE: IEC 61800-7-1:2015, 3.3.1.5]

3.1.27**status**

set of information from the PDS to the application control program reflecting the state or mode of the PDS or a functional element of the PDS

Note 1 to entry: The different status information may be coded with one bit each.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.6]

3.1.28**type**

hardware or software element which specifies the common attributes shared by all instances of the type

[SOURCE: IEC 61800-7-1:2015, 3.2.23]

3.1.29**use case**

class specification of a sequence of actions, including variants, that a system (or other entity) can perform, interacting with actors of the system

[SOURCE: IEC 61800-7-1:2015, 3.2.24]

3.1.30**variable**

software entity that may take different values, one at a time

Note 1 to entry: The values of a variable as well as of a parameter are usually restricted to a certain data type.

[SOURCE: IEC 61800-7-1:2015, 3.2.25]

3.2 Abbreviated terms

AC	alternating current
BL	brush-less
c	constant
CiA	CAN in Automation
COB	communication object
csp	cyclic synchronous profile mode
cst	cyclic synchronous torque mode
cstca	cyclic synchronous torque mode with commutation angle
csv	cyclic synchronous velocity mode
DC	direct current

DIV	divisor
FC	frequency converter
FE	functional element
FIFO	first In, first out
FSA	finite state automaton
hm	homing mode
HMI	human machine interface
I/O	input/output
ip	interpolated position mode
LSB	less significant bit/byte
MSB	most significant bit/byte
MUL	multiplication
NMT	network management
PDO	process data object
PDS	power drive system
PM	permanent magnet
pp	profile position mode
pv	profile velocity mode
r	reserved
r.m.s.	root mean square
ro	read-only
rw	read-write
tq	torque mode
vl	velocity mode

4 General

4.1 General considerations

This part of the IEC 61800-7 series specifies the bus-independent CiA 402 device profile for power drive systems such as frequency converters, servo controllers, or stepper motor controllers. It includes the definition of real-time control objects as well as of configuration, adjustment, identification and network management objects. The PDS finite state automaton (FSA) is also defined, which may be controlled externally by a control device communicating via a communication system to the drive device.

The device profile defines several modes of operation. They include profile position mode, homing mode, interpolated position mode, profile velocity mode, profile torque mode, velocity mode, cyclic synchronous position mode, cyclic synchronous velocity mode, and cyclic synchronous torque mode.

4.2 Communication interface

The communication system connects the drive device to the control device and other field devices. Via the communication system the control device uses communication services to exchange with the drive device:

- non real-time data (configuration, identification, adjustment, diagnostic, etc.);
- process data such as target values and actual values.

These services are defined in the IEC 61800-7-301. The process data are exchanged by real-time data messages. These messages may be configured by means of configuration services provided by the communication system.

The communication system shall provide services to transmit and receive communication objects (COB). The following COBs shall be supported:

- COB for real-time data transmission;
- COB for emergency information transmission;
- COB for network management purposes.

Additionally, the communication system may provide the following COBs:

- COB for configuration data transmission;
- COB for synchronization purposes;
- COB for system time distribution.

The COBs are defined in detail in IEC 61800-7-301.

4.3 Object dictionary

All objects in this part of the IEC 61800-7 series are grouped in the object dictionary, and defined by attributes as defined in EN 50325-4. All objects shall be accessible via the network in an ordered pre-defined fashion by means of COB for configuration data transmission. Each object within the dictionary shall be addressed uniquely by using a 16-bit index and an 8-bit sub-index. The communication-related objects are defined in detail in EN 50325-4 and IEC 61800-7-301.

The standardized device profile area at indices 6000_h through 9FFF_h shall contain all application objects common to this device profile specification. The following object indices shall be reserved for compatibility reasons: 6045_h, 6047_h, 604D_h, 604E_h, 604F_h, 6052_h, 6053_h, 6054_h, 6055_h, 6056_h, 6057_h, 6058_h, 6059_h, 6089_h, 608A_h, 608B_h, 608C_h, 608D_h, 608E_h, 6093_h, 6094_h, 6095_h, 6096_h, 6097_h, 60A0_h, 60A1_h, 60A2_h, 60F6_h, 60F7_h, 60F9_h, 60FB_h, 6410_h, 6504_h, and 6510_h. The following object indices range shall be reserved for compatibility reasons with other standards: from 6200_h to 62FF_h and from 6600_h to 67EF_h.

The objects may be read, respectively written via the network. Within this range of objects, up to 8 axes may be realized. Additionally, it is possible to implement other device profiles (e. g. generic I/O module or encoder) within the drive device. These other device profiles may be implemented instead of one or several axes.

For multi axes devices, the object range 6000_h to 67FF_h shall be shifted as follows:

- 6000_h to 67FF_h: axis 0
- 6800_h to 6FFF_h: axis 1
- 7000_h to 77FF_h: axis 2
- 7800_h to 7FFF_h: axis 3
- 8000_h to 87FF_h: axis 4
- 8800_h to 8FFF_h: axis 5
- 9000_h to 97FF_h: axis 6
- 9800_h to 9FFF_h: axis 7

The category and entry category attributes of an object indicate if the object shall be implemented (mandatory) or may be implemented (optional).

The object code and data type attributes are defined in detail in EN 50325-4 or in other network technology specifications. The used data type attributes are given in Clause 5. In the entry description, the access attribute indicating if an application object is read only (ro), read/write (rw) or write only (wo) or constant (c) is defined. Read only indicates that this shall not be written via the bus; read/write allows to read and to write this object; and write only means that this application object shall be not read via the bus.

The PDO mapping attribute shall indicate if this object shall be or may be or shall not be mapped into COB for real-time data transmission. The detailed definition of these attributes is given in IEC 61800-7-301.

The default value attribute defines the value of an object with access attribute of the value 'rw' and 'c' after power-on or application reset.

5 Data types

5.1 Standard data types

The data types used in this profile are listed in Table 1.

Table 1 – List of used data types

Data type	Reference
Unsigned8	EN 50325-4
Unsigned16	EN 50325-4
Unsigned32	EN 50325-4
Integer8	EN 50325-4
Integer16	EN 50325-4
Integer32	EN 50325-4
Visible string	EN 50325-4
Time of day	EN 50325-4
Interpolation time period	See Table 2
Interpolation data configuration	See Table 3
vI velocity acceleration/deceleration	See Table 4

5.2 Record definitions

Table 2, Table 3, and Table 4 define the records used in this part of the IEC 61800-7 series.

Table 2 – Interpolation time period

Index	Sub-index	Description	Data type
0080 _h	00 _h	Highest sub-index supported	Unsigned8
	01 _h	Interpolation time units	Unsigned8
	02 _h	Interpolation time index	Integer8

Table 3 – Interpolation data configuration

Index	Sub-index	Description	Data type
0081 _h	00 _h	Highest sub-index supported	Unsigned8
	01 _h	Maximum buffer size	Unsigned32
	02 _h	Actual buffer size	Unsigned32
	03 _h	Buffer organisation	Unsigned8
	04 _h	Buffer position	Unsigned16
	05 _h	Size of data record	Unsigned8
	06 _h	Buffer clear	Unsigned8

Table 4 – vl velocity acceleration/deceleration

Index	Sub-index	Description	Data type
0082 _h	00 _h	Highest sub-index supported	Unsigned8
	01 _h	Delta speed	Unsigned32
	02 _h	Delta time	Integer16

6 General object definitions

6.1 General

In the following subclauses, the communication parameter objects, the additional identification and the information objects are defined.

6.2 Communication parameter objects

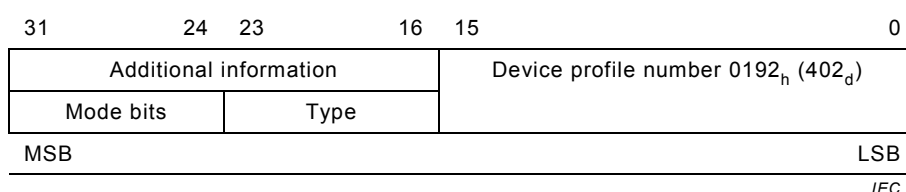
There are three communication parameter objects that shall be implemented:

- Device type object 1000_h
- Error register object 1001_h
- Identity object 1018_h

They are defined in EN 50325-4 and the following definitions shall also apply.

The device type object shall define the device type, the device's functionality, and the mapping variant.

For multi device modules, the additional information parameter shall contain 0FFF_h and the device profile number referenced by object 1000_h is the device profile of the first device in the object dictionary. All other devices of a multiple device module shall identify their profiles at object 67FF_h + x × 800_h with x = internal number of the device (0 to 7). For details, see EN 50325-4. Figure 2 specifies the structure and the values of the device type object, Table 5 specifies the object description, and Table 6 specifies the entry description.

**Figure 2 – Value definition**

Mode bits and type in the additional information are defined in IEC 61800-7-301.

Table 5 – Object description

Attribute	Value
Index	1000 _h
Name	Device type
Object code	See EN 50325-4
Data type	See EN 50325-4
Category	Mandatory

Table 6 – Entry description

Attribute	Value
Sub-index	00 _h
Access	c
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	Manufacturer-specific

The device-profile specific bit in the error register object (1001_h) shall be used to indicate that the error code in the Emergency message is defined in this part of the IEC 61800-7 series.

The corresponding error code is readable in object 1003_h (see EN 50325-4) or object 603F_h.

6.3 Additional identification and information objects

6.3.1 Object 6402_h: Motor type

This object shall indicate the type of motor attached to and driven by the drive device. Table 7 specifies the value definition, Table 8 specifies the object description, and Table 9 specifies the entry description.

Table 7 – Value definition

Value	CANopen name	Other names
0000 _h	Non-standard motor	–
0001 _h	Phase modulated DC motor	–
0002 _h	Frequency controlled DC motor	–
0003 _h	PM synchronous motor	–
0004 _h	FC synchronous motor	AC synchronous sinewave wound field
0005 _h	Switched reluctance motor	AC synchronous reluctance switched
0006 _h	Wound rotor induction motor	AC asynchronous induction polyphase wound rotor
0007 _h	Squirrel cage induction motor	AC asynchronous induction squirrel cage
0008 _h	Stepper motor	AC synchronous step
0009 _h	Micro-step stepper motor	–
000A _h	Sinusoidal PM BL motor	AC synchronous sinusoidal PM
000B _h	Trapezoidal PM BL motor	AC synchronous brushless PM trapezoidal
000C _h	AC synchronous reluctance sync	–
000D _h	DC commutator PM	–
000E _h	DC commutator wound field series	–
000F _h	DC commutator wound field shunt	–
0010 _h	DC commutator wound field compound	–
0011 _h to 7FFE _h	Reserved	–
7FFF _h	No motor type assigned	–
8000 _h to FFFF _h	Manufacturer-specific	–

Table 8 – Object description

Attribute	Value
Index	6402 _h
Name	Motor type
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 9 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 7
Default value	Manufacturer-specific

6.3.2 Object 6403_h: Motor catalogue number

This object shall indicate the motor catalogue number (nameplate number) provided by the motor manufacturer. If the number is not assigned yet, this object shall indicate this by /0

(empty string). Table 10 specifies the object description, and Table 11 specifies the entry description.

Table 10 – Object description

Attribute	Value
Index	6403 _h
Name	Motor catalogue number
Object code	Variable
Data type	Visible string
Category	Optional

Table 11 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Visible string
Default value	Manufacturer-specific

6.3.3 Object 6404_h: Motor manufacturer

This object shall indicate the name of the motor manufacturer. If the name is not assigned yet, this object shall indicate this by /0 (empty string). Table 12 specifies the object description, and Table 13 specifies the entry description.

Table 12 – Object description

Attribute	Value
Index	6404 _h
Name	Motor manufacturer
Object code	Variable
Data type	Visible string
Category	Optional

Table 13 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Visible string
Default value	Manufacturer-specific

6.3.4 Object 6405_h: http motor catalogue address

This object shall indicate the assigned web-address of the motor catalogue. If the address is not assigned yet, this object shall indicate this by /0 (empty string). Table 14 specifies the object description, and Table 15 specifies the entry description.

Table 14 – Object description

Attribute	Value
Index	6405 _h
Name	http motor catalogue address
Object code	Variable
Data type	Visible string
Category	Optional

Table 15 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Visible string
Default value	Manufacturer-specific

6.3.5 Object 6406_h: Motor calibration date

This object shall indicate the assigned date of the last motor inspection. If the date is not assigned yet, this object shall indicate this by a value of 0. Table 16 specifies the object description, and Table 17 specifies the entry description.

Table 16 – Object description

Attribute	Value
Index	6406 _h
Name	Motor calibration date
Object code	Variable
Data type	Time of day
Category	Optional

Table 17 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	0 _d or Time of day
Default value	Manufacturer-specific

6.3.6 Object 6407_h: Motor service period

This object shall indicate the assigned motor service period. If the period is not assigned yet, this object shall indicate this by 0000 0000_h. The value shall be given in multiples of hours. Table 18 specifies the object description, and Table 19 specifies the entry description.

Table 18 – Object description

Attribute	Value
Index	6407 _h
Name	Motor service period
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 19 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

6.3.7 Object 6503_h: Drive catalogue number

This object shall indicate the assigned manufacturer's drive catalogue number (nameplate number). Table 20 specifies the object description, and Table 21 specifies the entry description.

Table 20 – Object description

Attribute	Value
Index	6503 _h
Name	Drive catalogue number
Object code	Variable
Data type	Visible string
Category	Optional

Table 21 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	No
Default value	Manufacturer-specific

6.3.8 Object 6505_h: http drive catalogue address

This object shall indicate the assigned web address of the drive manufacturer. If the address is not assigned yet, this object shall indicate this by /0 (empty string). Table 22 specifies the object description, and Table 23 specifies the entry description.

Table 22 – Object description

Attribute	Value
Index	6505 _h
Name	http drive catalogue address
Object code	Variable
Data type	Visible string
Category	Optional

Table 23 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	No
Default value	Manufacturer-specific

7 Error codes and error behavior

7.1 Error codes

Emergency messages are triggered by internal errors and severe warnings detected within the drive device. They are defined in detail in the IEC 61800-7-301. They shall contain the 16-bit error code. Error codes from xx00_h to xx7F_h are defined in EN 50325-4 or in Table 24. Error codes between xx80_h and xxFF_h are used manufacturer-specific.

Table 24 – Error codes

Error code	Meaning
2110 _h	Short circuit/earth leakage (input)
2120 _h	Earth leakage (input)
2121 _h	Earth leakage phase L1
2122 _h	Earth leakage phase L2
2123 _h	Earth leakage phase L3
2130 _h	Short circuit (input)
2131 _h	Short circuit phases L1-L2
2132 _h	Short circuit phases L2-L3
2133 _h	Short circuit phases L3-L1
2211 _h	Internal current no.1
2212 _h	Internal current no.2
2213 _h	Over-current in ramp function
2214 _h	Over-current in the sequence
2220 _h	Continuous over current (device internal)
2221 _h	Continuous over current no.1
2222 _h	Continuous over current no.2
2230 _h	Short circuit/earth leakage (device internal)
2240 _h	Earth leakage (device internal)
2250 _h	Short circuit (device internal)
2310 _h	Continuous over current (device output side)
2311 _h	Continuous over current no.1
2312 _h	Continuous over current no.2
2320 _h	Short circuit/earth leakage (motor-side)
2330 _h	Earth leakage (motor-side)
2331 _h	Earth leakage phase U
2332 _h	Earth leakage phase V
2333 _h	Earth leakage phase W
2340 _h	Short circuit (motor-side)
2341 _h	Short circuit phases U-V
2342 _h	Earth leakage phase V-W
2343 _h	Earth leakage phase W-U
2350 _h	Load level fault (I ² t, thermal state)
2351 _h	Load level warning (I ² t, thermal state)
3110 _h	Mains over-voltage
3111 _h	Mains over-voltage phase L1
3112 _h	Mains over-voltage phase L2
3113 _h	Mains over-voltage phase L3
3120 _h	Mains under-voltage
3121 _h	Mains under-voltage phase L1
3122 _h	Mains under-voltage phase L2
3123 _h	Mains under-voltage phase L3
3130 _h	Phase failure
3131 _h	Phase failure L1

Error code	Meaning
3132 _h	Phase failure L2
3133 _h	Phase failure L3
3134 _h	Phase sequence
3140 _h	Mains frequency
3141 _h	Mains frequency too great
3142 _h	Mains frequency too small
3210 _h	DC link over-voltage
3211 _h	Over-voltage no. 1
3212 _h	Over voltage no. 2
3220 _h	DC link under-voltage
3221 _h	Under-voltage no. 1
3222 _h	Under-voltage no. 2
3230 _h	Load error
3310 _h	Output over-voltage
3311 _h	Output over-voltage phase U
3312 _h	Output over-voltage phase V
3313 _h	Output over-voltage phase W
3320 _h	Armature circuit
3321 _h	Armature circuit interrupted
3330 _h	Field circuit
3331 _h	Field circuit interrupted
4110 _h	Excess ambient temperature
4120 _h	Too low ambient temperature
4130 _h	Temperature supply air
4140 _h	Temperature air outlet
4210 _h	Excess temperature device
4220 _h	Too low temperature device
4300 _h	Temperature drive
4310 _h	Excess temperature drive
4320 _h	Too low temperature drive
4400 _h	Temperature supply
4410 _h	Excess temperature supply
4420 _h	Too low temperature supply
5100 _h	Supply device hardware
5110 _h	Supply low voltage
5111 _h	U1 = supply $\pm 15V$
5112 _h	U2 = supply +24 V
5113 _h	U3 = supply +5 V
5114 _h	U4 = manufacturer-specific
5115 _h	U5 = manufacturer-specific
5116 _h	U6 = manufacturer-specific
5117 _h	U7 = manufacturer-specific
5118 _h	U8 = manufacturer-specific
5119 _h	U9 = manufacturer-specific

Error code	Meaning
5120 _h	Supply intermediate circuit
5200 _h	Control
5210 _h	Measurement circuit
5220 _h	Computing circuit
5300 _h	Operating unit
5400 _h	Power section
5410 _h	Output stages
5420 _h	Chopper
5430 _h	Input stages
5440 _h	Contacts
5441 _h	Contact 1 = manufacturer-specific
5442 _h	Contact 2 = manufacturer-specific
5443 _h	Contact 3 = manufacturer-specific
5444 _h	Contact 4 = manufacturer-specific
5445 _h	Contact 5 = manufacturer-specific
5450 _h	Fuses
5451 _h	S1 = I1
5452 _h	S2 = I2
5453 _h	S3 = I3
5454 _h	S4 = manufacturer-specific
5455 _h	S5 = manufacturer-specific
5456 _h	S6 = manufacturer-specific
5457 _h	S7 = manufacturer-specific
5458 _h	S8 = manufacturer-specific
5459 _h	S9 = manufacturer-specific
5500 _h	Hardware memory
5510 _h	RAM
5520 _h	ROM/EPROM
5530 _h	EEPROM
6010 _h	Software reset (watchdog)
6301 _h to 630F _h	Data record no. 1 to no. 15
6310 _h	Loss of parameters
6320 _h	Parameter error
7100 _h	Power additional modules
7110 _h	Brake chopper
7111 _h	Failure brake chopper
7112 _h	Over current brake chopper
7113 _h	Protective circuit brake chopper
7120 _h	Motor
7121 _h	Motor blocked
7122 _h	Motor error or commutation malfunc.
7123 _h	Motor tilted
7200 _h	Measurement circuit
7300 _h	Sensor

Error code	Meaning
7301 _h	Tacho fault
7302 _h	Tacho wrong polarity
7303 _h	Resolver 1 fault
7304 _h	Resolver 2 fault
7305 _h	Incremental sensor 1 fault
7306 _h	Incremental sensor 2 fault
7307 _h	Incremental sensor 3 fault
7310 _h	Speed
7320 _h	Position
7400 _h	Computation circuit
7500 _h	Communication
7510 _h	Serial interface no. 1
7520 _h	Serial interface no. 2
7600 _h	Data storage (external)
8300 _h	Torque control
8311 _h	Excess torque
8312 _h	Difficult start up
8313 _h	Standstill torque
8321 _h	Insufficient torque
8331 _h	Torque fault
8400 _h	Velocity speed controller
8500 _h	Position controller
8600 _h	Positioning controller
8611 _h	Following error
8612 _h	Reference limit
8613 _h	Homing Error
8700 _h	Sync controller
8800 _h	Winding controller
8900 _h	Process data monitoring
8A00 _h	Control monitoring
F001 _h	Deceleration
F002 _h	Sub-synchronous run
F003 _h	Stroke operation
F004 _h	Control additional functions
FF00 _h to FFFF _h	Manufacturer-specific

7.2 Error behavior

The communication system may support an object specifying to which network management state the drive device shall transit, when a communication error or a severe device-internal error is detected. When the PDS FSA transits into error (fault or fault reaction active) state, this shall be regarded as a severe device-internal failure.

8 Controlling the power drive system

8.1 General

The PDS FSA is an abstraction to define the behavior of a black box as a control device experiences the PDS. It defines the application behavior of the PDS. Due to the requirement that a PDS provides local control even when the communication network is not working properly, the communication FSA as defined in the communication system mapping specifications and the PDS FSA are only loosely coupled.

Figure 3 specifies how the PDS may be operated locally or via the network remotely. The PDS is operated by local signals (not in the scope of this part of IEC 61800) and by the controlword sent by the control device via the network. The state of the PDS is reported by the statusword produced by the drive device. The FSA is also controlled by error detection signals.

The PDS FSA defines the PDS status and the possible control sequence of the PDS. A single state represents a special internal or external behavior. The state of the PDS also determines which commands are accepted. For example, it is only possible to start a point-to-point move when the drive is in the operation enabled state.

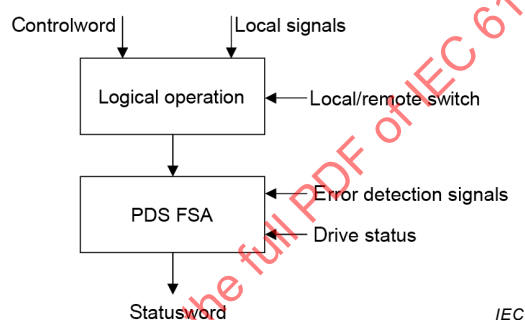


Figure 3 – Remote and local control

8.2 Finite state automaton

Figure 4 specifies the PDS FSA with respect to control of the power electronics as a result of user commands and internal drive faults.

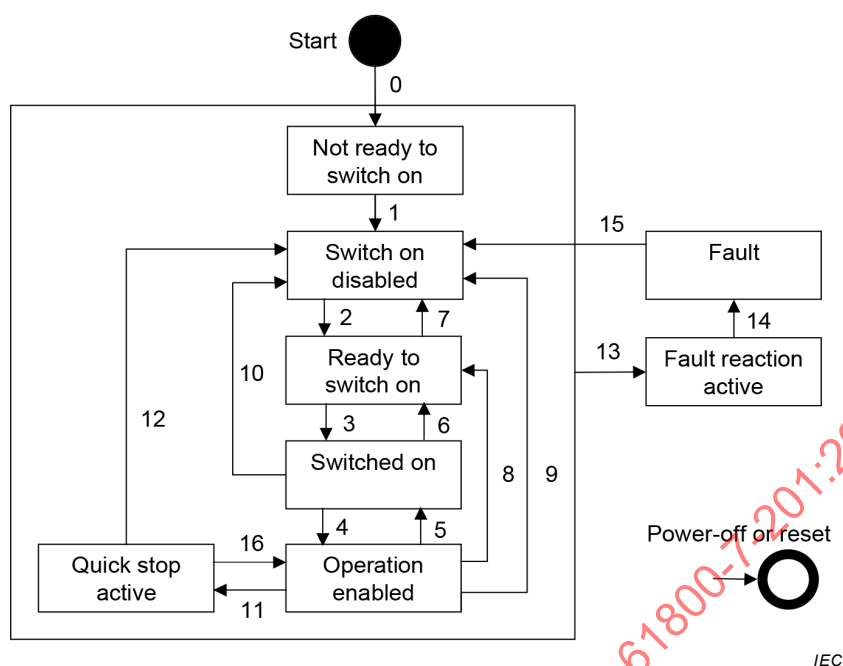


Figure 4 – Power drive system finite state automaton

The FSA states shall support the functions as shown in Table 25. The start state shall be a pseudo state indicating the start when the FSA is activated during the start-up sequence of the device drive's application software.

Table 25 – FSA states and supported functions

Function	FSA states							
	Not ready to switch on	Switch on disabled	Ready to switch on	Switched on	Operation enabled	Quick stop active	Fault reaction active	Fault
Brake applied, if present	Yes	Yes	Yes	Yes	Yes/No	Yes/No	Yes/No	Yes
Low-level power applied	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
High-level power applied	Yes/No	Yes/No	Yes/No	Yes	Yes	Yes	Yes	Yes/No
Drive function enabled	No	No	No	No	Yes	Yes	Yes	No
Configuration allowed	Yes	Yes	Yes	Yes	Yes/No	Yes/No	Yes/No	Yes

If in the quick stop active state the quick stop option code is set to 5, 6, 7 or 8, the drive device shall not leave this state, but it may transit to the operation enabled state with the enable operation command.

The drive device shall support the transitions and actions as given in Table 26. The events shall initiate the transition. The transition shall be terminated after the action has been performed.

Table 26 – Transition events and actions

Transition	Event(s)	Action(s)
0	Automatic transition after power-on or reset application	Drive device self-test and/or self initialization shall be performed.
1	Automatic transition	Communication shall be activated.
2	Shutdown command from control device or local signal	None
3	Switch on command received from control device or local signal	The high-level power shall be switched on, if possible.
4	Enable operation command received from control device or local signal	The drive function shall be enabled and all internal set-points cleared.
5	Disable operation command received from control device or local signal	The drive function shall be disabled.
6	Shutdown command received from control device or local signal	The high-level power shall be switched off, if possible.
7	Quick stop or disable voltage command from control device or local signal	None
8	Shutdown command from control device or local signal	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
9	Disable voltage command from control device or local signal	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
10	Disable voltage or quick stop command from control device or local signal	The high-level power shall be switched off, if possible.
11	Quick stop command from control device or local signal	The quick stop function shall be started.
12	Automatic transition when the quick stop function is completed and quick stop option code is 1, 2, 3 or 4, or disable voltage command received from control device (depends on the quick stop option code)	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
13	Fault signal (see also IEC 61800-7-301)	The configured fault reaction function shall be executed.
14	Automatic transition	The drive function shall be disabled; the high-level power shall be switched off, if possible.
15	Fault reset command from control device or local signal	A reset of the fault condition is carried out, if no fault exists currently on the drive device; after leaving the fault state, the fault reset bit in the controlword shall be cleared by the control device.
16	Enable operation command from control device, if the quick stop option code is 5, 6, 7, or 8	The drive function shall be enabled.
It is not recommended to support transition 16.		

If a state transition is requested, the related actions shall be processed completely before transitioning to the new state. Example: In operation enabled state, when the disable operation command is received, the drive device shall stay in the operation enabled state until the disable operation function (see object 605C_h) is completed.

Drive devices able to control the contactor for the mains may switch the high-level power. If the high-level power is switched-off, the motor shall be free to rotate if not braked.

Drive function is disabled implies no energy shall be supplied to the motor. Target or set-point values (e.g. torque, velocity, position) shall be not processed.

Drive function is enabled implies that energy may be supplied to the motor. Target or set-point values shall be processed.

If a fault is detected in the drive device, there shall be a transition to the fault reaction active state. In this state, the PDS shall execute a special fault reaction. After the execution of this fault reaction, the drive device shall switch automatically to the fault state. This state shall only be left by the fault reset command, but only if the fault is not active any more.

In case of fatal error, the drive device is not longer able to control the motor, so that an immediate switch-off of the drive device is necessary.

The behavior of drive disabling, quick stop, halt, and fault reaction functions is configurable by means of configuration objects defined in 8.4.

NOTE If a brake is present, the high-level power is switched off after a delay time in order to apply the brake.

8.3 Modes of operation

The PDS behavior depends on the activated mode of operation. The PDS may implement several modes of operation. Since it is not possible to operate the modes in parallel, the user is able to activate the required function by selecting a mode of operation.

The control device writes to the modes of operation object in order to select the operation mode. The drive device provides the modes of operation display object to indicate the actual activated operation mode. Controlword, statusword, and set-points are used mode-specific. This implies the responsibility of the control device to avoid inconsistencies and erroneous behavior. The switching between the modes of operation implies no automatic reconfiguration of COBs for real-time data transmission.

Therefore, the PDS may limit mode switching in one or some PDS FSA state(s). Mode switching may also be limited to the 'local control' function; this means it is not possible to select the operation mode via the network.

The following modes of operation are described in this part of the IEC 61800-7 series:

- profile position mode;
- homing mode;
- interpolated position mode;
- profile velocity mode (e.g. servo drives);
- torque profile mode;
- velocity mode (e.g. frequency converter);
- cyclic sync position mode;
- cyclic sync velocity mode;
- cyclic sync torque mode.

With the exception of the homing mode, the listed modes of operation deal with set-points. In addition to this, manufacturer-specific modes of operation may also be implemented. These are not limited to set-points.

Figure 5 shows the general relations between target, reference, effort, and actual values.

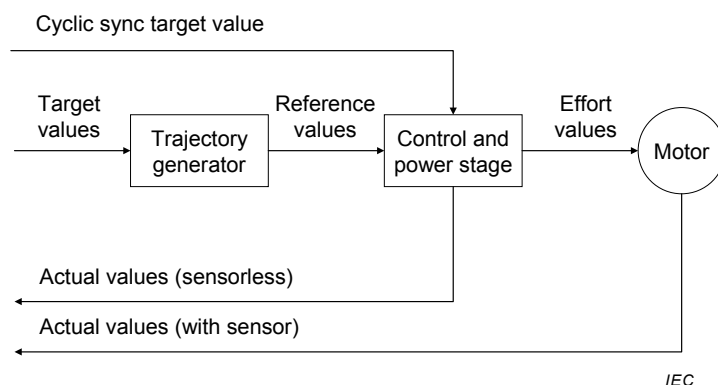
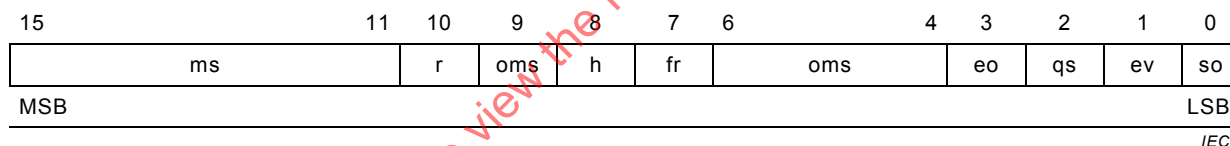


Figure 5 – Relation between different value parameters

8.4 Detailed object specifications

8.4.1 Object 6040_n: Controlword

This object shall indicate the received command controlling the PDS FSA. It shall be structured as defined in Figure 6. The bits 7, 3, 2, 1, and 0 shall be supported. The bits 0 to 9 shall be supported according to the mode of operation. If the related functionality is not available, an appropriate emergency message shall be generated. The manufacturer-specific (ms) bits may be supported. The commands shall be coded as given in Table 27. All implemented bits of the controlword are valid independent of the PDS FSA state. Starting of any movement is operation mode specific and is described in the related clause.



Key	
ms	manufacturer-specific
r	reserved
oms	operation mode specific
h	halt
fr	fault reset
eo	enable operation
qs	quick stop
ev	enable voltage
so	switch on

Figure 6 – Value definition

Table 27 – Command coding

Command	Bits of the controlword					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 (NOTE)
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset		X	X	X	X	15
NOTE Automatic transition to enable operation state after executing switched on state functionality.						

Bits 9, 6, 5, and 4 of the controlword are operation mode specific. The halt function (bit 8) behavior is operation mode specific. If the bit is 1, the commanded motion shall be interrupted, the PDS shall behave as defined in the halt option code. After releasing the halt function, the commanded motion shall be continued if possible.

The bit 10 is reserved for further use; it shall be set to 0. The bits 11, 12, 13, 14, and 15 are manufacturer-specific.

Table 28 specifies the object description, and Table 29 specifies the entry description.

Table 28 – Object description

Attribute	Value
Index	6040 _h
Name	Controlword
Object code	Variable
Data type	Unsigned16
Category	Mandatory

Table 29 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 27
Default value	Device and operation mode specific

8.4.2 Object 6041_h: Statusword

This object shall provide the status of the PDS FSA. The object shall be structured as defined in Figure 7. The bits 10, 9, and 6 to 0 shall be supported. The oms bits shall be supported if the mode of operation is supported. If the related functionality of the oms bits is not available,

the corresponding bit shall be 0_b. The manufacturer-specific (ms) bits may be supported. The bit combinations defined in Table 30 shall code the PDS FSA states. All implemented bits of the status word are valid independent of the PDS FSA state.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ms	oms		ila	tr	rm	ms	w	sod	qs	ve	f	oe	so	rtso	
MSB														LSB	
IEC															

Key:

ms	manufacturer-specific
oms	operation mode specific
ila	internal limit active
tr	target reached
rm	remote
w	warning
sod	switch on disabled
qs	quick stop
ve	voltage enabled
f	fault
oe	operation enabled
so	switched on
rtso	ready to switch on

Figure 7 – Value definition

Table 30 – State coding

Statusword	PDS FSA state
xxxx xxxx x0xx 0000 _b	Not ready to switch on
xxxx xxxx x1xx 0000 _b	Switch on disabled
xxxx xxxx x01x 0001 _b	Ready to switch on
xxxx xxxx x01x 0011 _b	Switched on
xxxx xxxx x01x 0111 _b	Operation enabled
xxxx xxxx x00x 0111 _b	Quick stop active
xxxx xxxx x0xx 1111 _b	Fault reaction active
xxxx xxxx x0xx 1000 _b	Fault

If bit 4 (voltage enabled) of the statusword is 1, this shall indicate that high voltage is applied to the PDS.

If bit 5 (quick stop) of the statusword is 0, this shall indicate that the PDS is reacting on a quick stop request.

If bit 7 (warning) of the statusword is 1, this shall indicate the presence of a warning condition. Warning is not an error or fault (examples: temperature limit exceeded, job refused). The status of the PDS FSA shall not be changed. The cause of the warning may be given in the fault code parameter object (603F_h).

If bit 9 (remote) of the statusword is 1, this shall indicate that the controlword is processed. If it is 0 (local), this shall indicate that the controlword is not processed. Nevertheless, the PDS may provide actual values, and the PDS may accept COB for configuration data transmission for other parameter objects.

If bit 10 (target reached) of the statusword is 1, this shall indicate that the PDS has reached the set-point. The set-point is operation mode specific and is defined in detail in the corresponding clauses of this part of the IEC 61800-7 series. Bit 10 shall also be set to 1, if the operation mode has been changed. The change of a target value by software shall alter this bit. If quick stop option code is 5, 6, 7 or 8, bit 10 shall be set to 1, when the quick stop

operation is finished and the PDS is halted. If halt occurred and the PDS has halted then bit 10 shall be set to 1, too. If the same internal value is commanded then bit 10 shall not alter, if bit 10 is supported.

If bit 11 (internal limit active) of the statusword is 1, this shall indicate that an internal limit is active (example: position range limit). The internal limits are manufacturer-specific.

Bit 13 and bit 12 of the statusword are operation mode specific.

Bit 14 and bit 15 are manufacturer-specific.

Table 31 specifies the object description, and Table 32 specifies the entry description.

Table 31 – Object description

Attribute	Value
Index	6041 _h
Name	Statusword
Object code	Variable
Data type	Unsigned16
Category	Mandatory

Table 32 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 30
Default value	No

8.4.3 Object 603F_h: Error code

This object shall provide the error code of the last error which occurred in the drive device. Table 24 specifies the value definition, Table 33 specifies the object description, and Table 34 specifies the entry description.

NOTE In CANopen networks, this object provides the same information as the lower 16-bit of sub-index 01_h of the pre-defined error field (1003_h).

Table 33 – Object description

Attribute	Value
Index	603F _h
Name	Error code
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 34 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 24
Default value	No

8.4.4 Object 6007_h: Abort connection option code

This object shall indicate what action shall be performed when one of the following events occurs: bus-off, heartbeat, life guarding, NMT stopped state entered, reset application, and reset communication. Table 35 specifies the value definition, Table 36 specifies the object description, and Table 37 specifies the entry description.

NOTE If the drive is switched in the LSS configuration state the reaction of the drive is manufacturer-specific.

Table 35 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	No action
+1	Fault signal
+2	Disable voltage command
+3	Quick stop command
+4 to +32 767	Reserved

Table 36 – Object description

Attribute	Value
Index	6007 _h
Name	Abort connection option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 37 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 35
Default value	+1

8.4.5 Object 605A_h: Quick stop option code

This object shall indicate what action is performed when the quick stop function is executed. The slow down ramp is the deceleration value of the used mode of operations. Table 38 specifies the value definition, Table 39 specifies the object description, and Table 40 specifies the entry description.

Table 38 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function
+1	Slow down on slow down ramp and transit into switch on disabled
+2	Slow down on quick stop ramp and transit into switch on disabled
+3	Slow down on current limit and transit into switch on disabled
+4	Slow down on voltage limit and transit into switch on disabled
+5	Slow down on slow down ramp and stay in quick stop active
+6	Slow down on quick stop ramp and stay in quick stop active
+7	Slow down on current limit and stay in quick stop active
+8	Slow down on voltage limit and stay in quick stop active
+9 to +32 767	Reserved

Table 39 – Object description

Attribute	Value
Index	605A _h
Name	Quick stop option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 40 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 38
Default value	+2

8.4.6 Object 605B_h: Shutdown option code

This object shall indicate what action is performed if there is a transition from operation enabled state to ready to switch on state. The slow down ramp is the deceleration value of the used mode of operations. Table 41 specifies the value definition, Table 42 specifies the object description, and Table 43 specifies the entry description.

Table 41 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function (switch-off the drive power stage)
+1	Slow down with slow down ramp; disable of the drive function
+2 to +32 767	Reserved

Table 42 – Object description

Attribute	Value
Index	605B _h
Name	Shutdown option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 43 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 41
Default value	0

8.4.7 Object 605C_h: Disable operation option code

This object shall indicate what action is performed if there is a transition from operation enabled state to switched on state. The slow down ramp is the deceleration value of the used mode of operations. Table 44 specifies the value definition, Table 45 specifies the object description, and Table 46 specifies the entry description.

Table 44 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function (switch-off the drive power stage)
+1	Slow down with slow down ramp; disable of the drive function
+2 to +32 767	reserved

Table 45 – Object description

Attribute	Value
Index	605C _h
Name	Disable operation option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 46 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 44
Default value	+1

8.4.8 Object 605D_h: Halt option code

This object shall indicate what action is performed when the halt function is executed. The slow down ramp is the deceleration value of the used mode of operations. Table 47 specifies the value definition, Table 48 specifies the object description, and Table 49 specifies the entry description.

Table 47 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Reserved
+1	Slow down on slow down ramp and stay in operation enabled
+2	Slow down on quick stop ramp and stay in operation enabled
+3	Slow down on current limit and stay in operation enabled
+4	Slow down on voltage limit and stay in operation enabled
+5 to +32 767	Reserved

Table 48 – Object description

Attribute	Value
Index	605D _h
Name	Halt option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 49 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 47
Default value	+1

8.4.9 Object 605E_h: Fault reaction option code

This object shall indicate what action is performed when fault is detected in the PDS. The slow down ramp is the deceleration value of the used mode of operations. Table 50 specifies the value definition, Table 51 specifies the object description, and Table 52 specifies the entry description.

Table 50 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function, motor is free to rotate
+1	Slow down on slow down ramp
+2	Slow down on quick stop ramp
+3	Slow down on current limit
+4	Slow down on voltage limit
+5 to +32 767	Reserved

Table 51 – Object description

Attribute	Value
Index	605E _h
Name	Fault reaction option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 52 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 50
Default value	+2

8.4.10 Object 6060_h: Modes of operation

This object shall indicate the requested operation mode.

Table 53 specifies the value definition, Table 54 specifies the object description, and Table 55 specifies the entry description.

NOTE 1 This object shows only the value of the requested operation mode, the actual operation mode of the PDS is reflected in the object modes of operation display.

NOTE 2 The behavior of the drive in mode of operation 0 is manufacturer-specific.

NOTE 3 If mode of operation is changed, the behavior of the drive is manufacturer-specific.

Table 53 – Value definition

Value	Definition
-128 to -1	Manufacturer-specific operation modes
0	No mode change/no mode assigned
+1	Profile position mode
+2	Velocity mode
+3	Profile velocity mode
+4	Torque profile mode
+5	Reserved
+6	Homing mode
+7	Interpolated position mode
+8	Cyclic sync position mode
+9	Cyclic sync velocity mode
+10	Cyclic sync torque mode
+11	Cyclic sync torque mode with commutation angle
+12 to +127	Reserved

Table 54 – Object description

Attribute	Value
Index	6060 _h
Name	Modes of operation
Object code	Variable
Data type	Integer8
Category	Conditional: mandatory, if more than one mode of operation is supported

Table 55 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 53
Default value	Manufacturer-specific

8.4.11 Object 6061_h: Modes of operation display

This object shall provide the actual operation mode.

Table 53 specifies the value definition, Table 56 specifies the object description, and Table 57 specifies the entry description.

Table 56 – Object description

Attribute	Value
Index	6061 _h
Name	Modes of operation display
Object code	Variable
Data type	Integer8
Category	Conditional: mandatory, if more than one mode of operation is supported

Table 57 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 53
Default value	No

8.4.12 Object 6502_h: Supported drive modes

This object shall provide information on the supported drive modes. Figure 8 specifies the value definition, Table 58 specifies the object description, and Table 59 specifies the entry description.

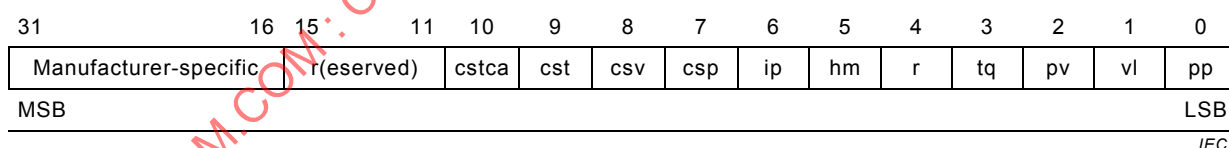


Figure 8 – Value definition

The following value definitions shall apply:

cstca, cst, csv, csp, ip, hm, tq, pv, vl, and pp bits:

1 = mode is supported 0 = mode is not supported

manufacturer-specific bits:

1 = function is supported 0 = function is not supported

r(eserved) bits: 0

Table 58 – Object description

Attribute	Value
Index	6502 _h
Name	Supported drive modes
Object code	Variable
Data type	Unsigned32
Category	Mandatory

Table 59 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Figure 8
Default value	Manufacturer-specific

9 Factor group

9.1 General

In some drive device applications several sensor resolution values and ratio values are needed. They may be presented by the objects defined in this clause.

The user-defined units as defined in this specification are used in the corresponding objects representing position, velocity, acceleration, or jerk values.

The user-defined units are specified by the SI unit objects (object 60A8_h, 60A9_h, 60AA_h, and 60AB_h). For the calculation of the respective values (and their physical units) see the following formulas. If some of the objects in the formulas are not implemented, the default values defined in the respective objects shall be used. Objects, whose values are not dependent on the factor group have fixed units specified within the objects. Figure 9 explains the scaling concept in more detail.

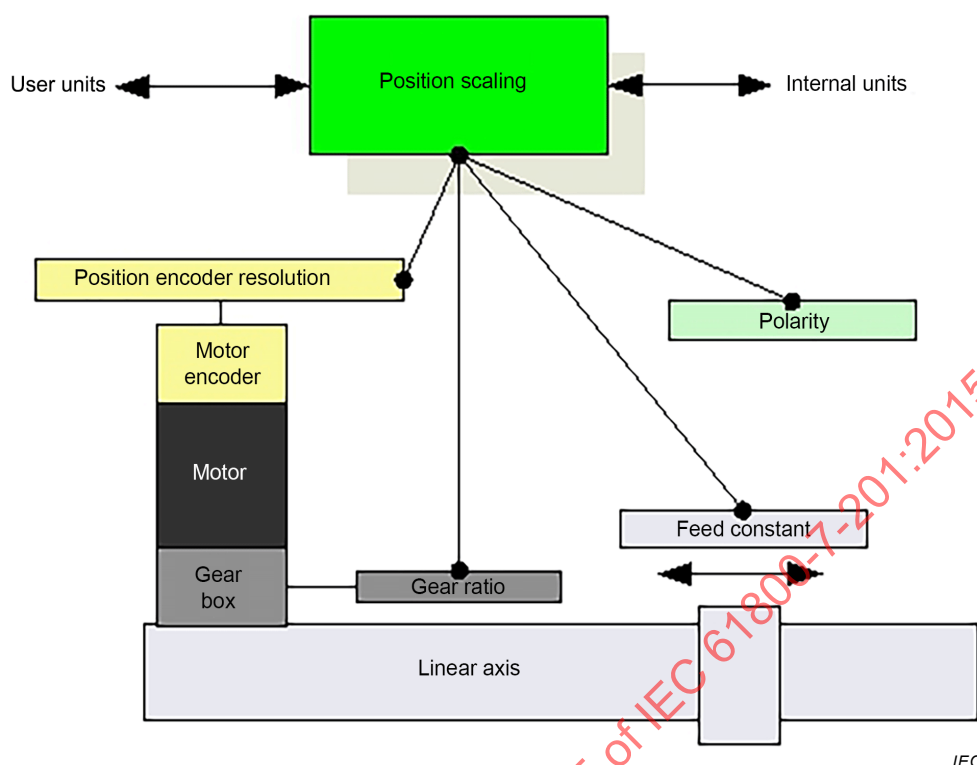


Figure 9 – Position scaling concept

Position units

The calculation of the position values is done by the following formula:

$$\text{position value} = \frac{\text{position internal value} \cdot \text{feed constant}}{\text{position encoder resolution} \cdot \text{gear ratio}}$$

The position value represents the objects containing values in user-defined position units, specified in the SI unit position (object 60A8_h). The factors in the formula shall be adjusted in a way that the SI unit position fits the mechanical conditions.

The position internal value is given in internal units, e.g. encoder increments. For calculation of the position internal values from the target position values the formula is transposed to:

$$\text{position internal value} = \frac{\text{position value} \cdot \text{position encoder resolution} \cdot \text{gear ratio}}{\text{feed constant}}$$

Velocity units

In case the velocity encoder resolution (object 6090_h) is implemented, the velocity values are calculated by:

$$\text{velocity value} = \frac{\text{velocity internal value} \cdot \text{feed constant}}{\text{velocity encoder resolution} \cdot \text{gear ratio}} \cdot \text{velocity factor}$$

The velocity internal value is taken from the separate encoder (object 606A_h, sensor selection code = 1), or by position internal value(s) (object 606A_h, sensor selection code = 0)

If object 6090_h is not implemented, the position encoder resolution is used for calculation:

$$\text{velocity value} = \frac{\text{velocity internal value} \cdot \text{feed constant}}{\text{position encoder resolution} \cdot \text{gear ratio}} \cdot \text{velocity factor}$$

or:

$$\text{velocity value} = \frac{\text{position value}}{s} \cdot \text{velocity factor}$$

The velocity value represents the objects containing values in user-defined velocity units, specified in the SI unit velocity (object 60A9_h). If object 60A9_h is not implemented, the user-defined velocity unit shall be the user-defined position unit/s.

The factors in the formulas shall be adjusted in a way that the SI unit velocity fits the mechanical conditions.

Acceleration units

$$\text{acceleration value} = \frac{\text{velocity value}}{s} \cdot \text{acceleration factor}$$

The acceleration value represents the objects containing values in user-defined acceleration units, specified in the SI unit acceleration (object 60AA_h). If object 60AA_h is not implemented, the user-defined acceleration unit shall be the user-defined velocity unit/s.

The factors in the formula shall be adjusted in a way that the SI unit acceleration fits the mechanical conditions.

Jerk units

$$\text{jerk value} = \frac{\text{acceleration value}}{s} \cdot \text{jerk factor}$$

The jerk value represents the objects containing values in user-defined jerk units, specified in the SI unit jerk (object 60AB_h). If object 60AB_h is not implemented the user-defined jerk unit shall be the user-defined velocity unit/s².

The factors in the formula shall be adjusted in a way that the SI unit jerk fits the mechanical conditions.

9.2 Detailed object definitions

9.2.1 Object 608F_h: Position encoder resolution

This object shall indicate the configured encoder increments and the number of motor revolutions. The position encoder resolution shall be calculated by the following formula:

$$\text{position encoder resolution} = \frac{\text{encoder increments}}{\text{motor revolutions}}$$

All values shall be dimensionless. Table 60 specifies the object description, and Table 61 specifies the entry description.

Table 60 – Object description

Attribute	Value
Index	608F _h
Name	Position encoder resolution
Object code	Array
Data type	Unsigned32
Category	Optional

Table 61 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	Encoder increments
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	Motor revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific (but not equal to 0)

9.2.2 Object 6090_h: Velocity encoder resolution

This object shall indicate the configured encoder increments per second and the motor revolutions per second. The velocity encoder resolution shall be calculated by the following formula:

$$\text{velocityencoderresolution} = \frac{\text{encoder} \frac{\text{increments}}{\text{second}}}{\text{motor} \frac{\text{revolutions}}{\text{second}}}$$

All values shall be dimensionless. Table 62 specifies the object description, and Table 63 specifies the entry description.

Table 62 – Object description

Attribute	Value
Index	6090 _h
Name	Velocity encoder resolution
Object code	Array
Data type	Unsigned32
Category	Optional

Table 63 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Encoder increments per second
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	Motor revolutions per second
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific (but not equal to 0)

9.2.3 Object 6091_h: Gear ratio

This object shall indicate the configured number of motor shaft revolutions and the number of driving shaft revolutions. The gear ratio shall be calculated by the following formula:

$$\text{gear ratio} = \frac{\text{motor shaft revolutions}}{\text{driving shaft revolutions}}$$

All values shall be dimensionless. Table 64 specifies the object description, and Table 65 specifies the entry description.

Table 64 – Object description

Attribute	Value
Index	6091 _h
Name	Gear ratio
Object code	Array
Data type	Unsigned32
Category	Optional

Table 65 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Motor shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	Driving shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

9.2.4 Object 6092_h: Feed constant

This object shall indicate the configured feed constant, which is the measurement distance per one revolution of the output shaft of the gearbox. The feed constant shall be calculated by the following formula:

$$\text{feed constant} = \frac{\text{feed}}{\text{driving shaft revolutions}}$$

The feed shall be given in user-defined position units, and the driving shaft revolutions value shall be dimensionless. Table 66 specifies the object description, and Table 67 specifies the entry description.

Table 66 – Object description

Attribute	Value
Index	6092 _h
Name	Feed constant
Object code	Array
Data type	Unsigned32
Category	Optional

Table 67 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Feed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	Shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

9.2.5 Object 6096_h: Velocity factor

This object can be used to match the velocity units to the user-defined velocity units. Table 68 specifies the object description, and Table 69 specifies the entry description.

Table 68 – Object description

Attribute	Value
Index	6096 _h
Name	Velocity factor
Object code	Array
Data type	Unsigned32
Category	Optional

Table 69 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to 2 ³² – 1
Default value	1
Sub-index	02 _h
Description	Divisor
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to 2 ³² – 1
Default value	1

9.2.6 Object 6097_h: Acceleration factor

This object can be used to match the acceleration units to the user-defined acceleration units. Table 70 specifies the object description, and Table 71 specifies the entry description.

Table 70 – Object description

Attribute	Value
Index	6097 _h
Name	Acceleration factor
Object code	Array
Data type	Unsigned32
Category	Optional

Table 71 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to $2^{32}-1$
Default value	1
Sub-index	02 _h
Description	Divisor
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to $2^{32}-1$
Default value	1

9.2.7 Object 60A2_h: Jerk factor

This object can be used to match the jerk units to the user-defined jerk units. Table 72 specifies the object description, and Table 73 specifies the entry description.

Table 72 – Object description

Attribute	Value
Index	60A2 _h
Name	Jerk factor
Object code	Array
Data type	Unsigned32
Category	Optional

Table 73 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to $2^{32}-1$
Default value	1
Sub-index	02 _h
Description	Divisor
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	1 to $2^{32}-1$
Default value	1

9.2.8 Object 607E_h: Polarity

This object shall indicate if the position demand value shall be multiplied by 1 or by –1. The polarity flag shall have no influence on the homing mode. The position polarity bit shall be used only for profile position (pp) mode and cyclic sync position mode (csp). The velocity polarity bit shall be used only for profile velocity (pv) mode and cyclic sync velocity mode (csv). Figure 10 specifies the value definition, Table 74 specifies the object description, and Table 75 specifies the entry description.

7	6	5	0
Position polarity	Velocity polarity	reserved (0)	
MSB			LSB

IEC

Figure 10 – Value definition

The polarity bits shall be coded as follows: 0_b = multiply by 1 and 1_b = multiply by -1

Table 74 – Object description

Attribute	Value
Index	607E _h
Name	Polarity
Object code	Variable
Data type	Unsigned8
Category	Optional

Table 75 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Figure 10
Default value	00 _h

9.2.9 Code table for device profile specific units

Table 76 specifies the representation of the additional specific units used in this profile.

Table 76 – Device profile specific units

Name of unit	International symbol	Notation index
Cubic second	s ³	A0 _h
Reserved	–	A1 _h to AB _h , AD _h to B3 _h , B6 _h to BF _h
Manufacturer-specific	–	C0 _h to FF _h
Revolution	none	B4 _h
Inc	none	B5 _h
Step	none	AC _h

9.2.10 Object 60A8_h: SI unit position

This object shall indicate the user-defined position units. The object structure is defined in Figure 1 in CiA 303-2:2012. The representation of the SI units and prefixes is given in CiA 303-2. The representation of the additional profile-specific units is defined in Table 76. The profile-specific field (bit 0 to bit 7) of this object is reserved (00_h).

The scaling from the real position increments to the position value in user-defined units is done using the objects 608F_h, 6091_h and 6092_h. Table 77 specifies the object description, and Table 78 specifies the entry description.

Table 77 – Object description

Attribute	Value
Index	60A8 _h
Name	SI unit position
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 78 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

Figure 11 shows an example for the object configuration in mm.

31	24	23	16	15	8	7	0
FD _h (means 10 ⁻³)		01 _h (means m)		00 _h		reserved (00 _h)	
MSB				LSB			

IEC

Figure 11 – Example for a position unit

9.2.11 Object 60A9_h: SI unit velocity

This object shall indicate the user-defined velocity units. If this object is not implemented, the user-defined velocity unit shall be the user-defined position unit/s. The object structure is defined in Figure 1 in CiA 303-2:2012. The representation of the SI units and prefixes is given in CiA 303-2. The representation of the additional profile-specific units is defined in Table 76. The profile-specific field (bit 0 to bit 7) of this object is reserved (00_h).

This object is taken as a definition for the user-defined velocity units, if the object 6090_h (velocity encoder resolution) is implemented. If the object 6090_h is not implemented, a calculation based on the position-related values has to be done. Table 79 specifies the object description, and Table 80 specifies the entry description.

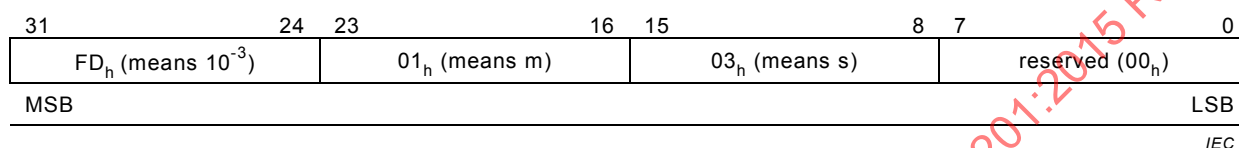
Table 79 – Object description

Attribute	Value
Index	60A9 _h
Name	SI unit velocity
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 80 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

Figure 12 shows an example for the object configuration in mm/s.

**Figure 12 – Example for a velocity unit**

9.2.12 Object 60AA_h: SI unit acceleration

This object shall indicate the user-defined acceleration units. If this object is not implemented, the user-defined acceleration unit shall be the user-defined velocity unit/s. The object structure is defined in Figure 1 in CiA 303-2:2012. The representation of the SI units and prefixes is given in CiA 303-2. The representation of the additional profile-specific units is defined in Table 76. The profile-specific field (bit 0 to bit 7) of this object is reserved (00_h).

To match the acceleration value to the user-defined units, a calculation based on the velocity value has to be done. Table 81 specifies the object description, and Table 82 specifies the entry description.

Table 81 – Object description

Attribute	Value
Index	60AA _h
Name	SI unit acceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 82 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

Figure 13 shows an example for the object configuration in mm/s².

31	24	23	16	15	8	7	0
FD _h (means 10 ⁻³)		01 _h (means m)		57 _h (means s ²)		reserved (00 _h)	
MSB				LSB			

IEC

Figure 13 – Example for an acceleration unit**9.2.13 Object 60AB_h: SI unit jerk**

This object shall indicate the user-defined jerk units. If this object is not implemented, the user-defined jerk unit shall be the user-defined velocity unit/s². The object structure is defined in Figure 1 in CiA 303-2:2012. The representation of the SI units and prefixes is given in CiA 303-2. The representation of the additional profile-specific units is defined in Table 76. The profile-specific field (bit 0 to bit 7) of this object is reserved (00_h).

Table 83 specifies the object description, and Table 84 specifies the entry description.

Table 83 – Object description

Attribute	Value
Index	60AB _h
Name	SI unit jerk
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 84 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	No
Value range	Unsigned32
Default value	Manufacturer-specific

Figure 14 shows an example for the object configuration in mm/s³.

31	24	23	16	15	8	7	0
FD _h (means 10 ⁻³)		01 _h (means m)		A0 _h (means s ³)		reserved (00 _h)	
MSB				LSB			

IEC

Figure 14 – Example for a jerk unit**10 Profile position mode****10.1 General information**

The overall structure for this mode is shown in Figure 15. A target position is applied to the trajectory generator. It is generating a position demand value for the position control loop described in the position control function (see 13.3.1). These two function blocks are optionally controlled by individual parameter sets.

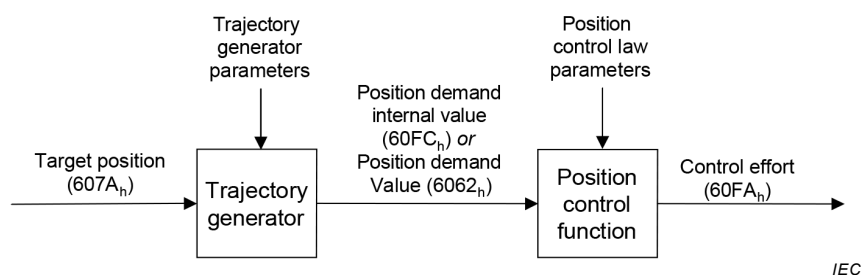


Figure 15 – Trajectory generator and position control function

At the input to the trajectory generator, parameters may have optional limits applied before being normalized to internal units. The simplest form of a trajectory generator is just to pass through a target position and to transform it to a position demand internal value with internal units (increments) only. Figure 16 defines the detailed structure of the trajectory generator.

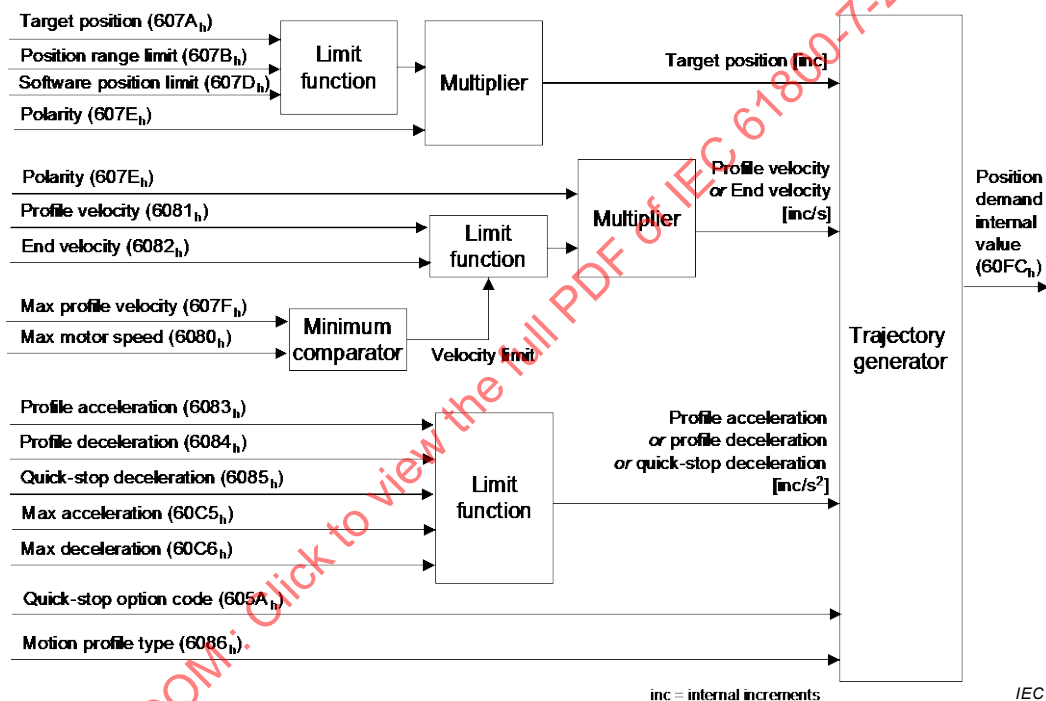


Figure 16 – Trajectory generator for profile position mode

10.2 Functional description

10.2.1 General

The setting of set-points is controlled by the timing of the new set-point bit and the change set immediately bit in the controlword as well as the set-point acknowledge bit in the statusword.

If the change set immediately bit of the controlword is set to 1, a single set-point is expected by the drive device. If the change set immediately bit of the controlword is set to 0, a set of set-points is expected by the drive device.

After a set-point is applied to the drive device, the control device signals that the set-point is valid by a rising edge of the new set-point bit in the controlword. The drive device sets the set-point acknowledge bit in the statusword to 1, and afterwards, the drive device signals with the set-point acknowledge bit set to 0 its ability to accept new set-points. An example is shown in Figure 17.

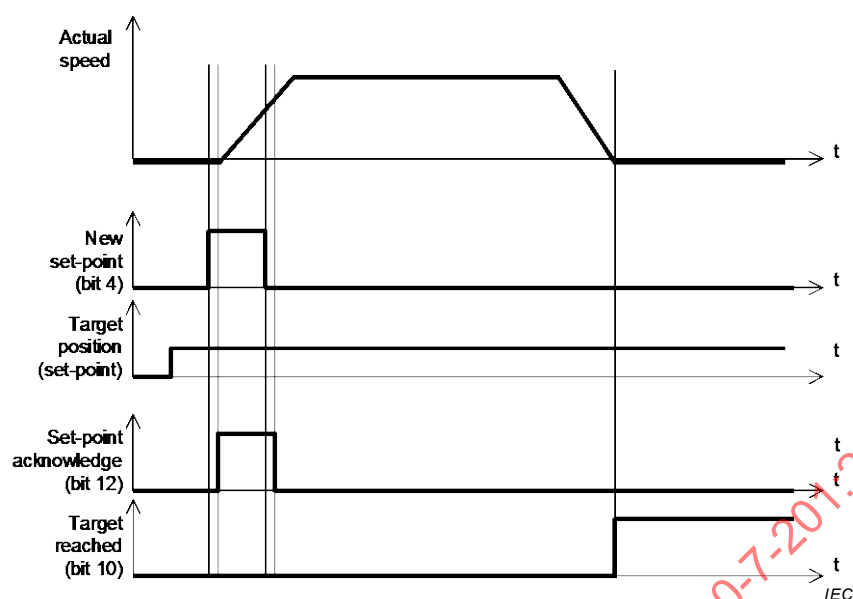


Figure 17 – Set-point example

If one set-point is still in progress and a new one is validated, two methods of handling are supported: single set-point (change set immediately bit of controlword is 1) and set of set-points (change set immediately bit of controlword is 0).

10.2.2 Single set-point

When a set-point is in progress and a new set-point is validated by the new set-point (bit 4) in the controlword, the new set-point shall be processed immediately. The handshaking procedure shown in Figure 18 is used for the single set-point method.

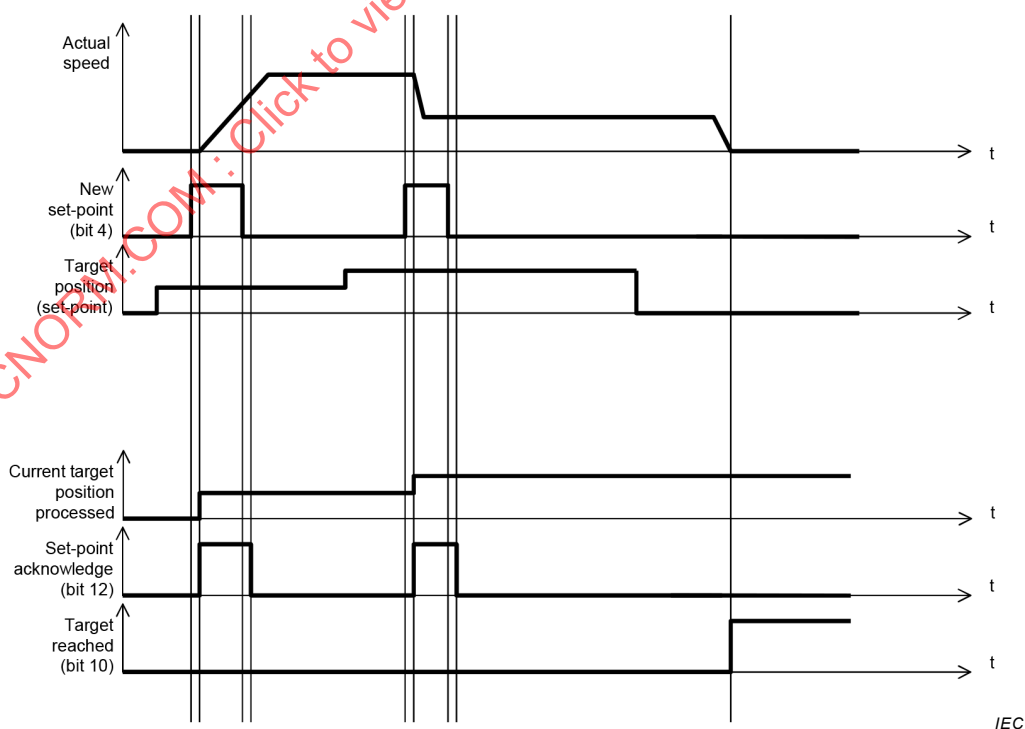


Figure 18 – Handshaking procedure for the single set-point method

10.2.3 Set of set-points

When a set-point is in progress and a new set-point is validated by the new set-point (bit 4) in the controlword, the new set-point shall be processed only after the previous has been reached. The handshaking procedure shown in Figure 19 is used for the set of set-points method. The additional grey line segment in the graph 'actual speed' shows the actual speed if the change of set-point bit (bit 9) is set to 1.

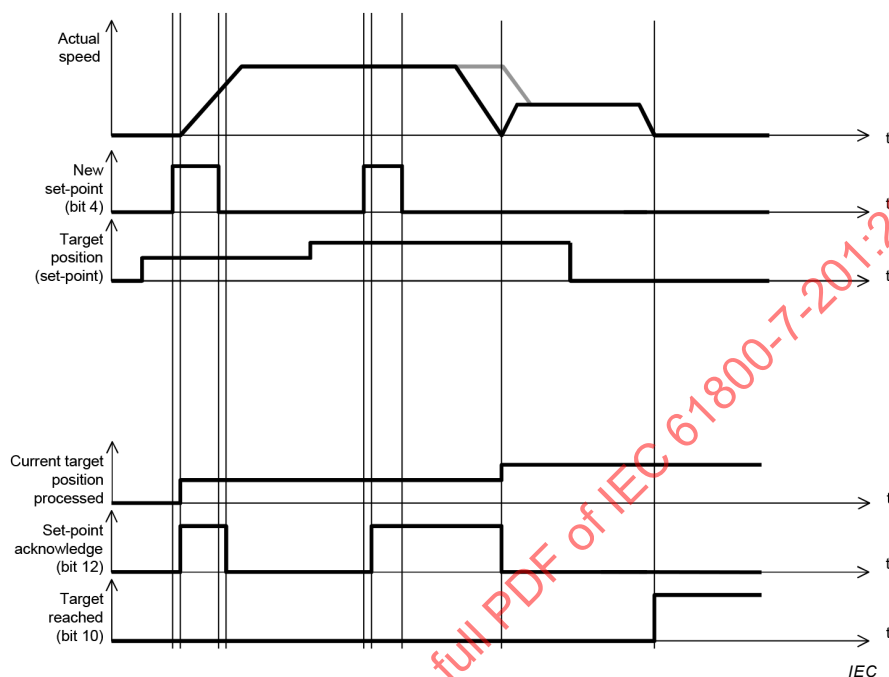


Figure 19 – Handshaking procedure for the set of set-points method

If a drive device supports set of set-points, a minimum of two set-points are available, a set-point that is currently been processed and a buffered set-point. The set-points are handled as shown in Figure 20.

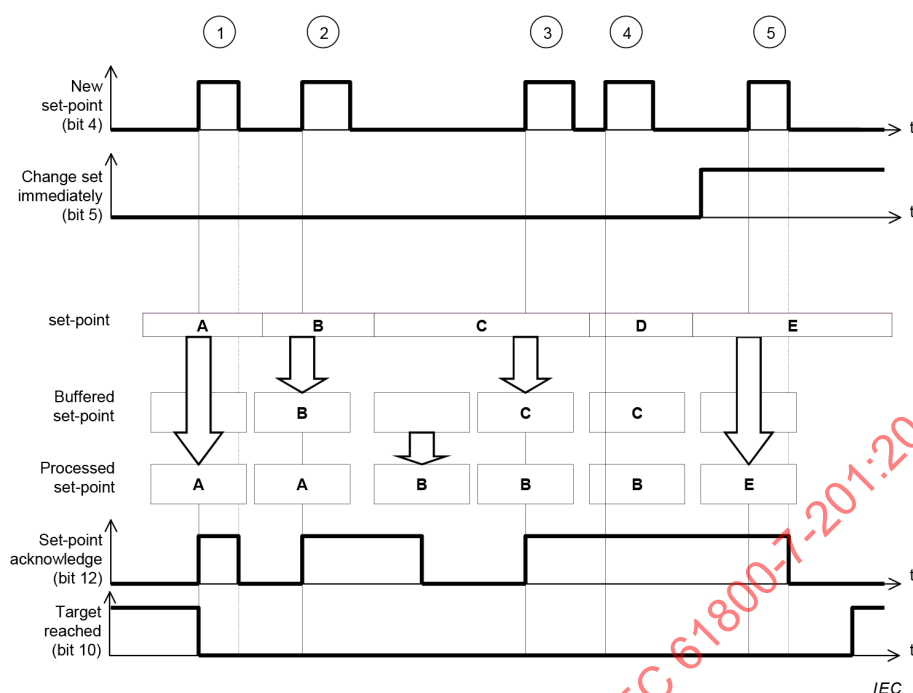


Figure 20 – Set-point handling for two set-points

New set-points are buffered in the set-point list as long as free set-points are available in the drive device. If no set-point is in progress, the new set-point shall become active immediately (1). If a set-point is in progress, the new set-point shall be stored in the first set-point buffer that is free (2 + 3).

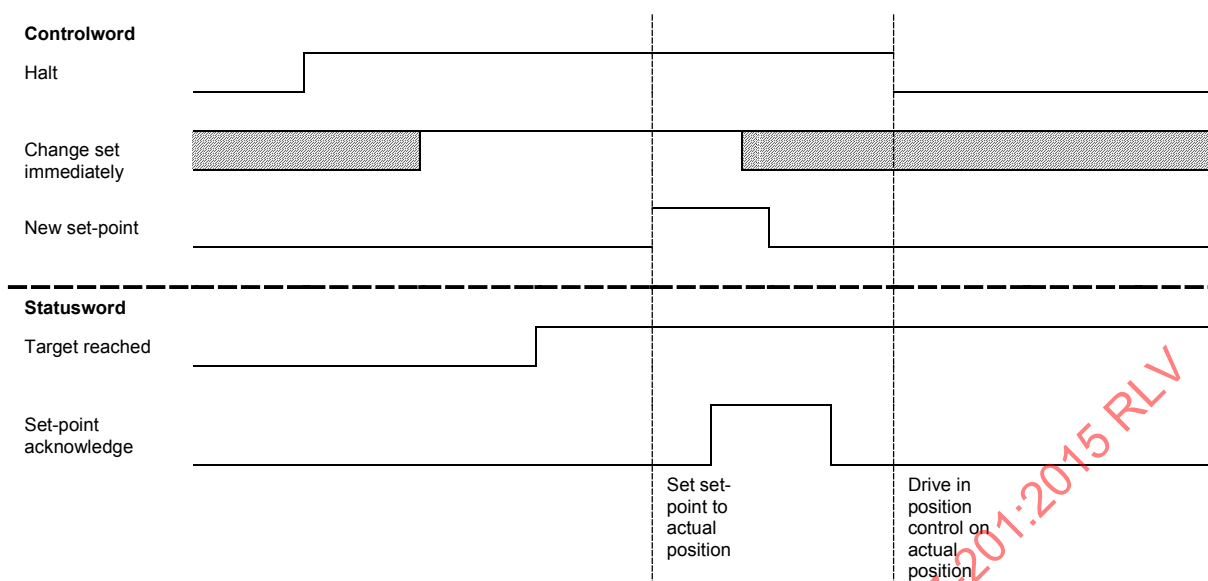
If all set-point buffers are busy (set-point acknowledge bit is 1), the reaction depends on the change set immediately bit. If the change set immediately bit is set to 1, the new set-point shall be processed immediately as single set-point. All previously loaded set-points shall be discarded (5).

The target reached bit shall remain 0 until all set-points are processed.

10.2.4 Usage of halt bit in conjunction with new set-point bit

The halt bit can be used to halt, set a new set-point and in combination with the new set-point bit to interrupt an actual movement which is described in this section.

If a drive is processing a set-point the halt bit (bit 8 of the controlword) can be used to stop the motor and keep it in position control. After releasing the halt bit the processing of the actual set-point is continued. Figure 21 describes a mechanism how to erase the processed set-point and set the actual position as a new set-point for that the drive remains at the current position in position control even after releasing the halt bit.



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Figure 21 – Erase set-point

The actual drive position shall be captured after a complete stand still of the motor. Therefore bit 8 (halt) of the controlword (6040_h) and bit 10 (target reached) of the statusword (6041_h) have to be equal to 1. Additional information on this bit combination can be found in Table 87.

To define the slowdown ramp which is applied during the halt command object 605D_h (halt option code) can be used.

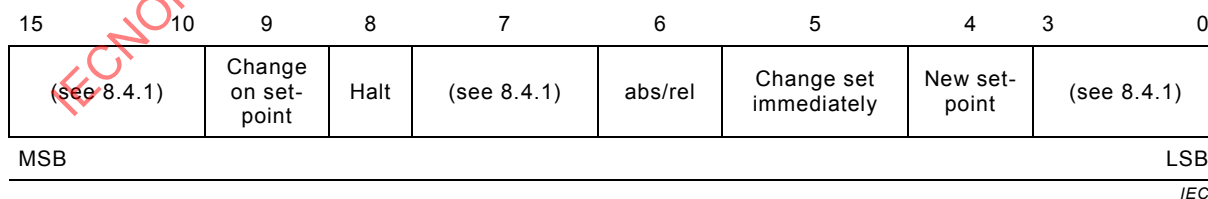
10.3 General definitions

The internal software limits shall not be exceeded by external settings configured by the user.

10.4 Use of controlword and statusword

The profile position mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 22 shows the structure of the controlword. If no positioning is in progress, the rising edge of bit 4 shall start the positioning of the axis. In case a positioning is in progress, the definitions given in Table 85 shall be used. Table 86 defines the values for bit 6 and 8 of the controlword.

NOTE It is assumed that the target position is edge-triggered 0->1 otherwise the drive could set immediately new values, which leads to unexpected behavior.



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Figure 22 – Controlword for profile position (pp) mode

Table 85 – Definition of bit 4, bit 5, and bit 9

Bit 9	Bit 5	Bit 4	Definition
0	0	0 -> 1	Positioning shall be completed (target reached) before the next one gets started (see Figure 17 and Figure 19)
X	1	0 -> 1	Next positioning shall be started immediately (see Figure 17 and Figure 18)
1	0	0 -> 1	Positioning with the current profile velocity up to the current set-point shall be proceeded and then next positioning (see Figure 17 and Figure 19) shall be applied

Table 86 – Definition of bit 6 and bit 8

Bit	Value	Definition
6	0	Target position shall be an absolute value
	1	Target position shall be a relative value (depending on object 60F2 _h)
8	0	Positioning shall be executed or continued
	1	Axis shall be stopped accordingly to halt option code (605D _h)

Figure 23 shows the structure of the statusword. Table 87 defines the values for bit 10, bit 12, and bit 13.

15	14	13	12	11	10	9	0
(see 8.4.2)	Following error	Set-point acknowledge	(see 8.4.2)	Target reached	(see 8.4.2)		
MSB							LSB

IEC

Figure 23 – Statusword for profile position (pp) mode**Table 87 – Definition of bit 10, bit 12, and bit 13**

Bit	Value	Definition
10	0	Halt (bit 8 in controlword) = 0: Target position not reached Halt (bit 8 in controlword) = 1: Axis decelerates
	1	Halt (bit 8 in controlword) = 0: Target position reached Halt (bit 8 in controlword) = 1: Velocity of axis is 0
12	0	Previous set-point already processed, waiting for new set-point
	1	Previous set-point still in process, set-point overwriting shall be accepted
13	0	No following error
	1	Following error

10.5 Detailed object definitions

10.5.1 Object 607A_h: Target position

This object shall indicate the commanded position that the drive should move to in position profile mode using the current settings of motion control parameters such as velocity, acceleration, deceleration, motion profile type etc. The value of this object shall be interpreted as absolute or relative depending on the abs/rel flag in the controlword. It shall be given in user-defined position units and shall be converted to position increments. Table 88 specifies the object description, and Table 89 specifies the entry description.

Table 88 – Object description

Attribute	Value
Index	607A _h
Name	Target position
Object code	Variable
Data type	Integer32
Category	Optional; mandatory if pp, pc or csp is supported

Table 89 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

10.5.2 Object 607B_h: Position range limit

This object shall indicate the configured maximal and minimal position range limits. It shall limit the numerical range of the input value. On reaching or exceeding these limits, the input value shall wrap automatically to the other end of the range. Wrap-around of the input value may be prevented by setting software position limits as defined in software position limit object (607D_h). To disable the position range limits the min position range limit (sub-index 01_h) and max position range limit (sub-index 02_h) shall be set to 0. The values shall be given in user-defined position units. Table 90 specifies the object description, and Table 91 specifies the entry description.

Table 90 – Object description

Attribute	Value
Index	607B _h
Name	Position range limit
Object code	Array
Data type	Integer32
Category	Optional

Table 91 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Min position range limit
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Max position range limit
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

10.5.3 Object 607D_h: Software position limit

This object shall indicate the configured maximal and minimal software position limits. These parameters shall define the absolute position limits for the position demand value and the position actual value as specified in Figure 24. Every new target position shall be checked against these limits.

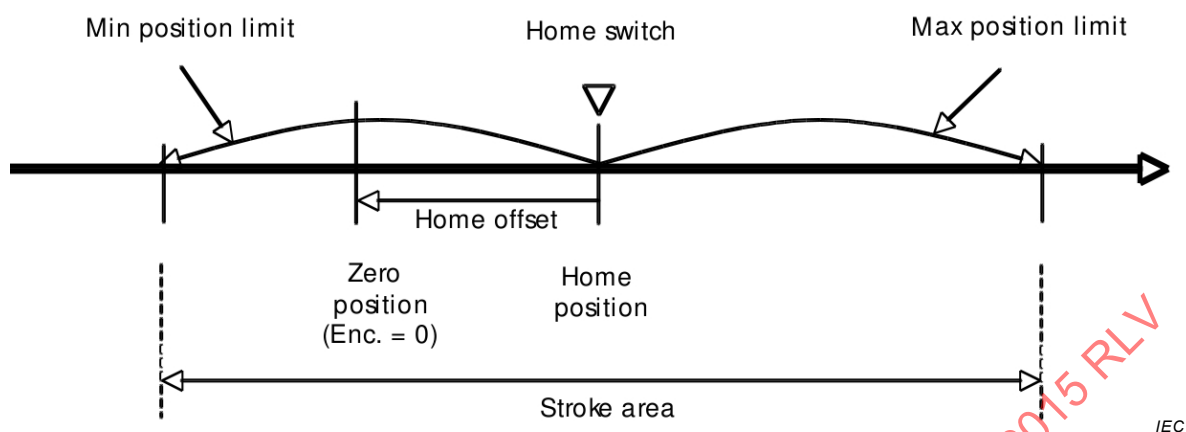


Figure 24 – Software position limits

The limit positions shall be given in user-defined position units (same as target position). Table 92 specifies the object description, and Table 93 specifies the entry description.

Supervision of software position limits requires a defined home position.

Table 92 – Object description

Attribute	Value
Index	607D _h
Name	Software position limit
Object code	Array
Data type	Integer32
Category	Optional

Table 93 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Min position limit
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Max position limit
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

10.5.4 Object 607F_h: Max profile velocity

This object shall indicate the configured maximal allowed velocity in either direction during a profiled motion. The value shall be given in the very same physical unit as the profile velocity object (6081_h). Table 94 specifies the object description, and Table 95 specifies the entry description.

Table 94 – Object description

Attribute	Value
Index	607F _h
Name	Max profile velocity
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 95 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.5 Object 6080_h: Max motor speed

This object shall indicate the configured maximal allowed speed for the motor in either direction. It is used to protect the motor and is taken from the motor data sheet. The value shall be given in rotations per minute (r/min) or user-defined velocity units. Table 96 specifies the object description, and Table 97 specifies the entry description.

Table 96 – Object description

Attribute	Value
Index	6080 _h
Name	Max motor speed
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 97 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.6 Object 6081_h: Profile velocity

This object shall indicate the configured velocity normally attained at the end of the acceleration ramp during a profiled motion and shall be valid for both directions of motion. The value shall be given in user-defined velocity units. The velocity units can depend on the user-defined position units (position units per second). The calculation of the user-defined position units is done via the factor group (see Clause 9). Table 98 specifies the object description, and Table 99 specifies the entry description.

Table 98 – Object description

Attribute	Value
Index	6081 _h
Name	Profile velocity
Object code	Variable
Data type	Unsigned32
Category	Conditional: mandatory if pp is supported

Table 99 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.7 Object 6082_h: End velocity

This object shall indicate the configured velocity, which the drive shall have on reaching the target position. Normally, the drive stops at the target position, i.e. the end velocity is 0. The value shall be given in the same physical units as the profile velocity object (6081_h). Table 100 specifies the object description, and Table 101 specifies the entry description.

Table 100 – Object description

Attribute	Value
Index	6082 _h
Name	End velocity
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 101 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	0000 0000 _h

10.5.8 Object 6083_h: Profile acceleration

This object shall indicate the configured acceleration. The value shall be given in user-defined acceleration units. Table 102 specifies the object description, and Table 103 specifies the entry description.

Table 102 – Object description

Attribute	Value
Index	6083 _h
Name	Profile acceleration
Object code	Variable
Data type	Unsigned32
Category	Conditional: mandatory if pp or pv is supported

Table 103 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.9 Object 6084_h: Profile deceleration

This object shall indicate the configured deceleration. If this parameter is not supported, then the profile acceleration object (6083_h) value shall be used for deceleration, too. The value shall be given in the same physical units as profile acceleration object (6083_h). Table 104 specifies the object description, and Table 105 specifies the entry description.

Table 104 – Object description

Attribute	Value
Index	6084 _h
Name	Profile deceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 105 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.10 Object 6085_h: Quick stop deceleration

This object shall indicate the configured deceleration used to stop the motor when the quick stop function is activated and the quick stop code object (605A_h) is set to 2 or 6. The quick stop deceleration is also used if the fault reaction code object (605E_h) is 2 and the halt option code object (605D_h) is 2. The value shall be given in the same physical unit as profile

acceleration object (6083_h). Table 106 specifies the object description, and Table 107 specifies the entry description.

Table 106 – Object description

Attribute	Value
Index	6085 _h
Name	Quick stop deceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 107 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.11 Object 6086_h: Motion profile type

This object shall indicate the configured type of motion profile used to perform a profiled motion. Table 108 specifies the value definition, Table 109 specifies the object description, and Table 110 specifies the entry description.

Table 108 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Linear ramp (trapezoidal profile)
+1	Sin ² ramp
+2	Jerk-free ramp
+3	Jerk-limited ramp
+4 to +32 767	Reserved

Table 109 – Object description

Attribute	Value
Index	6086 _h
Name	Motion profile type
Object code	Variable
Data type	Integer16
Category	Optional

Table 110 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0

10.5.12 Object 60A3_h: Profile jerk use

This object shall indicate the configured number of sub-indices used in the profile jerk object (60A4_h) for the jerk profile movement. If this object is not implemented, the profile jerk object shall be used as it is implemented. The value shall be dimensionless, the value of FF_h shall indicate that the profile jerk use is not configured. Table 111 specifies the object description, and Table 112 specifies the entry description.

Table 111 – Object description

Attribute	Value
Index	60A3 _h
Name	Profile jerk use
Object code	Variable
Data type	Unsigned8
Category	Optional

Table 112 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	01 _h to 06 _h and FF _h
Default value	Manufacturer-specific

10.5.13 Object 60A4_h: Profile jerk

This object shall indicate the configured set of jerk parameters that shall be used during the profile movement. Figure 25 shows the defined jerks (A, B, C, D, E, and F). The values shall be given in user-defined jerk units. Table 113 specifies the value assignment to jerks depending of the value of profile jerk use object (60A3_h). If object 60A3_h is not implemented, the sub-index 00_h shall be used to assign the values given in the other sub-indices to the jerks. Table 114 specifies the object description, and Table 115 specifies the entry description.

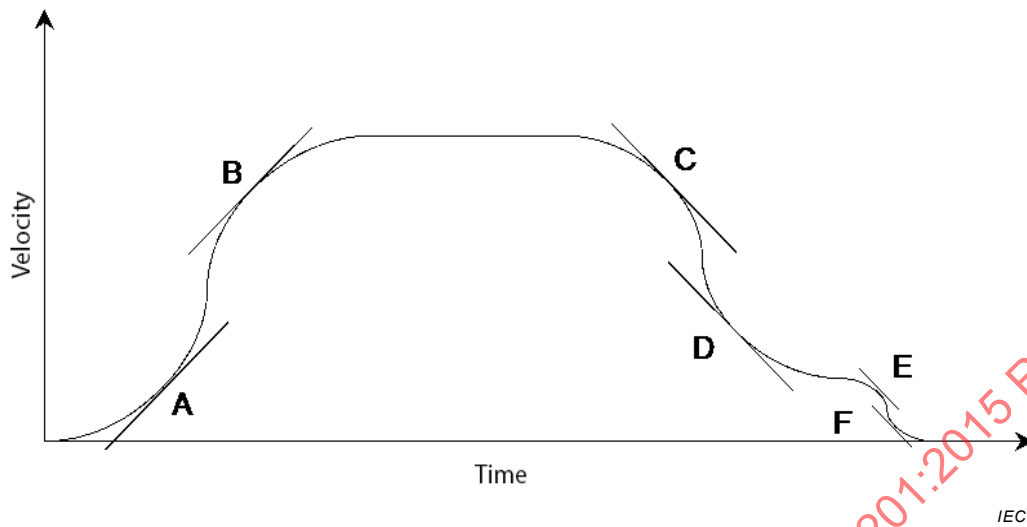


Figure 25 – Velocity/time diagram with jerk positions

Table 113 – Value assignments

Value in 60A3 _h or sub-index 00 _h of 60A4 _h if 60A3 _h is not implemented	Value assignment to jerks					
	A	B	C	D	E	F
01 _h	01 _h	01 _h	01 _h	01 _h	–	–
02 _h	01 _h	01 _h	02 _h	02 _h	–	–
04 _h	01 _h	03 _h	02 _h	04 _h	–	–
06 _h	01 _h	03 _h	02 _h	04 _h	05 _h	06 _h

Table 114 – Object description

Attribute	Value
Index	60A4 _h
Name	Profile jerk
Object code	Array
Data type	Unsigned32
Category	Optional

Table 115 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h , 02 _h , 04 _h , or 06 _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	Profile jerk 1
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Profile jerk 2
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	06 _h
Description	Profile jerk 6
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.14 Object 60C5_h: Max acceleration

This object shall indicate the configured maximal acceleration. It is used to limit the acceleration to an acceptable value in order to prevent the motor and the moved mechanics from being destroyed. The value shall be given in user-defined acceleration physical units. Table 116 specifies the object description, and Table 117 specifies the entry description.

Table 116 – Object description

Attribute	Value
Index	60C5 _h
Name	Max acceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 117 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

10.5.15 Object 60C6_h: Max deceleration

This object shall indicate the configured maximal deceleration. It is used to limit the acceleration to an acceptable value in order to prevent the motor and the moved mechanics from being destroyed. The value shall be given in the same physical unit as the max acceleration object (60C5_h). Table 118 specifies the object description, and Table 119 specifies the entry description.

Table 118 – Object description

Attribute	Value
Index	60C6 _h
Name	Max deceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 119 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

11 Homing mode

11.1 General information

This clause describes the method by which a drive seeks the home position (also called, the datum, reference point or zero point). There are various methods of achieving this using limit switches at the ends of travel or a home switch (zero point switch) in mid-travel, most of the methods also use the index (zero) pulse train from an incremental encoder.

11.2 Functional description

Figure 26 shows the defined input objects as well as the output objects. The user may specify the speeds, acceleration and the method of homing. There is a further object home offset, which allows the user to displace zero in the user's coordinate system from the home position.

There is no output data except for those bits in the statusword, which return the status or result of the homing process and the demand to the position control loops.

There are two homing speeds; in a typical cycle, the faster speed is used to find the home switch and the slower speed is used to find the index pulse. The manufacturer is allowed some discretion in the use of these speeds as the response to the signals may be dependent upon the hardware used.

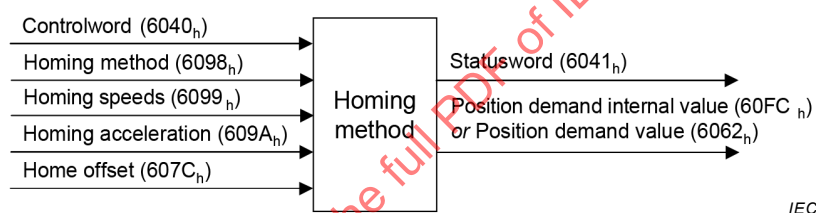


Figure 26 – Homing mode function

By choosing a homing method, the following behavior is determined: The homing signal (positive limit switch, negative limit switch, home switch), the direction of actuation and where appropriate, the position of the index pulse.

The home position and the zero position are offset by the home offset; see the definition of home offset for how this offset is used.

An encircled number in the figures Figure 27 to Figure 34 indicates the code for selection of this homing position. The direction of movement is also indicated.

There are four sources of homing signal available: These are the negative and positive limit switches, the home switch and the index pulse from an encoder. In case, that a limit switch has reached the drive shall move in the other direction to leave the position.

In the diagrams of homing sequences shown below, the encoder count increases as the axis's position moves to the right, in other words, the left is the minimum position and the right is the maximum position.

For the operation of positioning drives, an exact knowledge of the absolute position is normally required. Since, for cost reasons, drives often do not have an absolute encoder, a homing operation is necessary. There are several, application-specific methods. The homing method is used for selection.

The exact sequence of the homing operation is clearly described by the method. In some circumstances, a drive device has several methods to choose from, using the homing method.

11.3 General definitions

11.3.1 General

The homing modes are working on logical values of the limit- and homing-switches (object 60FD_h).

11.3.2 Method 1: Homing on negative limit switch and index pulse

Using this method as shown in Figure 27, the initial direction of movement shall be leftward if the negative limit switch is inactive (here: low). The home position shall be at the first index pulse to the right of the position where the negative limit switch becomes inactive.

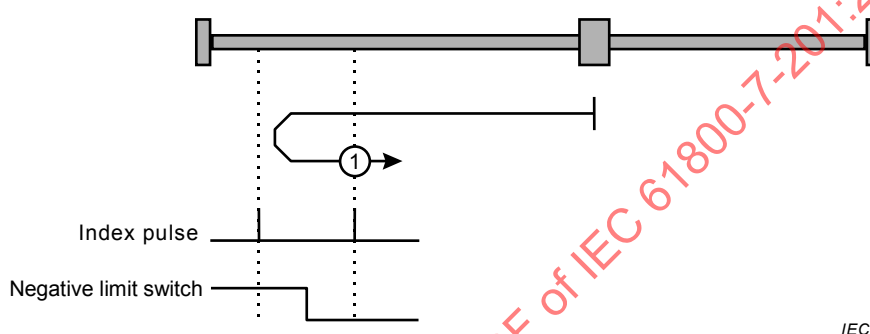


Figure 27 – Homing on negative limit switch and index pulse

11.3.3 Method 2: Homing on positive limit switch and index pulse

Using this method as shown in Figure 28, the initial direction of movement shall be rightward if the positive limit switch is inactive (here: low). The position of home shall be at the first index pulse to the left of the position where the positive limit switch becomes inactive.

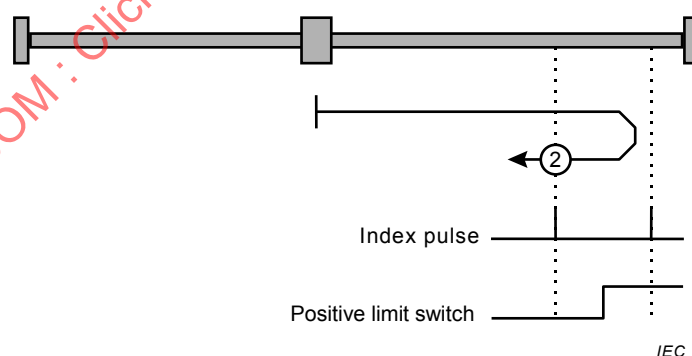


Figure 28 – Homing on positive limit switch and index pulse

11.3.4 Method 3 and 4: Homing on positive home switch and index pulse

Using these methods as shown in Figure 29, the initial direction of movement shall be dependent on the state of the home switch. The home position shall be at the index pulse to either to the left or the right of the point where the home switch changes state. If the initial position is situated so that the direction of movement shall reverse during homing, the point at which the reversal takes place is anywhere after a change of state of the home switch.

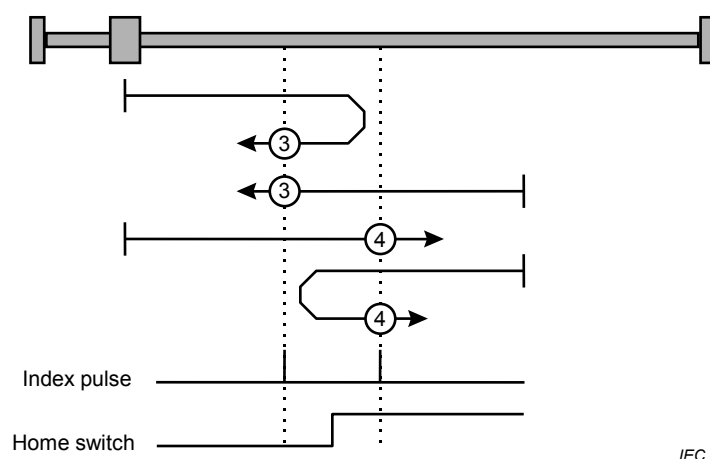


Figure 29 – Homing on positive home switch and index pulse

11.3.5 Method 5 and 6: Homing on negative home switch and index pulse

Using these methods as shown in Figure 30, the initial direction of movement shall be dependent on the state of the home switch. The home position shall be at the index pulse to either to the left or the right of the point where the home switch changes state. If the initial position is situated so that the direction of movement shall reverse during homing, the point at which the reversal takes place is anywhere after a change of state of the home switch.

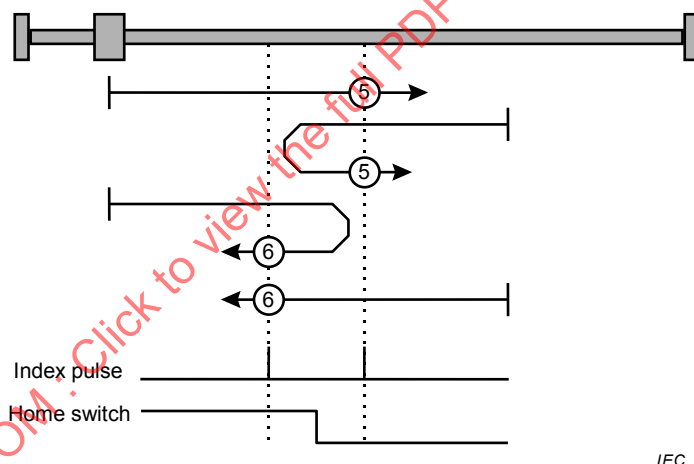


Figure 30 – Homing on negative home switch and index pulse

11.3.6 Method 7 to 14: Homing on home switch and index pulse

These methods use a home switch, which is active over only a portion of the travel, in effect the switch has a 'momentary' action as the axis's position sweeps past the switch. Using the methods 7 to 10, the initial direction of movement shall be to the right, and using methods 11 to 14, the initial direction of movement shall be to the left except if the home switch is active at the start of the motion. In this case, the initial direction of motion shall be dependent on the edge being sought. The home position shall be at the index pulse on either side of the rising or falling edges of the home switch, as shown in Figure 31 and Figure 32. If the initial direction of movement leads away from the home switch, the drive shall reverse on encountering the relevant limit switch.

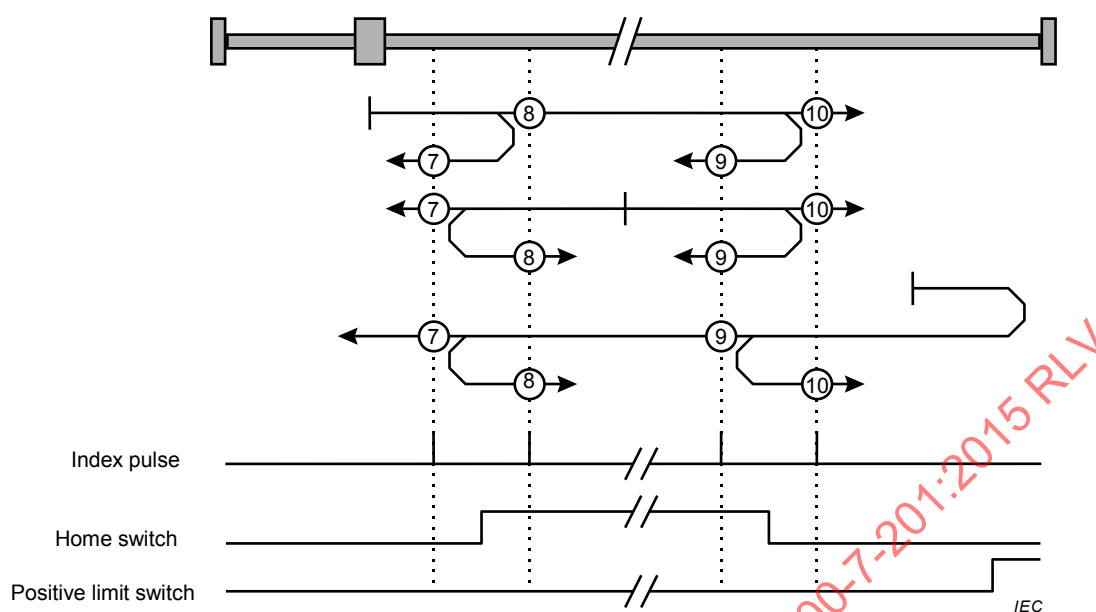


Figure 31 – Homing on home switch and index pulse – positive initial motion

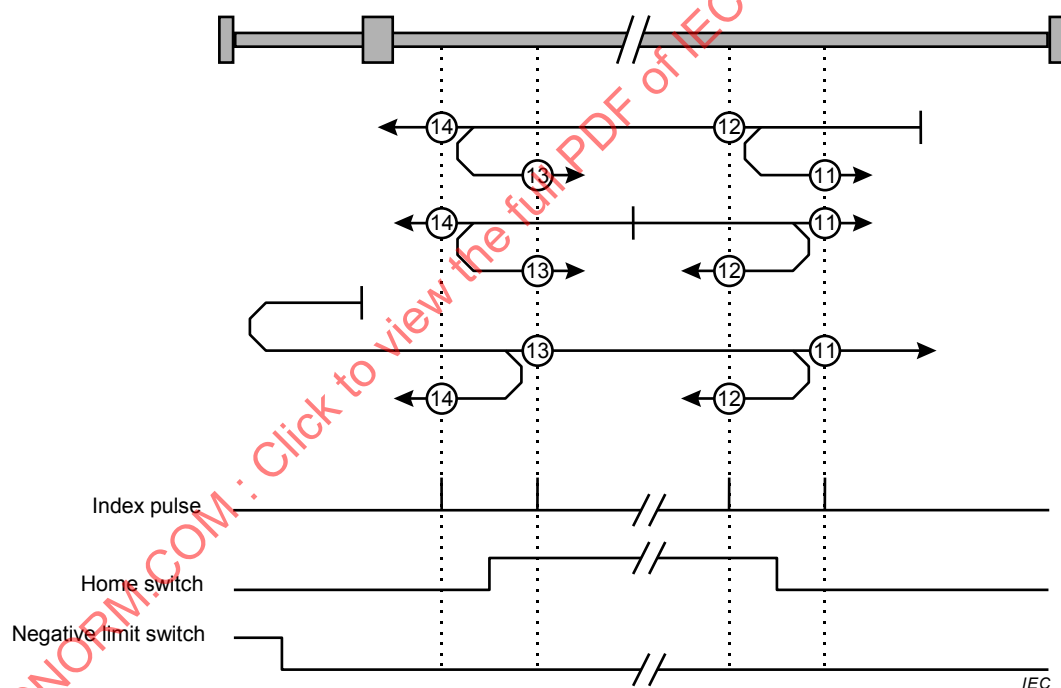


Figure 32 – Homing on home switch and index pulse – negative initial motion

11.3.7 Method 15 and 16: Reserved

These methods are reserved.

11.3.8 Method 17 to 30: Homing without index pulse

These methods are similar to methods 1 to 14 except that the home position is not dependent on the index pulse but only dependent on the relevant home or limit switch transitions. For example methods 19 and 20 are similar to methods 3 and 4 as shown in Figure 33.

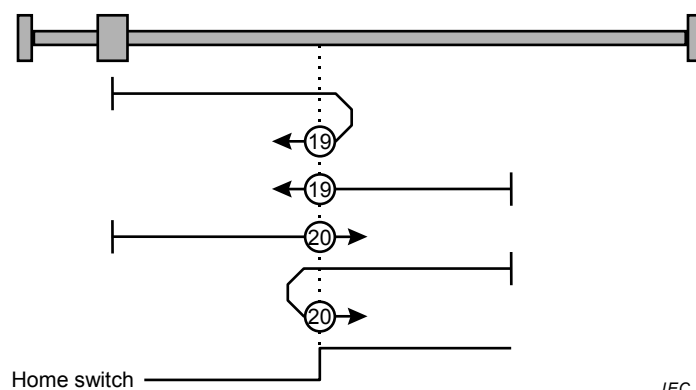


Figure 33 – Homing on positive home switch

11.3.9 Method 31 and 32: Reserved

These methods are reserved.

11.3.10 Method 33 and 34: Homing on index pulse

Using these methods, the direction of homing is negative or positive respectively. The home position shall be at the index pulse found in the selected direction as shown in Figure 34.

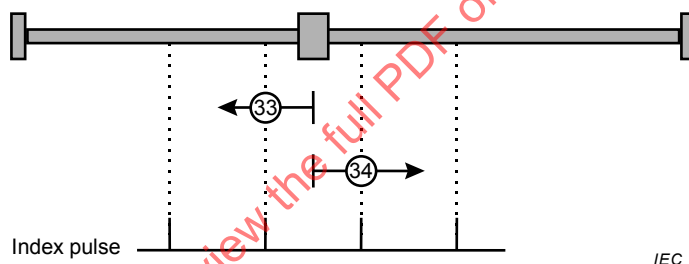


Figure 34 – Homing on index pulse

11.3.11 Method 35: Homing on current position (obsolete)

In this method, the current position shall be taken to be the home position. This method does not require the drive device to be in operation enabled state.

NOTE This method is obsolete because of compatibility reasons.

11.3.12 Method 36: Reserved for compatibility reasons

11.3.13 Method 37: Homing on current position

In this method, the position sensor information (converted in user-defined position units) shall be taken to be the home position. This method does not require the drive device to be in operation enabled state.

At the home position (i.e. after the homing process) the position actual value (6064_h) is calculated as follows:

$$\text{Position actual value } (6064_h) = \text{Home offset } (607C_h)$$

EXAMPLE: The control device can set the operation mode and runs the drive to the home position. At the home position the control device switches the operation mode to the homing mode, method 37. The drive takes the current mechanical position as the machine home position. Then the control device switches back to operation mode.

11.4 Use of controlword and statusword

The homing mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 35 shows the structure of the controlword. Table 120 defines the values for bit 4 and 8 of the controlword.

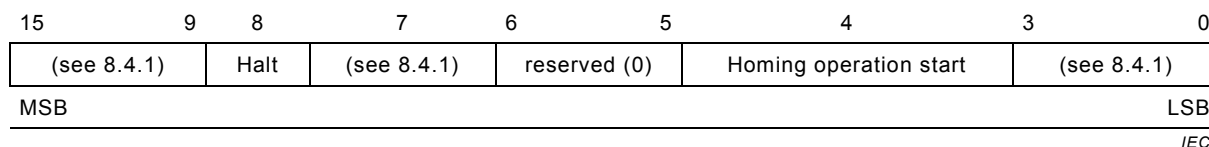


Figure 35 – Controlword for homing mode

Table 120 – Definition of bit 4 and bit 8

Bit	Value	Definition
4	0	Do not start homing procedure
	1	Start or continue homing procedure
8	0	Enable bit 4
	1	Stop axis according to halt option code (605D _h)

Figure 36 shows the structure of the statusword. Table 121 defines the values for bit 10, bit 12, and bit 13. Bit 12 shall provide the actual homing status. Bit 12 may be used to observe whether homing is attained without executing the homing procedure.

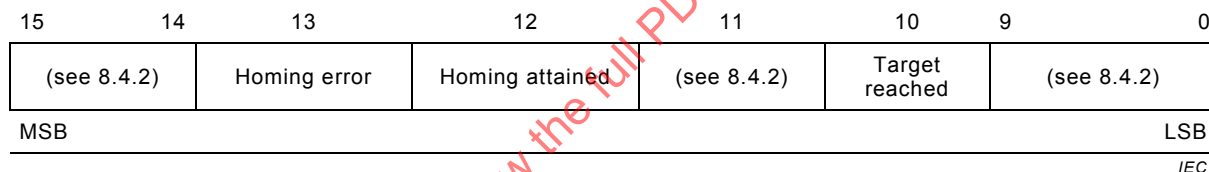


Figure 36 – Statusword for homing mode

Table 121 – Definition of bit 10, bit 12, and bit 13

Bit 13	Bit 12	Bit 10	Definition
0	0	0	Homing procedure is in progress
0	0	1	Homing procedure is interrupted or not started
0	1	0	Homing is attained, but target is not reached
0	1	1	Homing procedure is completed successfully
1	0	0	Homing error occurred, velocity is not 0
1	0	1	Homing error occurred, velocity is 0
1	1	X	Reserved

11.5 Detailed object definitions

11.5.1 Object 607C_h: Home offset

This object shall indicate the configured difference between the zero position for the application and the machine home position (found during homing). During homing, the machine home position is found and once the homing is completed, the zero position is offset from the home position by adding the home offset to the home position.

The zero position is calculated by following equation:

zero position = home position + home offset

All subsequent absolute moves shall be taken relative to this new zero position. This is illustrated in Figure 37. If this object is not implemented, then the home offset shall be regarded as zero. The value of this object shall be given in user-defined position units. Negative values shall indicate the opposite direction.

The activation of a new value of the object home offset is manufacturer-specific. It is recommended to apply the new value only while the drive is in homing mode.

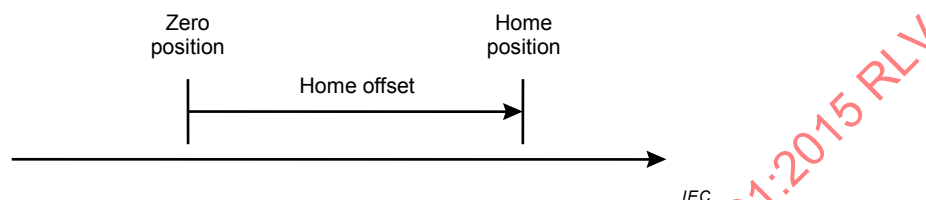


Figure 37 – Home offset definition

Table 122 specifies the object description, and Table 123 specifies the entry description.

Table 122 – Object description

Attribute	Value
Index	607C _h
Name	Home offset
Object code	Variable
Data type	Integer32
Category	Optional

Table 123 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	0 _d

11.5.2 Object 6098_h: Homing method

This object shall indicate the configured homing method that shall be used. Table 124 specifies the value definition, Table 125 specifies the object description, and Table 126 specifies the entry description.

Table 124 – Value definition

Value	Definition
-128_d to -1_d	Manufacturer-specific
0_d	No homing method assigned
$+1_d$	Method 1 shall be used
to	
$+37_d$	Method 37 shall be used
$+38_d$ to $+127_d$	Reserved

Table 125 – Object description

Attribute	Value
Index	6098_h
Name	Homing method
Object code	Variable
Data type	Integer8
Category	Conditional: mandatory if hm is supported

Table 126 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 124
Default value	Manufacturer-specific

11.5.3 Object $60E3_h$: Supported homing methods

This object shall provide the supported homing methods of the drive. Table 124 specifies the value definition. Table 127 specifies the object description, and Table 128 specifies the entry description.

Table 127 – Object description

Attribute	Value
Index	$60E3_h$
Name	Supported homing methods
Object code	Array
Data type	Integer8
Category	Optional

Table 128 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st supported homing method
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	See Table 124
Default value	+37 _d
Sub-index	02 _h
Description	2nd supported homing method
Entry category	Optional
Access	c
PDO mapping	See IEC 61800-7-301
Value range	See Table 124
Default value	Manufacturer-specific
to	
Sub-index	FE _h
Description	254th supported homing method
Entry category	Optional
Access	c
PDO mapping	See IEC 61800-7-301
Value range	See Table 124
Default value	Manufacturer-specific

11.5.4 Object 6099_h: Homing speeds

This object shall indicate the configured speeds used during homing procedure. The values shall be given in user-defined velocity units. Table 129 specifies the object description, and Table 130 specifies the entry description.

Table 129 – Object description

Attribute	Value
Index	6099 _h
Name	Homing speeds
Object code	Array
Data type	Unsigned32
Category	Conditional: mandatory if hm is supported

Table 130 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Speed during search for switch
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Speed during search for zero
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

11.5.5 Object 609A_h: Homing acceleration

This object shall indicate the configured acceleration and deceleration to be used during homing operation. The value shall be given in user-defined acceleration units. Table 131 specifies the object description, and Table 132 specifies the entry description.

Table 131 – Object description

Attribute	Value
Index	609A _h
Name	Homing acceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 132 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

12 Touch probe functionality

12.1 Object 60B8_h: Touch probe function

This object shall indicate the configured function of the touch probe. Table 133 specifies the value definition, Table 134 specifies the object description, and Table 135 specifies the entry description.

Table 133 – Value definition

Bit	Value	Definition
0	0	Switch off touch probe 1
	1	Enable touch probe 1
1	0	Trigger first event
	1	continuous
3, 2	00 _b	Trigger with touch probe 1 input
	01 _b	Trigger with zero impulse signal or position encoder
	10 _b	Touch probe source as defined in object 60D0 _n , sub-index 01 _n
	11 _b	Reserved
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1
6, 7	–	User-defined (e.g. for testing)
8	0	Switch off touch probe 2
	1	Enable touch probe 2
9	0	Trigger first event
	1	Continuous
11, 10	00 _b	Trigger with touch probe 2 input
	01 _b	Trigger with zero impulse signal or position encoder
	10 _b	Touch probe source as defined in object 60D0 _n , sub-index 02 _n
	11 _b	Reserved
12	0	Switch off sampling at positive edge of touch probe 2
	1	Enable sampling at positive edge of touch probe 2
13	0	Switch off sampling at negative edge of touch probe 2
	1	Enable sampling at negative edge of touch probe 2
14, 15	–	User-defined (e.g. for testing)

Table 134 – Object description

Attribute	Value
Index	60B8 _n
Name	Touch probe function
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 135 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 133
Default value	Manufacturer-specific

12.2 Object 60B9_h: Touch probe status

This object shall provide the status of the touch probe. Table 136 specifies the value, Table 137 specifies the object description, and Table 138 specifies the entry description.

Table 136 – Value definition

Bit	Value	Definition
0	0	Touch probe 1 is switched off
	1	Touch probe 1 is enabled
1	0	Touch probe 1 no positive edge value stored
	1	Touch probe 1 negative edge position stored
2	0	Touch probe 1 no negative edge value stored
	1	Touch probe 1 positive edge position stored
3 to 5	0	Reserved
6, 7	–	User-defined (e.g. for testing)
8	0	Touch probe 2 is switched off
	1	Touch probe 2 is enabled
9	0	Touch probe 2 no positive edge value stored
	1	Touch probe 2 negative edge position stored
10	0	Touch probe 2 no negative edge value stored
	1	Touch probe 2 positive edge position stored
11 to 13	0	Reserved
14, 15	–	User-defined (e.g. for testing)

NOTE Bit 1 and bit 2 are set to 0_b when touch probe 1 is switched off (object 60B8_h bit 0 is 0_b). Bit 9 and 10 are set to 0_b when touch probe 2 is switched off (object 60B8_h bit 8 is 0_b).

Table 137 – Object description

Attribute	Value
Index	60B9 _h
Name	Touch probe status
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 138 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 136
Default value	No

12.3 Object 60BA_h: Touch probe 1 positive edge

This object shall provide the position value of the touch probe 1 at positive edge. The value shall be given in user-defined position units. Table 139 specifies the object description, and Table 140 specifies the entry description.

Table 139 – Object description

Attribute	Value
Index	60BA _h
Name	Touch probe positive edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 140 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

12.4 Object 60BB_h: Touch probe 1 negative edge

This object shall provide the position value of the touch probe 1 at negative edge. The value shall be given in user-defined position units. Table 141 specifies the object description, and Table 142 specifies the entry description.

Table 141 – Object description

Attribute	Value
Index	60BB _h
Name	Touch probe 1 negative edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 142 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

12.5 Object 60BC_h: Touch probe 2 positive edge

This object shall provide the position value of the touch probe 2 at positive edge. The value shall be given in user-defined position units. Table 143 specifies the object description, and Table 144 specifies the entry description.

Table 143 – Object description

Attribute	Value
Index	60BC _h
Name	Touch probe 2 positive edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 144 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

12.6 Object 60BD_h: Touch probe 2 negative edge

This object shall provide the position value of the touch probe 2 at negative edge. The value shall be given in user-defined position units. Table 145 specifies the object description, and Table 146 specifies the entry description.

Table 145 – Object description

Attribute	Value
Index	60BD _h
Name	Touch probe 2 negative edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 146 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

12.7 Object 60D0_h: Touch probe source

This object shall provide the source of the touch probe functions. Table 147 specifies the value definition.

Table 148 specifies the object description, and Table 149 specifies the entry description.

Table 147 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Reserved
+1	Touch probe 1 input
+2	Touch probe 2 input
+3	Touch probe 3 input
+4	Touch probe 4 input
+5	Hardware zero impulse signal of position encoder
+6	Software zero impulse signal of position encoder
+7 to +32 767	Reserved

Table 148 – Object description

Attribute	Value
Index	60D0 _h
Name	Touch probe source
Object code	Array
Data type	Integer16
Category	Optional

Table 149 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	No
Sub-index	01 _h
Description	Touch probe 1 source
Entry category	Mandatory
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 147
Default value	No
Sub-index	02 _h
Description	Touch probe 2 source
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 147
Default value	No
to	
Sub-index	FE _h
Description	Touch probe 254 source
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Table 147
Default value	No

12.8 Touch probe time stamp latch

12.8.1 General

In addition to the position values (objects 60BA_h, 60BB_h, 60BC_h and 60BD_h) the current time stamp may be latched by the device. The objects 60D1_h, 60D2_h, 60D3_h and 60D4_h provide the corresponding time stamp for touch probe 1 and 2. The control device may use several process values with the same time stamp to calculate new set-points.

12.8.2 Object 60D1_h: Touch probe time stamp 1 positive value

This object shall provide the time stamp value of the touch probe 1 at positive edge. The value shall be given in nanoseconds. Table 150 specifies the object description, and Table 151 specifies the entry description.

Table 150 – Object description

Attribute	Value
Index	60D1 _h
Name	Touch probe time stamp 1 positive value
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 151 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

12.8.3 Object 60D2_h: Touch probe time stamp 1 negative value

This object shall provide the time stamp value of the touch probe 1 at negative edge. The value shall be given in nanoseconds. Table 152 specifies the object description, and Table 153 specifies the entry description.

Table 152 – Object description

Attribute	Value
Index	60D2 _h
Name	Touch probe time stamp 1 negative value
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 153 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

12.8.4 Object 60D3_h: Touch probe time stamp 2 positive value

This object shall provide the time stamp value of the touch probe 2 at positive edge. The value shall be given in nanoseconds. Table 154 specifies the object description, and Table 155 specifies the entry description.

Table 154 – Object description

Attribute	Value
Index	60D3 _h
Name	Touch probe time stamp 2 positive value
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 155 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

12.8.5 Object 60D4_h: Touch probe time stamp 2 negative value

This object shall provide the time stamp value of the touch probe 2 at negative edge. The value shall be given in nanoseconds. Table 156 specifies the object description, and Table 157 specifies the entry description.

Table 156 – Object description

Attribute	Value
Index	60D4 _h
Name	Touch probe time stamp 2 negative value
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 157 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

12.9 Touch probe edge counter for continuous mode

12.9.1 General

For continuous touch probe mode (60B8_h, bit 1 = 1_b or 60B8_h, bit 9 = 1_b) a counter per touch probe channel is incremented on each touch probe event. Thus, the control device may check how many touch probe events happen between the control cycles. Per touch probe and per edge a counter object (objects 60D5_h, 60D6_h, 60D7_h and 60D8_h) is defined.

12.9.2 Object 60D5_h: Touch probe 1 positive edge counter

This object shall provide a continuous counter that is incremented with each positive edge at touch probe 1. The counter is only valid if the touch probe input is enabled (60B8_h, bit 0 = 1_b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.

Table 158 specifies the object description, and Table 159 specifies the entry description.

Table 158 – Object description

Attribute	Value
Index	60D5 _h
Name	Touch probe 1 positive edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 159 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	No

12.9.3 Object 60D6_h: Touch probe 1 negative edge counter

This object shall provide a continuous counter that is incremented with each negative edge at touch probe 1. The counter is only valid if the touch probe input is enabled (60B8_h, bit 0 = 1_b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.

Table 160 specifies the object description, and Table 161 specifies the entry description.

Table 160 – Object description

Attribute	Value
Index	60D6 _h
Name	Touch probe 1 negative edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 161 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	No

12.9.4 Object 60D7_h: Touch probe 2 positive edge counter

This object shall provide a continuous counter that is incremented with each positive edge at touch probe 2. The counter is only valid if the touch probe input is enabled (60B8_h, bit 8 = 1_b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.

Table 162 specifies the object description, and Table 163 specifies the entry description.

Table 162 – Object description

Attribute	Value
Index	60D7 _h
Name	Touch probe 2 positive edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 163 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	No

12.9.5 Object 60D8_h: Touch probe 2 negative edge counter

This object shall provide a continuous counter that is incremented with each negative edge at touch probe 2. The counter is only valid if the touch probe input is enabled (60B8_h, bit 8 = 1_b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.

Table 164 specifies the object description, and Table 165 specifies the entry description.

Table 164 – Object description

Attribute	Value
Index	60D8 _h
Name	Touch probe 2 negative edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 165 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	No

12.10 Timing diagram for touch probe example

Figure 38 shows a timing diagram for an example touch probe configuration and the corresponding behavior. Table 166 explains the timing diagram.

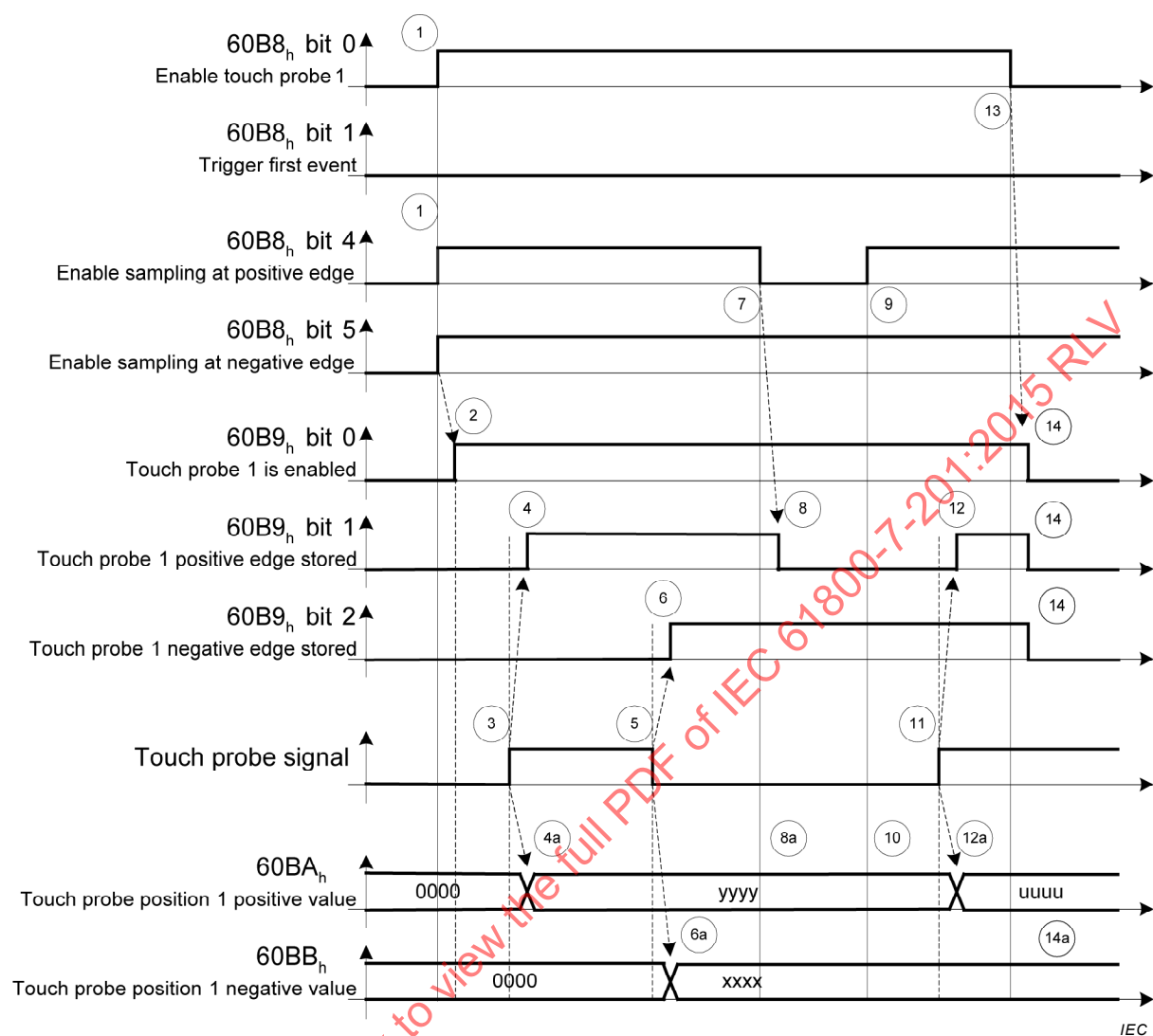


Figure 38 – Timing diagram for touch probe example

Table 166 – Explanation of the timing diagram

Number	Touch probe behavior	
(1)	60B8 _h , bit 0 = 1 _b	Enable touch probe 1
	60B8 _h , bit 1, 4, 5	Configure and enable touch probe 1 positive and negative edge
(2)	→ 60B9 _h , bit 0 = 1 _b	Status “Touch probe 1 enabled” is set
(3)	External touch probe signal has positive edge	
(4)	→ 60B9 _h , bit 1 = 1 _b	Status “Touch probe 1 positive edge stored” is set
(4a)	→ 60BA _h	Touch probe position 1 positive value is stored
(5)	External touch probe signal has negative edge	
(6)	→ 60B9 _h , bit 2 = 1 _b	Status “Touch probe 1 negative edge stored” is set
(6a)	→ 60BB _h	Touch probe position 1 negative value is stored
(7)	60B8 _h , bit 4 = 0 _b	Sample positive edge is disabled
(8)	→ 60B9 _h , bit 0 = 0 _b	Status “Touch probe 1 positive edge stored” is reset
(8a)	→ 60BA _h	Touch probe position 1 positive value is not changed
(9)	60B8 _h , bit 4 = 1 _b	Sample positive edge is enabled
(10)	→ 60BA _h	Touch probe position 1 positive value is not changed
(11)	External touch probe signal has positive edge	
(12)	→ 60B9 _h , bit 1 = 1 _b	Status “Touch probe 1 positive edge stored” is set
(12a)	→ 60BA _h	Touch probe position 1 positive value is stored
(13)	60B8 _h , bit 0 = 0 _b	Touch probe 1 is disabled
(14)	→ 60B9 _h , bit 0, 1, 2 = 0 _b	Status bits are reset
(14a)	→ 60BA _h , 60BB _h	Touch probe position 1 positive/negative value are not changed

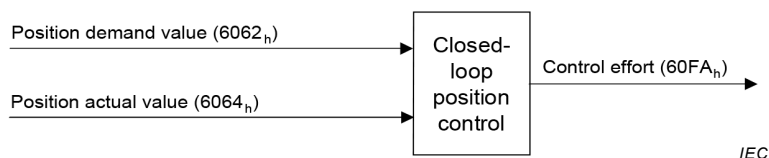
13 Position control function

13.1 General information

For closed-loop position, the position demand value (as one of the outputs of the trajectory generator) and the output of the position detection unit (position actual value) such as a resolver or encoder, are used input parameters. The behavior of the closed-loop control is influenced by control parameters, which are externally applicable. To keep the loop stable, a relative limitation of the output using the previous control effort is optional. In order not to exceed the physical limits of a drive, an absolute limit function may be implemented for the control effort.

13.2 Functional description

Figure 39 shows the inputs and outputs of the position control function. The control effort may be a velocity demand value, a position demand value or any other output value, depending on the modes of operation implemented in the drive device. Especially in cascaded control structures, where a position control is followed by a torque control, for example the control effort of the position control loop is used as an input for a further calculation.

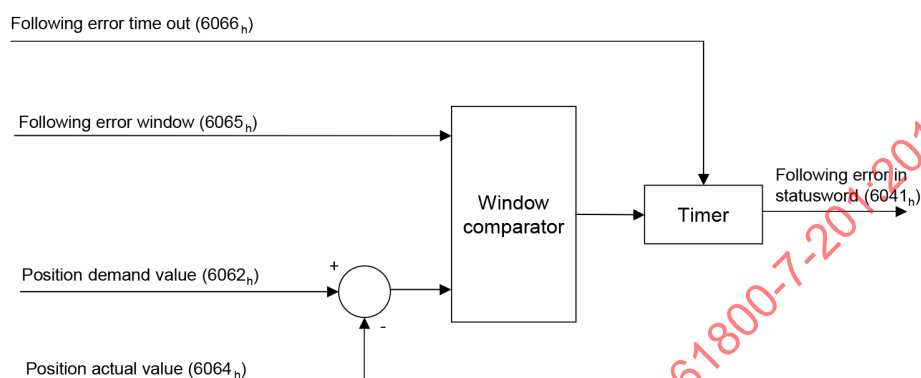


IEC

Figure 39 – Position control function

All values are transformed – if necessary – from user-defined units to normalized units such as increments.

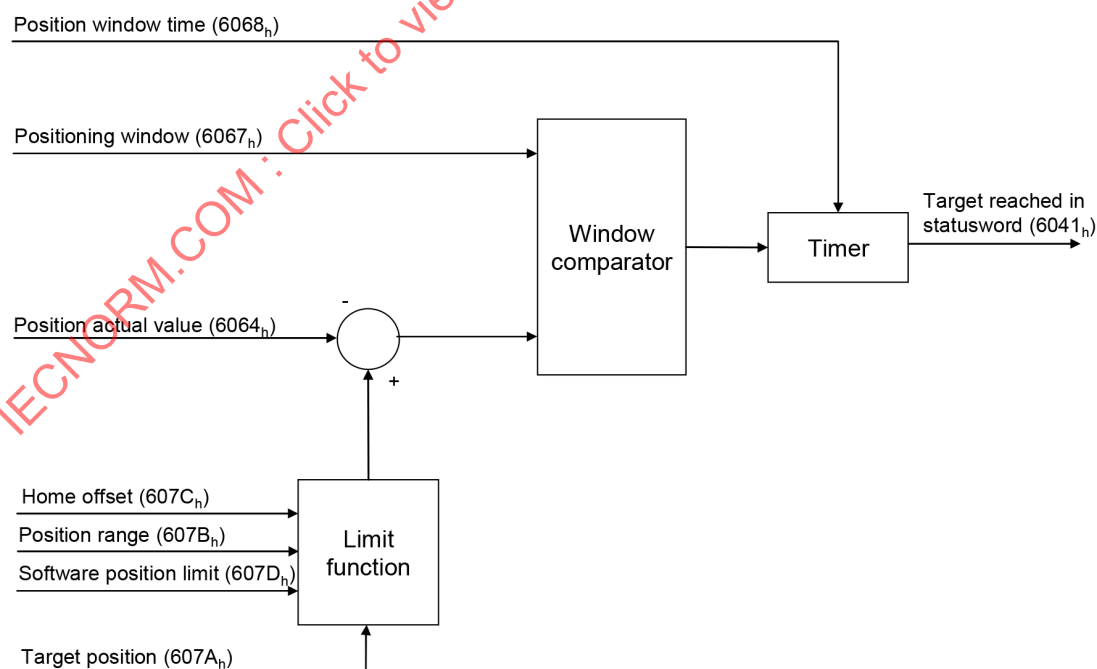
A position actual value outside the allowed range of the following error window around a position demand value for longer than the following error time out shall result in setting bit 13 (following error) in the statusword to 1. This is shown in detail in Figure 40. Depending on the supported modes of operation (pp, hm, or ip) and on the capabilities of different categories of drives, only some of the mentioned input parameters may be necessary.



IEC

Figure 40 – Following error (functional overview)

The position reached function as shown in Figure 41 offers the possibility to define a position range around a position demand value to be regarded as valid. If a drive's position is within this area for a specified time – the position window time – the related control bit 10 target reached in the statusword shall be set to 1.



IEC

Figure 41 – Position reached (functional overview)

The control functions following error and position reached have direct access to the statusword and shall give immediate notification to the user if their results change.

Figure 42 shows the definitions of the sub-function position reached. A window is defined for the accepted position range symmetrically around the target position. If a drive is situated in the accepted position range over the time position window time, the bit target reached (bit 10) in the statusword shall be set to 1.

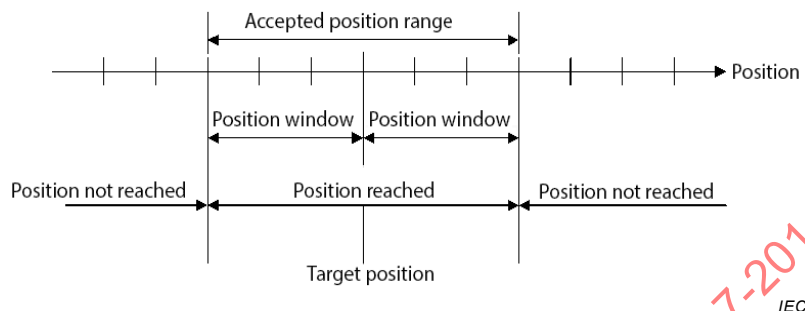


Figure 42 – Position reached (definitions)

Figure 43 shows the definitions of the sub-function following error in the profile position mode. A window is defined for the accepted following error tolerance symmetrically around the reference position. If a drive is situated out of the accepted position range for more than following error time out time, the bit following error (bit 13) in the statusword shall be set to 1.

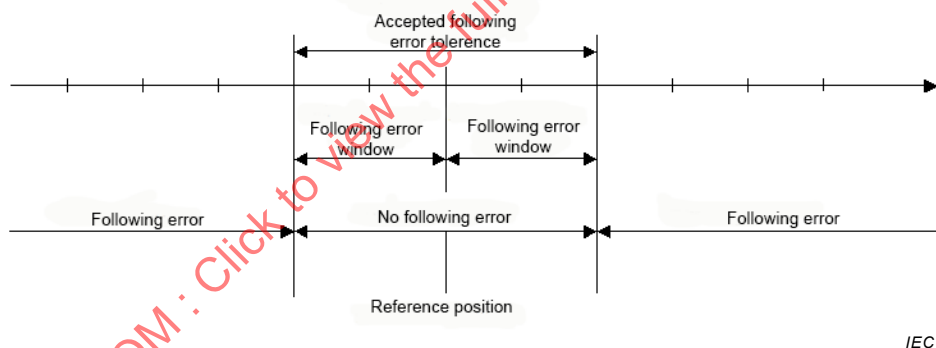


Figure 43 – Following error (definitions)

13.3 Detailed object definitions

13.3.1 Object 6062_h: Position demand value

This object shall provide the demanded position value. The value shall be given in user-defined position units. Table 167 specifies the object description, and Table 168 specifies the entry description.

Table 167 – Object description

Attribute	Value
Index	6062 _h
Name	Position demand value
Object code	Variable
Data type	Integer32
Category	Optional

Table 168 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.2 Object 6063_h: Position actual internal value

This object shall provide the actual value of the position measurement device, which shall be one of the two input values of the closed-loop position control. If necessary, the data unit may be transformed from user-defined units to increments. The value shall be given in internal units. Table 169 specifies the object description, and Table 170 specifies the entry description.

Table 169 – Object description

Attribute	Value
Index	6063 _h
Name	Position actual internal value
Object code	Variable
Data type	Integer32
Category	Optional

Table 170 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.3 Object 6064_h: Position actual value

This object shall provide the actual value of the position measurement device. The value shall be given in user-defined position units. Table 171 specifies the object description, and Table 172 specifies the entry description.

Table 171 – Object description

Attribute	Value
Index	6064 _h
Name	Position actual value
Object code	Variable
Data type	Integer32
Category	Mandatory if pp, ip or csp is supported

Table 172 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.4 Object 6065_h: Following error window

This object shall indicate the configured range of tolerated position values symmetrically to the position demand value. If the position actual value is out of the following error window, a following error occurs. A following error may occur when a drive is blocked, unreachable profile velocity occurs, or at wrong closed-loop coefficients. The value shall be given in user-defined position units. If the value of the following error window is FFFF FFFF_h, the following control shall be switched off. Table 173 specifies the object description, and Table 174 specifies the entry description.

Table 173 – Object description

Attribute	Value
Index	6065 _h
Name	Following error window
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 174 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

13.3.5 Object 6066_h: Following error time out

This object shall indicate the configured time for a following error condition, after that the bit 13 of the statusword shall be set to 1. The reaction of the drive when a following error occurs is manufacturer-specific. The value shall be given in ms. Table 175 specifies the object description, and Table 176 specifies the entry description.

Table 175 – Object description

Attribute	Value
Index	6066 _h
Name	Following error time out
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 176 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

13.3.6 Object 6067_h: Position window

This object shall indicate the configured symmetrical range of accepted positions relative to the target position. If the actual value of the position encoder is within the position window, this target position shall be regarded as having been reached. As the user mostly prefers to specify the position window in his application in user-defined units, the value is transformed into increments. The target position shall be handled in the same manner as in the trajectory generator concerning limiting functions and transformation into internal machine units before it may be used with this function. The value shall be given in user-defined position units. If the value of the position window is FFFF FFFF_h, the position window control shall be switched off. Table 177 specifies the object description, and Table 178 specifies the entry description.

Table 177 – Object description

Attribute	Value
Index	6067 _h
Name	Position window
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 178 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

13.3.7 Object 6068_h: Position window time

This object shall indicate the configured time, during which the actual position within the position window is measured. The value shall be given in ms. Table 179 specifies the object description, and Table 180 specifies the entry description.

Table 179 – Object description

Attribute	Value
Index	6068 _h
Name	Position window time
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 180 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

13.3.8 Object 60F4_h: Following error actual value

This object shall provide the actual value of the following error. The value shall be given in user-defined position units. Table 181 specifies the object description, and Table 182 specifies the entry description.

Table 181 – Object description

Attribute	Value
Index	60F4 _h
Name	Following error actual value
Object code	Variable
Data type	Integer32
Category	Optional

Table 182 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.9 Object 60FA_h: Control effort

This object shall provide the control effort as the output of the position control loop. It is particular to the position control function that the notation of the control effort is mode-dependent and therefore not specified. The value shall be given in user-defined velocity units. Table 183 specifies the object description, and Table 184 specifies the entry description.

Table 183 – Object description

Attribute	Value
Index	60FA _h
Name	Control effort
Object code	Variable
Data type	Integer32
Category	Optional

Table 184 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.10 Object 60FC_h: Position demand internal value

This object shall provide the output of the trajectory generator in profile position mode. This value shall be given in increments of the position encoder. Table 185 specifies the object description, and Table 186 specifies the entry description.

Table 185 – Object description

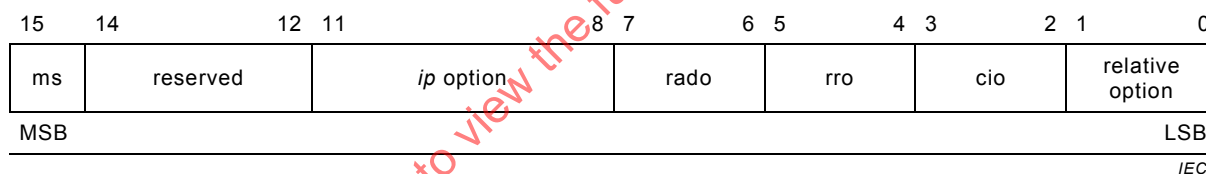
Attribute	Value
Index	60FC _h
Name	Position demand internal value
Object code	Variable
Data type	Integer32
Category	Optional

Table 186 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

13.3.11 Object 60F2_h: Positioning option code

This object shall indicate the configured positioning behavior as described by the profile positioning mode or the interpolated positioning mode. Figure 44 shows the defined object structure.

**Key**

ms	manufacturer-specific
rro	request-response option
cio	change immediately option
rado	rotary axis direction option

Figure 44 – Object structure

The relative option bits shall control the behavior of positioning tasks in detail when the abs/rel bit (bit 6) of the controlword is set to 1 in pp mode. Table 187 shows the bit value definitions.

Table 187 – Value definition for bit 0 and bit 1

Bit 1	Bit 0	Definition
0	0	Positioning moves shall be performed relative to the preceding (internal absolute) target position (rsp. relative to 0 if there is no preceding target position) as described in 10.2
0	1	Positioning moves shall be performed relative to the actual position demand value (object 60FC _h) – output of the trajectory generator
1	0	Positioning moves shall be performed relative to the position actual value (object 6064 _h)
1	1	Reserved

The change immediately option bits shall control the behavior of positioning tasks in detail when the change set immediately bit (bit 5) of the controlword is set to 1 in pp mode. Table 188 shows the bit value definitions.

Table 188 – Value definition for bit 2 and bit 3

Bit 3	Bit 2	Definition
0	0	The drive device shall readapt the actual motion to the new target position (considering potentially changed profile velocity and accelerations etc.) immediately as described in 10.2
0	1	The actually performed positioning task shall be continued (without attempting to stop on target position) and blended to the newly commanded task (considering potentially changed profile velocity and accelerations etc.) when target position is touched
1	0	Reserved
1	1	Reserved

The request-response option bits shall allow the drive device to release the new set-point bit (bit 4) of the controlword internally in order to avoid the need of setting this bit to 0 by the control device in pp mode. After internally releasing the new set-point bit, the drive device shall indicate the action to the control device by setting the set-point acknowledge bit (bit 12) in the statusword to 0. Table 189 shows the bit value definitions.

Table 189 – Value definition for bit 4 and bit 5

Bit 5	Bit 4	Definition
0	0	The handshake as described in 10.2 shall be performed
0	1	The drive device shall release autonomously the new set-point bit as soon as target is reached
1	0	The drive shall release autonomously the new set-point bit as soon as able to accept new set-point data
1	1	Reserved

Controlled rotary axes are needed for rotary tables and conveyor belts. It is also needed for cases where the host controller position limits are wider than the position range limits available in the drive. In these cases the software position limits (object 607D_h) are out of the position range limits (object 607B_h). To disable the position range limits the min position range limit (607B_h, sub-index 01_h) and max position range limit (607B_h, sub-index 02_h) shall be set to 0. Depending on the application, there are different rotary axis movements possible, which are coded by bit 6 and 7. Table 190 shows the bit value definitions.

Table 190 – Value definition for bit 6 and bit 7

Bit 7	Bit 6	Definition
0	0	Normal positioning similar to linear axis; If reaching or exceeding the position range limits (607B _h) the input value shall wrap automatically to the other end of the range. Positioning can be relative or absolute. Only with this bit combination, the movement greater than a modulo value is possible.
0	1	Positioning only in negative direction; if target position is higher than actual position, axis moves over the min position limit (607D _h , sub-index 01 _h) to the target position.
1	0	Positioning only in positive direction; if target position is lower than actual position, axis moves over the max position limit (607B _h , sub-index 02 _h) to the target position.
1	1	Positioning with the shortest way to the target position. NOTE If the difference between actual value and target position in a 360° system is 180°, the axis moves in positive direction.

Figure 45 shows movement examples depending on settings of the bits 6 and 7. Here the min position range limit (607B_h, sub-index 01_h) is 0° and the max position range limit (607B_h, sub-index 02_h) is 360°.

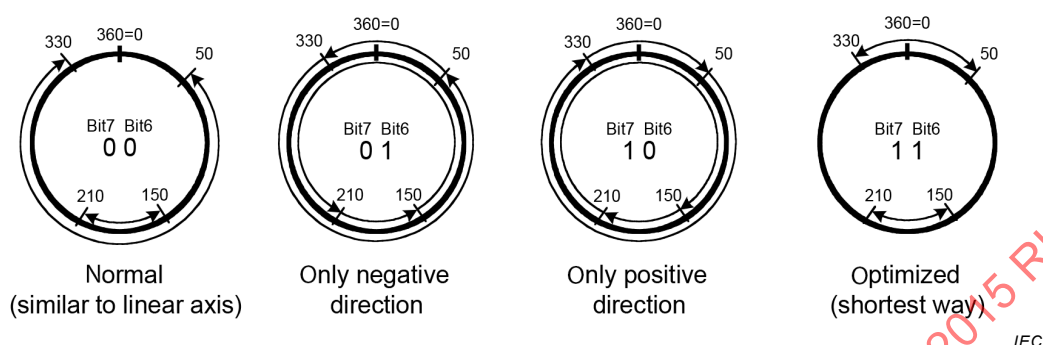


Figure 45 – Rotary axis positioning example

A movement greater than a modulo value with more than 360° (bit 6 and 7 in this object are set to 0) on a rotary axis can be done with relative and absolute values depending on the bit 6 in the controlword. In addition the relative option bits (bit 0 and 1 in this object) are valid. There are positive and negative values possible.

Figure 46 shows an example for absolute positioning in a 360° system. The actual position is 90° and absolute target position is 630°. The axis will move in positive direction one time via the max position limit to 270°. To move in negative direction, the negative sign for target position shall be used.

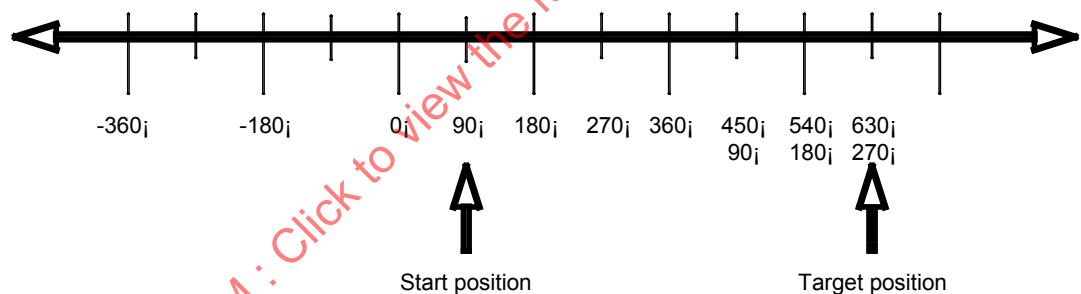


Figure 46 – Example for absolute movement greater than modulo value

Figure 47 shows an example for relative positioning in a 360° system. The actual position is 300° and relative target position is 500°. The axis will move in positive direction two times via the max position limit to 80°. To move in negative direction, the negative sign for target position shall be used. The difference between min and max position range limits (see object 607B_h) shall be representable in multiples of encoder increments.

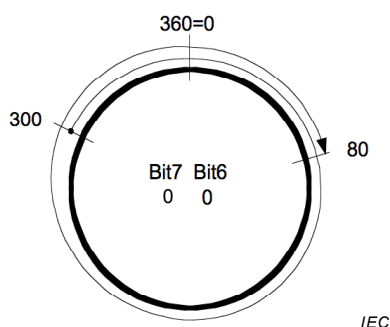


Figure 47 – Example for relative movement greater than modulo value

The ip option bits are reserved for defining the interpolated position mode. When the manufacturer-specific bit is set to 0, the function shall be not enabled; if it is set to 1, the manufacturer-specific function shall be enabled. The other reserved bits shall be set to 0.

Table 191 specifies the object description, and Table 192 specifies the entry description.

Table 191 – Object description

Attribute	Value
Index	60F2 _h
Name	Positioning option code
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 192 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 187, Table 188, Table 189
Default value	0000 _h

14 Interpolated position mode

14.1 General information

The interpolated position mode is used to control multiple coordinated axes or a single axis with the need for time-interpolation of set-point data. The interpolated position mode normally uses time synchronization mechanisms for a time coordination of the related drive units.

The interpolation data record contains the interpolation data; the data type of the sub-indices of this structure are manufacturer-specific.

For synchronous operation, the interpolation cycle time is defined by the object interpolation time period. Time synchronization may be done by network dependent mechanisms. Each synchronization cycle actuates the next data record if a valid data record is available.

For asynchronous operation, the interpolation time (for each time slice), may be included in the interpolation data record. If this is so, then the units for the interpolation time are still specified by the interpolation time index as for synchronous operation. The next data record shall be actuated as soon as the interpolation time expires and a valid data record is available.

The interpolated position mode allows the control device to transmit a stream of interpolation data with either an implicit or explicit time reference to a drive unit. If the drive supports an input buffer, the interpolation data may be sent in bursts rather than continuously in real time. The maximum size of the input buffer may be read by the control device using the interpolation data configuration. The actual buffer size may be both written and read by the control device using the interpolation data configuration. The buffer size is the number of interpolation data records which may be sent to a drive to fill the input buffer and it is not the size in bytes. Drive devices without input buffer capabilities shall accept at least one interpolation data item.

The interpolation data buffer may be implemented as a FIFO or a ring. The definition of a valid data record for each type of buffer shall be as follows:

- for the FIFO implementation, a valid data record is one that has not been actuated yet;
- for the ring implementation, all data records within the actual buffer size are treated as valid data records, so interpolation data will continue to be actuated while ip enable is true.

The interpolation algorithm is defined in the interpolation sub mode select (object 60C0h). Linear interpolation is the default interpolation method. This requires only one interpolation data item to be buffered for the calculation of the next demand value. For each interpolation cycle, the drive shall calculate a position demand value by interpolating positions over a period of time.

Optionally the common limit functions for speed, acceleration and deceleration may be applied to the interpolation data.

The placement of the scaling and limiting of the interpolation data record in Figure 48 is for indication only. These functions may be performed during the input of the interpolation data record.

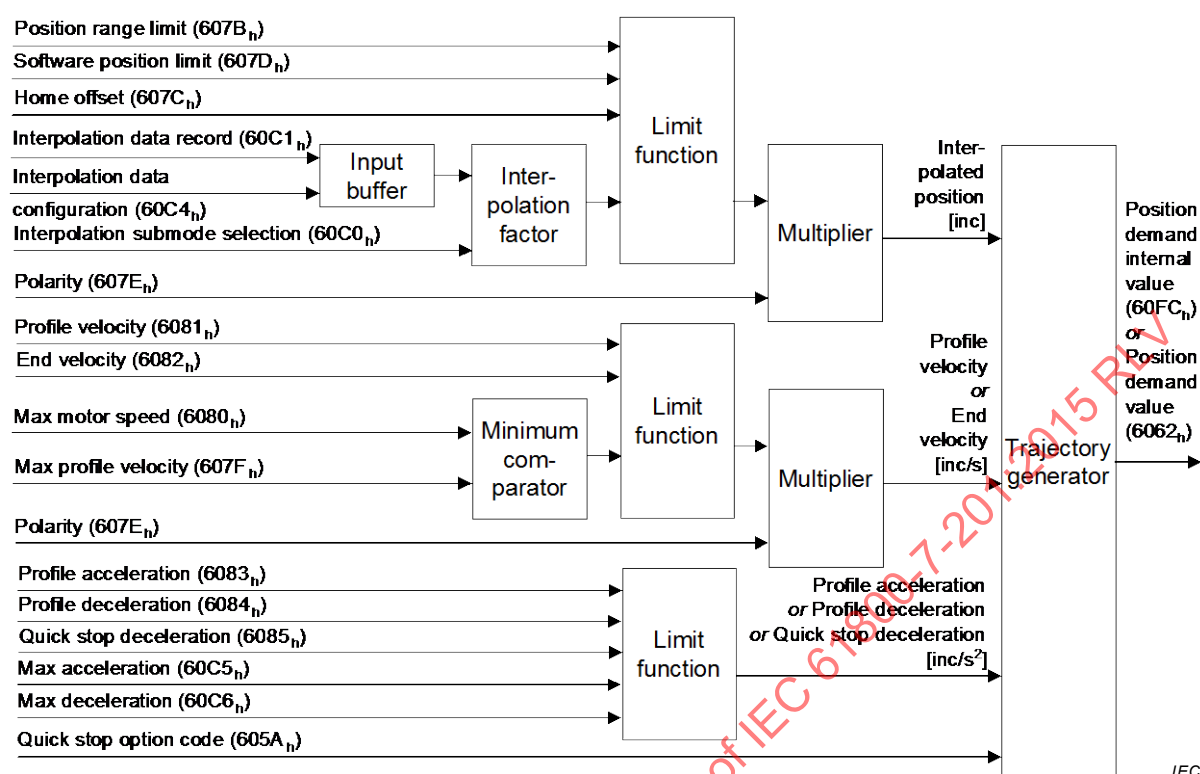


Figure 48 – Interpolation controller

14.2 Functional description

14.2.1 General

The manufacturer specifies the way the drive device handles the next valid interpolation data record. This may be in a way corresponding to the standard position mode, or might be a more complex algorithm. The standard method is to apply the new data immediately, after the next synchronization signal in synchronous mode or after the previous interpolation time has expired in asynchronous mode.

An input buffer for interpolation data records eases the data exchange between control device and drive device. The real-time requirements to the network as well as to the drive device decrease in this case, because an input buffer decouples the data processing in the drive device from the data transmission on the network.

14.2.2 Linear interpolated position mode with several axes

In order to follow a two- or more-dimensional curve through the space with a defined speed, the control device calculates the different positions P_i for each set of coordinates which shall be reached at specified times t_i .

For each set-point P_i the control device shall calculate x_i , y_i and t_i . Each axis gets a set of interpolation data records, which each axis shall process internally independent from the other axes according to the chosen interpolation mode. This is shown in Figure 49.

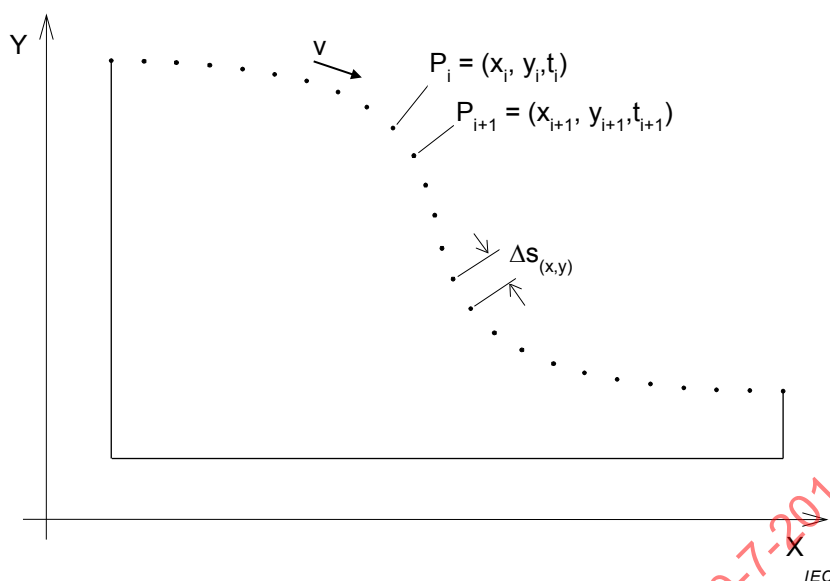


Figure 49 – Interpolated position mode for two axes

In a centralized drive system with a remote motion device doing the interpolation calculation, a central clocking scheme for synchronization of the different axes. This results in a movement depending on the calculation cycle time of the interpolation controller. The velocity becomes more or less a fixed value for each axis. This is detailed in Table 193.

Table 193 – Position calculation in interpolated position mode for several axes

Calculated positions	ip data records for		
	x-axis	y-axis	z-axis
P_i	x_i, t_i	y_i, t_i	z_i, t_i
$P_i + 1$	$x_i + 1, t_i + 1$	$y_i + 1, t_i + 1$	$z_i + 1, t_i + 1$
$P_i + 2$	$x_i + 2, t_i + 2$	$y_i + 2, t_i + 2$	$z_i + 2, t_i + 2$
...	...	...	...
$P_i + n$	$x_i + n, t_i + n$	$y_i + n, t_i + n$	$z_i + n, t_i + n$

In decentralized motion systems, the control device starts all relevant axes by changing the mode-internal state to interpolation active after preparing and sending one or more interpolation data records to all axes and synchronizes them. Each axis calculates internally and independently the necessary speed and acceleration needed to move from one position to the next. This may be done by calculating a linear or any other move between two given position set-points. Along this track, every axis controls the movement between the set-points independently from the other axes. The axes may continue their movement, as long as there is enough data to continue the calculations. Therefore it is easy to use the input buffer to give data records ahead.

With this information, each axis may act as shown in Figure 50.

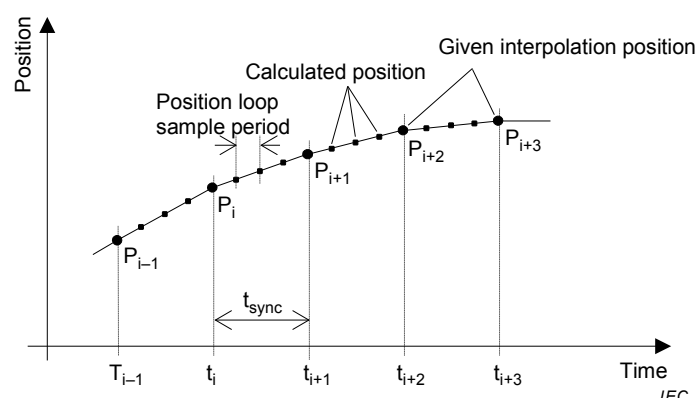


Figure 50 – Linear interpolation for one axis

NOTE In CANopen synchronous mode, the interpolation time is normally the same as the nominal period for the sync signal.

14.2.3 Buffer strategies for the interpolated position mode

If a drive device provides an input buffer for interpolation data records, its size may be organized by the control device using the interpolation data configuration. The control device splits the available buffer capacity into pages which have the size of one interpolation data record each. This is done by size of data record. If one page remains, which does not keep one complete data record, it may not be used. After the reorganization of the input buffer, all previous stored data will be lost. All devices supporting the interpolated position mode shall implement an input buffer, which at least may keep one interpolation data record. The input buffer organization is specified in Figure 51.

The content of the buffer items may only be accessed via the interpolation data record.

Commonly, first-in-first-out (FIFO) structures or ring buffers are used as input buffers.

FIFO: If the buffer is organized as FIFO, every new received interpolation data record is placed at the end of the queue, and the device takes the next data record from the top of the queue. When the last item of a data record is stored, the buffer pointer is incremented in order to point to the next buffer position. For this buffer principle, the object buffer position does not have any influence.

Ring buffer: If the buffer is structured as a ring, the control device may place an interpolation data record into any valid position in the ring by changing the pointer defined in buffer position. Without changing the buffer position, all data records will be written at the same location. The drive reads the next entry out of the buffer by an internal ring pointer. It is set to the first data record with a clear buffer, and after the reorganization of the input buffer.

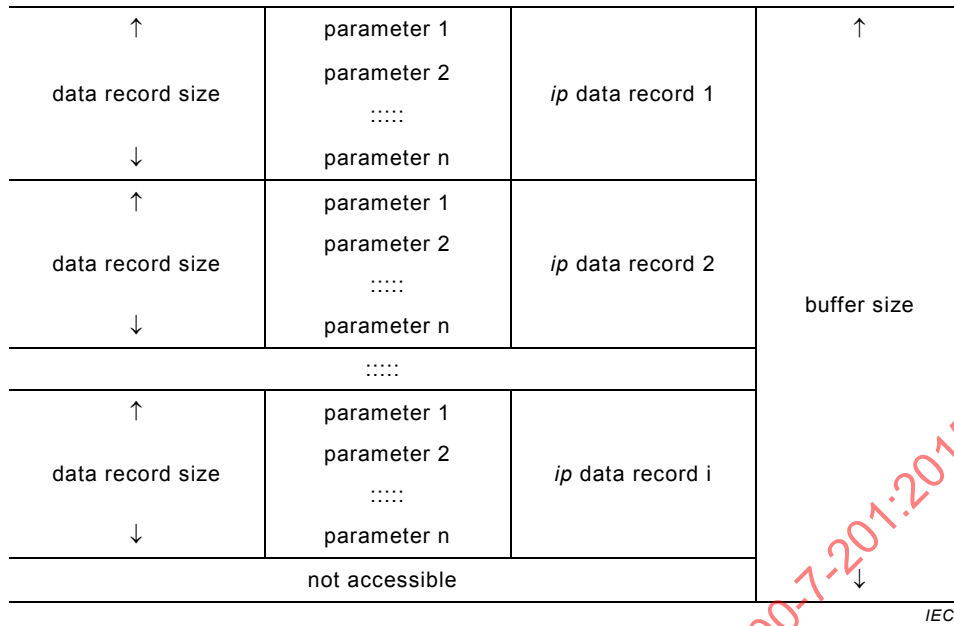
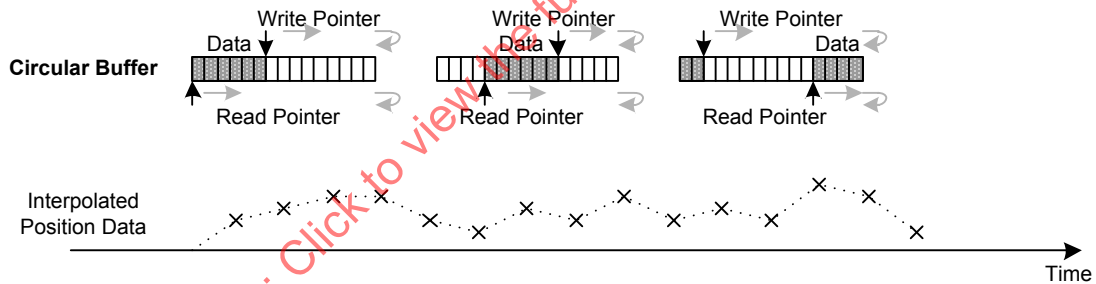


Figure 51 – Input buffer organization

Figure 52 shows the difference between a FIFO buffer and a ring buffer. The ring buffer may be used to achieve a periodic motion and all data records in the actual data buffer are considered to be valid. If no new data is written to the FIFO, then the motion shall halt and interpolation should become inactive at the last valid data point.

FIFO



Ring

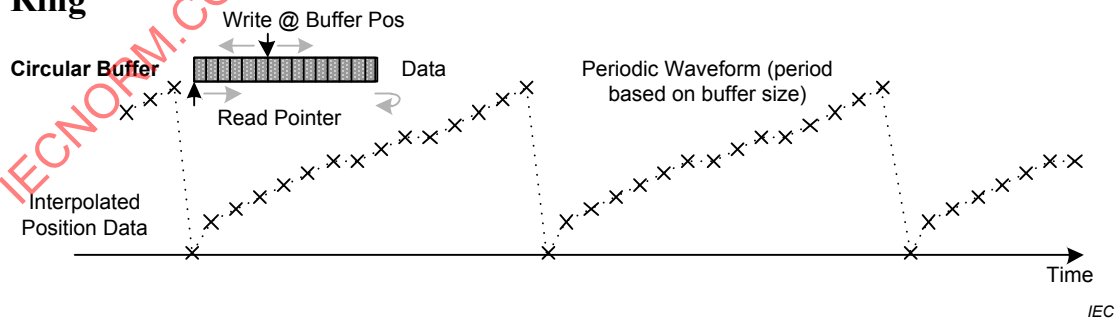
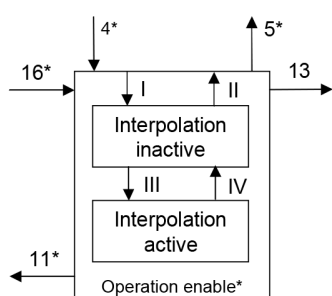


Figure 52 – Input buffer examples

14.2.4 Interpolated position mode FSA

Figure 53 specifies the interpolated position mode FSA. It is a sub FSA of the operation enabled state as shown in Figure 4.



* See power drive system FSA

IEC

Figure 53 – Interpolated position mode FSA

The FSA states shall support the functions as shown in Table 194.

Table 194 – FSA states and supported functions

FSA state	Function
Interpolation inactive	The drive device will accept input data and will buffer it for interpolation calculations, but it does not move the axis.
Interpolation active	The drive unit will accept input data and it moves the axis.

The drive device supporting the ip mode shall support the transitions and actions as given in Table 195. The events shall initiate the transitions. The transition shall be terminated, after the action has been performed.

Table 195 – Transition events and actions

Transition	Event(s)	Action(s)
I	ip mode selected (see object 6060 _h)	None
II	ip mode not selected (see object 6060 _h)	None
III	Enable interpolation (bit 4 of the controlword is 1)	None
IV	Disable interpolation (bit 4 of the controlword is 0)	None

14.3 General definitions

The output values provided by the interpolated position mode depend on the number and type of interpolation functions implemented. For the predefined linear time interpolation, the output is a position demand internal value.

14.4 Use of controlword and statusword

The interpolated position mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 54 shows the structure of the controlword. Table 196 defines the values for bit 4 and bit 8 of the controlword.

15	9	8	7	6	5	4	3	0
(see 8.4.1)	Halt	(see 8.4.1)	reserved (0)	Enable interpolation	(see 8.4.1)			
MSB								LSB

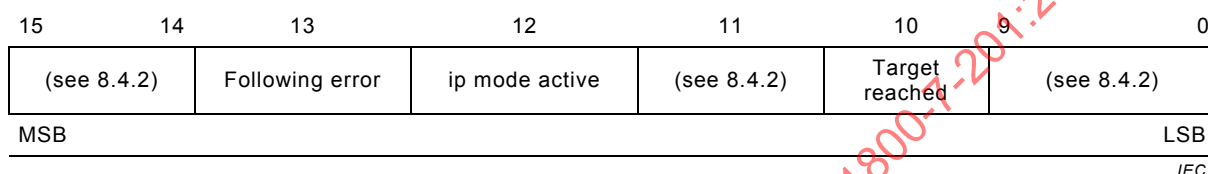
IEC

Figure 54 – Controlword for interpolated position mode

Table 196 – Definition of bit 4 and bit 8

Bit	Value	Definition
4	0	Disable interpolation
	1	Enable interpolation
8	0	Execute instruction of bit 4
	1	Axis shall be stopped accordingly to halt option code (605D _h), and bit 12 in the statusword shall be set to 0

Figure 55 shows the structure of the statusword. Table 197 defines the values for bit 10 and bit 12 of the statusword. The target position reached bit shall remain 0 until all set-points are processed.

**Figure 55 – Statusword for interpolated position mode****Table 197 – Definition of bit 10 and bit 12**

Bit	Value	Definition
10	0	Target position not (yet) reached (if Halt bit in last controlword was 0) or axle decelerates (if Halt bit in last controlword was 1)
	1	Target position reached (if Halt bit in last controlword was 0) or axle has velocity 0 (if halt bit in last controlword was 1)
12	0	Interpolation inactive
	1	Interpolation active
13	0	No following error
	1	Following error

14.5 Detailed object definitions

14.5.1 Object 60C0_h: Interpolation sub mode select

This object shall indicate the actually chosen interpolation mode. If linear interpolation is the only algorithm available, then it is not necessary to implement this object. If a manufacturer-specific interpolation mode is selected, the corresponding interpolation data record shall be implemented in the manufacturer-specific profile area of the object dictionary. If the linear interpolation mode is selected, the interpolation data given in object 60C1_h shall be used. Table 198 specifies the value definition, Table 199 specifies the object description, and Table 200 specifies the entry description.

Table 198 – Value definition

Value	Definition
–32 768 to –1	Manufacturer-specific
0	Linear interpolation
+1 to +32 767	Reserved

Table 199 – Object description

Attribute	Value
Index	60C0 _h
Name	Interpolation sub mode select
Object code	Variable
Data type	Integer16
Category	Optional

Table 200 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 198
Default value	0

14.5.2 Object 60C1_h: Interpolation data record

This object shall indicate data words, which are necessary to perform the interpolation algorithm. The number N of data words in the record is defined by interpolation data configuration. The interpretation of the data words in interpolation data record may vary with the different possible interpolation modes as set by the interpolation sub mode select.

For the linear interpolation mode, each interpolation data record simply is regarded as a new position set-point. To describe a cubic spline interpolation, four or more data words are needed for the spline coefficients, and further interpolation parameters.

After the last item of an interpolation data record is written to the drive device's input buffer, the pointer of the buffer shall be automatically incremented to the next buffer position.

Table 201 specifies the object description, and Table 202 specifies the entry description.

Table 201 – Object description

Attribute	Value
Index	60C1 _h
Name	Interpolation data record
Object code	Array
Data type	Integer32
Category	Optional

Table 202 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st set-point
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	2nd set-point
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific
to	
Sub-index	FE _h
Description	254th set-point
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

14.5.3 Object 60C2_h: Interpolation time period

This object shall indicate the configured interpolation cycle time. The interpolation time period (sub-index 01_h) value shall be given in 10^(interpolation time index) s(econd). The interpolation time index (sub-index 02_h) shall be dimensionless.

Table 203 specifies the object description, and Table 204 specifies the entry description.

Table 203 – Object description

Attribute	Value
Index	60C2 _h
Name	Interpolation time period
Object code	Record
Data type	Interpolation time period record (0080 _h)
Category	Conditional: mandatory if ip, csp, csv or cst mode is supported

Table 204 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Interpolation time period value
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned8
Default value	01 _h
Sub-index	02 _h
Description	Interpolation time index
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	–128 to +63
Default value	–3

14.5.4 Object 60C4_h: Interpolation data configuration

This object shall provide the maximum buffer size, shall indicate the configured buffer organization of interpolation data, and shall provide objects to define the size of the data record and to clear the buffers. This object is used to enable the drive device to receive the needed data in advance. It also is used to store the positions and further data sent by the control device.

The value of sub-index 01_h shall be given in numbers of interpolation data records.

The value of sub-index 02_h shall be given in numbers of interpolation data records.

If sub-index 03_h is 00_h this shall indicate a FIFO buffer organization, if it is 01_h this shall indicate a ring buffer organization. All other values are reserved.

The value of sub-index 04_h shall be dimensionless indicating the next free buffer entry point.

The value of sub-index 05_h shall be given in bytes.

If 00_h is written to sub-index 06_h this shall clear the buffer inputs, shall disable the access, and shall clear all ip data records. If 01_h is written to sub-index 06_h, this enables access to the input buffers. All other values are reserved.

Table 205 specifies the object description, and Table 206 specifies the entry description.

Table 205 – Object description

Attribute	Value
Index	60C4 _h
Name	Interpolation data configuration
Object code	Record
Data type	Interpolation data configuration record (for data type of the sub-indices see record 0081 _h)
Category	Optional

Table 206 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	06 _h
Default value	06 _h
Sub-index	01 _h
Description	Maximum buffer size
Entry category	Mandatory
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No
Sub-index	02 _h
Description	Actual buffer size
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	0000 0000 _h
Attribute	Value
Sub-index	03 _h
Description	Buffer organisation
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	00 _h or 01 _h
Default value	00 _h
Sub-index	04 _h
Description	Buffer position
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	0000 _h

Sub-index	05 _h
Description	Size of data record
Entry category	Mandatory
Access	wo
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	01 _h
Sub-index	06 _h
Description	Buffer clear
Entry category	Mandatory
Access	wo
PDO mapping	See IEC 61800-7-301
Value range	00 _h or 01 _h
Default value	00 _h

15 Profile velocity mode

15.1 General information

The profile velocity mode covers the following sub-functions:

- demand value input via trajectory generator;
- velocity capture using position sensor or velocity sensor;
- velocity control function with appropriate input and output signals;
- monitoring of the profile velocity using a window-function;
- monitoring of velocity actual value using a threshold.

The operation of the reference value generator and the following input parameters are described in Clause 10:

- profile velocity;
- profile acceleration;
- profile deceleration;
- quick stop deceleration;
- motion profile type.

Various sensors may be used for velocity capture. In particular, the aim is that costs are reduced and the drive power system is simplified by evaluating position and velocity using a common sensor, such as is optional using a resolver or an encoder.

The velocity control function is not specified more precisely at this point, as it is highly manufacturer-specific. Monitoring functions for the velocity actual value provide status information for super-ordinated systems.

15.2 Functional description

Figure 56 shows the defined structure of the profile velocity mode. The actual velocity may be obtained through differentiation from the position encoder and is represented in position encoder increments.

The target reached bit (bit 10) shall be set to 1 in the statusword when the difference between the target velocity and the velocity actual value is within the velocity window longer than the velocity window time.

As soon as the velocity actual value exceeds the velocity threshold longer than the velocity threshold time, then bit 12 shall be set to 0 in the statusword. Below this threshold, the bit shall be set to 1 and shall indicate that the axis is stationary.

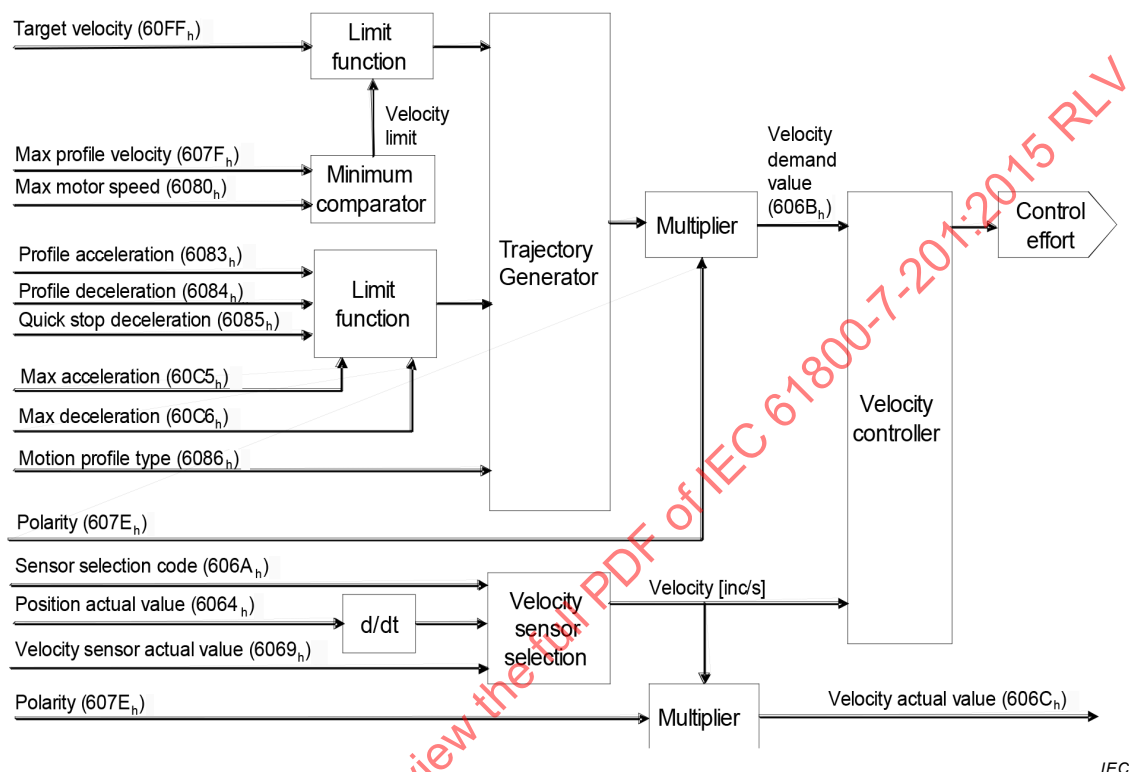


Figure 56 – Profile velocity mode

15.3 General definitions

The factors necessary for scaling have a linear relationship and therefore they are described in the factor group. The polarity is described in the factor group as well.

15.4 Use of controlword and statusword

The profile velocity mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 57 shows the structure of the controlword. Table 207 defines the values for bit 8 of the controlword.

15	9	8	7	6	4	3	0
(see 8.4.1)	Halt	(see 8.4.1)	reserved	(see 8.4.1)			
MSB							LSB

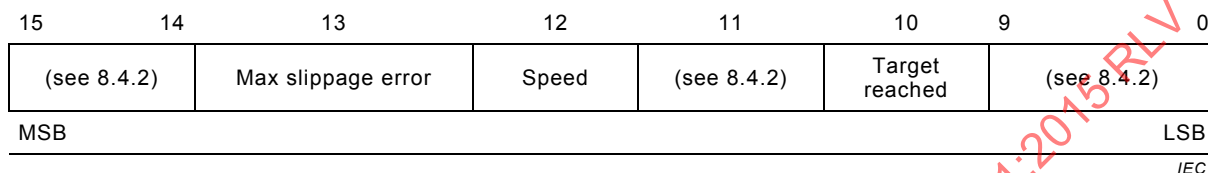
IEC

Figure 57 – Controlword for profile velocity mode

Table 207 – Definition of bit 8

Bit	Value	Definition
8	0	The motion shall be executed or continued
	1	Axis shall be stopped according to the halt option code (605D _h)

Figure 58 shows the structure of the statusword. Table 208 defines the values for bit 10, 12, and 13 of the statusword.

**Figure 58 – Statusword for profile velocity mode****Table 208 – Definition of bit 10, bit 12, and bit 13**

Bit	Value	Definition
10	0	Halt (bit 8 in controlword) = 0: Target not reached Halt (bit 8 in controlword) = 1: Axis decelerates
	1	Halt (bit 8 in controlword) = 0: Target reached Halt (bit 8 in controlword) = 1: Velocity of axis is 0
12	0	Speed is not equal 0
	1	Speed is equal 0
13	0	Maximum slippage not reached
	1	Maximum slippage reached

15.5 Detailed object definitions

15.5.1 Object 6069_h: Velocity sensor actual value

This object shall provide the value read from a velocity sensor. The value shall be given in increments per second. Table 209 specifies the object description, and Table 210 specifies the entry description.

Table 209 – Object description

Attribute	Value
Index	6069 _h
Name	Velocity sensor actual value
Object code	Variable
Data type	Integer32
Category	Optional

Table 210 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

15.5.2 Object 606A_h: Sensor selection code

This object shall provide the source of the velocity sensor actual value. It determines whether a differentiated position signal or the signal from a separate velocity sensor is evaluated. Table 211 specifies the value definition, Table 212 specifies the object description, and Table 213 specifies the entry description.

Table 211 – Value definition

Value	Definition
0000 _h	Actual velocity value from position encoder
0001 _h	Actual velocity value from velocity encoder
0002 _h to 7FFF _h	Reserved
8000 _h to FFFF _h	Manufacturer-specific

Table 212 – Object description

Attribute	Value
Index	606A _h
Name	Sensor selection code
Object code	Variable
Data type	Integer16
Category	Optional

Table 213 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See Table 211
Default value	Manufacturer-specific

15.5.3 Object 606B_h: Velocity demand value

This object shall provide the output value of the trajectory generator. The value shall be given in the user-defined velocity units. Table 214 specifies the object description, and Table 215 specifies the entry description.

Table 214 – Object description

Attribute	Value
Index	606B _h
Name	Velocity demand value
Object code	Variable
Data type	Integer32
Category	Optional

Table 215 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

15.5.4 Object 606C_h: Velocity actual value

This object shall provide the actual velocity value derived either from the velocity sensor or the position sensor. The value shall be given in user-defined velocity units. Table 216 specifies the object description, and Table 217 specifies the entry description.

Table 216 – Object description

Attribute	Value
Index	606C _h
Name	Velocity actual value
Object code	Variable
Data type	Integer32
Category	Conditional: mandatory if pv or csv is supported

Table 217 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

15.5.5 Object 606D_h: Velocity window

This object shall indicate the configured velocity window. The value shall be given in user-defined velocity units. Table 218 specifies the object description, and Table 219 specifies the entry description.

Table 218 – Object description

Attribute	Value
Index	606D _h
Name	Velocity window
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 219 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

15.5.6 Object 606E_h: Velocity window time

This object shall indicate the configured velocity window time. The value shall be given in milliseconds. Table 220 specifies the object description, and Table 221 specifies the entry description.

Table 220 – Object description

Attribute	Value
Index	606E _h
Name	Velocity window time
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 221 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	0000 _h

15.5.7 Object 606F_h: Velocity threshold

This object shall indicate the configured velocity threshold. The value shall be given in user-defined velocity units. Table 222 specifies the object description, and Table 223 specifies the entry description.

Table 222 – Object description

Attribute	Value
Index	606F _h
Name	Velocity threshold
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 223 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

15.5.8 Object 6070_h: Velocity threshold time

This object shall indicate the configured velocity threshold time. The value shall be given in milliseconds. Table 224 specifies the object description, and Table 225 specifies the entry description.

Table 224 – Object description

Attribute	Value
Index	6070 _h
Name	Velocity threshold time
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 225 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

15.5.9 Object 60FF_h: Target velocity

This object shall indicate the configured target velocity and shall be used as input for the trajectory generator. The value shall be given in user-defined velocity units. Table 226 specifies the object description, and Table 227 specifies the entry description.

Table 226 – Object description

Attribute	Value
Index	60FF _h
Name	Target velocity
Object code	Variable
Data type	Integer32
Category	Conditional: mandatory if pv or csv is supported

Table 227 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

15.5.10 Object 60F8_h: Max slippage

This object shall indicate the configured maximal slippage of an asynchronous motor. When the max slippage has been reached, the corresponding bit 13 max slippage error in the statusword shall be set to 1. The reaction of the drive device, when the max slippage error occurs, is manufacturer-specific. This value shall be given in user-defined units. Table 228 specifies the object description, and Table 229 specifies the entry description.

Table 228 – Object description

Attribute	Value
Index	60F8 _h
Name	Max slippage
Object code	Variable
Data type	Integer32
Category	Optional

Table 229 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	Manufacturer-specific

16 Profile torque mode

16.1 General information

The profile torque mode allows control device (i.e. closed-loop speed controller, open-loop transmission force controller) to transmit the target torque value, which is processed via the trajectory generator. The torque slope and torque profile type parameters are required.

16.2 Functional description

If the control device switches the controlword bit 8 (halt) from 0 to 1 or from 1 to 0, than the trajectory generator ramps its control effort output down to zero, respectively up to the target torque. In both cases, the trajectory generator takes the torque slope and torque profile type into consideration.

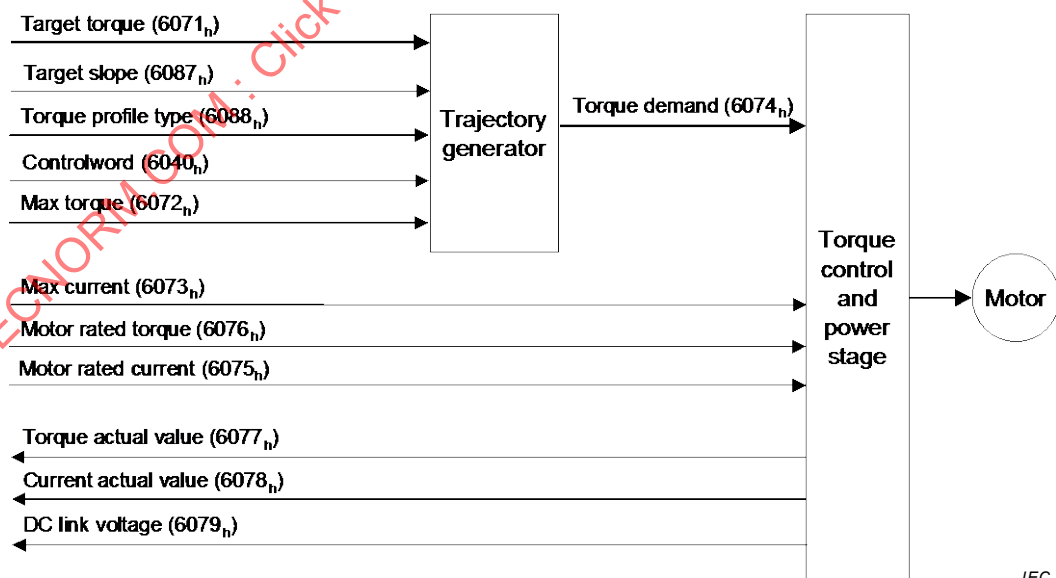
All definitions refer to rotating motors. Using linear motors instead requires that all "torque" objects refer to a "force" instead. For the sake of simplicity, the objects are not duplicated and their names are not modified. As an example, the linear motor target force is transmitted using the target torque object. Refer to the object descriptions for additional information.

The manufacturer-specific torque control and power-stage functions are not described as they fall beyond the scope of this drive profile specification. They are only mentioned for showing how some parameters affect them. As an example, the closed-loop torque control coefficients (if any) are to be defined and described by the manufacturer.

The torque control parameters, power stage parameters and motor parameters are defined as objects in order that they may be handled (i.e. downloaded) in a standard way. Their detailed data definition is manufacturer-specific.

The torque demand, torque actual value, current actual value and DC link voltage are available to the user as parameters, if they are monitored.

Figure 59 shows the defined structure of the profile torque mode.



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Figure 59 – Structure of the profile torque mode

16.3 General definitions

There are no general definitions given for the profile torque mode.

16.4 Use of controlword and statusword

The profile torque mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 60 shows the structure of the controlword. Table 230 defines the values for bit 8 of the controlword.

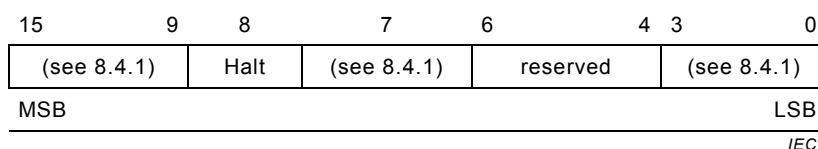


Figure 60 – Controlword for profile torque mode

Table 230 – Definition of bit 8

Bit	Value	Definition
8	0	The motion shall be executed or continued
	1	Axis shall be stopped according to the halt option code (605D _h)

Figure 61 shows the structure of the statusword. Table 231 defines the values for bit 10 of the statusword. Target torque reached is defined by a manufacturer-specific time or window object.

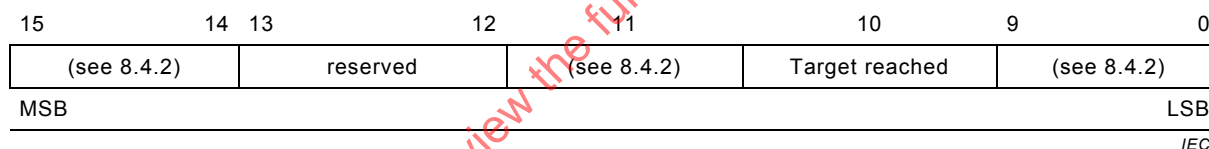


Figure 61 – Statusword for profile torque mode

Table 231 – Definition of bit 10

Bit	Value	Definition
10	0	Halt (bit 8 in controlword) = 0: Target torque not reached Halt (bit 8 in controlword) = 1: Axis decelerates
	1	Halt (bit 8 in controlword) = 0: Target torque reached Halt (bit 8 in controlword) = 1: Velocity of axis is 0

16.5 Detailed object definitions

16.5.1 Object 6071_h: Target torque

This object shall indicate the configured input value for the torque controller in profile torque mode. The value shall be given per thousand of rated torque. Table 232 specifies the object description, and Table 233 specifies the entry description.

Table 232 – Object description

Attribute	Value
Index	6071 _h
Name	Target torque
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if tq or cst is supported

Table 233 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0000 _h

16.5.2 Object 6072_h: Max torque

This object shall indicate the configured maximum permissible torque in the motor. The value shall be given per thousand of rated torque. Table 234 specifies the object description, and Table 235 specifies the entry description.

Table 234 – Object description

Attribute	Value
Index	6072 _h
Name	Max torque
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 235 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

16.5.3 Object 60E0_h: Positive torque limit value

This object shall indicate the configured maximum positive torque in the motor. The value shall be given per thousand of rated torque. Positive torque takes effect in the case of motive operation is positive velocity or regenerative operation is negative velocity.

Table 236 specifies the object description, and Table 237 specifies the entry description.

Table 236 – Object description

Attribute	Value
Index	60E0 _h
Name	Positive torque limit value
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 237 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

16.5.4 Object 60E1_h: Negative torque limit value

This object shall indicate the configured maximum negative torque in the motor. The value shall be given per thousand of rated torque. Negative torque takes effect in the case of motive operation is negative velocity or regenerative operation is positive velocity.

Table 238 specifies the object description, and Table 239 specifies the entry description.

Table 238 – Object description

Attribute	Value
Index	60E1 _h
Name	Negative torque limit value
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 239 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

16.5.5 Object 6073_h: Max current

This object shall indicate the configured maximum permissible torque creating current in the motor. The value shall be given per thousand of rated current. Table 240 specifies the object description, and Table 241 specifies the entry description.

Table 240 – Object description

Attribute	Value
Index	6073 _h
Name	Max current
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 241 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

16.5.6 Object 6074_h: Torque demand

This object shall provide the output value of the trajectory generator. The value shall be given per thousand of rated torque. Table 242 specifies the object description, and Table 243 specifies the entry description.

Table 242 – Object description

Attribute	Value
Index	6074 _h
Name	Torque demand
Object code	Variable
Data type	Integer16
Category	Optional

Table 243 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

16.5.7 Object 6075_h: Motor rated current

This object shall indicate the configured motor rated current. It is taken from the motor's name-plate. Depending on the motor and drive technology, this current is DC, peak or r.m.s. (root-mean-square) current. All relative current data refers to this value. The value shall be given in mA. Table 244 specifies the object description, and Table 245 specifies the entry description.

Table 244 – Object description

Attribute	Value
Index	6075 _h
Name	Motor rated current
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 245 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

16.5.8 Object 6076_h: Motor rated torque

This object shall indicate the configured motor rated torque. It is taken from the motor's name-plate. All relative torque data shall refer to this value. For linear motors, the object name is not changed, but the motor rated force value shall be entered as multiples of mN (milli Newton). The value shall be given in mNm (milli Newton metre). Table 246 specifies the object description, and Table 247 specifies the entry description.

Table 246 – Object description

Attribute	Value
Index	6076 _h
Name	Motor rated torque
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 247 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

16.5.9 Object 6077_h: Torque actual value

This object shall provide the actual value of the torque. It shall correspond to the instantaneous torque in the motor. The value shall be given per thousand of rated torque. Table 248 specifies the object description, and Table 249 specifies the entry description.

Table 248 – Object description

Attribute	Value
Index	6077 _h
Name	Torque actual value
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if cst is supported

Table 249 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

16.5.10 Object 6078_h: Current actual value

This object shall provide the actual value of the current. It shall correspond to the current in the motor. The value shall be given per thousand of rated current. Table 250 specifies the object description, and Table 251 specifies the entry description.

Table 250 – Object description

Attribute	Value
Index	6078 _h
Name	Current actual value
Object code	Variable
Data type	Integer16
Category	Optional

Table 251 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

16.5.11 Object 6079_h: DC link circuit voltage

This object shall provide the instantaneous DC link current voltage at the drive device. The value shall be given in mV. Table 252 specifies the object description, and Table 253 specifies the entry description.

Table 252 – Object description

Attribute	Value
Index	6079 _h
Name	DC link circuit voltage
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 253 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	No

16.5.12 Object 6087_h: Torque slope

This object shall indicate the configured rate of change of torque. The value shall be given in units of per thousand of rated torque per second. Table 254 specifies the object description, and Table 255 specifies the entry description.

Table 254 – Object description

Attribute	Value
Index	6087 _h
Name	Torque slope
Object code	Variable
Data type	Unsigned32
Category	Conditional: mandatory if tq is supported

Table 255 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

16.5.13 Object 6088_h: Torque profile type

This object shall indicate the configured type of profile used to perform a torque change. Table 256 specifies the value definition, Table 257 specifies the object description, and Table 258 specifies the entry description.

Table 256 – Value definition

Value	Definition
0000 _h	Linear ramp (trapezoidal profile)
0001 _h	sin ² ramp
0002 _h to 7FFF _h	Reserved
8000 _h to FFFF _h	Manufacturer-specific

Table 257 – Object description

Attribute	Value
Index	6088 _h
Name	Torque profile type
Object code	Variable
Data type	Integer16
Category	Optional

Table 258 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0000 _h

17 Velocity mode

17.1 General information

This mode is used by frequency inverters, but not limited to this kind of drive device. Most applications use a velocity set-point and a controlword for switching the drive device on and off.

Figure 62 shows the overall structure of the velocity mode. The possible torque control function is not in the scope of this part of the IEC 61800-7 series, it may use the target torque and torque actual value objects defined in 16.5.1 or respectively in 16.5.9.

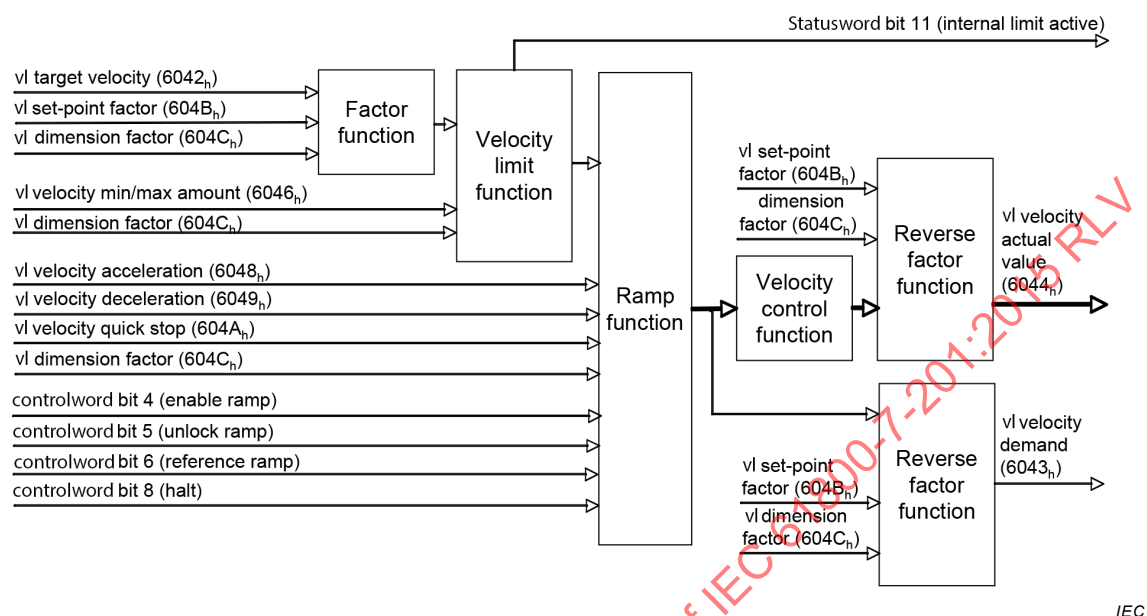


Figure 62 – Velocity mode with all objects

All drive devices using this profile and supporting the velocity mode shall implement the mandatory objects and their functionality as shown in Figure 63.

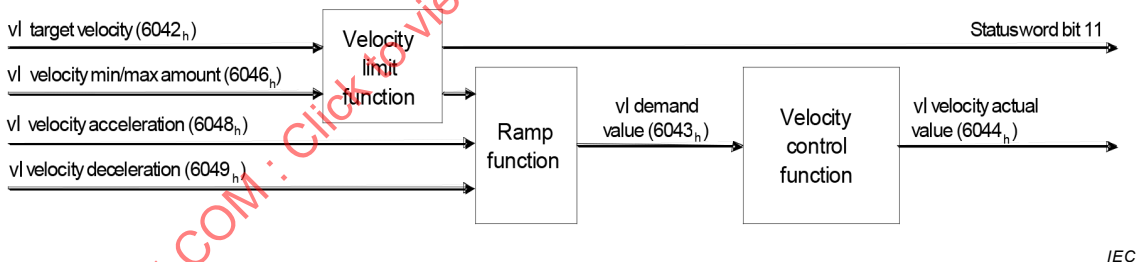


Figure 63 – Velocity mode with mandatory objects only

17.2 Functional description

17.2.1 Ramp function

Figure 64 shows the velocity profile that is used to limit the increase and decrease of velocity. The velocity output is equal to the input as long as the changes are below as defined in vl velocity acceleration, vl velocity deceleration, and vl velocity quickstop.

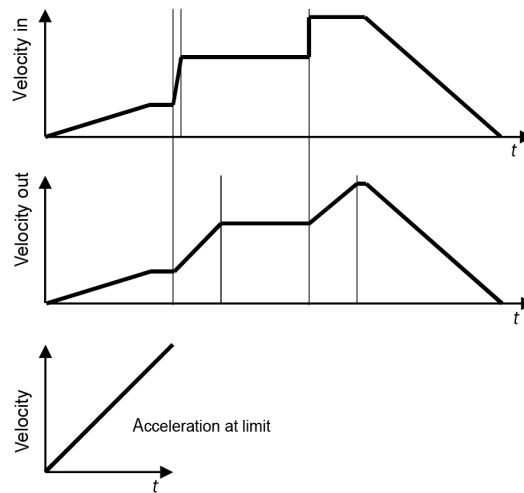


Figure 64 – Velocity profile

17.2.2 Velocity control function

On the basis of the vl velocity demand, the velocity control function provides the vl actual value.

17.2.3 Factor function

The factor function multiplies the input variables by the assigned factors. The factor shall have a value of 1, if it is not implemented.

Figure 65 shows the structure of the factor function; the factor function for two factors is built of two functions in series connection.

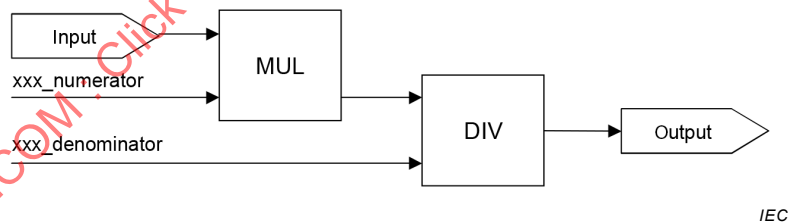


Figure 65 – Factor function

Figure 66 shows the structure of the reverse factor function. The reverse factor function divides the input variables by the assigned factors.

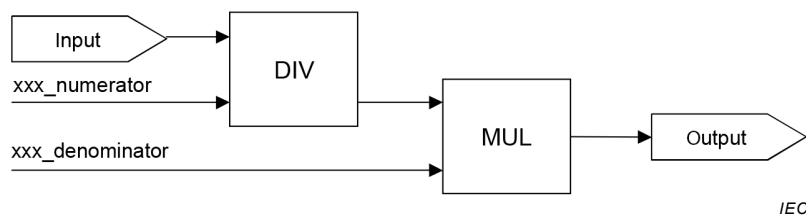


Figure 66 – Reverse factor function

17.3 General definitions

All objects defined in 17.5 are used only for the velocity mode.

17.4 Use of controlword and statusword

The velocity mode uses some bits of the controlword and the statusword for mode-specific purposes. Figure 67 shows the structure of the controlword. Table 259 and Figure 68 define the values for bit 4, bit 5, bit 6, and bit 8 of the controlword. These bits are optional.

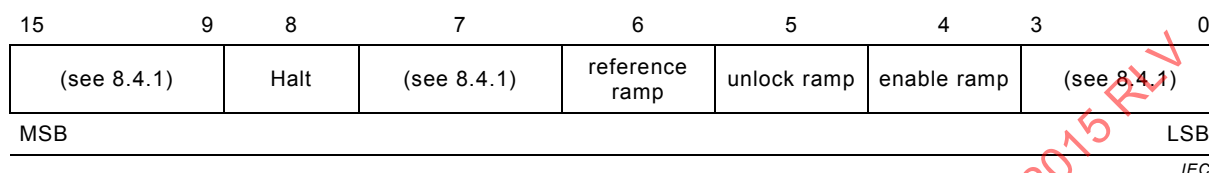


Figure 67 – Controlword for profile velocity mode

Table 259 – Definition of bit 4, bit 5, bit 6, and bit 8

Bit	Value	Definition
4	0	Velocity demand value shall be controlled in any other (manufacturer-specific) way, for example by a test function generator or manufacturer-specific halt function
	1	Velocity demand value shall accord with ramp output value
5	0	Ramp output value shall be locked to current output value
	1	Ramp output value shall follow ramp input value
6	0	Ramp input value shall be set to zero
	1	Ramp input value shall accord with ramp reference
8	0	No command
	1	Motor shall be stopped

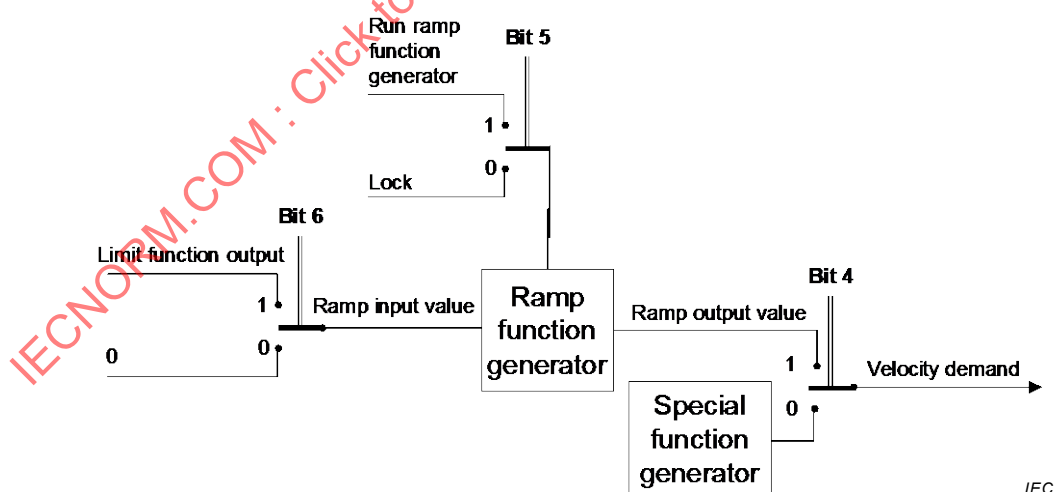


Figure 68 – Usage of controlword bits in velocity mode

Figure 69 shows the structure of the statusword.

15	14	13	12	11	10	9	0
(see 8.4.2)	reserved (0)		(see 8.4.2)	reserved (0)		(see 8.4.2)	
MSB							LSB

IEC

Figure 69 – Statusword for profile velocity mode**17.5 Detailed object definitions****17.5.1 Object 6042_h: vl target velocity**

This object shall indicate the required velocity of the system. It shall be multiplied by the vl dimension factor and the vl set-point factor, if these are implemented. The value shall be given in user-defined velocity units or in revolutions per minute (r/min), if the vl dimension factor and the vl set-point factor are not implemented or have the value 1. Positive values shall indicate forward direction and negative values shall indicate reverse direction. Table 260 specifies the object description, and Table 261 specifies the entry description.

Table 260 – Object description

Attribute	Value
Index	6042 _h
Name	vl target velocity
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if vl is supported

Table 261 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0000 _h

17.5.2 Object 6043_h: vl velocity demand

This object shall provide the instantaneous velocity generated by the ramp function. It is an internal object of the drive device. The value shall be given in the very same unit as the vl target velocity. Positive values shall indicate forward direction and negative values shall indicate reverse direction. Table 262 specifies the object description, and Table 263 specifies the entry description.

Table 262 – Object description

Attribute	Value
Index	6043 _h
Name	vl velocity demand
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory if vl is supported

Table 263 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

17.5.3 Object 6044_h: vl velocity actual value

This object shall provide the velocity at the motor spindle or load. Depending on the implementation (simple drive device, without sensor, with sensor, etc.), the drive shall provide the appropriate image of the actual velocity derived for example from velocity demand or a sensor signal.

The value shall be given in the very same unit as the vl target velocity. Positive values shall indicate forward direction and negative values shall indicate reverse direction. Table 264 specifies the object description, and Table 265 specifies the entry description.

Table 264 – Object description

Attribute	Value
Index	6044 _h
Name	vl velocity actual value
Object code	Variable
Data type	Integer16
Category	Conditional: mandatory, if vl is supported

Table 265 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	No

17.5.4 Object 6046_n: vl velocity min max amount

This object shall indicate the configured minimum and maximum amount of velocity. The vl velocity max amount sub-object shall be mapped internally to the vl velocity max pos and vl velocity max neg values. The vl velocity min amount sub-object shall be mapped internally to the vl velocity min pos and vl velocity min neg values.

This transfer characteristic is shown in Figure 70.

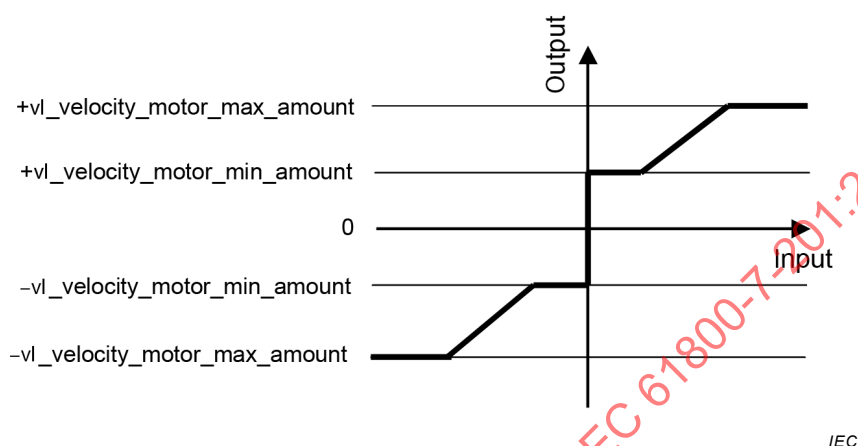


Figure 70 – Transfer characteristic of vl velocity min max amount

The values shall be given in rotations per minute (r/min) or in user-defined velocity units if the vl dimension factor object is implemented and is not set to 1. Table 266 specifies the object description, and Table 267 specifies the entry description.

Table 266 – Object description

Attribute	Value
Index	6046 _n
Name	vl velocity min max amount
Object code	Array
Data type	Unsigned32
Category	Conditional: mandatory if vl mode is supported

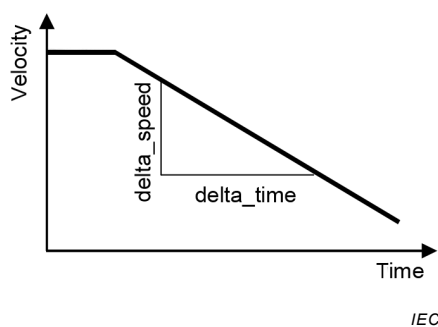
Table 267 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	vI velocity min amount
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	vI velocity max amount
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific

17.5.5 Object 6049_h: vI velocity deceleration

This object shall indicate the configured delta speed and delta time of the slope of the deceleration ramp as shown in Figure 71.

$$vI \text{ velocity deceleration} = \frac{\text{delta speed}}{\text{delta time}}$$

**Figure 71 – Transfer characteristic of the velocity deceleration**

The value of delta speed shall be given in rotations per minute (r/min) or in user-defined velocity units if the vl dimension factor object is implemented and is not set to 1. The value of delta time shall be given in s. Table 268 specifies the object description, and Table 269 specifies the entry description. If this object is not implemented, the value in object 6048_h shall be used for vl velocity deceleration.

Table 268 – Object description

Attribute	Value
Index	6049 _h
Name	vl velocity deceleration
Object code	Record
Data type	vl velocity acceleration deceleration (for data type of the sub-indices see record 0082 _h)
Category	Conditional: mandatory in vl mode

Table 269 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Delta speed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Delta time
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

17.5.6 Object 6048_h: vl velocity acceleration

This object shall indicate the configured delta speed and delta time of the slope of the acceleration ramp as shown in Figure 72.

$$vI \text{ velocity acceleration} = \frac{\text{delta speed}}{\text{delta time}}$$

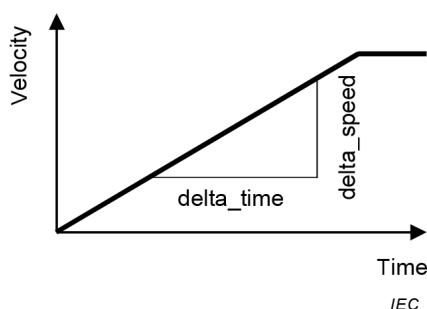


Figure 72 – Transfer characteristic of the velocity acceleration

The value of delta speed shall be given in rotations per minute (r/min) or in user-defined velocity units if the vI dimension factor object is implemented and is not set to 1. The value of delta time shall be given in s. Example: If you ramp to 1 500 r/min in 3,7 s, the delta speed equals to 15 000 (r/min) and delta time equals to 37 s.

Table 270 specifies the object description, and Table 271 specifies the entry description.

Table 270 – Object description

Attribute	Value
Index	6048 _h
Name	vI velocity acceleration
Object code	Record
Data type	vI velocity acceleration deceleration (for data type of the sub-indices see record 0082 _h)
Category	Conditional: mandatory if vI is supported

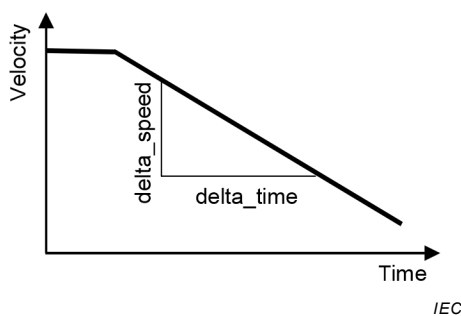
Table 271 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Delta speed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Delta time
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

17.5.7 Object 604A_h: vl velocity quick stop

This object shall indicate the configured delta speed and delta time of the slope of the deceleration ramp for quick stop as shown in Figure 73.

$$\text{velocityquick stop} = \frac{\text{delta speed}}{\text{delta time}}$$

**Figure 73 – Transfer characteristic of the quick stop deceleration**

The value of delta speed shall be given in rotations per minute (r/min) or in user-defined velocity units if the vl dimension factor object is implemented and is not set to 1. The value of delta time shall be given in s. Table 272 specifies the object description, and Table 273 specifies the entry description.

Table 272 – Object description

Attribute	Value
Index	604A _h
Name	vl velocity quick stop
Object code	Record
Data type	vl velocity acceleration deceleration (for data type of the sub-indices see record 0082 _h)
Category	Optional

Table 273 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	Delta speed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02 _h
Description	Delta time
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	Manufacturer-specific

17.5.8 Object 604B_h: vl set-point factor

This object shall indicate the configured numerator and denominator of the vl set-point factor. The vl set-point factor serves to modify the resolution or directing range of the specified set-point. It is also included in calculation of the vl velocity demand, and vl velocity actual value. It does not influence the velocity limit function and the ramp function. The value shall be

dimensionless and shall be given in the range from –32 768 to +32 767, but the value of 0 shall not be used. Table 274 specifies the object description, and Table 275 specifies the entry description.

Table 274 – Object description

Attribute	Value
Index	604B _h
Name	vl set-point factor
Object code	Array
Data type	Integer16
Category	Optional

Table 275 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	vl set-point factor numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	+1
Sub-index	02 _h
Description	vl set-point factor denominator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	+1

17.5.9 Object 604C_h: vl dimension factor

This object shall indicate the configured numerator and denominator of the vl dimension factor. The vl dimension factor serves to include gearing in calculation or serves to scale the frequencies or specific units of the user. It influences the vl target velocity, vl velocity demand, vl velocity actual value as well as the velocity limit function and the ramp function.

Calculating the vl dimension factor: Every user-specific velocity consists of specific units referred to specific units of time (e.g. 1/s, bottles/min, m/s, etc.). The purpose of the vl dimension factor is to convert the specific velocity units to the revolutions/minute.

Velocity [user-defined units] × vl dimension factor [r/min/user-defined units] = Velocity [r/min]

The values shall be in the range of –2 147 483 648 to +2 147 483 647, but the value of 0 shall be not used. Example: If the target unit is 0,1 Hz the numerator is 120 and the denominator is the pole number.

Table 276 specifies the object description, and Table 277 specifies the entry description.

Table 276 – Object description

Attribute	Value
Index	604C _h
Name	vl dimension factor
Object code	Array
Data type	Integer32
Category	Optional

Table 277 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	02 _h
Default value	02 _h
Sub-index	01 _h
Description	vl dimension factor numerator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	+1
Sub-index	02 _h
Description	vl dimension factor denominator
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	See value definition
Default value	+1

18 Cyclic synchronous position mode

18.1 General information

The overall structure for this mode is shown in Figure 74. With this mode, the trajectory generator is located in the control device, not in the drive device. In cyclic synchronous manner, it provides a target position to the drive device, which performs position control, velocity control and torque control. Optionally, additive velocity and torque values can be provided by the control system in order to allow for velocity and/or torque feedforward. Measured by sensors, the drive device may provide actual values for position, velocity and torque to the control device.

The behavior of the control function is influenced by control parameters such as limit functions, which are externally applicable. The drive internal control function is not specified more precisely in this part of the IEC 618700-7 series as it is highly manufacturer specific, but the format and content of the control parameters are provided.

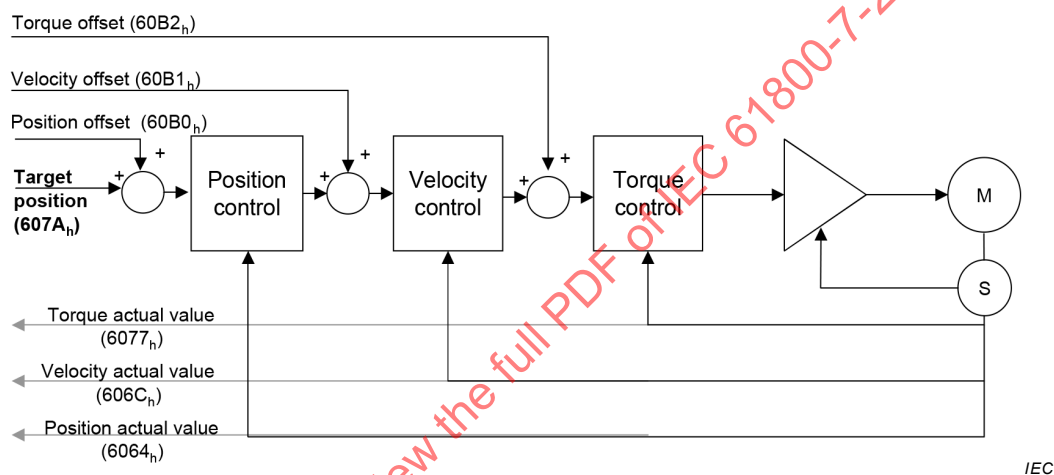


Figure 74 – Cyclic synchronous position mode overview

18.2 Functional description

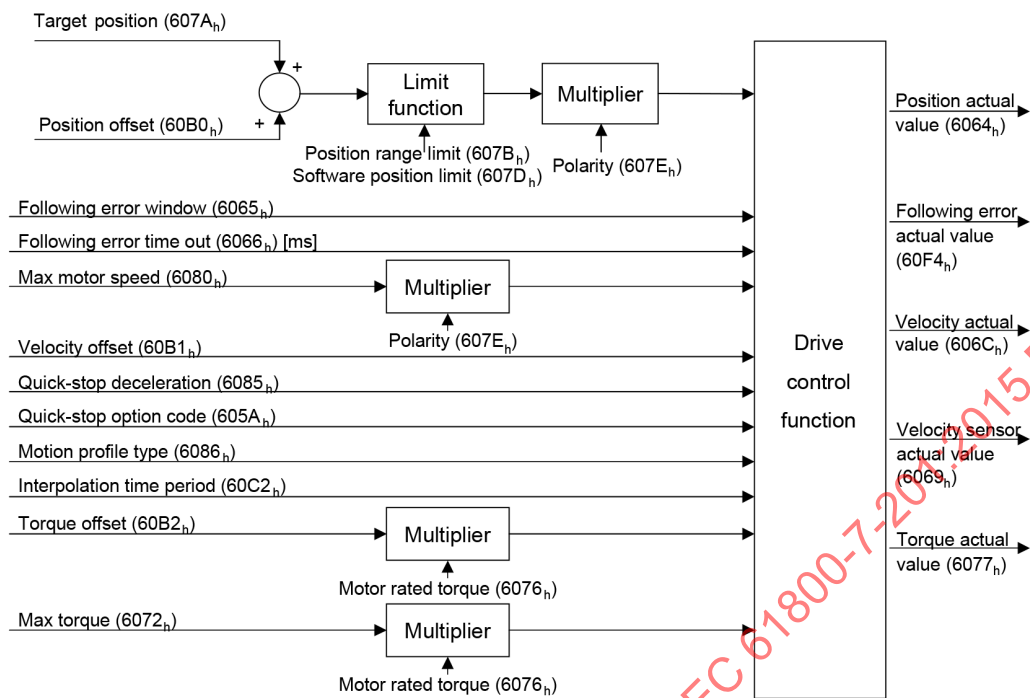
Figure 75 shows the inputs and outputs of the drive control function. The input values (from the control function point of view) are the target position and optionally a position offset (to be added to the target position to allow two instances to set up the position) as well as an optional velocity offset and an optional torque offset used for feedforward control. Especially in cascaded control structures, where a position control is followed by a velocity or torque control, the output of the position control loop is used as an input for a further calculation in the drive device. Limit functions may be used to restrict the range of values to avoid unintended positions.

The drive device monitors the following error. Other features specified in this mode are limitation of motor speed and a quick stop function for emergency reasons. The torque may be limited as well.

The interpolation time period defines the time period between two updates of the target position and/or additive position and shall be used for intercycle interpolation.

The target position shall be interpreted as absolute value.

The position actual value is used as mandatory output to the control device. Further outputs may be the velocity actual value, torque actual value and the velocity sensor actual value. The following error actual value may be used as an additional parameter.



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Figure 75 – Cyclic synchronous position control function

All values are transformed – if necessary – from user-defined units to normalized units such as increments using the functions as specified in Clause 9.

A target position value or position offset outside the allowed range of the following error window around a position demand value for longer than the following error time out shall result in setting bit 13 (following error) in the statusword to 1.

18.3 Use of controlword and statusword

The cyclic synchronous position mode uses no mode-specific bits of the controlword and three bits of the statusword for mode-specific purposes. Figure 76 shows the structure of the statusword. Table 278 defines the values for bit 10, 12, and 13 of the statusword.

15	14	13	12	11	10	9	0
(see 8.4.2)	Following error		Drive follows the command value	(see 8.4.2)	reserved	(see 8.4.2)	
MSB							LSB

IEC

Figure 76 – Statusword for profile cyclic synchronous position mode

Table 278 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Reserved
	1	Reserved
12	0	Drive does not follow the command value – Target position ignored
	1	Drive follows the command value – Target position used as input to position control loop
13	0	No following error
	1	Following error

18.4 Detailed object definitions

18.4.1 Object 60B0_h: Position offset

This object shall provide the offset of the target position. The offset shall be given in user-defined position units.

NOTE The value itself is absolute and thus independent of how often it is transmitted over the communication system, for example, transmitted twice does not mean double value. Since the additive position value represents an offset to the target position, it can be also used to control the drive with relative values with regard to the target position.

Table 279 specifies the object description, and Table 280 specifies the entry description.

Table 279 – Object description

Attribute	Value
Index	60B0 _h
Name	Position offset
Object code	Variable
Data type	Integer32
Category	Optional

Table 280 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	0

18.4.2 Object 60B1_h: Velocity offset

This object shall provide the offset for the velocity value. The offset shall be given in user-defined velocity units. In cyclic synchronous position mode, this object contains the input value for velocity feed forward. In cyclic synchronous velocity mode (see Clause 19), it contains the commanded offset of the drive device.

NOTE The value itself is absolute and thus independent of how often it is transmitted over the communication system, for example transmitted twice does not mean double value. Since the additive velocity value represents an offset to the target velocity, it can be also used to control the drive with relative values with regard to the target velocity.

Table 281 specifies the object description, and Table 282 specifies the entry description.

Table 281 – Object description

Attribute	Value
Index	60B1 _h
Name	Velocity offset
Object code	Variable
Data type	Integer32
Category	Optional

Table 282 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	0

18.4.3 Object 60B2_h: Torque offset

This object shall provide the offset for the torque value. The offset shall be given in per thousand rated torque. In cyclic synchronous position mode and cyclic synchronous velocity mode (see Clause 20), this object contains the input value for torque feed forward. In cyclic synchronous torque mode (see Clause 20) it contains the commanded additive torque of the drive, which is added to the target torque value.

NOTE The value itself is absolute and thus independent of how often it is transmitted over the communication system, for example transmitted twice does not mean double value.

Table 283 specifies the object description, and Table 284 specifies the entry description.

Table 283 – Object description

Attribute	Value
Index	60B2 _h
Name	Torque offset
Object code	Variable
Data type	Integer16
Category	Optional

Table 284 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Integer16
Default value	0

19 Cyclic synchronous velocity mode

19.1 General information

The overall structure for this mode is shown in Figure 77. With this mode, the trajectory generator is located in the control device, not in the drive device. In cyclic synchronous manner, it provides a target velocity to the drive device, which performs velocity control and torque control. If desired, the position control loop may be closed over the communication system. Optionally, additive velocity and torque values may be provided by the control system in order to allow a second source for velocity and/or a torque feed forward. Measured by sensors, the drive device may provide actual values for position, velocity and torque to the control device.

The cyclic synchronous velocity mode covers the following sub-functions:

- demand value input;
- velocity capture using position sensor or velocity sensor;
- velocity control function with appropriate input and output signals;
- limitation of torque demand.

Various sensors may be used for velocity capture. In particular, the aim is that costs are reduced and the drive power system is simplified by evaluating position and velocity using a common sensor, such as is optional using a resolver or an encoder.

The behavior of the control function is influenced by control parameters such as limit functions, which are externally applicable. The drive internal control function is not specified more precisely in this part of the IEC 61800-7 series, as it is highly manufacturer-specific, but the format and content of the control parameters are provided.

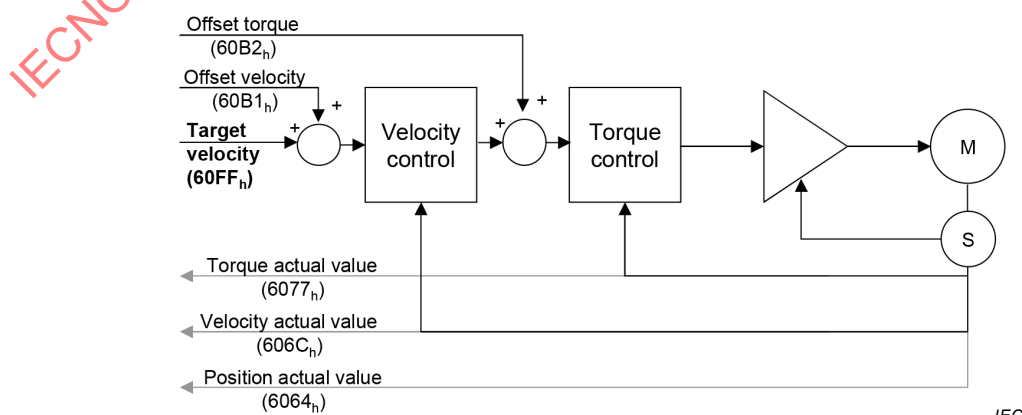


Figure 77 – Cyclic synchronous velocity mode overview

19.2 General definitions

The factors necessary for scaling have a linear relationship and therefore they are described in the factor group. The polarity is described in the factor group as well.

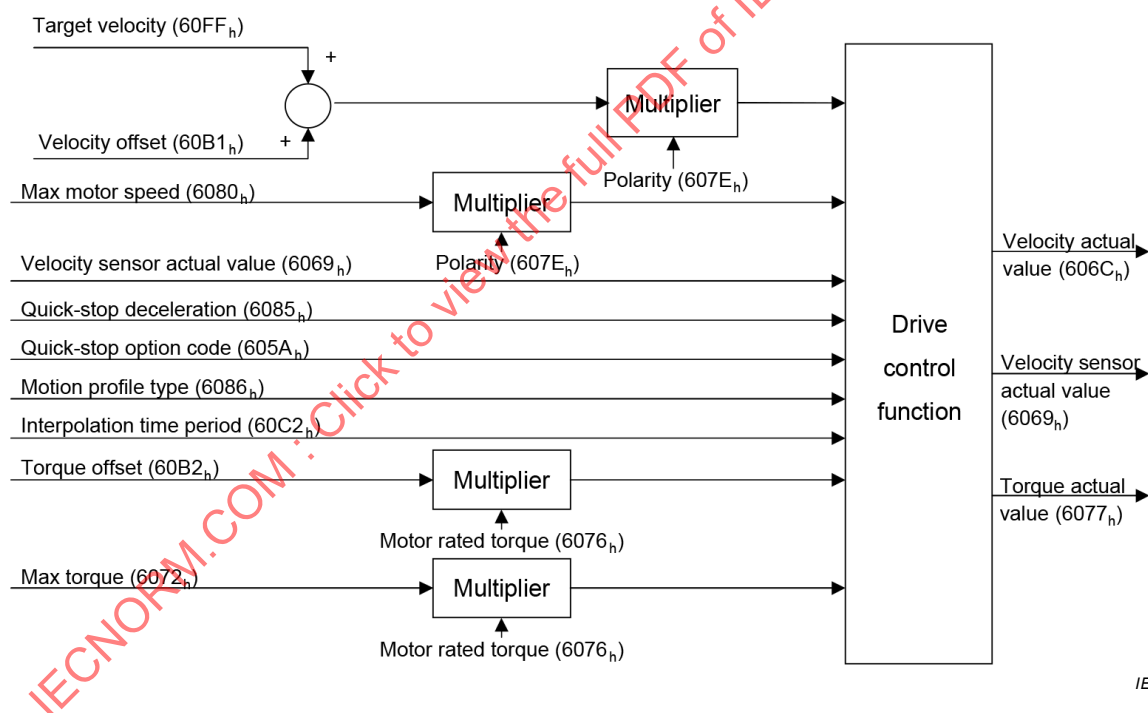
19.3 Functional description

Figure 78 shows the inputs and outputs of the drive control function. The input (from the control device point of view) are the target velocity and optionally, a velocity offset (to be added to the target velocity to allow two instances to set up the velocity) as well as a torque offset. Especially in cascaded control structures, where a velocity control is followed by a torque control, the output of the velocity control loop is used as an input for a further calculation in the drive device.

The drive device may support limitation of motor speed and a quick stop function for emergency reasons. The torque may be limited as well.

The interpolation time period defines the time period between two updates of the target velocity and/or additive velocity and shall be used for intercycle interpolation.

The velocity actual value is used as mandatory output to the control device. Further outputs may be the torque actual value and the velocity sensor actual value.



IEC

Figure 78 – Cyclic synchronous velocity control function

All values are transformed – if necessary – from user-defined units to normalized units such as increments using the functions as specified in Clause 9.

19.4 Use of controlword and statusword

The cyclic synchronous velocity mode uses no mode-specific bits of the controlword and some bits of the statusword for mode-specific purposes. Figure 79 shows the structure of the statusword. Table 285 defines the values for bit 10, 12, and 13 of the statusword.

15	14	13	12	11	10	9	0
(see 8.4.2)	reserved	Drive follows the command value	(see 8.4.2)	reserved	(see 8.4.2)		
MSB						LSB	

IEC

Figure 79 – Statusword for profile cyclic synchronous velocity mode**Table 285 – Definition of bit 10, bit 12, and bit 13**

Bit	Value	Definition
10	0	Reserved
	1	Reserved
12	0	Drive does not follow the command value – Target velocity ignored
	1	Drive follows the command value – Target velocity used as input to velocity control loop
13	0	Reserved
	1	Reserved

20 Cyclic synchronous torque mode

20.1 General information

The overall structure for this mode is shown in Figure 80. With this mode, the trajectory generator is located in the control device, not in the drive device. In cyclic synchronous manner, it provides a target torque to the drive device, which performs torque control. Optionally, an additive torque value can be provided by the control system in order to allow two instances to set up the torque. Measured by sensors, the drive device may provide actual values for position, velocity and torque to the control device.

The cyclic synchronous torque mode covers the following sub-functions:

- demand value input;
- torque capture;
- torque control function with appropriate input and output signals;
- limitation of torque demand.

The drive internal control function is not specified more precisely in this part of the IEC 61800-7 series as it is highly manufacturer-specific, but the format and content of the control parameters are provided.

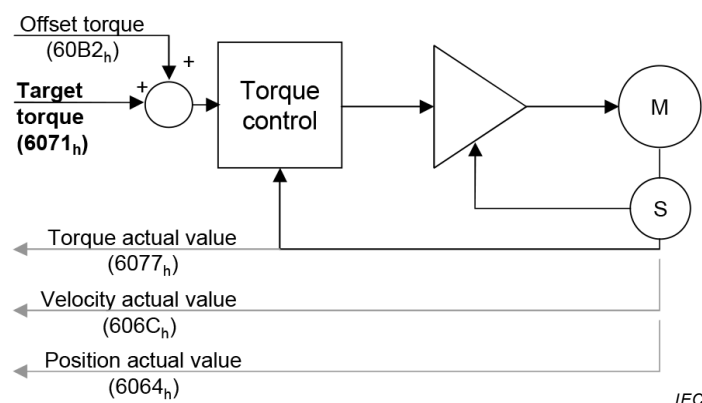


Figure 80 – Cyclic synchronous torque mode overview

20.2 General definitions

The factors necessary for scaling have a linear relationship and therefore they are described in the factor group. The polarity is described in the factor group as well.

20.3 Functional description

Figure 81 shows the inputs and outputs of the torque control function. The input (from the control function point of view) are the target torque and optionally a torque offset (to be added to the target torque to allow two instances to set up the torque).

The drive device can have features for limitation of motor speed. The torque can be limited as well.

The interpolation time period defines the time period between two updates of the target velocity and/or additive velocity and shall be used for intercycle interpolation.

The torque actual value is used as mandatory output to the control device.

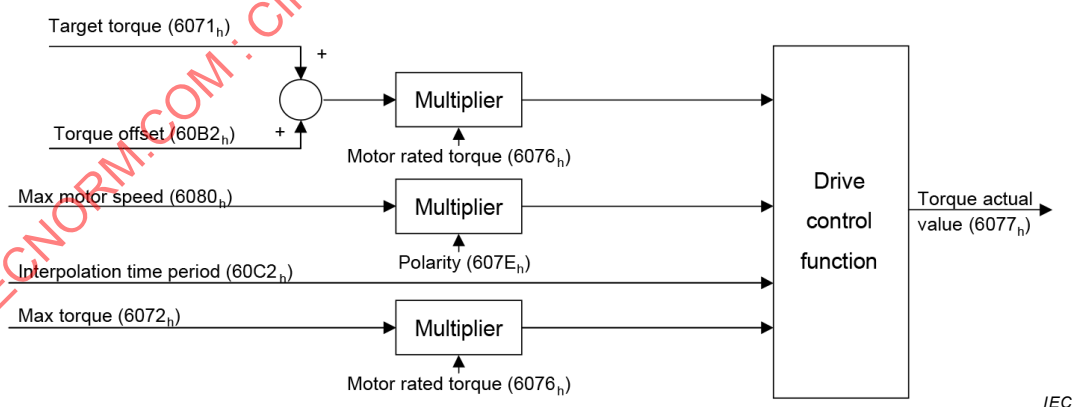


Figure 81 – Cyclic synchronous torque control function

20.4 Use of controlword and statusword

The cyclic synchronous torque mode uses no mode-specific bits of the controlword and some bits of the statusword for mode-specific purposes. Figure 82 shows the structure of the statusword. Table 286 defines the values for bit 10, 12, and 13 of the statusword.

15	14	13	12	11	10	9	0
(see 8.4.2)	reserved	Drive follows the command value	(see 8.4.2)	reserved	(see 8.4.2)		
MSB						LSB	

IEC

Figure 82 – Statusword for profile cyclic synchronous torque mode

Table 286 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Reserved
	1	Reserved
12	0	Drive does not follow the command value – Target torque ignored
	1	Drive follows the command value – Target torque used as input to torque control loop
13	0	Reserved
	1	Reserved

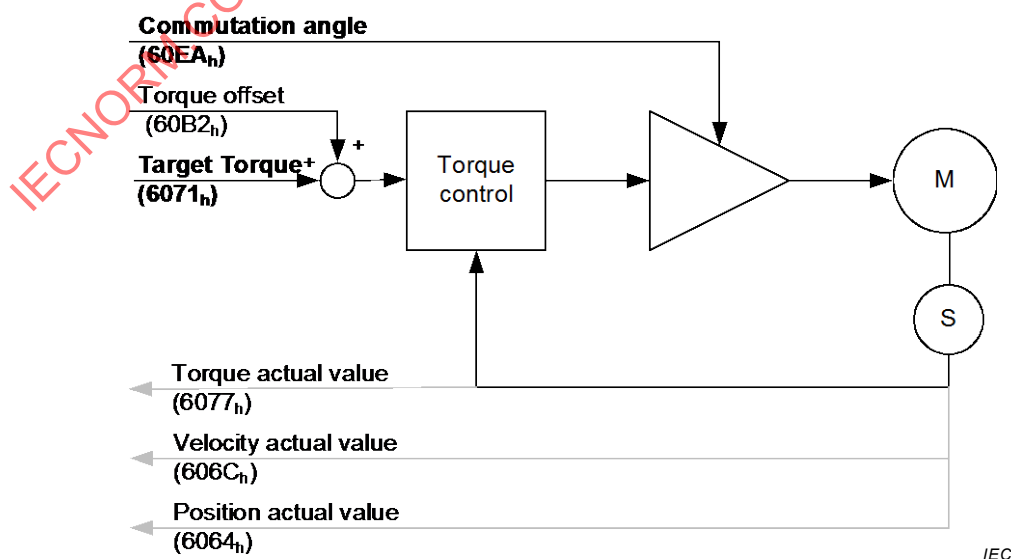
21 Cyclic synchronous torque mode with commutation angle (cstca)

21.1 General information

The overall structure for this mode is shown in Figure 83. With this mode, the trajectory generator is located in the control device, not in the drive device. In cyclic synchronous manner, it provides a commutation angle and a target torque to the drive device, which performs current control and space vector modulation. Optionally, an additive torque value can be provided by the control system in order to allow two instances to set up the torque. Measured by sensors, the drive device could provide actual values for position or may provide velocity and torque to the control device.

This mode can be used for example:

- to find the commutation angle during commissioning;
- to check the function (increments, zero signal) and direction of the sensor.



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Figure 83 – Cyclic synchronous torque mode with commutation angle overview

21.2 General definitions

The factors necessary for scaling have a linear relationship and therefore they are described in the factor group. The polarity is described in the factor group as well.

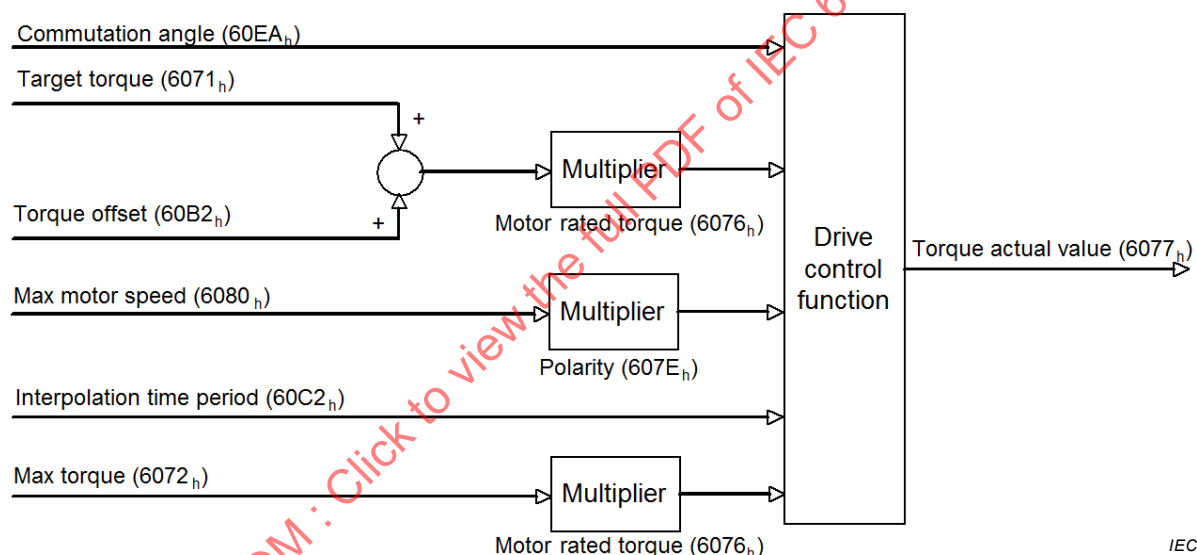
21.3 Functional description

Figure 84 shows the inputs and outputs of the torque control function with commutation angle. The inputs (from the control function point of view) are the commutation angle and the target torque and optionally a torque offset (to be added to the target torque to allow two instances to set up the torque).

The drive device can have features for limitation of motor speed. The torque can be limited as well.

The interpolation time period defines the time period between two updates of the target velocity and/or additive velocity and shall be used for intercycle interpolation.

The torque actual value can be used as output to the control device. The objects marked bold in Figure 84 are used for cstca.



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Figure 84 – Cyclic synchronous torque with commutation angle control function

21.4 Use of controlword and statusword

The operation mode specific bits (bit 4 to 6, bit 9) and the halt bit (bit 8) in the controlword shall be ignored by the drive. In the cstca mode the bit 8 shall be ignored because the halt function is controlled by the control device.

Figure 85 shows the structure of the statusword.

15	14	13	12	11	10	9	0
(see 8.4.2)	reserved	Drive follows the command value	(see 8.4.2)	reserved	(see 8.4.2)		
MSB							LSB

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Figure 85 – Statusword for cstca mode

The bit 12 is mandatory. The value of the bit 12 shall be 0_b if the drive does not follow the target torque value because of local reasons (internal set-point settings). The bit 12 shall be set to 1_b if the drive is in operation enabled state and follows the target and set-point values of the control device. In all other cases it shall be 0_b. Table 287 defines the values of bit 10, bit 12 and bit 13.

Table 287 – Definition of bit 10, bit 12, and bit 13

Bit	Value	Definition
10	0	Reserved
	1	Reserved
12	0	Drive does not follow the command value – Target torque ignored
	1	Drive follows the command value – Target torque used as input to torque control loop
13	0	Reserved
	1	Reserved

21.5 Object 60EA_h: Commutation angle

This object shall indicate the electrical commutation angle for the space vector modulation. The value shall be given in multiples of $360^\circ/2^{16}$, whereby the electrical angle is used. Table 288 specifies the object description, and Table 289 specifies the entry description.

Table 288 – Object description

Attribute	Value
Index	60EA _h
Name	Commutation angle
Object code	Variable
Data type	Unsigned16
Category	Mandatory if cstca is supported

Table 289 – Entry description

Attribute	Value
Sub-index	00 _h
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned16
Default value	0000 _h

22 Support of additional sensor interfaces

22.1 General

A drive may support several sensor interfaces. This clause specifies the objects required for use of additional sensor interfaces.

22.2 Object 60E4_h: Additional position actual value

This object provides the additional position actual values. The value shall be given in user-defined position units. Table 290 specifies the object description, and Table 291 specifies the entry description.

Table 290 – Object description

Attribute	Value
Index	60E4 _h
Name	Additional position actual value
Object code	Array
Data type	Integer32
Category	Optional

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Table 291 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional position actual value
Entry category	Mandatory
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No
Sub-index	02 _h
Description	2nd additional position actual value
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No
to	
Sub-index	FE _h
Description	254th additional position actual value
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

22.3 Object 60E5_h: Additional velocity actual value

This object provides the additional velocity actual values. The value shall be given in user-defined velocity units. Table 292 specifies the object description, and Table 293 specifies the entry description.

Table 292 – Object description

Attribute	Value
Index	60E5 _h
Name	Additional velocity actual value
Object code	Array
Data type	Integer32
Category	Optional

Table 293 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional velocity actual value
Entry category	Mandatory
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No
Sub-index	02 _h
Description	2nd additional velocity actual value
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No
to	
Sub-index	FE _h
Description	254th additional velocity actual value
Entry category	Optional
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Integer32
Default value	No

22.4 Object 60E6_h: Additional position encoder resolution – encoder increments

This object provides the encoder increments for the additional position encoder resolution. This object shall be used with the corresponding sub-index of the object 60EB_h (motor revolutions for the additional position encoder resolution). The additional position encoder resolution value is calculated by the formula as given in the object 608F_h. Table 294 specifies the object description, and Table 295 specifies the entry description.

Table 294 – Object description

Attribute	Value
Index	60E6 _h
Name	Additional position encoder resolution – encoder increments
Object code	Array
Data type	Unsigned32
Category	Optional

Table 295 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional position encoder resolution – encoder increments
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific
Sub-index	02 _h
Description	2nd additional position encoder resolution – encoder increments
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific
to	
Sub-index	FE _h
Description	254th additional position encoder resolution – encoder increments
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific

22.5 Object 60EB_h: Additional position encoder resolution – motor revolutions

This object provides the motor revolutions for the additional position encoder resolution. This object shall be used with the corresponding sub-index of the object 60E6_h (encoder

increments for the additional position encoder resolution). The additional position encoder resolution value is calculated by the formula as given in the object 608F_h. Table 296 specifies the object description, and Table 297 specifies the entry description.

Table 296 – Object description

Attribute	Value
Index	60EB _h
Name	Additional position encoder resolution – motor revolutions
Object code	Array
Data type	Unsigned32
Category	Conditional: if object 60E6 _h is supported

Table 297 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional position encoder resolution – motor revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific

Attribute	Value
Sub-index	02 _h
Description	2nd additional position encoder resolution – motor revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific
to	
Sub-index	FE _h
Description	254th additional position encoder resolution – motor revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32 (0 equals 2 ³²)
Default value	Manufacturer-specific

22.6 Object 60E7_h: Additional velocity encoder resolution – encoder increments per second

This object provides the encoder increments per second for the additional velocity encoder resolution. This object shall be used with the corresponding sub-index of the object 60EC_h (motor revolutions per second for the additional velocity encoder resolution). The additional velocity encoder resolution value is calculated by the formula as given in the object 6090_h. Table 298 specifies the object description, and Table 299 specifies the entry description.

Table 298 – Object description

Attribute	Value
Index	60E7 _h
Name	Additional velocity encoder resolution – encoder increments per second
Object code	Array
Data type	Unsigned32
Category	Conditional if 60EC _h is supported

Table 299 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional velocity encoder resolution – encoder increments per second
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional velocity encoder resolution – encoder increments per second
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional velocity encoder resolution – encoder increments per second
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.7 Object 60EC_h: Additional velocity encoder resolution – motor revolutions per second

This object provides the motor revolutions per second for the additional velocity encoder resolution. This object shall be used with the corresponding sub-index of the object 60E7_h (encoder increments per second for the additional velocity encoder resolution). The additional velocity encoder resolution value is calculated by the formula as given in the object 6090_h. Table 300 specifies the object description, and Table 301 specifies the entry description.

Table 300 – Object description

Attribute	Value
Index	60EC _h
Name	Additional velocity encoder resolution – motor revolutions per second
Object code	Array
Data type	Unsigned32
Category	Conditional: if object 60E7 _h is supported

Table 301 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional velocity encoder resolution – motor revolutions per second
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional velocity encoder resolution – motor revolutions per second
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional velocity encoder resolution – motor revolutions per second
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.8 Object 60E8_h: Additional gear ratio – motor shaft revolutions

This object provides the motor shaft revolutions for the additional gear ratio calculation. This object shall be used with the corresponding sub-index of the object 60ED_h (driving shaft revolutions for the additional gear ratio calculation). The additional gear ratio value is calculated by the formula as given in the object 6091_h. Table 302 specifies the object description, and Table 303 specifies the entry description.

Table 302 – Object description

Attribute	Value
Index	60E8 _h
Name	Additional gear ratio – motor shaft revolutions
Object code	Array
Data type	Unsigned32
Category	Conditional if 60ED _h is supported

Table 303 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional gear ratio – motor shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional gear ratio – motor shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional gear ratio – motor shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.9 Object 60ED_h: Additional gear ratio – driving shaft revolutions

This object provides the driving shaft revolutions for the additional gear ratio calculation. This object shall be used with the corresponding sub-index of the object 60E8_h (motor shaft revolutions for the additional gear ratio calculation). The additional gear ratio value is calculated by the formula as given in the object 6091_h. Table 304 specifies the object description, and Table 305 specifies the entry description.

Table 304 – Object description

Attribute	Value
Index	60ED _h
Name	Additional gear ratio – driving shaft revolutions
Object code	Array
Data type	Unsigned32
Category	Conditional: if object 60E8 _h is supported

Table 305 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional gear ratio – driving shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional gear ratio – driving shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional gear ratio – driving shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.10 Object 60E9_h: Additional feed constant – feed

This object provides the feed for the additional feed constant calculation. This object shall be used with the corresponding sub-index of the object 60EE_h (driving shaft revolutions for the additional feed constant calculation). The additional feed constant value is calculated by the

formula as given in the object 6092_h. Table 306 specifies the object description, and Table 307 specifies the entry description.

Table 306 – Object description

Attribute	Value
Index	60E9 _h
Name	Additional feed constant – feed
Object code	Array
Data type	Unsigned32
Category	Conditional if 60EE _h is supported

Table 307 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional feed constant – feed
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional feed constant – feed
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional feed constant – feed
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

22.11 Object 60EE_h: Additional feed constant – driving shaft revolutions

This object provides the driving shaft revolutions for the additional feed constant calculation. This object shall be used with the corresponding sub-index of the object 60E9_h (feed for the additional feed constant calculation). The additional feed constant value is calculated by the formula as given in the object 6092_h. Table 308 specifies the object description, and Table 309 specifies the entry description.

Table 308 – Object description

Attribute	Value
Index	60EE _h
Name	Additional feed constant – driving shaft revolutions
Object code	Array
Data type	Unsigned32
Category	Conditional: if object 60E9 _h is supported

Table 309 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h to FE _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	1st additional feed constant – driving shaft revolutions
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
Sub-index	02 _h
Description	2nd additional feed constant – driving shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)
to	
Sub-index	FE _h
Description	254th additional feed constant – driving shaft revolutions
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	Manufacturer-specific (but not equal to 0)

23 Optional application FE

23.1 General

The objects defined in this clause are used for the optional generic input/output FE.

23.2 Object 60FD_h: Digital inputs

This object shall provide digital inputs. Figure 86 specifies the object structure. This object represents the physical input levels. If a certain input function is supported the pin assignment shall be as defined in Figure 86.

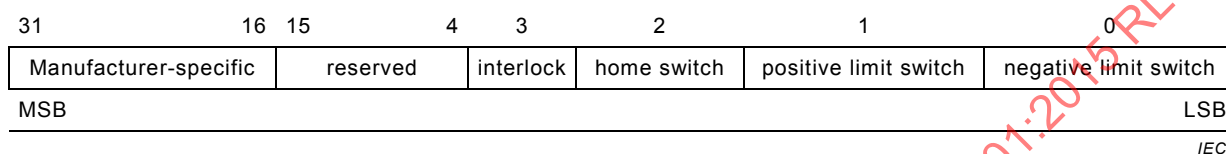


Figure 86 – Object structure

The conversion from external physical values into internal logical values is manufacturer-specific.

Bit 3 (interlock) displays the state of the interlock input. If the logical input signal changes to not activated, the drive has to enter the switch on disabled or fault reaction active state. This means the power stage of the drive is disabled and locked against switching on.

Table 310 specifies the values.

Table 310 – Value definition

Value	Definition
0 _b	Switched off (0 V)
1 _b	Switched on (supply voltage [V _{dc}])

Table 311 specifies the object description, Table 312 specifies the entry description.

Table 311 – Object description

Attribute	Value
Index	60FD _h
Name	Digital inputs
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 312 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	no

23.3 Object 60FE_h: Digital outputs

This object shall command simple digital outputs. This object represents the physical output levels. If a certain output function is supported the pin assignment shall be as defined in Figure 87.

Figure 87 specifies the object structure.

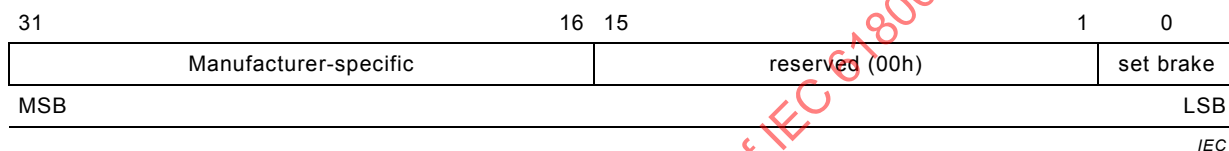


Figure 87 – Object structure

Table 313 specifies the values.

Table 313 – Value definition

Value	Definition for bit 0	Definition for bit 16 to 31
0 _b	Switch off/do not set brake	Disable output
1 _b	Switch on/set brake	Enable output

Table 314 specifies the object description, Table 315 specifies the entry description.

Table 314 – Object description

Attribute	Value
Index	60FE _h
Name	Digital output
Object code	Array
Data type	Unsigned32
Category	Optional

Table 315 – Entry description

Attribute	Value
Sub-index	00 _h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See IEC 61800-7-301
Value range	01 _h or 02 _h
Default value	Manufacturer-specific
Sub-index	01 _h
Description	Physical outputs
Entry category	Mandatory
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	0000 0000 _h
Sub-index	02 _h
Description	Bit mask
Entry category	Optional
Access	rw
PDO mapping	See IEC 61800-7-301
Value range	Unsigned32
Default value	0000 0000 _h

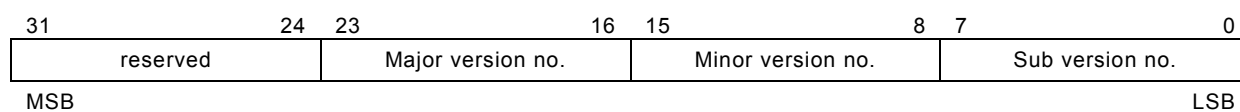
24 Device information

24.1 General

The objects defined in this clause provide general device information.

24.2 Object 67FE_h: Version number

This object shall provide the version number of the CiA 402 profile which is used to build up the device. Object 67FE_h shall be applied as well for single and multi axis devices. The version number consists out of three figures. For this international standard the number 3.1.0 shall be used.



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Figure 88 – Structure of the standard version parameter

Table 316 specifies the object description, and Table 317 specifies the entry description.

Table 316 – Object description

Attribute	Value
Index	67FE _h
Name	Version number
Object code	Variable
Data type	Unsigned32
Category	Mandatory

Table 317 – Entry description

Attribute	Value
Sub-index	00 _h
Access	ro
PDO mapping	See IEC 61800-7-301
Value range	See Figure 88
Default value	Manufacturer-specific

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¹⁷ See also the IEC Multilingual Dictionary – Electricity, Electronics and Telecommunications.

SOMMAIRE

AVANT-PROPOS	210
INTRODUCTION	212
1 Domaine d'application	217
2 Références normatives	217
3 Termes, définitions et abréviations	217
3.1 Termes et définitions	217
3.2 Abréviations	221
4 Généralités	222
4.1 Considérations d'ordre général	222
4.2 Interface de communication	223
4.3 Dictionnaire d'objets	223
5 Types de données	224
5.1 Types de données normalisés	224
5.2 Définitions des enregistrements	225
6 Définitions d'objets générales	225
6.1 Généralités	225
6.2 Objets de paramètres de communication	225
6.3 Objets d'identification et d'informations supplémentaires	227
6.3.1 Objet 6402 _h : Type de moteur	227
6.3.2 Objet 6403 _h : Numéro de lot du moteur	228
6.3.3 Objet 6404 _h : Constructeur du moteur	228
6.3.4 Objet 6405 _h : Adresse http de lot du moteur	229
6.3.5 Objet 6406 _h : Date d'étalonnage du moteur	229
6.3.6 Objet 6407 _h : Durée de service du moteur	230
6.3.7 Objet 6503 _h : Numéro de lot du dispositif d'entraînement	231
6.3.8 Objet 6505 _h : Adresse http de lot du dispositif d'entraînement	231
7 Codes d'erreurs et comportement aux erreurs	232
7.1 Codes d'erreurs	232
7.2 Comportement aux erreurs	236
8 Commande de l'entraînement électrique de puissance	237
8.1 Généralités	237
8.2 Automatisation d'états finis	237
8.3 Modes de fonctionnement	241
8.4 Spécifications d'objets détaillées	242
8.4.1 Objet 6040 _h : Mot de commande	242
8.4.2 Objet 6041 _h : Mot d'état	244
8.4.3 Objet 603F _h : Code d'erreur	246
8.4.4 Objet 6007 _h : Code de l'option Abandon de connexion	247
8.4.5 Objet 605A _h : Code de l'option Arrêt rapide	247
8.4.6 Objet 605B _h : Code de l'option Interruption	248
8.4.7 Objet 605C _h : Code de l'option Désactiver le mode de fonctionnement	249
8.4.8 Objet 605D _h : Code de l'option Arrêt	250
8.4.9 Objet 605E _h : Code de l'option Réaction au défaut	251
8.4.10 Objet 6060 _h : Modes de fonctionnement	252
8.4.11 Objet 6061 _h : Affichage des modes de fonctionnement	253

8.4.12	Objet 6502 _h : Modes d'entraînement pris en charge	253
9	Groupe de facteurs	254
9.1	Généralités	254
9.2	Définitions d'objets détaillées	257
9.2.1	Objet 608F _h : Résolution du codeur de position	257
9.2.2	Objet 6090 _h : Résolution du codeur de vitesse	258
9.2.3	Objet 6091 _h : Rapport d'engrenage	259
9.2.4	Objet 6092 _h : Constante d'avance	260
9.2.5	Objet 6096 _h : Facteur de vitesse	262
9.2.6	Objet 6097 _h : Facteur d'accélération	262
9.2.7	Objet 60A2 _h : Facteur d'à-coup	263
9.2.8	Objet 607E _h : Polarité	264
9.2.9	Table de codes des unités spécifiques au profil de dispositif	265
9.2.10	Objet 60A8 _h : Unité SI de position	265
9.2.11	Objet 60A9 _h : Unité SI de vitesse	266
9.2.12	Objet 60AA _h : Unité SI d'accélération	267
9.2.13	Objet 60AB _h : Unité SI d'à-coup	268
10	Mode de position de profil	269
10.1	Informations d'ordre général	269
10.2	Description fonctionnelle	271
10.2.1	Généralités	271
10.2.2	Point de consigne unique	272
10.2.3	Ensemble de points de consigne	272
10.2.4	Utilisation du bit Arrêt en combinaison avec le bit du nouveau point de consigne	275
10.3	Définitions générales	276
10.4	Utilisation du mot de commande et du mot d'état	276
10.5	Définitions d'objets détaillées	277
10.5.1	Objet 607A _h : Position cible	277
10.5.2	Objet 607B _h : Limite de plage de position	277
10.5.3	Objet 607D _h : Limite de position de logiciel	278
10.5.4	Objet 607F _h : Vitesse maximale du profil	280
10.5.5	Objet 6080 _h : Régime maximal du moteur	281
10.5.6	Objet 6081 _h : Vitesse de profil	281
10.5.7	Objet 6082 _h : Vitesse finale	282
10.5.8	Objet 6083 _h : Accélération de profil	283
10.5.9	Objet 6084 _h : Décélération de profil	283
10.5.10	Objet 6085 _h : Décélération par arrêt rapide	284
10.5.11	Objet 6086 _h : Type de profil de mouvement	284
10.5.12	Objet 60A3 _h : Utilisation de profil par à-coup	285
10.5.13	Objet 60A4 _h : Profil par à-coup	286
10.5.14	Objet 60C5 _h : Accélération maximale	288
10.5.15	Objet 60C6 _h : Décélération maximale	288
11	Mode de retour à la position de référence	289
11.1	Informations d'ordre général	289
11.2	Description fonctionnelle	289
11.3	Définitions générales	291
11.3.1	Généralités	291

11.3.2	Méthode 1: Retour à la position de référence avec l'interrupteur de fin de course négatif et l'impulsion d'index.....	291
11.3.3	Méthode 2: Retour à la position de référence avec l'interrupteur de fin de course positif et l'impulsion d'index.....	291
11.3.4	Méthodes 3 et 4: Retour à la position de référence avec l'interrupteur d'origine positif et l'impulsion d'index.....	292
11.3.5	Méthodes 5 et 6: Retour à la position de référence avec l'interrupteur d'origine négatif et l'impulsion d'index.....	293
11.3.6	Méthodes 7 à 14: Retour à la position de référence avec l'interrupteur d'origine et l'impulsion d'index.....	293
11.3.7	Méthodes 15 et 16: Réservé.....	295
11.3.8	Méthodes 17 à 30: Retour à la position de référence sans impulsion d'index.....	295
11.3.9	Méthodes 31 et 32: Réservé.....	296
11.3.10	Méthodes 33 et 34: Retour à la position de référence avec l'impulsion d'index.....	296
11.3.11	Méthode 35: Retour à la position courante (obsolète).....	296
11.3.12	Méthode 36: Réservé pour des raisons de compatibilité.....	297
11.3.13	Méthode 37: Retour à la position courante.....	297
11.4	Utilisation du mot de commande et du mot d'état.....	297
11.5	Définitions d'objets détaillées.....	298
11.5.1	Objet 607C _h : Décalage d'origine.....	298
11.5.2	Objet 6098 _h : Méthode de retour à la position de référence.....	299
11.5.3	Objet 60E3 _h : Méthodes de retour à la position de référence prises en charge.....	300
11.5.4	Objet 6099 _h : Vitesses de retour à la position de référence.....	301
11.5.5	Objet 609A _h : Accélération de retour à la position de référence.....	302
12	Fonctionnalité de la sonde tactile.....	303
12.1	Objet 60B8 _h : Fonction de la sonde tactile.....	303
12.2	Objet 60B9 _h : État de la sonde tactile.....	305
12.3	Objet 60BA _h : Bord positif de la sonde tactile 1.....	306
12.4	Objet 60BB _h : Bord négatif de la sonde tactile 1.....	306
12.5	Objet 60BC _h : Bord positif de la sonde tactile 2.....	307
12.6	Objet 60BD _h : Bord négatif de la sonde tactile 2.....	307
12.7	Objet 60D0 _h : Source de la sonde tactile.....	308
12.8	Verrouillage de l'horodatage de la sonde tactile.....	309
12.8.1	Généralités.....	309
12.8.2	Objet 60D1 _h : Valeur positive de l'horodatage de la sonde tactile 1.....	310
12.8.3	Objet 60D2 _h : Valeur négative de l'horodatage de la sonde tactile 1.....	310
12.8.4	Objet 60D3 _h : Valeur positive de l'horodatage de la sonde tactile 2.....	311
12.8.5	Objet 60D4 _h : Valeur négative de l'horodatage de la sonde tactile 2.....	311
12.9	Compteur au niveau des bords de la sonde tactile pour le mode continu.....	312
12.9.1	Généralités.....	312
12.9.2	Objet 60D5 _h : Compteur au bord positif de la sonde tactile 1.....	312
12.9.3	Objet 60D6 _h : Compteur au bord négatif de la sonde tactile 1.....	312
12.9.4	Objet 60D7 _h : Compteur au bord positif de la sonde tactile 2.....	313
12.9.5	Objet 60D8 _h : Compteur au bord négatif de la sonde tactile 2.....	314
12.10	Exemple de chronogramme pour la sonde tactile.....	314
13	Fonction d'asservissement de position.....	316
13.1	Informations d'ordre général.....	316

13.2	Description fonctionnelle	316
13.3	Définitions d'objets détaillées	320
13.3.1	Objet 6062 _h : Valeur de demande de position	320
13.3.2	Objet 6063 _h : Valeur interne instantanée de position	320
13.3.3	Objet 6064 _h : Valeur instantanée de position	321
13.3.4	Objet 6065 _h : Fenêtre d'erreur suivante	321
13.3.5	Objet 6066 _h : Temporisation d'erreur suivante	322
13.3.6	Objet 6067 _h : Fenêtre de position	323
13.3.7	Objet 6068 _h : Créneau de position	323
13.3.8	Objet 60F4 _h : Valeur instantanée d'erreur suivante	324
13.3.9	Objet 60FA _h : Mesure de contrôle	324
13.3.10	Objet 60FC _h : Valeur interne de demande de position	325
13.3.11	Objet 60F2 _h : Code de l'option Positionnement	325
14	Mode de position interpolée	329
14.1	Informations d'ordre général	329
14.2	Description fonctionnelle	332
14.2.1	Généralités	332
14.2.2	Mode de position interpolée linéaire avec plusieurs axes	332
14.2.3	Stratégies de la mémoire tampon pour le mode de position interpolée	333
14.2.4	FSA de mode de position interpolée	336
14.3	Définitions générales	337
14.4	Utilisation du mot de commande et du mot d'état	337
14.5	Définitions d'objets détaillées	338
14.5.1	Objet 60C0 _h : Sélection du sous-mode d'interpolation	338
14.5.2	Objet 60C1 _h : Registre des données d'interpolation	339
14.5.3	Objet 60C2 _h : Délai d'interpolation	341
14.5.4	Objet 60C4 _h : Configuration des données d'interpolation	342
15	Mode de vitesse de profil	344
15.1	Informations d'ordre général	344
15.2	Description fonctionnelle	345
15.3	Définitions générales	346
15.4	Utilisation du mot de commande et du mot d'état	346
15.5	Définitions d'objets détaillées	347
15.5.1	Objet 6069 _h : Valeur instantanée du capteur de vitesse	347
15.5.2	Objet 606A _h : Code de sélection du capteur	348
15.5.3	Objet 606B _h : Valeur de demande de vitesse	348
15.5.4	Objet 606C _h : Valeur instantanée de vitesse	349
15.5.5	Objet 606D _h : Plage de vitesse	350
15.5.6	Objet 606E _h : Créneau de vitesse	350
15.5.7	Objet 606F _h : Seuil de vitesse	351
15.5.8	Objet 6070 _h : Durée de seuil de vitesse	351
15.5.9	Objet 60FF _h : Vitesse cible	352
15.5.10	Objet 60F8 _h : Glissement max	352
16	Mode de couple de profil	353
16.1	Informations d'ordre général	353
16.2	Description fonctionnelle	353
16.3	Définitions générales	354
16.4	Utilisation du mot de commande et du mot d'état	354
16.5	Définitions d'objets détaillées	355

16.5.1	Objet 6071 _h : Couple cible.....	355
16.5.2	Objet 6072 _h : Couple max.	356
16.5.3	Objet 60E0 _h : Valeur limite positive de couple	356
16.5.4	Objet 60E1 _h : Valeur limite négative de couple	357
16.5.5	Objet 6073 _h : Courant max.	358
16.5.6	Objet 6074 _h : Demande de couple	358
16.5.7	Objet 6075 _h : Courant assigné du moteur	359
16.5.8	Objet 6076 _h : Couple assigné du moteur	359
16.5.9	Objet 6077 _h : Valeur instantanée de couple.....	360
16.5.10	Objet 6078 _h : Valeur instantanée de courant	360
16.5.11	Objet 6079 _h : Tension de circuit de liaison en courant continu	361
16.5.12	Objet 6087 _h : Pente de couple.....	361
16.5.13	Objet 6088 _h : Type de profil de couple	362
17	Mode de vitesse	362
17.1	Informations d'ordre général	362
17.2	Description fonctionnelle	364
17.2.1	Fonction de rampe	364
17.2.2	Fonction de commande de vitesse	365
17.2.3	Fonction factorielle	365
17.3	Définitions générales	366
17.4	Utilisation du mot de commande et du mot d'état	366
17.5	Définitions d'objets détaillées	367
17.5.1	Objet 6042 _h : Vitesse cible vl	367
17.5.2	Objet 6043 _h : Demande de vitesse vl.....	368
17.5.3	Objet 6044 _h : Valeur instantanée de vitesse vl	369
17.5.4	Objet 6046 _h : Niveau de vitesse max. min. vl.....	369
17.5.5	Objet 6049 _h : Décélération en vitesse vl	371
17.5.6	Objet 6048 _h : Accélération en vitesse vl	373
17.5.7	Objet 604A _h : Arrêt rapide de vitesse vl.....	375
17.5.8	Objet 604B _h : Facteur de point de consigne vl	377
17.5.9	Objet 604C _h : Facteur de dimension vl	378
18	Mode de position à synchronisation cyclique	380
18.1	Informations d'ordre général	380
18.2	Description fonctionnelle	381
18.3	Utilisation du mot de commande et du mot d'état	383
18.4	Définitions d'objets détaillées	383
18.4.1	Objet 60B0 _h : Décalage de position	383
18.4.2	Objet 60B1 _h : Décalage de vitesse	384
18.4.3	Objet 60B2 _h : Décalage de couple.....	385
19	Mode de vitesse à synchronisation cyclique.....	385
19.1	Informations d'ordre général	385
19.2	Définitions générales	387
19.3	Description fonctionnelle	387
19.4	Utilisation du mot de commande et du mot d'état	388
20	Mode de couple à synchronisation cyclique	389
20.1	Informations d'ordre général	389
20.2	Définitions générales	390
20.3	Description fonctionnelle	390

20.4	Utilisation du mot de commande et du mot d'état	391
21	Mode de couple à synchronisation cyclique avec angle de commutation (cstca)	392
21.1	Informations d'ordre général	392
21.2	Définitions générales	393
21.3	Description fonctionnelle	393
21.4	Utilisation du mot de commande et du mot d'état	394
21.5	Objet 60EA _h : Angle de commutation	395
22	Prise en charge des interfaces supplémentaires de capteur	396
22.1	Généralités	396
22.2	Objet 60E4 _h : Valeur instantanée de position supplémentaire	396
22.3	Objet 60E5 _h : Valeur instantanée de vitesse supplémentaire	397
22.4	Objet 60E6 _h : Résolution du codeur de position supplémentaire – incréments du codeur	399
22.5	Objet 60EB _h : Résolution du codeur de position supplémentaire – rotations du moteur	400
22.6	Objet 60E7 _h : Résolution du codeur de vitesse supplémentaire – incréments du codeur par seconde	401
22.7	Objet 60EC _h : Résolution du codeur de vitesse supplémentaire – rotations du moteur par seconde	402
22.8	Objet 60E8 _h : Rapport d'engrenage supplémentaire – rotations de l'arbre moteur	403
22.9	Objet 60ED _h : Rapport d'engrenage supplémentaire – rotations de l'arbre d'entraînement	405
22.10	Objet 60E9 _h : Constante d'avance supplémentaire – avance	406
22.11	Objet 60EE _h : Constante d'avance supplémentaire – rotations de l'arbre d'entraînement	407
23	FE Application facultative	408
23.1	Généralités	408
23.2	Objet 60FD _h : Entrées numériques	408
23.3	Objet 60FE _h : Sorties numériques	409
24	Informations relatives au dispositif	410
24.1	Généralités	410
24.2	Objet 67FE _h : Numéro de version	410
	Bibliographie	412
	Figure 1 – Structure de l'IEC 61800-7	216
	Figure 2 – Définition des valeurs	226
	Figure 3 – Commande distante et commande locale	237
	Figure 4 – Automatisation d'états finis de l'entraînement électrique de puissance	238
	Figure 5 – Relation entre les différents paramètres de valeurs	242
	Figure 6 – Définition des valeurs	243
	Figure 7 – Définition des valeurs	244
	Figure 8 – Définition des valeurs	253
	Figure 9 – Concept de mise à l'échelle de la position	255
	Figure 10 – Définition des valeurs	265
	Figure 11 – Exemple d'une unité de position	266
	Figure 12 – Exemple d'une unité de vitesse	267
	Figure 13 – Exemple d'une unité d'accélération	268

Figure 14 – Exemple d'une unité d'à-coup	269
Figure 15 – Générateur de trajectoire et fonction d'asservissement de position	269
Figure 16 – Générateur de trajectoire pour le mode de position de profil.....	270
Figure 17 – Exemple de point de consigne.....	271
Figure 18 – Procédure de transfert pour la méthode de point de consigne unique	272
Figure 19 – Procédure de transfert pour la méthode d'ensemble de points de consigne	273
Figure 20 – Traitement des points de consigne dans le cas de deux points de consigne	274
Figure 21 – Suppression du point de consigne	275
Figure 22 – Mot de commande pour le mode de position de profil (pp).....	276
Figure 23 – Mot d'état pour le mode de position de profil (pp)	276
Figure 24 – Limites de position de logiciel.....	279
Figure 25 – Diagramme vitesse/temps avec les positions d'à-coup	286
Figure 26 – Fonction du mode de retour à la position de référence	290
Figure 27 – Retour à la position de référence avec l'interrupteur de fin de course négatif et l'impulsion d'index	291
Figure 28 – Retour à la position de référence avec l'interrupteur de fin de course positif et l'impulsion d'index	292
Figure 29 – Retour à la position de référence avec l'interrupteur d'origine positif et l'impulsion d'index.....	292
Figure 30 – Retour à la position de référence avec l'interrupteur d'origine négatif et l'impulsion d'index.....	293
Figure 31 – Retour à la position de référence avec l'interrupteur d'origine et l'impulsion d'index – déplacement initial positif	294
Figure 32 – Retour à la position de référence avec l'interrupteur d'origine et l'impulsion d'index – déplacement initial négatif	295
Figure 33 – Retour à la position de référence avec l'interrupteur d'origine positif	296
Figure 34 – Retour à la position de référence avec l'impulsion d'index	296
Figure 35 – Mot de commande pour le mode de retour à la position de référence	297
Figure 36 – Mot d'état pour le mode de retour à la position de référence	297
Figure 37 – Définition du décalage d'origine	298
Figure 38 – Exemple de chronogramme pour la sonde tactile	315
Figure 39 – Fonction d'asservissement de position	317
Figure 40 – Erreur suivante (présentation générale des fonctions)	317
Figure 41 – Position atteinte (présentation générale des fonctions)	318
Figure 42 – Position atteinte (définitions)	319
Figure 43 – Erreur suivante (définitions)	319
Figure 44 – Structure d'objet.....	326
Figure 45 – Exemple de positionnement de l'axe rotatif	328
Figure 46 – Exemple de mouvement absolu supérieur à la valeur modulo	328
Figure 47 – Exemple de mouvement relatif supérieur à la valeur modulo	329
Figure 48 – Contrôleur d'interpolation	331
Figure 49 – Mode de position interpolée pour deux axes.....	332
Figure 50 – Interpolation linéaire pour un axe	333
Figure 51 – Organisation de la mémoire tampon d'entrée	335

Figure 52 – Exemples de mémoire tampon d'entrée	336
Figure 53 – FSA de mode de position interpolée	337
Figure 54 – Mot de commande pour le mode de position interpolée	338
Figure 55 – Mot d'état pour le mode de position interpolée	338
Figure 56 – Mode de vitesse de profil	346
Figure 57 – Mot de commande pour le mode de vitesse de profil	346
Figure 58 – Mot d'état pour le mode de vitesse de profil	347
Figure 59 – Structure du mode de couple de profil	354
Figure 60 – Mot de commande pour le mode de couple de profil	355
Figure 61 – Mot d'état pour le mode de couple de profil	355
Figure 62 – Mode de vitesse avec tous les objets	363
Figure 63 – Mode de vitesse avec les objets obligatoires uniquement	364
Figure 64 – Profil de vitesse	365
Figure 65 – Fonction factorielle	365
Figure 66 – Fonction factorielle inverse	366
Figure 67 – Mot de commande pour le mode de vitesse de profil	366
Figure 68 – Utilisation des bits de mot de commande en mode de vitesse	367
Figure 69 – Mot d'état pour le mode de vitesse de profil	367
Figure 70 – Caractéristique de transfert des niveaux maximum et minimum de vitesse v _l	370
Figure 71 – Caractéristique de transfert de la décélération en vitesse	372
Figure 72 – Caractéristique de transfert de l'accélération en vitesse	374
Figure 73 – Caractéristique de transfert de la décélération par arrêt rapide	376
Figure 74 – Présentation générale du mode de position à synchronisation cyclique	380
Figure 75 – Fonction d'asservissement de position à synchronisation cyclique	382
Figure 76 – Mot d'état pour le mode de position à synchronisation cyclique de profil	383
Figure 77 – Présentation générale du mode de vitesse à synchronisation cyclique	386
Figure 78 – Fonction de commande de vitesse à synchronisation cyclique	388
Figure 79 – Mot d'état pour le mode de vitesse à synchronisation cyclique de profil	389
Figure 80 – Présentation générale du mode de couple à synchronisation cyclique	390
Figure 81 – Fonction d'asservissement de couple à synchronisation cyclique	391
Figure 82 – Mot d'état pour le mode de couple à synchronisation cyclique de profil	391
Figure 83 – Présentation générale du mode de couple à synchronisation cyclique avec angle de commutation	393
Figure 84 – Fonction d'asservissement de couple à synchronisation cyclique avec angle de commutation	394
Figure 85 – Mot d'état pour le mode cstca	394
Figure 86 – Structure d'objet	408
Figure 87 – Structure d'objet	409
Figure 88 – Structure du paramètre de version normalisé	410
Tableau 1 – Liste des types de données utilisés	224
Tableau 2 – Délai d'interpolation	225
Tableau 3 – Configuration de données d'interpolation	225

Tableau 4 – Accélération/décélération en vitesse v_l	225
Tableau 5 – Description de l'objet	226
Tableau 6 – Description d'entrée	226
Tableau 7 – Définition des valeurs	227
Tableau 8 – Description de l'objet	227
Tableau 9 – Description d'entrée	228
Tableau 10 – Description de l'objet	228
Tableau 11 – Description d'entrée	228
Tableau 12 – Description de l'objet	229
Tableau 13 – Description d'entrée	229
Tableau 14 – Description de l'objet	229
Tableau 15 – Description d'entrée	229
Tableau 16 – Description de l'objet	230
Tableau 17 – Description d'entrée	230
Tableau 18 – Description de l'objet	230
Tableau 19 – Description d'entrée	230
Tableau 20 – Description de l'objet	231
Tableau 21 – Description d'entrée	231
Tableau 22 – Description de l'objet	231
Tableau 23 – Description d'entrée	232
Tableau 24 – Codes d'erreurs	233
Tableau 25 – États FSA et fonctions prises en charge	239
Tableau 26 – Événements et actions de transitions	240
Tableau 27 – Codage des commandes	243
Tableau 28 – Description de l'objet	244
Tableau 29 – Description d'entrée	244
Tableau 30 – Codage des états	245
Tableau 31 – Description de l'objet	246
Tableau 32 – Description d'entrée	246
Tableau 33 – Description de l'objet	246
Tableau 34 – Description d'entrée	246
Tableau 35 – Définition des valeurs	247
Tableau 36 – Description de l'objet	247
Tableau 37 – Description d'entrée	247
Tableau 38 – Définition des valeurs	248
Tableau 39 – Description de l'objet	248
Tableau 40 – Description d'entrée	248
Tableau 41 – Définition des valeurs	249
Tableau 42 – Description de l'objet	249
Tableau 43 – Description d'entrée	249
Tableau 44 – Définition des valeurs	249
Tableau 45 – Description de l'objet	250
Tableau 46 – Description d'entrée	250

Tableau 47 – Définition des valeurs	250
Tableau 48 – Description de l'objet	250
Tableau 49 – Description d'entrée	251
Tableau 50 – Définition des valeurs	251
Tableau 51 – Description de l'objet	251
Tableau 52 – Description d'entrée	251
Tableau 53 – Définition des valeurs	252
Tableau 54 – Description de l'objet	252
Tableau 55 – Description d'entrée	253
Tableau 56 – Description de l'objet	253
Tableau 57 – Description d'entrée	253
Tableau 58 – Description de l'objet	254
Tableau 59 – Description d'entrée	254
Tableau 60 – Description de l'objet	257
Tableau 61 – Description d'entrée	258
Tableau 62 – Description de l'objet	259
Tableau 63 – Description d'entrée	259
Tableau 64 – Description de l'objet	260
Tableau 65 – Description d'entrée	260
Tableau 66 – Description de l'objet	261
Tableau 67 – Description d'entrée	261
Tableau 68 – Description de l'objet	262
Tableau 69 – Description d'entrée	262
Tableau 70 – Description de l'objet	263
Tableau 71 – Description d'entrée	263
Tableau 72 – Description de l'objet	264
Tableau 73 – Description d'entrée	264
Tableau 74 – Description de l'objet	265
Tableau 75 – Description d'entrée	265
Tableau 76 – Unités spécifiques au profil de dispositif	265
Tableau 77 – Description de l'objet	266
Tableau 78 – Description d'entrée	266
Tableau 79 – Description de l'objet	267
Tableau 80 – Description d'entrée	267
Tableau 81 – Description de l'objet	267
Tableau 82 – Description d'entrée	268
Tableau 83 – Description de l'objet	268
Tableau 84 – Description d'entrée	268
Tableau 85 – Définition du bit 4, du bit 5 et du bit 9	276
Tableau 86 – Définition du bit 6 et du bit 8	276
Tableau 87 – Définition du bit 10, du bit 12 et du bit 13	277
Tableau 88 – Description de l'objet	277
Tableau 89 – Description d'entrée	277

Tableau 90 – Description de l'objet	278
Tableau 91 – Description d'entrée	278
Tableau 92 – Description de l'objet	279
Tableau 93 – Description d'entrée	280
Tableau 94 – Description de l'objet	280
Tableau 95 – Description d'entrée	281
Tableau 96 – Description de l'objet	281
Tableau 97 – Description d'entrée	281
Tableau 98 – Description de l'objet	282
Tableau 99 – Description d'entrée	282
Tableau 100 – Description de l'objet	282
Tableau 101 – Description d'entrée	282
Tableau 102 – Description de l'objet	283
Tableau 103 – Description d'entrée	283
Tableau 104 – Description de l'objet	283
Tableau 105 – Description d'entrée	284
Tableau 106 – Description de l'objet	284
Tableau 107 – Description d'entrée	284
Tableau 108 – Définition des valeurs	285
Tableau 109 – Description de l'objet	285
Tableau 110 – Description d'entrée	285
Tableau 111 – Description de l'objet	285
Tableau 112 – Description d'entrée	286
Tableau 113 – Assignations de valeurs	286
Tableau 114 – Description de l'objet	287
Tableau 115 – Description d'entrée	287
Tableau 116 – Description de l'objet	288
Tableau 117 – Description d'entrée	288
Tableau 118 – Description de l'objet	288
Tableau 119 – Description d'entrée	289
Tableau 120 – Définition du bit 4 et du bit 8	297
Tableau 121 – Définition du bit 10, du bit 12 et du bit 13	298
Tableau 122 – Description de l'objet	299
Tableau 123 – Description d'entrée	299
Tableau 124 – Définition des valeurs	299
Tableau 125 – Description de l'objet	299
Tableau 126 – Description d'entrée	300
Tableau 127 – Description de l'objet	300
Tableau 128 – Description d'entrée	301
Tableau 129 – Description de l'objet	302
Tableau 130 – Description d'entrée	302
Tableau 131 – Description de l'objet	303
Tableau 132 – Description d'entrée	303

Tableau 133 – Définition des valeurs	304
Tableau 134 – Description de l'objet	304
Tableau 135 – Description d'entrée.....	305
Tableau 136 – Définition des valeurs	305
Tableau 137 – Description de l'objet	305
Tableau 138 – Description d'entrée.....	306
Tableau 139 – Description de l'objet	306
Tableau 140 – Description d'entrée.....	306
Tableau 141 – Description de l'objet	306
Tableau 142 – Description d'entrée.....	307
Tableau 143 – Description de l'objet	307
Tableau 144 – Description d'entrée.....	307
Tableau 145 – Description de l'objet	307
Tableau 146 – Description d'entrée.....	308
Tableau 147 – Définition des valeurs	308
Tableau 148 – Description de l'objet	308
Tableau 149 – Description d'entrée.....	309
Tableau 150 – Description de l'objet	310
Tableau 151 – Description d'entrée.....	310
Tableau 152 – Description de l'objet	310
Tableau 153 – Description d'entrée.....	310
Tableau 154 – Description de l'objet	311
Tableau 155 – Description d'entrée.....	311
Tableau 156 – Description de l'objet	311
Tableau 157 – Description d'entrée.....	311
Tableau 158 – Description de l'objet	312
Tableau 159 – Description d'entrée.....	312
Tableau 160 – Description de l'objet	313
Tableau 161 – Description d'entrée.....	313
Tableau 162 – Description de l'objet	313
Tableau 163 – Description d'entrée.....	313
Tableau 164 – Description de l'objet	314
Tableau 165 – Description d'entrée.....	314
Tableau 166 – Explication du chronogramme.....	316
Tableau 167 – Description de l'objet	320
Tableau 168 – Description d'entrée.....	320
Tableau 169 – Description de l'objet	320
Tableau 170 – Description d'entrée.....	321
Tableau 171 – Description de l'objet	321
Tableau 172 – Description d'entrée.....	321
Tableau 173 – Description de l'objet	322
Tableau 174 – Description d'entrée.....	322
Tableau 175 – Description de l'objet	322

Tableau 176 – Description d'entrée.....	322
Tableau 177 – Description de l'objet.....	323
Tableau 178 – Description d'entrée.....	323
Tableau 179 – Description de l'objet.....	323
Tableau 180 – Description d'entrée.....	324
Tableau 181 – Description de l'objet.....	324
Tableau 182 – Description d'entrée.....	324
Tableau 183 – Description de l'objet.....	325
Tableau 184 – Description d'entrée.....	325
Tableau 185 – Description de l'objet.....	325
Tableau 186 – Description d'entrée.....	325
Tableau 187 – Définition des valeurs du bit 0 et du bit 1.....	326
Tableau 188 – Définition des valeurs du bit 2 et du bit 3.....	326
Tableau 189 – Définition des valeurs du bit 4 et du bit 5.....	327
Tableau 190 – Définition des valeurs du bit 6 et du bit 7.....	327
Tableau 191 – Description de l'objet.....	329
Tableau 192 – Description d'entrée.....	329
Tableau 193 – Calcul de la position en mode de position interpolée pour plusieurs axes.....	333
Tableau 194 – États FSA et fonctions prises en charge.....	337
Tableau 195 – Événements et actions de transitions.....	337
Tableau 196 – Définition du bit 4 et du bit 8.....	338
Tableau 197 – Définition du bit 10 et du bit 12.....	338
Tableau 198 – Définition des valeurs.....	339
Tableau 199 – Description de l'objet.....	339
Tableau 200 – Description d'entrée.....	339
Tableau 201 – Description de l'objet.....	340
Tableau 202 – Description d'entrée.....	340
Tableau 203 – Description de l'objet.....	341
Tableau 204 – Description d'entrée.....	341
Tableau 205 – Description de l'objet.....	342
Tableau 206 – Description d'entrée.....	343
Tableau 207 – Définition du bit 8.....	346
Tableau 208 – Définition du bit 10, du bit 12 et du bit 13.....	347
Tableau 209 – Description de l'objet.....	347
Tableau 210 – Description d'entrée.....	347
Tableau 211 – Définition des valeurs.....	348
Tableau 212 – Description de l'objet.....	348
Tableau 213 – Description d'entrée.....	348
Tableau 214 – Description de l'objet.....	349
Tableau 215 – Description d'entrée.....	349
Tableau 216 – Description de l'objet.....	349
Tableau 217 – Description d'entrée.....	349

Tableau 218 – Description de l'objet	350
Tableau 219 – Description d'entrée.....	350
Tableau 220 – Description de l'objet	350
Tableau 221 – Description d'entrée.....	350
Tableau 222 – Description de l'objet	351
Tableau 223 – Description d'entrée.....	351
Tableau 224 – Description de l'objet	351
Tableau 225 – Description d'entrée.....	351
Tableau 226 – Description de l'objet	352
Tableau 227 – Description d'entrée.....	352
Tableau 228 – Description de l'objet	352
Tableau 229 – Description d'entrée.....	353
Tableau 230 – Définition du bit 8	355
Tableau 231 – Définition du bit 10.....	355
Tableau 232 – Description de l'objet	355
Tableau 233 – Description d'entrée.....	356
Tableau 234 – Description de l'objet	356
Tableau 235 – Description d'entrée.....	356
Tableau 236 – Description de l'objet	357
Tableau 237 – Description d'entrée.....	357
Tableau 238 – Description de l'objet	357
Tableau 239 – Description d'entrée.....	357
Tableau 240 – Description de l'objet	358
Tableau 241 – Description d'entrée.....	358
Tableau 242 – Description de l'objet	358
Tableau 243 – Description d'entrée.....	358
Tableau 244 – Description de l'objet	359
Tableau 245 – Description d'entrée.....	359
Tableau 246 – Description de l'objet	359
Tableau 247 – Description d'entrée.....	360
Tableau 248 – Description de l'objet	360
Tableau 249 – Description d'entrée.....	360
Tableau 250 – Description de l'objet	360
Tableau 251 – Description d'entrée.....	361
Tableau 252 – Description de l'objet	361
Tableau 253 – Description d'entrée.....	361
Tableau 254 – Description de l'objet	361
Tableau 255 – Description d'entrée.....	362
Tableau 256 – Définition des valeurs	362
Tableau 257 – Description de l'objet	362
Tableau 258 – Description d'entrée.....	362
Tableau 259 – Définition du bit 4, du bit 5, du bit 6 et du bit 8.....	366
Tableau 260 – Description de l'objet	368

Tableau 261 – Description d'entrée.....	368
Tableau 262 – Description de l'objet.....	368
Tableau 263 – Description d'entrée.....	368
Tableau 264 – Description de l'objet.....	369
Tableau 265 – Description d'entrée.....	369
Tableau 266 – Description de l'objet.....	370
Tableau 267 – Description d'entrée.....	371
Tableau 268 – Description de l'objet.....	372
Tableau 269 – Description d'entrée.....	373
Tableau 270 – Description de l'objet.....	374
Tableau 271 – Description d'entrée.....	375
Tableau 272 – Description de l'objet.....	376
Tableau 273 – Description d'entrée.....	377
Tableau 274 – Description de l'objet.....	377
Tableau 275 – Description d'entrée.....	378
Tableau 276 – Description de l'objet.....	379
Tableau 277 – Description d'entrée.....	379
Tableau 278 – Définition du bit 10, du bit 12 et du bit 13.....	383
Tableau 279 – Description de l'objet.....	384
Tableau 280 – Description d'entrée.....	384
Tableau 281 – Description de l'objet.....	384
Tableau 282 – Description d'entrée.....	385
Tableau 283 – Description de l'objet.....	385
Tableau 284 – Description d'entrée.....	385
Tableau 285 – Définition du bit 10, du bit 12 et du bit 13.....	389
Tableau 286 – Définition du bit 10, du bit 12 et du bit 13.....	392
Tableau 287 – Définition du bit 10, du bit 12 et du bit 13.....	395
Tableau 288 – Description de l'objet.....	395
Tableau 289 – Description d'entrée.....	395
Tableau 290 – Description de l'objet.....	396
Tableau 291 – Description d'entrée.....	397
Tableau 292 – Description de l'objet.....	398
Tableau 293 – Description d'entrée.....	398
Tableau 294 – Description de l'objet.....	399
Tableau 295 – Description d'entrée.....	399
Tableau 296 – Description de l'objet.....	400
Tableau 297 – Description d'entrée.....	400
Tableau 298 – Description de l'objet.....	401
Tableau 299 – Description d'entrée.....	402
Tableau 300 – Description de l'objet.....	403
Tableau 301 – Description d'entrée.....	403
Tableau 302 – Description de l'objet.....	404
Tableau 303 – Description d'entrée.....	404

Tableau 304 – Description de l'objet	405
Tableau 305 – Description d'entrée.....	405
Tableau 306 – Description de l'objet	406
Tableau 307 – Description d'entrée.....	406
Tableau 308 – Description de l'objet	407
Tableau 309 – Description d'entrée.....	407
Tableau 310 – Définition des valeurs	408
Tableau 311 – Description de l'objet	408
Tableau 312 – Description d'entrée.....	409
Tableau 313 – Définition des valeurs	409
Tableau 314 – Description de l'objet	409
Tableau 315 – Description d'entrée.....	410
Tableau 316 – Description de l'objet	411
Tableau 317 – Description d'entrée.....	411

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**ENTRAÎNEMENTS ÉLECTRIQUES
DE PUISSANCE À VITESSE VARIABLE –****Partie 7-201: Interface générique et utilisation de profils
pour les entraînements électriques de puissance –
Spécification de profil de type 1****AVANT-PROPOS**

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La Norme internationale IEC 61800-7-201 a été établie par le sous-comité 22G: Systèmes d'entraînement électrique à vitesse variable, comprenant des convertisseurs à semi-conducteurs, du comité d'études 22 de l'IEC: Systèmes et équipements électroniques de puissance.

Cette deuxième édition annule et remplace la première édition parue en 2007. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- Mises à jour, clarifications et améliorations.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
22G/307/FDIS	22G/322/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61800, publiées sous le titre général *Entraînements électriques de puissance à vitesse variable*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

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INTRODUCTION

La série IEC 61800 est destinée à fournir un ensemble commun de spécifications dédiées aux entraînements électriques de puissance à vitesse variable.

L'IEC 61800-7 spécifie les profils dédiés aux entraînements électriques de puissance (PDS) et leur mise en correspondance avec les systèmes de communication existants grâce à un modèle d'interface générique.

L'IEC 61800-7 décrit une interface générique entre les systèmes de commande et les entraînements électriques de puissance. Cette interface peut être intégrée au système de commande. Le système de commande proprement dit peut également être situé dans le dispositif d'entraînement (parfois appelé "dispositif d'entraînement intelligent").

Il existe un grand nombre d'interfaces physiques disponibles (entrées et sorties analogiques et numériques, interfaces séries et parallèles, bus de terrain et réseaux). Les profils établis sur des interfaces physiques spécifiques sont déjà définis pour certains domaines d'application (par exemple, commande de mouvement) et certaines classes de dispositifs (par exemple, dispositifs d'entraînement classiques, positionneur). Les implémentations correspondantes des interfaces de programmes de commande et de programmeurs d'application associées sont de nature propriétaire et varient de manière importante.

L'IEC 61800-7 définit un ensemble de fonctions, paramètres et diagrammes d'états communs pour la commande de dispositifs d'entraînement ou une description de séquences d'opérations à mettre en correspondance avec les profils d'entraînement.

L'IEC 61800-7 fournit une procédure d'accès aux fonctions et données d'un dispositif d'entraînement, indépendante du profil d'entraînement et de l'interface de communication employés. Il s'agit de définir un modèle commun d'entraînement comportant des fonctions génériques et des objets pouvant être mis en correspondance avec des interfaces de communication différentes. Ceci permet de prévoir des implémentations communes de commande de mouvement (ou applications de commande de vitesse ou de commande d'entraînement) dans les contrôleurs sans aucune connaissance spécifique de la mise en œuvre du dispositif d'entraînement.

Il y a plusieurs raisons de définir une interface générique:

Pour un constructeur de dispositif d'entraînement

- assistance plus aisée des intégrateurs de systèmes;
- description plus aisée des fonctions d'entraînement du fait d'une terminologie commune;
- le choix des dispositifs d'entraînement ne dépend pas de la disponibilité d'une assistance spécifique;

Pour un constructeur de dispositif de commande

- aucune influence de la technologie de bus;
- intégration aisée des dispositifs;
- indépendance par rapport à un fournisseur de dispositifs d'entraînement;

Pour un intégrateur de systèmes

- effort moindre d'intégration des dispositifs;
- méthode intelligible unique de modélisation;
- indépendance par rapport à la technologie de bus.

Concevoir une application de commande de mouvement avec plusieurs dispositifs d'entraînement différents et un système de commande spécifique nécessite un effort certain. Les tâches de mise en œuvre des logiciels systèmes et de compréhension de la description fonctionnelle des composants individuels peuvent conduire à l'épuisement des ressources d'un projet. Dans certains cas, les dispositifs d'entraînement ne partagent pas la même interface physique. Certains dispositifs de commande ne prennent en charge qu'une interface unique qui n'est pas prise en charge par un dispositif d'entraînement spécifique. D'autre part, les fonctions et les structures de données sont souvent spécifiées avec des incompatibilités. Cela exige de l'intégrateur de systèmes d'établir des interfaces spéciales pour le logiciel d'application alors que cette opération ne relève pas vraiment de sa responsabilité.

Certaines applications nécessitent de pouvoir échanger des dispositifs, voire intégrer de nouveaux dispositifs dans une configuration existante. Elles sont alors confrontées à différentes solutions incompatibles. Les efforts nécessaires pour adapter une solution relative à un profil d'entraînement et aux extensions spécifiques au constructeur peuvent se révéler inacceptables. Ceci réduit le degré de liberté concernant le choix d'un dispositif le mieux adapté à cette application à la simple sélection du dispositif disponible pour une interface physique spécifique et pris en charge par le contrôleur.

L'IEC 61800-7-1 est divisée en une partie générique et en plusieurs annexes comme le présente la Figure 1. Les types de profils d'entraînement pour CiA® 402¹, CIP Motion™², PROFIdrive³ et SERCOS®⁴ sont mis en correspondance avec l'interface générique dans l'annexe correspondante. Les annexes ont été soumises par des organismes internationaux indépendants spécialisés dans les réseaux ou les bus de terrain, et responsables du contenu de l'annexe qui y est associée, ainsi que de l'utilisation des marques connexes.

La présente partie ou l'IEC 61800-7 spécifie le type de profil 1 (CiA® 402).

Les types de profils 2, 3 et 4 sont spécifiés dans l'IEC 61800-7-202, l'IEC 61800-7-203 et l'IEC 61800-7-204.

¹ CiA®402 est une marque déposée de CAN in Automation, e.V. (CiA). Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque déposée CiA® 402. L'utilisation de la marque déposée CiA® 402 nécessite l'autorisation de CAN in Automation e.V. (CiA).

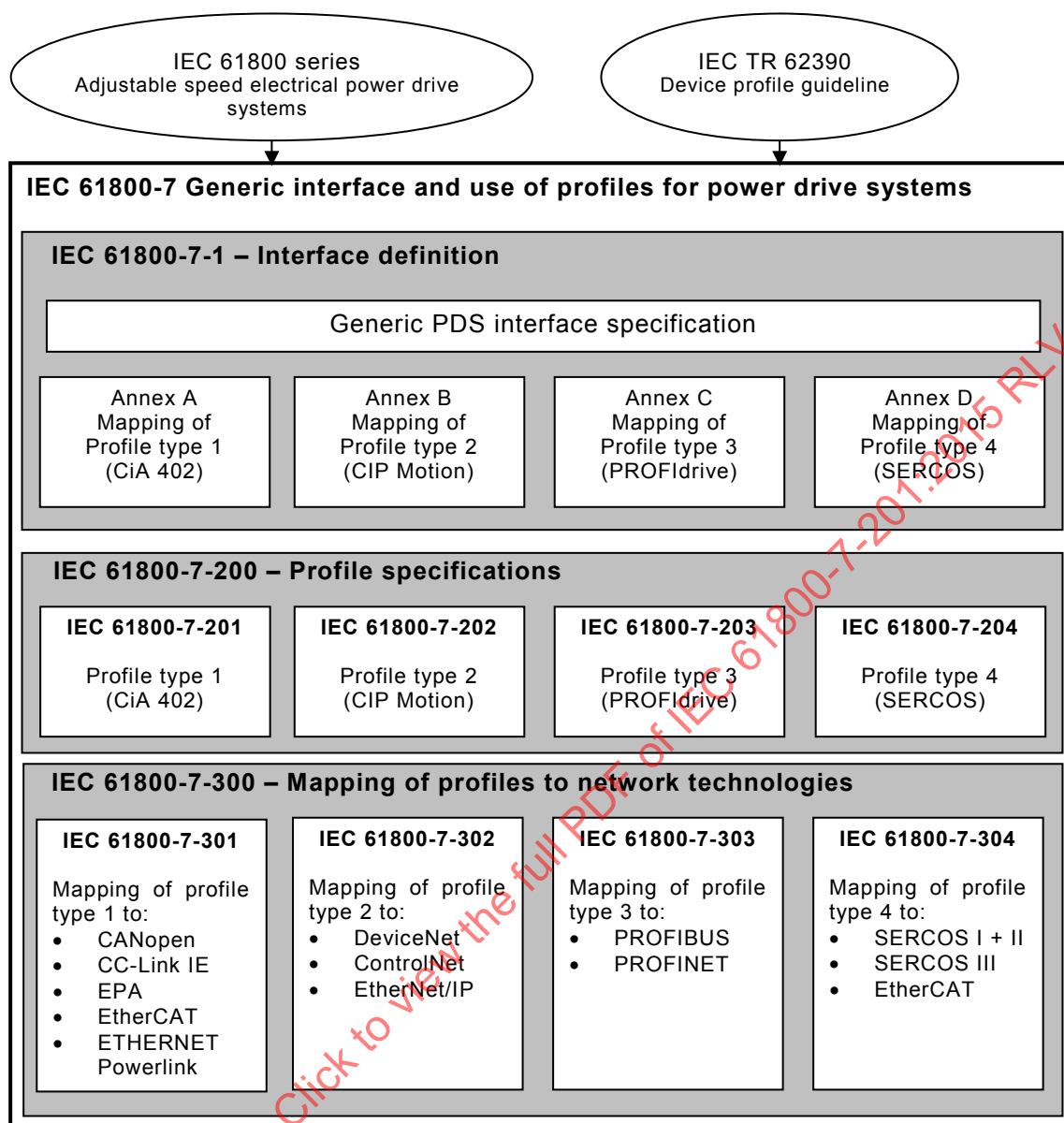
² CIP Motion™ est une marque de ODVA, Inc. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque CIP Motion™. L'utilisation de la marque CIP Motion™ nécessite l'autorisation de ODVA, Inc.

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Les IEC 61800-7-301, IEC 61800-7-302, IEC 61800-7-303 et IEC 61800-7-304 spécifient la ou les méthodes de mise en correspondance des types de profils 1, 2, 3 et 4 avec différentes technologies de réseau (telles que CANopen^{®5}, CC-Link IE[®] Field Network⁶, EPA^{™7}, EtherCAT^{®8}, Ethernet Powerlink^{™9}, DeviceNet^{™10}, ControlNet^{™11}, EtherNet/IP^{™12}, PROFIBUS¹³, PROFINET¹⁴ et SERCOS[®]).

- 5 CANopen[®] est une marque déposée de CAN in Automation, e.V. (CiA). Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque déposée CANopen[®]. L'utilisation de la marque déposée CANopen[®] nécessite l'autorisation de CAN in Automation e.V. (CiA). CANopen[®] est l'acronyme de "Controller Area Network open (Gestionnaire de réseau de communication ouvert) et fait référence à l'EN 50325-4.
- 6 CC-Link IE[®] Field Network est une marque déposée de Mitsubishi Electric Corporation. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque déposée CC-Link IE[®] Field Network. L'utilisation de la marque déposée CC-Link IE[®] Field Network nécessite l'autorisation de Mitsubishi Electric Corporation.
- 7 EPA[™] est une marque de SUPCON Group Co. Ltd. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque EPA[™]. L'utilisation de la marque EPA[™] nécessite l'autorisation de son détenteur.
- 8 EtherCAT[®] est une marque déposée de Beckhoff, Verl. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque EtherCAT[®]. L'utilisation de la marque déposée EtherCAT[®] nécessite l'autorisation de son détenteur.
- 9 Ethernet Powerlink[™] est une marque de B&R., le contrôle de son utilisation est confié à l'organisme à but non lucratif EPSG. Cette information est fournie pour la commodité des utilisateurs de la présente Norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque Ethernet Powerlink[™]. L'utilisation de la marque Ethernet Powerlink[™] nécessite l'autorisation de son détenteur.
- 10 DeviceNet[™] est une marque de ODVA, Inc. Cette information est fournie pour la commodité des utilisateurs de la présente Norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque DeviceNet[™]. L'utilisation de la marque DeviceNet[™] nécessite l'autorisation de ODVA, Inc.
- 11 ControlNet[™] est une marque de ODVA, Inc. Cette information est fournie pour la commodité des utilisateurs de la présente Norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque ControlNet[™]. L'utilisation de la marque ControlNet[™] nécessite l'autorisation de ODVA, Inc.
- 12 EtherNet/IP[™] est une marque de ODVA, Inc. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque EtherNet/IP[™]. L'utilisation de la marque EtherNet/IP[™] nécessite l'autorisation de ODVA, Inc.
- 13 PROFIBUS est une marque de PROFIBUS & PROFINET International. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque PROFIBUS. L'utilisation de la marque PROFIBUS nécessite l'autorisation de PROFIBUS & PROFINET International.
- 14 PROFINET est une marque de PROFIBUS & PROFINET International. Cette information est fournie pour la commodité des utilisateurs de la présente norme internationale et ne constitue en aucun cas un entérinement par l'IEC du détenteur de la marque ou de l'un quelconques de ses produits. La conformité à ce profil n'implique pas l'utilisation de la marque PROFINET. L'utilisation de la marque PROFINET nécessite l'autorisation de PROFIBUS & PROFINET International.



IEC

Anglais	Français
IEC 61800 series Adjustable speed electrical power drive systems	Série IEC 61800 Entraînements électriques de puissance à vitesse variable
IEC/TR 62390 Device profile guideline	IEC TR 62390 Device profile guideline (disponible en anglais seulement)
IEC 61800-7 Generic interface and use of profiles for power drive systems	IEC 61800-7 Interface générique et utilisation de profils pour les entraînements électriques de puissance
IEC 61800-7-1 Interface definition	IEC 61800-7-1 Définition de l'interface
Generic PDS interface specification	Spécification d'interface PDS générique
Annex A, Mapping of Profile type 1 (CiA 402)	Annexe A, Mise en correspondance du profil de type 1 (CiA 402)
Annex B, Mapping of Profile type 2 (CIP Motion)	Annexe B, Mise en correspondance du profil de type 2 (CIP Motion)
Annex C, Mapping of Profile type 3 (PROFIdrive)	Annexe C, Mise en correspondance du profil de type 3 (PROFIdrive)
Annex D, Mapping of Profile type 4 (SERCOS)	Annexe D, Mise en correspondance du profil de type 4 (SERCOS)

Anglais	Français
IEC 61800-7-200 – Profile specifications	IEC 61800-7-200 – Spécifications des profils
IEC 61800-7-201 Profile type 1 (CiA 402)	IEC 61800-7-201 Profil de type 1 (CiA 402)
IEC 61800-7-202 Profile type 2 (CIP Motion)	IEC 61800-7-202 Profil de type 2 (CIP Motion)
IEC 61800-7-203 Profile type 3 (PROFIdrive)	IEC 61800-7-203 Profil de type 3 (PROFIdrive)
IEC 61800-7-204 Profile type 4 (PROFIdrive)	IEC 61800-7-204 Profil de type 4 (SERCOS)
IEC 61800-7-300 – Mapping of profiles to network technologies	IEC 61800-7-300 – Mise en correspondance de profils avec les technologies de réseaux
IEC 61800-7-301 Mapping of profile type 1 to CANopen CC-Link IE EPA EtherCAT ETHERNET Powerlink	IEC 61800-7-301 Mise en correspondance du profil de type 1 avec CANopen CC-Link IE EPA EtherCAT ETHERNET Powerlink
IEC 61800-7-302 Mapping of profile type 2 to DeviceNet ControlNet EtherNet/IP	IEC 61800-7-302 Mise en correspondance du profil de type 2 avec DeviceNet ControlNet EtherNet/IP
IEC 61800-7-303 Mapping of profile type 3 to PROFIBUS PROFINET	IEC 61800-7-303 Mise en correspondance du profil de type 3 avec PROFIBUS PROFINET
IEC 61800-7-304 Mapping of profile type 4 to SERCOS I + II SERCOS III EtherCAT	IEC 61800-7-304 Mise en correspondance du profil de type 4 avec SERCOS I + II SERCOS III EtherCAT

Figure 1 – Structure de l'IEC 61800-7

ENTRAÎNEMENTS ÉLECTRIQUES DE PUISSANCE À VITESSE VARIABLE –

Partie 7-201: Interface générique et utilisation de profils pour les entraînements électriques de puissance – Spécification de profil de type 1

1 Domaine d'application

La présente partie de l'IEC 61800 spécifie le type de profil 1 pour les entraînements électriques de puissance (PDS). Le type de profil 1 peut être mis en correspondance avec différentes technologies de réseau de communication.

Les fonctions spécifiées dans la présente partie de l'IEC 61800 ne sont pas destinées à assurer la sécurité fonctionnelle. Ceci exige l'application de mesures supplémentaires conformes aux normes, conventions et lois pertinentes.

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 61800-7-301¹⁵, *Entraînements électriques de puissance à vitesse variable – Partie 7-301: Interface générique et utilisation de profils pour les entraînements électriques de puissance – Mise en correspondance du profil de type 1 avec les technologies de réseaux*

EN 50325-4, *Sous-système de communications industriel basé sur l'ISO 11898 (CAN) pour les interfaces des dispositifs de commande – Partie 4: CANopen*

CiA 303-2:2012, *CANopen recommendation – Part 2: Representation of SI units and prefixes*¹⁶

3 Termes, définitions et abréviations

3.1 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

3.1.1

valeur instantanée

valeur d'une grandeur variable à un instant déterminé

Note 1 à l'article: La valeur instantanée est utilisée dans le présent document comme données d'entrée du programme de commande d'application pour superviser les variables du PDS (par exemple, variables de réaction).

¹⁵ À publier.

¹⁶ Le CiA 303-2 peut être téléchargé gratuitement à l'adresse www.can-cia.org. Pour éviter tout téléchargement abusif, la personne qui l'effectue est tenue de remplir un formulaire d'enregistrement qui n'implique aucune obligation pour l'utilisateur de la spécification.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.1.]

3.1.2

algorithme

séquence finie d'opérations complètement déterminée par laquelle la valeur des données de sortie peut être calculée à partir de la valeur des données d'entrée

[SOURCE: IEC 61800-7-1:2015, 3.2.1]

3.1.3

application

élément fonctionnel logiciel spécifique à la résolution d'un problème en termes de mesure et de commande de procédés industriels

Note 1 à l'article: Une application peut être répartie entre les ressources, et peut communiquer avec d'autres applications.

[SOURCE: IEC 61800-7-1:2015, 3.2.2]

3.1.4

mode d'application

type d'application pouvant être demandé à un PDS

Note 1 à l'article: Les différents modes d'application reflètent la boucle d'asservissement dédiée à l'asservissement de couple ou de position, à la commande de vitesse ou à d'autres applications comme le retour à la position de référence.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.2]

3.1.5

attribut

propriété ou caractéristique d'une entité

[SOURCE: IEC 61800-7-1:2015, 3.2.3]

3.1.6

classe

description d'un ensemble d'objets qui partagent les mêmes attributs, opérations, méthodes, relations et sémantique

[SOURCE: IEC 61800-7-1:2015, 3.2.5]

3.1.7

commandes

consignes

ensemble de commandes entre le programme de commande d'application et le PDS permettant de contrôler le comportement du PDS ou les éléments fonctionnels de celui-ci

Note 1 à l'article: Les états ou les modes de fonctionnement reflètent le comportement.

Note 2 à l'article: Les différentes commandes peuvent être représentées par un bit chacune.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.3]

3.1.8

commande

régulation

action délibérée sur (ou dans) un processus, en vue d'atteindre des objectifs définis

[SOURCE: IEC 61800-7-1:2015, 3.2.6]

3.1.9

dispositif de commande/régulation

unité physique contenant – dans un module/sous-ensemble ou dispositif – un programme d'application de commande du PDS

[SOURCE: IEC 61800-7-1:2015, 3.2.7]

3.1.10

type de données

ensemble de valeurs associé à un ensemble d'opérations autorisées

[SOURCE: IEC 61800-7-1:2015, 3.2.8]

3.1.11

dispositif

dispositif de terrain

<blocs de fonction> entité physique indépendante en réseau dans un système d'automatisation industriel, capable d'accomplir des fonctions spécifiées dans un contexte particulier et délimitée par ses interfaces

[SOURCE: IEC 61800-7-1:2015, 3.2.9]

3.1.12

profil de dispositif

représentation d'un dispositif en termes de ses paramètres, ensembles de paramètres et comportement selon un modèle de dispositif qui décrit les données et le comportement du dispositif tel que perçus par l'intermédiaire d'un réseau, indépendamment de toute technologie de réseau

[SOURCE: IEC 61800-7-1:2015, 3.2.11]

3.1.13

variable de réaction

grandeur variable qui représente la variable commandée et qui est réintroduite dans le comparateur

[SOURCE: IEC 61800-7-1:2015, 3.2.12]

3.1.14

élément fonctionnel

entité de logiciel ou logiciel combiné au matériel, capable d'accomplir une fonction spécifiée d'un dispositif

Note 1 à l'article: Un élément fonctionnel comporte une interface et des associations à d'autres éléments fonctionnels et fonctions.

Note 2 à l'article: Un élément fonctionnel peut être constitué de bloc(s) de fonctions, d'objet(s) ou de liste(s) de paramètres.

[SOURCE: IEC 61800-7-1:2015, 3.2.13]

3.1.15

alimentation de haut niveau

alimentation électrique principale du dispositif d'entraînement

3.1.16

données d'entrée

données transférées d'une source externe dans un dispositif, une ressource ou un élément fonctionnel

[SOURCE: IEC 61800-7-1:2015, 3.2.14]

3.1.17

interface

frontière partagée entre deux entités, définie par des caractéristiques fonctionnelles, des caractéristiques de signal ou d'autres caractéristiques appropriées

[SOURCE: IEC 61800-7-1:2015, 3.2.15]

3.1.18

système logique d'entraînement électrique de puissance

modèle qui comprend un PDS et un réseau de communication accessible par l'interface PDS générique

[SOURCE: IEC 61800-7-1:2015, 3.2.16]

3.1.19

alimentation de faible niveau

alimentation électrique de la partie contrôle du dispositif d'entraînement

3.1.20

modèle

représentation mathématique ou physique d'un système ou d'un processus, basée, avec une précision suffisante, sur des lois connues, sur une identification ou sur des hypothèses spécifiées

[SOURCE: IEC 61800-7-1:2015, 3.2.17]

3.1.21

mode de fonctionnement

caractérisation de la manière et du degré avec lequel l'opérateur humain intervient sur l'équipement de commande

[SOURCE: IEC 61800-7-1:2015, 3.2.18]

3.1.22

données de sortie

données provenant d'un dispositif, d'une ressource ou d'un élément fonctionnel et transférées de ces derniers vers des systèmes externes

[SOURCE: IEC 61800-7-1:2015, 3.2.19]

3.1.23

paramètre

élément de donnée qui représente les informations d'un dispositif qui peuvent être lues ou saisies dans un dispositif, par exemple, par le biais du réseau ou d'une IHM locale

Note 1 à l'article: Un paramètre est caractérisé généralement par son nom, le type de données et la direction d'accès.

[SOURCE: IEC 61800-7-1:2015, 3.2.20]

3.1.24**profil**

représentation d'une interface PDS en termes de ses paramètres, ensembles de paramètres et comportement selon un profil de communication et un profil de dispositif

[SOURCE: IEC 61800-7-1:2015, 3.2.21, modifiée – La Note 1 à l'article est supprimée.]

3.1.25**variable de référence**

variable d'entrée d'un comparateur dans un système de régulation, qui détermine la valeur prescrite de la variable commandée et qui est déduite de la variable de consigne

[SOURCE: IEC 61800-7-1:2015, 3.2.22]

3.1.26**point de consigne**

valeur ou variable utilisée comme donnée de sortie du programme de commande d'application afin de commander le PDS

[SOURCE: IEC 61800-7-1:2015, 3.3.1.5]

3.1.27**état****statut**

ensemble d'informations entre le PDS et le programme de commande d'application, qui reflète l'état ou le mode du PDS ou un élément fonctionnel de ce dernier

Note 1 à l'article: Les différentes informations d'état peuvent être codées avec un bit chacune.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.6]

3.1.28**type**

élément matériel ou logiciel qui spécifie les attributs communs partagés par toutes les instances du type

[SOURCE: IEC 61800-7-1:2015, 3.2.23]

3.1.29**cas d'application**

spécification de classe d'une séquence d'actions, y compris les variantes, qu'un système (ou autre entité) peut exécuter, en interaction avec les acteurs du système

[SOURCE: IEC 61800-7-1:2015, 3.2.24]

3.1.30**variable**

entité logicielle qui peut prendre différentes valeurs, mais une seule valeur à la fois

Note 1 à l'article: Les valeurs d'une variable, ainsi que d'un paramètre, se limitent habituellement à un certain type de données.

[SOURCE: IEC 61800-7-1:2015, 3.2.25]

3.2 Abréviations

CA alternating current (courant alternatif)

BL brush-Less (sans balais)

c	constant
CiA	CAN in Automation (CAN en mode automatisation)
COB	communication Object (objet de communication)
csp	cyclic synchronous profile mode (mode de profil à synchronisation cyclique)
cst	cyclic synchronous torque mode (mode de couple à synchronisation cyclique)
cstca	cyclic synchronous torque mode with commutation angle (mode de couple à synchronisation cyclique avec angle de commutation)
csv	cyclic synchronous velocity mode (mode de vitesse à synchronisation cyclique)
DC	direct current (courant continu)
DIV	divisor (diviseur)
FC	frequency converter (convertisseur de fréquence)
FE	functional element (élément fonctionnel)
FIFO	first in, first out (premier entré, premier sorti)
FSA	finite state automation (automatisation d'états finis)
hm	homing mode (mode de retour à la position de référence)
IHM	interface homme-machine
E/S	entrée/sortie
ip	interpolated position mode (mode de position interpolée)
LSB	less significant bit/byte (bit/octet de poids faible)
MSB	most significant bit/byte (bit/octet de poids fort)
MUL	multiplication
NMT	network management (gestion de réseau)
PDO	process data object (objet de données de processus)
PDS	power drive system (entraînement électrique de puissance)
PM	permanent magnet (aimant permanent)
pp	profile position mode (mode de position de profil)
pvp	profile velocity mode (mode de vitesse de profil)
r	reserved (réservé)
r.m.s.	root mean square (valeur efficace)
ro	read-only (lecture seule)
rw	read-write (lecture-écriture)
tq	torque mode (mode de couple)
vl	velocity mode (mode de vitesse)

4 Généralités

4.1 Considérations d'ordre général

La présente partie de la série IEC 61800-7 spécifie le profil de dispositif CiA 402 indépendant du bus pour les entraînements électriques de puissance tels que les convertisseurs de fréquence, les contrôleurs asservis ou les commandes de moteurs pas à pas. Elle inclut la définition des objets de commande en temps réel, ainsi que des objets de configuration, d'ajustement, d'identification et de gestion de réseau. L'automatisation d'états finis (FSA) des PDS est également définie, qui peut être commandée de manière externe, par un dispositif de commande qui communique via un système de communication avec le dispositif d'entraînement.

Le profil de dispositif définit plusieurs modes de fonctionnement. Ces modes comprennent les modes de position de profil, de retour à la position de référence, de position interpolée, de vitesse de profil, de couple de profil, de vitesse, de position à synchronisation cyclique, de vitesse à synchronisation cyclique et de couple à synchronisation cyclique.

4.2 Interface de communication

Le système de communication connecte le dispositif d'entraînement avec le dispositif de commande et les autres dispositifs de terrain. Le dispositif de commande, via le système de communication, utilise les services de communication pour les échanges de données suivants avec le dispositif d'entraînement:

- données en temps non réel (configuration, identification, ajustement, diagnostic, etc.);
- données de processus telles que les valeurs cibles et les valeurs instantanées.

Ces services sont définis dans l'IEC 61800-7-301. Les données de processus sont échangées par des messages de données en temps réel. Ces messages peuvent être configurés au moyen des services de configuration fournis par le système de communication.

Le système de communication doit fournir les services de transmission et de réception des objets de communication (COB). Les COB suivants doivent être pris en charge:

- COB pour la transmission de données en temps réel;
- COB pour la transmission des informations d'urgence;
- COB pour la gestion de réseau.

Par ailleurs, le système de communication peut fournir les COB suivants:

- COB pour la transmission de données de configuration;
- COB à des fins de synchronisation;
- COB pour la répartition du temps système.

Les COB sont définis de manière détaillée dans l'IEC 61800-7-301.

4.3 Dictionnaire d'objets

Tous les objets mentionnés dans la présente partie de la série IEC 61800-7 sont regroupés dans le dictionnaire d'objets, et définis par des attributs comme cela est décrit dans l'EN 50325-4. Tous les objets doivent être accessibles via le réseau de manière prédéfinie et ordonnée, et ce, au moyen du COB pour la transmission de données de configuration. Chaque objet du dictionnaire doit avoir une adresse unique qui utilise un index à 16 bits et un sous-index à 8 bits. Les objets liés à la communication sont définis de manière détaillée dans l'EN 50325-4 et l'IEC 61800-7-301.

La zone de profil de dispositif normalisée aux index 6000_h à 9FFF_h doit contenir tous les objets d'application communs à cette spécification de profil de dispositif. Les index d'objets suivants doivent être réservés pour des raisons de compatibilité: 6045_h, 6047_h, 604D_h, 604E_h, 604F_h, 6052_h, 6053_h, 6054_h, 6055_h, 6056_h, 6057_h, 6058_h, 6059_h, 6089_h, 608A_h, 608B_h, 608C_h, 608D_h, 608E_h, 6093_h, 6094_h, 6095_h, 6096_h, 6097_h, 60A0_h, 60A1_h, 60A2_h, 60F6_h, 60F7_h, 60F9_h, 60FB_h, 6410_h, 6504_h et 6510_h. Les plages d'index d'objets suivantes doivent être réservées pour des raisons de compatibilité avec d'autres normes: plage de 6200_h à 62FF_h et plage de 6600_h à 67EF_h.

Les objets peuvent être lus, et saisis respectivement, via le réseau. 8 axes au maximum peuvent être réalisés dans cette plage d'objets. De plus, il est possible de mettre en œuvre d'autres profils de dispositifs (par exemple, module E/S ou codeur générique) au sein du dispositif d'entraînement. Ces autres profils de dispositif peuvent être mis en œuvre au lieu d'un ou de plusieurs axes.

Pour les dispositifs multiaxe, la plage d'objets 6000_h à 67FF_h doit être décalée comme suit:

- 6000_h à 67FF_h: axe 0
- 6800_h à 6FFF_h: axe 1
- 7000_h à 77FF_h: axe 2
- 7800_h à 7FFF_h: axe 3
- 8000_h à 87FF_h: axe 4
- 8800_h à 8FFF_h: axe 5
- 9000_h à 97FF_h: axe 6
- 9800_h à 9FFF_h: axe 7

Les attributs de catégorie et de catégorie d'entrée d'un objet indiquent si ce dernier doit être mis en œuvre (obligatoire) ou peut être mis en œuvre (facultatif).

Les attributs de code de l'objet et de type de données sont définis de manière détaillée dans l'EN 50325-4 ou dans d'autres spécifications de technologies de réseau. Les attributs de types de données utilisés sont indiqués à l'Article 5. L'attribut d'accès qui indique si un objet d'application est en lecture seule (ro), lecture/écriture (rw), écriture seule (wo) ou constant (c), est défini dans la description d'entrée. Lecture seule indique que cet objet ne doit pas être écrit via le bus; lecture/écriture permet de lire et d'écrire cet objet, et écriture seule signifie que cet objet d'application ne doit pas être lu via le bus.

L'attribut de mise en correspondance PDO doit indiquer si cet objet doit être ou peut être ou ne doit pas être mis en correspondance avec le COB pour la transmission de données en temps réel. La définition détaillée de ces attributs est donnée dans l'IEC 61800-7-301.

L'attribut de la valeur par défaut définit la valeur d'un objet avec l'attribut d'accès de la valeur 'rw' et 'c' après mise sous tension ou réinitialisation de l'application.

5 Types de données

5.1 Types de données normalisés

Les types de données utilisés dans ce profil sont énumérés dans le Tableau 1.

Tableau 1 – Liste des types de données utilisés

Type de données	Référence
Unsigned8	EN 50325-4
Unsigned16	EN 50325-4
Unsigned32	EN 50325-4
Integer8	EN 50325-4
Integer16	EN 50325-4
Integer32	EN 50325-4
Chaîne visible	EN 50325-4
Heure	EN 50325-4
Délai d'interpolation	Voir Tableau 2
Configuration des données d'interpolation	Voir Tableau 3
Accélération/décélération en vitesse vl	Voir Tableau 4

5.2 Définitions des enregistrements

Le Tableau 2, le Tableau 3 et le Tableau 4 définissent les enregistrements utilisés dans la présente partie de la série IEC 61800-7.

Tableau 2 – Délai d'interpolation

Index	Sous-index	Description	Type de données
0080 _h	00 _h	Plus grand sous- index pris en charge	Unsigned8
	01 _h	Unités de délai d'interpolation	Unsigned8
	02 _h	Index de délai d'interpolation	Integer8

Tableau 3 – Configuration de données d'interpolation

Index	Sous-index	Description	Type de données
0081 _h	00 _h	Plus grand sous-index pris en charge	Unsigned8
	01 _h	Capacité maximale de mémoire tampon	Unsigned32
	02 _h	Capacité réelle de mémoire tampon	Unsigned32
	03 _h	Organisation de la mémoire tampon	Unsigned8
	04 _h	Position de la mémoire tampon	Unsigned16
	05 _h	Capacité du registre de données	Unsigned8
	06 _h	Effacement de la mémoire tampon	Unsigned8

Tableau 4 – Accélération/décélération en vitesse v1

Index	Sous-index	Description	Type de données
0082 _h	00 _h	Plus grand sous-index pris en charge	Unsigned8
	01 _h	Vitesse delta	Unsigned32
	02 _h	Temps delta	Integer16

6 Définitions d'objets générales

6.1 Généralités

Les objets de paramètres de communication, les objets d'identification et les objets d'information supplémentaires sont définis dans les paragraphes suivants.

6.2 Objets de paramètres de communication

Trois objets de paramètres de communication doivent être mis en œuvre:

- objet de type de dispositif 1000_h
- objet de registre d'erreur 1001_h
- objet d'identité 1018_h

Ces objets sont définis dans l'EN 50325-4 et les définitions suivantes doivent également s'appliquer.

L'objet de type de dispositif doit définir le type de dispositif, la fonctionnalité du dispositif et la variante de mise en correspondance.

Pour les modules à plusieurs dispositifs, le paramètre d'information supplémentaire doit contenir $0FFF_h$ et le numéro de profil de dispositif référencé par l'objet 1000_h est le profil de dispositif du premier dispositif dans le dictionnaire d'objets. Tous les autres dispositifs d'un module à plusieurs dispositifs doivent identifier leurs profils à l'objet $67FF_h + x \times 800_h$ avec x = numéro interne du dispositif (0 à 7). Voir l'EN 50325-4 pour des informations détaillées.

La Figure 2 spécifie la structure et les valeurs de l'objet Type de dispositif, le Tableau 5 spécifie la description de l'objet et le Tableau 6 spécifie la description d'entrée.

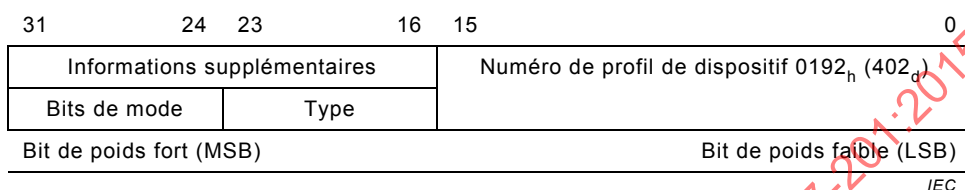


Figure 2 – Définition des valeurs

Bits de mode et Type dans les informations supplémentaires sont définis dans l'IEC 61800-7-301.

Tableau 5 – Description de l'objet

Attribut	Valeur
Index	1000_h
Nom	Type de dispositif
Code de l'objet	Voir EN 50325-4
Type de données	Voir EN 50325-4
Catégorie	Obligatoire

Tableau 6 – Description d'entrée

Attribut	Valeur
Sous-index	00_h
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir définition des valeurs
Valeur par défaut	Spécifique au constructeur

Le bit spécifique au profil de dispositif dans l'objet Registre d'erreurs (1001_h) doit être utilisé pour indiquer que le code d'erreur dans le message d'urgence est défini dans la présente partie de la série IEC 61800-7.

Le code d'erreur correspondant est lisible dans l'objet 1003_h (voir EN 50325-4) ou l'objet $603F_h$.

6.3 Objets d'identification et d'informations supplémentaires

6.3.1 Objet 6402_h: Type de moteur

Cet objet doit indiquer le type de moteur relié au dispositif d'entraînement et entraîné par ce dernier. Le Tableau 7 spécifie la définition des valeurs, le Tableau 8 spécifie la description de l'objet et le Tableau 9 spécifie la description d'entrée.

Tableau 7 – Définition des valeurs

Valeur	Nom CANopen	Autres noms
0000 _h	Moteur non standard	–
0001 _h	Moteur à courant continu à modulation de phase	–
0002 _h	Moteur à courant continu commandé en fréquence	–
0003 _h	Moteur synchrone à modulation de phase	–
0004 _h	Moteur synchrone commandé en fréquence	Moteur bobiné sinusoïdal à courant alternatif
0005 _h	Moteur SRM	Moteur à réluctance à courant alternatif
0006 _h	Moteur à induction à rotor bobiné	Rotor bobiné polyphasé à induction asynchrone à courant alternatif
0007 _h	Moteur à induction à cage d'écureuil	Cage d'écureuil à induction asynchrone à courant alternatif
0008 _h	Moteur pas-à-pas	Pas synchrone à courant alternatif
0009 _h	Moteur pas à pas à micro-pas	–
000A _h	Moteur BL PM sinusoïdal	Moteur à modulation de phase sinusoïdal synchrone à courant alternatif
000B _h	Moteur BL PM trapézoïdal	Moteur trapézoïdal PM sans balais synchrone à courant alternatif
000C _h	Moteur à réluctance à courant alternatif	–
000D _h	Moteur PM à commutateur à courant continu	–
000E _h	Moteur à série bobiné à commutateur à courant continu	–
000F _h	Moteur à shuntage bobiné à commutateur à courant continu	–
0010 _h	Moteur à excitation composée bobiné à commutateur à courant continu	–
0011 _h à 7FFE _h	Réservé	–
7FFF _h	Aucun type de moteur assigné	–
8000 _h à FFFF _h	Spécifique au constructeur	–

Tableau 8 – Description de l'objet

Attribut	Valeur
Index	6402 _h
Nom	Type de moteur
Code de l'objet	Variable
Type de données	Unsigned16
Catégorie	Facultative

Tableau 9 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 7
Valeur par défaut	Spécifique au constructeur

6.3.2 Objet 6403_h: Numéro de lot du moteur

Cet objet doit indiquer le numéro de lot du moteur (numéro de plaque signalétique) fourni par le constructeur. Si aucun numéro n'est encore assigné, cet objet doit indiquer cette absence par /0 (chaîne vide). Le Tableau 10 spécifie la description de l'objet et le Tableau 11 spécifie la description d'entrée.

Tableau 10 – Description de l'objet

Attribut	Valeur
Index	6403 _h
Nom	Numéro de lot du moteur
Code de l'objet	Variable
Type de données	Chaîne visible
Catégorie	Facultative

Tableau 11 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Chaîne visible
Valeur par défaut	Spécifique au constructeur

6.3.3 Objet 6404_h: Constructeur du moteur

Cet objet doit indiquer le nom du constructeur du moteur. Si aucun nom n'est encore assigné, cet objet doit indiquer cette absence par /0 (chaîne vide). Le Tableau 12 spécifie la description de l'objet et le Tableau 13 spécifie la description d'entrée.

Tableau 12 – Description de l'objet

Attribut	Valeur
Index	6404 _h
Nom	Constructeur du moteur
Code de l'objet	Variable
Type de données	Chaîne visible
Catégorie	Facultative

Tableau 13 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Chaîne visible
Valeur par défaut	Spécifique au constructeur

6.3.4 Objet 6405_h: Adresse http de lot du moteur

Cet objet doit indiquer l'adresse Web assignée de lot du moteur. Si aucune adresse n'est encore assignée, cet objet doit indiquer cette absence par /0 (chaîne vide). Le Tableau 14 spécifie la description de l'objet et le Tableau 15 spécifie la description d'entrée.

Tableau 14 – Description de l'objet

Attribut	Valeur
Index	6405 _h
Nom	Adresse http de lot du moteur
Code de l'objet	Variable
Type de données	Chaîne visible
Catégorie	Facultative

Tableau 15 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Chaîne visible
Valeur par défaut	Spécifique au constructeur

6.3.5 Objet 6406_h: Date d'étalonnage du moteur

Cet objet doit indiquer la date assignée de la dernière inspection du moteur. Si aucune date n'est encore assignée, cet objet doit indiquer cette absence par une valeur de 0. Le Tableau 16 spécifie la description de l'objet et le Tableau 17 spécifie la description d'entrée.

Tableau 16 – Description de l'objet

Attribut	Valeur
Index	6406 _h
Nom	Date d'étalonnage du moteur
Code de l'objet	Variable
Type de données	Heure
Catégorie	Facultative

Tableau 17 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	0 _d ou heure
Valeur par défaut	Spécifique au constructeur

6.3.6 Objet 6407_h: Durée de service du moteur

Cet objet doit indiquer la durée assignée de service du moteur. Si aucune période n'est encore assignée, cet objet doit indiquer cette absence par 0000 0000_h. La valeur doit être donnée en multiples d'heures. Le Tableau 18 spécifie la description de l'objet et le Tableau 19 spécifie la description d'entrée.

Tableau 18 – Description de l'objet

Attribut	Valeur
Index	6407 _h
Nom	Durée de service du moteur
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 19 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

6.3.7 Objet 6503_h: Numéro de lot du dispositif d'entraînement

Cet objet doit indiquer le numéro de lot du dispositif d'entraînement assigné par le constructeur (numéro de plaque signalétique). Le Tableau 20 spécifie la description de l'objet et le Tableau 21 spécifie la description d'entrée.

Tableau 20 – Description de l'objet

Attribut	Valeur
Index	6503 _h
Nom	Numéro de lot du dispositif d'entraînement
Code de l'objet	Variable
Type de données	Chaîne visible
Catégorie	Facultative

Tableau 21 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Non
Valeur par défaut	Spécifique au constructeur

6.3.8 Objet 6505_h: Adresse http de lot du dispositif d'entraînement

Cet objet doit indiquer l'adresse Web assignée du constructeur du dispositif d'entraînement. Si aucune adresse n'est encore assignée, cet objet doit indiquer cette absence par /0 (chaîne vide). Le Tableau 22 spécifie la description de l'objet et le Tableau 23 spécifie la description d'entrée.

Tableau 22 – Description de l'objet

Attribut	Valeur
Index	6505 _h
Nom	adresse http de lot du dispositif d'entraînement
Code de l'objet	Variable
Type de données	Chaîne visible
Catégorie	Facultative

Tableau 23 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Non
Valeur par défaut	Spécifique au constructeur

7 Codes d'erreurs et comportement aux erreurs

7.1 Codes d'erreurs

Les messages d'urgence sont déclenchés par des erreurs internes et les avertissements importants sont détectés au sein du dispositif d'entraînement. Ils sont définis de manière détaillée dans l'IEC 61800-7-301. Ils doivent contenir le code d'erreur à 16 bits. Les codes d'erreurs compris entre xx00_h et xx7F_h sont définis dans l'EN 50325-4 ou dans le Tableau 24. Les codes d'erreurs compris entre xx80_h et xxFF_h sont utilisés selon les instructions spécifiques du constructeur.

Tableau 24 – Codes d'erreurs

Code d'erreur	Signification
2110 _h	Court-circuit/fuite à la terre (entrée)
2120 _h	Fuite à la terre (entrée)
2121 _h	Phase de fuite à la terre L1
2122 _h	Phase de fuite à la terre L2
2123 _h	Phase de fuite à la terre L3
2130 _h	Court-circuit (entrée)
2131 _h	Phases de court-circuit L1-L2
2132 _h	Phases de court-circuit L2-L3
2133 _h	Phases de court-circuit L3-L1
2211 _h	Courant interne n°1
2212 _h	Courant interne n°2
2213 _h	Surintensité en fonction de rampe
2214 _h	Surintensité dans la séquence
2220 _h	Surintensité continue (interne au dispositif)
2221 _h	Surintensité continue n°1
2222 _h	Surintensité continue n°2
2230 _h	Court-circuit/fuite à la terre (interne au dispositif)
2240 _h	Fuite à la terre (interne au dispositif)
2250 _h	Court-circuit (interne au dispositif)
2310 _h	Surintensité continue (côté sortie du dispositif)
2311 _h	Surintensité continue n° 1
2312 _h	Surintensité continue n° 2
2320 _h	Court-circuit/fuite à la terre (côté moteur)
2330 _h	Fuite à la terre (côté moteur)
2331 _h	Phase de fuite à la terre U
2332 _h	Phase de fuite à la terre V
2333 _h	Phase de fuite à la terre W
2340 _h	Court-circuit (côté moteur)
2341 _h	Phases de court-circuit U-V
2342 _h	Phase de fuite à la terre V-W
2343 _h	Phase de fuite à la terre W-U
2350 _h	Défaut de niveau de charge (I ² t, état thermique)
2351 _h	Avertissement de niveau de charge (I ² t, état thermique)
3110 _h	Surtension de secteur
3111 _h	Phase de surtension de secteur L1
3112 _h	Phase de surtension de secteur L2
3113 _h	Phase de surtension de secteur L3
3120 _h	Sous-tension de secteur
3121 _h	Phase de sous-tension de secteur L1
3122 _h	Phase de sous-tension de secteur L2
3123 _h	Phase de sous-tension de secteur L3
3130 _h	Coupure de phase
3131 _h	Coupure de phase L1

Code d'erreur	Signification
3132 _h	Coupure de phase L2
3133 _h	Coupure de phase L3
3134 _h	Séquence de phases
3140 _h	Fréquence du réseau électrique
3141 _h	Fréquence du réseau électrique trop élevée
3142 _h	Fréquence du réseau électrique trop faible
3210 _h	Surtension de liaison en courant continu
3211 _h	Surtension n° 1
3212 _h	Surtension n° 2
3220 _h	Sous-tension de liaison en courant continu
3221 _h	Sous-tension n° 1
3222 _h	Sous-tension n° 2
3230 _h	Erreur de charge
3310 _h	Surtension de sortie
3311 _h	Phase de surtension de sortie U
3312 _h	Phase de surtension de sortie V
3313 _h	Phase de surtension de sortie W
3320 _h	Circuit d'induit
3321 _h	Interruption du circuit d'induit
3330 _h	Circuit inducteur
3331 _h	Interruption du circuit inducteur
4110 _h	Température ambiante trop élevée
4120 _h	Température ambiante trop faible
4130 _h	Température de l'air fourni
4140 _h	Température de la sortie d'air
4210 _h	Température trop élevée du dispositif
4220 _h	Température trop faible du dispositif
4300 _h	Température du dispositif d'entraînement
4310 _h	Température trop élevée du dispositif d'entraînement
4320 _h	Température trop faible du dispositif d'entraînement
4400 _h	Température de l'air fourni
4410 _h	Température trop élevée de l'air fourni
4420 _h	Température trop faible de l'air fourni
5100 _h	Matériel du dispositif d'alimentation
5110 _h	Basse tension d'alimentation
5111 _h	U1 = alimentation ±15 V
5112 _h	U2 = alimentation +24 V
5113 _h	U3 = alimentation +5 V
5114 _h	U4 = spécifique au constructeur
5115 _h	U5 = spécifique au constructeur
5116 _h	U6 = spécifique au constructeur
5117 _h	U7 = spécifique au constructeur
5118 _h	U8 = spécifique au constructeur
5119 _h	U9 = spécifique au constructeur

Code d'erreur	Signification
5120 _h	Circuit intermédiaire d'alimentation
5200 _h	Commande
5210 _h	Circuit de mesure
5220 _h	Circuit de calcul
5300 _h	Unité de fonctionnement
5400 _h	Section motrice
5410 _h	Étages de sortie
5420 _h	Hacheur
5430 _h	Étages d'entrée
5440 _h	Contacts
5441 _h	Contact 1 = spécifique au constructeur
5442 _h	Contact 2 = spécifique au constructeur
5443 _h	Contact 3 = spécifique au constructeur
5444 _h	Contact 4 = spécifique au constructeur
5445 _h	Contact 5 = spécifique au constructeur
5450 _h	Fusibles
5451 _h	S1 = I1
5452 _h	S2 = I2
5453 _h	S3 = I3
5454 _h	S4 = spécifique au constructeur
5455 _h	S5 = spécifique au constructeur
5456 _h	S6 = spécifique au constructeur
5457 _h	S7 = spécifique au constructeur
5458 _h	S8 = spécifique au constructeur
5459 _h	S9 = spécifique au constructeur
5500 _h	Mémoire active (matériel)
5510 _h	RAM
5520 _h	ROM/EPROM
5530 _h	EEPROM
6010 _h	Réinitialisation du logiciel (chien de garde)
6301 _h à 630F _h	Registres de données n° 1 à n° 15
6310 _h	Perte de paramètres
6320 _h	Erreur de paramètre
7100 _h	Modules supplémentaires de puissance
7110 _h	Hacheur de frein
7111 _h	Défaillance – hacheur de frein
7112 _h	Surintensité – hacheur de frein
7113 _h	Circuit de protection – hacheur de frein
7120 _h	Moteur
7121 _h	Blocage du moteur
7122 _h	Erreur du moteur ou dysfonctionnement de commutation
7123 _h	Inclinaison du moteur
7200 _h	Circuit de mesure
7300 _h	Capteur

Code d'erreur	Signification
7301 _h	Défaut de tachymètre
7302 _h	Polarité erronée du tachymètre
7303 _h	Défaut de résolveur 1
7304 _h	Défaut de résolveur 2
7305 _h	Défaut de capteur incrémental 1
7306 _h	Défaut de capteur incrémental 2
7307 _h	Défaut de capteur incrémental 3
7310 _h	Vitesse
7320 _h	Position
7400 _h	Circuit de calcul
7500 _h	Communication
7510 _h	Interface série n° 1
7520 _h	Interface série n° 2
7600 _h	Mise en mémoire (externe)
8300 _h	Asservissement de couple
8311 _h	Couple trop élevé
8312 _h	Démarrage difficile
8313 _h	Couple d'immobilisation
8321 _h	Couple insuffisant
8331 _h	Défaut de couple
8400 _h	Régulateur de régime/vitesse
8500 _h	Contrôleur de position
8600 _h	Contrôleur de positionnement
8611 _h	Erreur suivante
8612 _h	Limite de référence
8613 _h	Erreur de retour à la position de référence
8700 _h	Contrôleur de synchronisation
8800 _h	Contrôleur d'enroulement
8900 _h	Contrôle de données de processus
8A00 _h	Surveillance de commande
F001 _h	Décélération
F002 _h	Fonctionnement sous-synchrone
F003 _h	Course
F004 _h	Fonctions supplémentaires de commande
FF00 _h à FFFF _h	Spécifique au constructeur

7.2 Comportement aux erreurs

Le système de communication peut prendre en charge un objet qui spécifie l'état de gestion de réseau vers lequel le dispositif d'entraînement doit passer, lorsqu'une erreur de communication ou une erreur grave interne du dispositif est détectée. Lorsque la FSA PDS passe à l'état erreur (défaut ou état réaction au défaut actif), ceci doit être considéré comme une défaillance grave interne du dispositif.

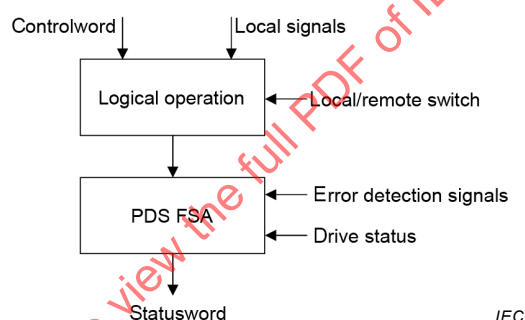
8 Commande de l'entraînement électrique de puissance

8.1 Généralités

La FSA PDS permet de définir de manière abstraite le comportement d'une boîte noire, dans la mesure où un dispositif de commande utilise le PDS. Elle définit le comportement d'application du PDS. Du fait de l'exigence selon laquelle un PDS assure une commande locale même lorsque le réseau de communication ne fonctionne pas correctement, la FSA de communication telle que définie dans les spécifications de mise en correspondance du système de communication et la FSA PDS font l'objet d'un couplage lâche uniquement.

La Figure 3 spécifie comment le PDS peut être utilisé localement ou via le réseau à distance. Le PDS est utilisé par des signaux locaux (ne relevant pas du domaine d'application de la présente partie de l'IEC 61800) et par le mot de commande transmis par le dispositif de commande via le réseau. L'état du PDS est indiqué par le mot d'état généré par le dispositif d'entraînement. La FSA est également commandée par les signaux de détection d'erreur.

La FSA PDS définit l'état du PDS et la séquence de commande potentielle du PDS. Un état unique représente un comportement interne ou externe spécial. L'état du PDS détermine également les commandes acceptées. Par exemple, il est possible d'initier un déplacement point à point uniquement lorsque le dispositif d'entraînement est dans l'état fonctionnement activé.

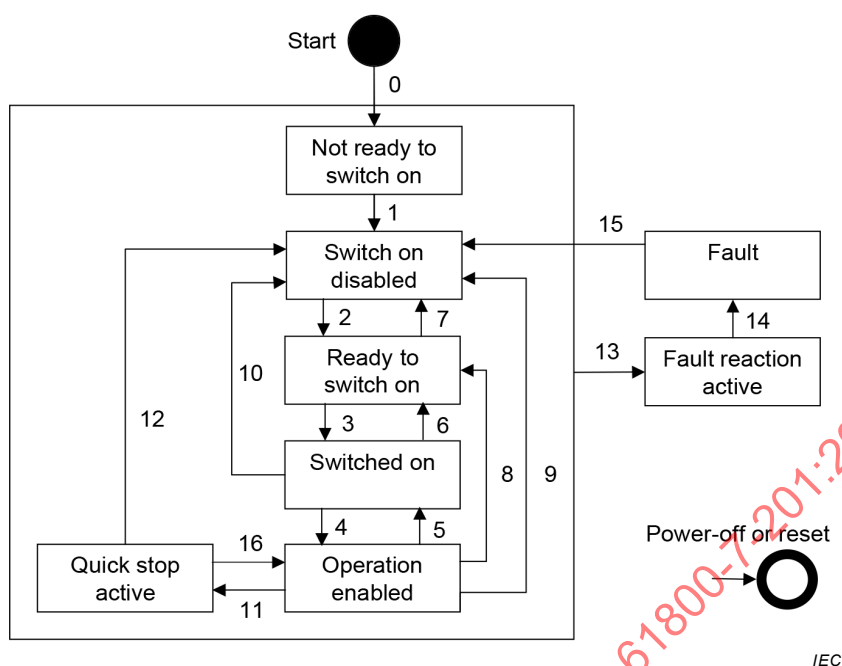


Anglais	Français
Controlword	Mot de commande
Local signals	Signaux locaux
Logical operation	Fonctionnement logique
Local/remote switch	Interrupteur local/distant
PDS FSA	FSA PDS
Error detection signals	Signaux de détection d'erreur
Drive status	Etat du dispositif d'entraînement
Statusword	Mot d'état

Figure 3 – Commande distante et commande locale

8.2 Automatisation d'états finis

La Figure 4 spécifie la FSA PDS eu égard à la commande de l'électronique de puissance, du fait des commandes utilisateur et des défauts internes du dispositif d'entraînement.



Anglais	Français
Start	Démarrage
Not ready to switch on	État mise sous tension non prêt
Switch on disabled	État mise sous tension désactivé
Fault	Défaut
Ready to switch on	État mise sous tension prêt
Fault reaction active	État réaction au défaut actif
Switched on	État mise sous tension
Quick stop active	État arrêt rapide actif
Operation enabled	État fonctionnement activé
Power-off or reset	Mise hors tension ou réinitialisation

**Figure 4 – Automatisation d'états finis
de l'entraînement électrique de puissance**

Les états FSA doivent prendre en charge les fonctions indiquées dans le Tableau 25. L'état Démarrage doit être un pseudoétat qui indique le début d'activation de la FSA pendant la séquence de démarrage du logiciel d'application du dispositif d'entraînement.

Tableau 25 – États FSA et fonctions prises en charge

Fonction	États FSA							
	État mise sous tension non prêt	État mise sous tension désactivé	État mise sous tension prêt	État mise sous tension	État fonctionnement activé	État arrêt rapide actif	État réaction au défaut actif	Défaut
Frein appliqué, si présent	Oui	Oui	Oui	Oui	Oui/Non	Oui/Non	Oui/Non	Oui
Alimentation de faible niveau appliquée	Oui	Oui	Oui	Oui	Oui	Oui	Oui	Oui
Alimentation de haut niveau appliquée	Oui/Non	Oui/Non	Oui/Non	Oui	Oui	Oui	Oui	Oui/Non
Fonction d'entraînement activée	Non	Non	Non	Non	Oui	Oui	Oui	Non
Configuration admise	Oui	Oui	Oui	Oui	Oui/Non	Oui/Non	Oui/Non	Oui

Si, dans l'état Arrêt rapide actif, le code de l'option Arrêt rapide est réglé sur 5, 6, 7 ou 8, le dispositif d'entraînement ne doit pas quitter cet état, mais il peut passer à l'état Fonctionnement activé avec la commande Activation du fonctionnement.

Le dispositif d'entraînement doit prendre en charge les transitions et actions indiquées dans le Tableau 26. Les événements doivent déclencher la transition. La transition doit s'achever une fois l'action accomplie.

Tableau 26 – Événements et actions de transitions

Transition	Événement(s)	Action(s)
0	Transition automatique après mise sous tension ou application de réinitialisation	Un autotest et/ou une auto-initialisation du dispositif d'entraînement doivent être effectués.
1	Transition automatique	La communication doit être activée.
2	Commande d'arrêt émise par le dispositif de commande ou le signal local	Aucune
3	Commande de mise sous tension émise par le dispositif de commande ou le signal local	L'alimentation de haut niveau doit être mise sous tension, si possible.
4	Commande Activer le fonctionnement émise par le dispositif de commande ou le signal local	La fonction d'entraînement doit être activée et tous les points de consigne internes doivent être annulés.
5	Commande Désactiver le fonctionnement émise par le dispositif de commande ou le signal local	La fonction d'entraînement doit être désactivée.
6	Commande d'arrêt émise par le dispositif de commande ou le signal local	L'alimentation de haut niveau doit être mise hors tension, si possible.
7	Commande d'arrêt rapide ou de désactivation de tension émise par le dispositif de commande ou le signal local	Aucune
8	Commande d'arrêt émise par le dispositif de commande ou le signal local	La fonction d'entraînement doit être désactivée, et l'alimentation de haut niveau doit être mise hors tension, si possible.
9	Commande Désactiver la tension émise par le dispositif de commande ou le signal local	La fonction d'entraînement doit être désactivée, et l'alimentation de haut niveau doit être mise hors tension, si possible.
10	Commande Désactiver la tension ou Arrêt rapide émise par le dispositif de commande ou le signal local	L'alimentation de haut niveau doit être mise hors tension, si possible.
11	Commande Arrêt rapide émise par le dispositif de commande ou le signal local	La fonction d'arrêt rapide doit être lancée.
12	Transition automatique une fois la fonction d'arrêt rapide achevée et lorsque le code de l'option Arrêt rapide est 1, 2, 3 ou 4, ou commande Désactiver la tension émise par le dispositif de commande (dépend du code de l'option Arrêt rapide)	La fonction d'entraînement doit être désactivée, et l'alimentation de haut niveau doit être mise hors tension, si possible.
13	Signal de défaut (voir également IEC 61800-7-301)	La fonction configurée de réaction au défaut doit être exécutée.
14	Transition automatique	La fonction d'entraînement doit être désactivée; l'alimentation de haut niveau doit être mise hors tension, si possible.
15	Commande de réinitialisation suite à un défaut émise par le dispositif de commande ou le signal local	La condition de défaut fait l'objet d'une réinitialisation si aucun défaut n'est actuellement présent sur le dispositif d'entraînement; après sortie de l'état défaut, le bit de réinitialisation suite à un défaut dans le mot de commande doit être supprimé par le dispositif de commande..
16	Commande Activer le fonctionnement émise par le dispositif de commande, si le code de l'option Arrêt rapide est 5, 6, 7 ou 8	La fonction d'entraînement doit être activée.
Il n'est pas recommandé de prendre en charge la transition 16.		

Lorsqu'une transition d'état est sollicitée, les actions associées doivent être accomplies entièrement avant de passer au nouvel état. Exemple: Dans l'état Fonctionnement activé, lorsque la commande Désactiver le fonctionnement est émise, le dispositif d'entraînement doit rester à l'état Fonctionnement activé jusqu'à l'achèvement de la fonction de désactivation du fonctionnement (voir objet 605C_n).

Les dispositifs d'entraînement capables de commander le contacteur pour le secteur peuvent commuter l'alimentation de haut niveau. Lorsque l'alimentation de haut niveau est mise hors tension, le moteur doit pouvoir tourner librement si le frein n'est pas appliqué.

La désactivation de la fonction d'entraînement implique qu'aucune source d'énergie ne doit alimenter le moteur. Les valeurs cibles ou de point de consigne (par exemple, couple, vitesse, position) ne doivent pas être traitées.

L'activation de la fonction d'entraînement implique qu'une source d'énergie peut alimenter le moteur. Les valeurs cibles ou de point de consigne doivent être traitées.

La détection d'un défaut dans le dispositif d'entraînement doit générer une transition vers l'état réaction au défaut actif. Dans cet état, le PDS doit exécuter une réaction au défaut particulière. Une fois cette réaction au défaut exécutée, le dispositif d'entraînement doit basculer automatiquement sur l'état Défaut. Cet état doit être quitté uniquement par la commande de réinitialisation suite à un défaut, mais uniquement si le défaut n'est plus actif.

En cas d'erreur fatale, le dispositif de commande n'est plus capable de contrôler le moteur, si bien qu'une mise hors tension immédiate du dispositif d'entraînement est nécessaire.

Le comportement des fonctions de désactivation du dispositif d'entraînement, d'arrêt rapide, d'arrêt et de réaction au défaut est configurable au moyen des objets de configuration définis en 8.4.

NOTE En présence d'un frein, l'alimentation de haut niveau est mise hors tension après un délai d'attente, afin d'appliquer le frein.

8.3 Modes de fonctionnement

Le comportement du PDS dépend du mode de fonctionnement activé. Le PDS peut mettre en œuvre plusieurs modes de fonctionnement. Dans la mesure où il n'est pas possible d'exécuter les modes en parallèle, l'utilisateur est capable d'activer la fonction requise en choisissant un mode de fonctionnement.

Le dispositif de commande s'adresse à l'objet Modes de fonctionnement afin de sélectionner le mode de fonctionnement. Le dispositif d'entraînement fournit l'objet Affichage des modes de fonctionnement pour indiquer le mode de fonctionnement activé réel. Le mot de commande, le mot d'état et les points de consigne sont utilisés selon le mode. Ceci implique la responsabilité qui incombe au dispositif de commande d'éviter les incohérences et tout comportement erroné. La commutation entre les modes de fonctionnement implique l'absence de reconfiguration automatique des COB pour une transmission des données en temps réel.

Par conséquent, le PDS peut limiter la commutation de mode dans un ou certains états FSA PDS. La commutation de mode peut également être limitée à la fonction de "commande locale"; cela signifie qu'il n'est pas possible de sélectionner le mode de fonctionnement via le réseau.

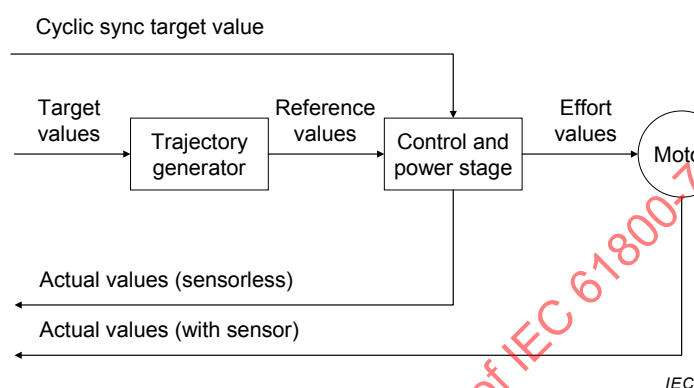
Les modes de fonctionnement suivants sont décrits dans la présente partie de la série IEC 61800-7:

- mode de position de profil;
- mode de retour à la position de référence;
- mode de position interpolée;
- mode de vitesse de profil (par exemple, entraînements asservis);
- mode de profil de couple;
- mode de vitesse (par exemple, convertisseur de fréquence);
- mode de position à synchronisation cyclique;

- mode de vitesse à synchronisation cyclique;
- mode de couple à synchronisation cyclique.

À l'exception du mode de retour à la position de référence, les modes de fonctionnement énumérés traitent des points de consigne. Outre cet élément, les modes de fonctionnement spécifiques au constructeur peuvent également être mis en œuvre. Ceux-ci ne se limitent pas aux points de consigne.

La Figure 5 présente les relations générales entre les valeurs cibles, de référence, de contrôle et instantanées.



Anglais	Français
Cyclic sync target value	Valeur cible à synchronisation cyclique
Target values	Valeurs cibles
Trajectory generator	Générateur de trajectoire
Reference values	Valeurs de référence
Control and power stage	Étage de commande et de puissance
Effort values	Valeurs de contrôle
Motor	Moteur
Actual values (sensorless)	Valeurs instantanées (sans capteur)
Actual values (with sensor)	Valeurs instantanées (avec capteur)

Figure 5 – Relation entre les différents paramètres de valeurs

8.4 Spécifications d'objets détaillées

8.4.1 Objet 6040_h: Mot de commande

Cet objet doit indiquer la commande reçue de contrôle de la FSA PDS. Il doit être structuré tel que défini à la Figure 6. Les bits 7, 3, 2, 1 et 0 doivent être pris en charge. Les bits 0 à 9 doivent être pris en charge selon le mode de fonctionnement. Si la fonctionnalité correspondante n'est pas disponible, un message d'urgence approprié doit être généré. Les bits spécifiques au constructeur (ms) peuvent être pris en charge. Les commandes doivent être codées comme cela est indiqué dans le Tableau 27. Tous les bits du mot de commande mis en œuvre sont valides indépendamment de l'état FSA PDS. Le démarrage de tout mouvement est spécifique au mode de fonctionnement et est décrit dans l'article correspondant.

15		11	10	9	8	7	6		4	3	2	1	0
ms				r	oms	h	fr	oms	eo	qs	ev	so	
Bit de poids fort (MSB)								Bit de poids faible (LSB)					

IEC

Légende

ms spécifique au constructeur

r réservé

oms spécifique au mode de fonctionnement

h mode arrêt

fr mode réinitialisation suite à un défaut

eo mode activer le fonctionnement

qs mode arrêt rapide

ev mode activer la tension

so état mise sous tension

Figure 6 – Définition des valeurs

Tableau 27 – Codage des commandes

Commande	Bits du mot de commande					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Arrêt	0	X	1	1	0	2,6,8
Mise sous tension	0	0	1	1	1	3
Mise sous tension + activer le fonctionnement	0	1	1	1	1	3 + 4 (NOTE)
Désactiver la tension	0	X	X	0	X	7,9,10,12
Arrêt rapide	0	X	0	1	X	7,10,11
Désactiver le fonctionnement	0	0	1	1	1	5
Activer le fonctionnement	0	1	1	1	1	4,16
Réinitialisation suite à un défaut		X	X	X	X	15
NOTE Transition automatique vers l'état Fonctionnement activé après exécution de la fonction de l'état mise sous tension						

Les bits 9, 6, 5 et 4 du mot de commande sont spécifiques au mode de fonctionnement. Le comportement de la fonction d'arrêt (bit 8) est également spécifique au mode de fonctionnement. Si le bit est égal à 1, le mouvement commandé doit être interrompu, et le PDS doit se comporter tel que défini dans le code de l'option Arrêt. Une fois la fonction d'arrêt libérée, le mouvement commandé doit se poursuivre si possible.

Le bit 10 est réservé pour une utilisation ultérieure; il doit être mis à 0. Les bits 11, 12, 13, 14 et 15 sont spécifiques au constructeur.

Le Tableau 28 spécifie la description de l'objet et le Tableau 29 spécifie la description d'entrée.

Tableau 28 – Description de l'objet

Attribut	Valeur
Index	6040 _h
Nom	Mot de commande
Code de l'objet	Variable
Type de données	Unsigned16
Catégorie	Obligatoire

Tableau 29 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	Rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 27
Valeur par défaut	Spécifique au dispositif et au mode de fonctionnement

8.4.2 Objet 6041_h: Mot d'état

Cet objet doit fournir l'état de la FSA PDS. L'objet doit être structuré tel que défini à la Figure 7. Les bits 10, 9 et 6 à 0 doivent être pris en charge. Les bits oms doivent être pris en charge si le mode de fonctionnement est pris en charge. Si la fonctionnalité correspondante des bits oms n'est pas disponible, le bit correspondant doit être 0_b. Les bits spécifiques au constructeur (ms) peuvent être pris en charge. Les combinaisons de bits définies dans le Tableau 30 doivent coder les états FSA PDS. Tous les bits du mot de commande mis en œuvre sont valides indépendamment de l'état FSA PDS.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ms		oms		ila	tr	rm	ms	w	sod	qs	ve	f	oe	so	rtso
Bit de poids fort (MSB)										Bit de poids faible (LSB)					

IEC

Légende:

ms spécifique au constructeur

oms spécifique au mode de fonctionnement

ila limite interne active

tr cible atteinte

rm distant

w avertissement

sod état mise sous tension désactivé

qs mode arrêt rapide

ve mode tension activé

f défaut

oe état fonctionnement activé

so état mise sous tension

rtso état mise sous tension prêt

Figure 7 – Définition des valeurs

Tableau 30 – Codage des états

Mot d'état	État FSA PDS
xxxxxxx x0xx 0000 _b	État mise sous tension non prêt
xxxxxxx x1xx 0000 _b	État mise sous tension désactivé
xxxxxxx x01x 0001 _b	État mise sous tension prêt
xxxxxxx x01x 0011 _b	État mise sous tension
xxxxxxx x01x 0111 _b	État fonctionnement activé
xxxxxxx x00x 0111 _b	État arrêt rapide actif
xxxxxxx x0xx 1111 _b	État réaction au défaut actif
xxxxxxx x0xx 1000 _b	Défaut

Lorsque le bit 4 (tension activée) du mot d'état est égal à 1, ceci doit indiquer que la haute tension est appliquée au PDS.

Lorsque le bit 5 (arrêt rapide) du mot d'état est égal à 0, ceci doit indiquer que le PDS réagit à une demande d'arrêt rapide.

Lorsque le bit 7 (avertissement) du mot d'état est égal à 1, ceci doit indiquer la présence d'une condition d'avertissement. L'avertissement n'est ni une erreur, ni un défaut (exemples: dépassement de la limite de température, tâche refusée). L'état de la FSA PDS ne doit pas être modifié. La cause de l'avertissement peut être donnée dans l'objet Paramètre du code de défaut (603F_h).

Lorsque le bit 9 (distant) du mot d'état est égal à 1, ceci doit indiquer le traitement du mot de commande. Lorsque ce bit est égal à 0 (local), ceci doit indiquer l'absence de traitement du mot de commande. Néanmoins, le PDS peut fournir des valeurs instantanées, et peut accepter le COB pour la transmission des données de configuration pour d'autres objets de paramètres.

Lorsque le bit 10 (cible atteinte) du mot d'état est égal à 1, ceci doit indiquer que le PDS a atteint le point de consigne. Le point de consigne est spécifique au mode de fonctionnement et est défini de manière détaillée dans les articles correspondants de la présente partie de la série IEC 61800-7. Le bit 10 doit être également mis à 1, si le mode de fonctionnement a été modifié. Le changement d'une valeur cible par le logiciel doit modifier ce bit. Si le code de l'option Arrêt rapide est 5, 6, 7 ou 8, le bit 10 doit être mis à 1, lorsque le fonctionnement à l'état arrêt rapide est terminé et lorsque le PDS est à l'arrêt. En cas d'arrêt effectif et d'immobilisation du PDS, le bit 10 doit alors être également mis à 1. Si la même valeur interne est commandée, le bit 10 ne doit pas modifier s'il est pris en charge.

Lorsque le bit 11 (limite interne active) du mot d'état est égal à 1, ceci doit indiquer qu'une limite interne est active (exemple: limite de plage de position). Les limites internes sont spécifiques au constructeur.

Les bits 13 et 12 du mot d'état sont spécifiques au mode de fonctionnement.

Les bits 14 et 15 sont spécifiques au constructeur.

Le Tableau 31 spécifie la description de l'objet et le Tableau 32 spécifie la description d'entrée.

Tableau 31 – Description de l'objet

Attribut	Valeur
Index	6041 _h
Nom	Mot d'état
Code de l'objet	Variable
Type de données	Unsigned16
Catégorie	Obligatoire

Tableau 32 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	ro
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 30
Valeur par défaut	Non

8.4.3 Objet 603F_h: Code d'erreur

Cet objet doit fournir le code d'erreur de la dernière erreur qui s'est produite dans le dispositif d'entraînement. Le Tableau 24 spécifie la définition des valeurs, le Tableau 33 spécifie la description de l'objet et le Tableau 34 spécifie la description d'entrée.

NOTE Dans les réseaux CANopen, cet objet fournit les mêmes informations que l'objet de 16 bits inférieur du sous-index 01_h du champ d'erreur prédéfini (1003_h).

Tableau 33 – Description de l'objet

Attribut	Valeur
Index	603F _h
Nom	Code d'erreur
Code de l'objet	Variable
Type de données	Unsigned16
Catégorie	Facultative

Tableau 34 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	ro
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 24
Valeur par défaut	Non

8.4.4 Objet 6007_h: Code de l'option Abandon de connexion

Cet objet doit indiquer quelle action doit être effectuée lorsque l'un des événements suivants se produit: mise hors tension du bus, pulsation, surveillance, passage à l'état d'arrêt NMT, application de réinitialisation et communication de réinitialisation. Le Tableau 35 spécifie la définition des valeurs, le Tableau 36 spécifie la description de l'objet et le Tableau 37 spécifie la description d'entrée.

NOTE Si le dispositif d'entraînement est commuté dans l'état de configuration LSS, la réaction du dispositif d'entraînement est spécifique au constructeur.

Tableau 35 – Définition des valeurs

Valeur	Définition
-32 768 à -1	Spécifique au constructeur
0	Aucune action
+1	Signal de défaut
+2	Commande Désactiver la tension
+3	Commande Arrêt rapide
+4 à +32 767	Réservé

Tableau 36 – Description de l'objet

Attribut	Valeur
Index	6007 _h
Nom	Code de l'option Abandon de connexion
Code de l'objet	Variable
Type de données	Integer16
Catégorie	Facultative

Tableau 37 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 35
Valeur par défaut	+1

8.4.5 Objet 605A_h: Code de l'option Arrêt rapide

Cet objet doit indiquer quelle action est effectuée lorsque la fonction Arrêt rapide est exécutée. La rampe de ralentissement représente la valeur de décélération du mode de fonctionnement utilisé. Le Tableau 38 spécifie la définition des valeurs, le Tableau 39 spécifie la description de l'objet et le Tableau 40 spécifie la description d'entrée.

Tableau 38 – Définition des valeurs

Valeur	Définition
-32 768 à -1	Spécifique au constructeur
0	Désactiver la fonction d'entraînement
+1	Ralentir sur la rampe de ralentissement et passer au mode mise sous tension désactivé
+2	Ralentir sur la rampe d'arrêt rapide et passer au mode mise sous tension désactivé
+3	Ralentir en rapport avec la limite de courant et passer au mode mise sous tension désactivé
+4	Ralentir en rapport avec la limite de tension et passer au mode mise sous tension désactivé
+5	Ralentir sur la rampe de ralentissement et maintenir au mode arrêt rapide actif
+6	Ralentir sur la rampe d'arrêt rapide et maintenir au mode arrêt rapide actif
+7	Ralentir en rapport avec la limite de courant et maintenir au mode arrêt rapide actif
+8	Ralentir en rapport avec la limite de tension et maintenir au mode arrêt rapide actif
+9 à +32 767	Réservé

Tableau 39 – Description de l'objet

Attribut	Valeur
Index	605A _h
Nom	Code de l'option Arrêt rapide
Code de l'objet	Variable
Type de données	Integer16
Catégorie	Facultative

Tableau 40 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 38
Valeur par défaut	+2

8.4.6 Objet 605B_h: Code de l'option Interruption

Cet objet doit indiquer quelle action est effectuée en cas de transition entre l'état fonctionnement activé et l'état mise sous tension prêt. La rampe de ralentissement représente la valeur de décélération du mode de fonctionnement utilisé. Le Tableau 41 spécifie la définition des valeurs, le Tableau 42 spécifie la description de l'objet et le Tableau 43 spécifie la description d'entrée.

Tableau 41 – Définition des valeurs

Valeur	Définition
-32 768 à -1	Spécifique au constructeur
0	Désactiver la fonction d'entraînement (mettre hors tension l'étage de puissance d'entraînement)
+1	Ralentir au moyen de la rampe de ralentissement; désactivation de la fonction d'entraînement
+2 à +32 767	Réservé

Tableau 42 – Description de l'objet

Attribut	Valeur
Index	605B _h
Nom	Code de l'option Interruption
Code de l'objet	Variable
Type de données	Integer16
Catégorie	Facultative

Tableau 43 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 41
Valeur par défaut	0

8.4.7 Objet 605C_h: Code de l'option Désactiver le mode de fonctionnement

Cet objet doit indiquer quelle action est effectuée en cas de transition entre l'état fonctionnement activé et l'état mise sous tension. La rampe de ralentissement représente la valeur de décélération du mode de fonctionnement utilisé. Le Tableau 44 spécifie la définition des valeurs, le Tableau 45 spécifie la description de l'objet et le Tableau 46 spécifie la description d'entrée.

Tableau 44 – Définition des valeurs

Valeur	Définition
-32 768 à -1	Spécifique au constructeur
0	Désactiver la fonction d'entraînement (mettre hors tension l'étage de puissance d'entraînement)
+1	Ralentir au moyen de la rampe de ralentissement; désactivation de la fonction d'entraînement
+2 à +32 767	Réservé

Tableau 45 – Description de l'objet

Attribut	Valeur
Index	605C _h
Nom	Code de l'option Désactiver le mode de fonctionnement
Code de l'objet	Variable
Type de données	Integer16
Catégorie	Facultative

Tableau 46 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 44
Valeur par défaut	+1

8.4.8 Objet 605D_h: Code de l'option Arrêt

Cet objet doit indiquer quelle action est effectuée lorsque la fonction Arrêt est exécutée. La rampe de ralentissement représente la valeur de décélération du mode de fonctionnement utilisé. Le Tableau 47 spécifie la définition des valeurs, le Tableau 48 spécifie la description de l'objet et le Tableau 49 spécifie la description d'entrée.

Tableau 47 – Définition des valeurs

Valeur	Définition
-32 768 à -1	Spécifique au constructeur
0	Réservé
+1	Ralentir sur la rampe de ralentissement et maintenir au mode fonctionnement activé
+2	Ralentir sur la rampe d'arrêt rapide et maintenir au mode fonctionnement activé
+3	Ralentir en rapport avec la limite de courant et maintenir au mode fonctionnement activé
+4	Ralentir en rapport avec la limite de tension et maintenir au mode fonctionnement activé
+5 à +32 767	Réservé

Tableau 48 – Description de l'objet

Attribut	Valeur
Index	605D _h
Nom	Code de l'option Arrêt
Code de l'objet	Variable
Type de données	Integer16
Catégorie	Facultative

Tableau 49 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 47
Valeur par défaut	+1

8.4.9 Objet 605E_h: Code de l'option Réaction au défaut

Cet objet doit indiquer quelle action est effectuée lorsqu'un défaut est détecté dans le PDS. La rampe de ralentissement représente la valeur de décélération du mode de fonctionnement utilisé. Le Tableau 50 spécifie la définition des valeurs, le Tableau 51 spécifie la description de l'objet et le Tableau 52 spécifie la description d'entrée.

Tableau 50 – Définition des valeurs

Valeur	Définition
-32 768 à -1	Spécifique au constructeur
0	Désactiver la fonction d'entraînement, le moteur peut tourner librement
+1	Ralentir sur la rampe de ralentissement
+2	Ralentir sur la rampe d'arrêt rapide
+3	Ralentir en rapport avec la limite de courant
+4	Ralentir en rapport avec la limite de tension
+5 à +32 767	Réserve

Tableau 51 – Description de l'objet

Attribut	Valeur
Index	605E _h
Nom	Code de l'option Réaction au défaut
Code de l'objet	Variable
Type de données	Integer16
Catégorie	Facultative

Tableau 52 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 50
Valeur par défaut	+2

8.4.10 Objet 6060_h: Modes de fonctionnement

Cet objet doit indiquer le mode de fonctionnement sollicité.

Le Tableau 53 spécifie la définition des valeurs, le Tableau 54 spécifie la description de l'objet et le Tableau 55 spécifie la description d'entrée.

NOTE 1 Cet objet montre uniquement la valeur du mode de fonctionnement sollicité, le mode de fonctionnement réel du PDS étant reflété dans l'objet Affichage des modes de fonctionnement.

NOTE 2 Le comportement du dispositif d'entraînement en mode de fonctionnement 0 est spécifique au constructeur.

NOTE 3 En cas de changement du mode de fonctionnement, le comportement du dispositif d'entraînement est spécifique au constructeur.

Tableau 53 – Définition des valeurs

Valeur	Définition
-128 à -1	Modes de fonctionnement spécifiques au constructeur
0	Aucun changement de mode/aucun mode assigné
+1	Mode de position de profil
+2	Mode de vitesse
+3	Mode de vitesse de profil
+4	Mode de profil de couple
+5	Réservé
+6	Mode de retour à la position de référence
+7	Mode de position interpolée
+8	Mode de position à synchronisation cyclique
+9	Mode de vitesse à synchronisation cyclique
+10	Mode de couple à synchronisation cyclique
+11	Mode de couple à synchronisation cyclique avec angle de commutation
+12 à +127	Réservé

Tableau 54 – Description de l'objet

Attribut	Valeur
Index	6060 _h
Nom	Modes de fonctionnement
Code de l'objet	Variable
Type de données	Integer8
Catégorie	Conditionnelle: obligatoire si plus d'un mode de fonctionnement est pris en charge

Tableau 55 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 53
Valeur par défaut	Spécifique au constructeur

8.4.11 Objet 6061_h: Affichage des modes de fonctionnement

Cet objet doit fournir le mode de fonctionnement réel.

Le Tableau 53 spécifie la définition des valeurs, le Tableau 56 spécifie la description de l'objet et le Tableau 57 spécifie la description d'entrée.

Tableau 56 – Description de l'objet

Attribut	Valeur
Index	6061 _h
Nom	Affichage des modes de fonctionnement
Code de l'objet	Variable
Type de données	Integer8
Catégorie	Conditionnelle, obligatoire si plus d'un mode de fonctionnement est pris en charge

Tableau 57 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	ro
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Tableau 53
Valeur par défaut	Non

8.4.12 Objet 6502_h: Modes d'entraînement pris en charge

Cet objet doit fournir les informations concernant les modes d'entraînement pris en charge.

La Figure 8 spécifie la définition des valeurs, le Tableau 58 spécifie la description de l'objet et le Tableau 59 spécifie la description d'entrée.

31	16	15	11	10	9	8	7	6	5	4	3	2	1	0
Spécifique au constructeur	r(éservé)	cstca	cst	csv	csp	ip	hm	r	tq	p _v	vl	pp		
Bit de poids fort (MSB)											Bit de poids faible LSB			

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Figure 8 – Définition des valeurs

Les définitions des valeurs suivantes doivent s'appliquer:

bits cstca, cst, csv, csp, ip, hm, tq, pv, vl, et pp:

1 = le mode est pris en charge

0 = le mode n'est pas pris en charge

bits spécifiques au constructeur:

1 = la fonction est prise en charge

0 = la fonction n'est pas prise en charge

bits r(éservés):

0

Tableau 58 – Description de l'objet

Attribut	Valeur
Index	6502 _h
Nom	Modes d'entraînement pris en charge
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Obligatoire

Tableau 59 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	ro
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Figure 8
Valeur par défaut	Spécifique au constructeur

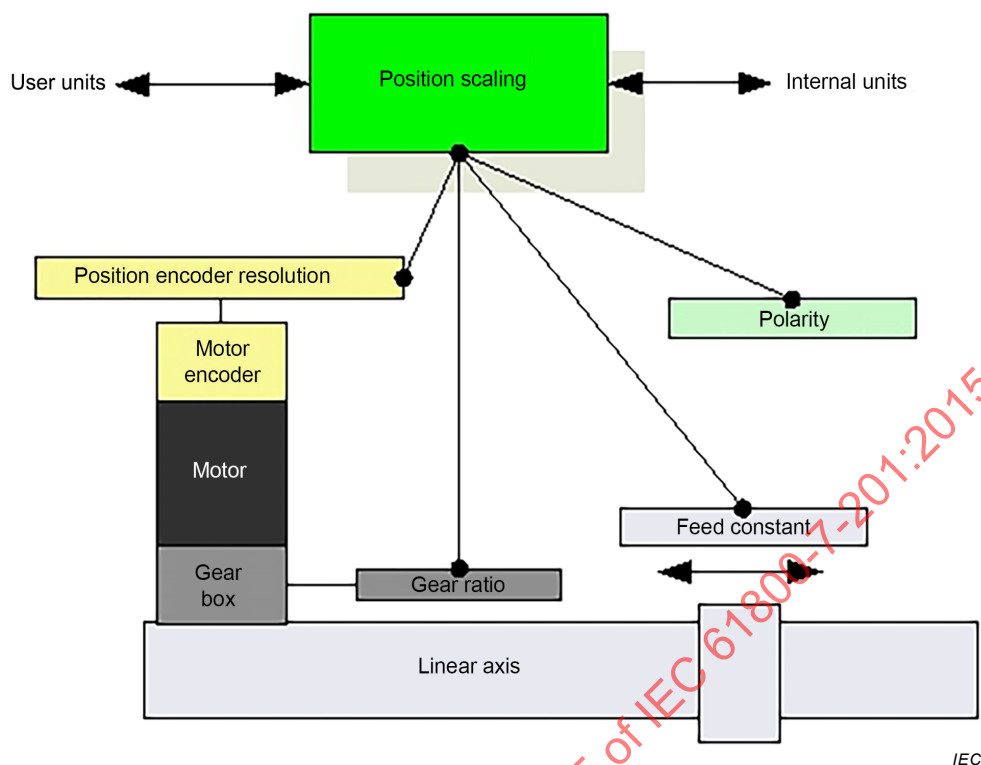
9 Groupe de facteurs

9.1 Généralités

Dans certaines applications de dispositifs d'entraînement, plusieurs valeurs de résolution de capteur et plusieurs valeurs de rapport sont nécessaires. Elles peuvent être présentées par les objets définis dans le présent article.

Les unités définies par l'utilisateur telles que définies dans la présente spécification sont utilisées dans les objets correspondants représentant les valeurs de position, de vitesse, d'accélération ou d'à-coup.

Les unités définies par l'utilisateur sont spécifiées par les objets de l'unité SI (objets 60A8_h, 60A9_h, 60AA_h et 60AB_h). Pour le calcul des valeurs correspondantes (et leurs unités physiques), se reporter aux formules ci-dessous. Si certains des objets dans les formules ne sont pas mis en œuvre, les valeurs par défaut définies dans les objets correspondants doivent être utilisées. Les objets, dont les valeurs ne dépendent pas du groupe de facteurs, ont des unités fixes spécifiées dans les objets. La Figure 9 explique de façon plus détaillée le concept de mise à l'échelle.



Anglais	Français
User units	Unités définies par l'utilisateur
Position scaling	Mise à l'échelle de la position
Internal units	Unités internes
Position encoder resolution	Résolution du codeur de position
Motor encoder	Codeur du moteur
Motor	Moteur
Gear box	Boîte d'engrenage
Gear ratio	Rapport d'engrenage
Polarity	Polarité
Feed constant	Constante d'avance
Linear axis	Axe linéaire

Figure 9 – Concept de mise à l'échelle de la position

Unités de position

Le calcul des valeurs de position est effectué par l'équation suivante:

$$\text{valeur de position} = \frac{\text{valeur interne de position} \cdot \text{constante d'avance}}{\text{résolution du codeur de position} \cdot \text{rapport d'engrenage}}$$

La valeur de position représente les objets contenant des valeurs exprimées en unités de position définies par l'utilisateur, spécifiées dans l'unité SI de position (objet 60A8_n). Les facteurs dans la formule doivent être ajustés de manière à ce que l'unité SI de position corresponde aux conditions mécaniques.

La valeur interne de position est exprimée en unités internes, par exemple les incréments du codeur. Pour calculer les valeurs internes de positions à partir des valeurs de position cible, la formule est transposée en:

$$\text{valeur interne de position} = \frac{\text{valeur de position} \cdot \text{résolution du codeur de position} \cdot \text{rapport d'engrenage}}{\text{constante d'avance}}$$

Unités de vitesse

Lorsque la résolution du codeur de vitesse (objet 6090_h) est mise en œuvre, les valeurs de vitesse sont calculées par

$$\text{valeur de vitesse} = \frac{\text{valeur interne de vitesse} \cdot \text{constante d'avance}}{\text{résolution du codeur de vitesse} \cdot \text{rapport d'engrenage}} \cdot \text{facteur de vitesse}$$

La valeur interne de vitesse est prise du codeur distinct (objet 606A_h, code de sélection du capteur = 1), ou par la (les) valeur(s) interne(s) de position (objet 606A_h, code de sélection du capteur = 0).

Si l'objet 6090_h n'est pas mis en œuvre, la résolution du codeur de position est utilisée pour le calcul:

$$\text{valeur de vitesse} = \frac{\text{valeur interne de vitesse} \cdot \text{constante d'avance}}{\text{résolution du codeur de position} \cdot \text{rapport d'engrenage}} \cdot \text{facteur de vitesse}$$

ou:

$$\text{valeur de vitesse} = \frac{\text{valeur de position}}{s} \cdot \text{facteur de vitesse}$$

La valeur de vitesse représente les objets contenant des valeurs exprimées en unités de vitesse définies par l'utilisateur, spécifiées dans l'unité SI de vitesse (objet 60A9_h). Si l'objet 60A9_h n'est pas mis en œuvre, l'unité de vitesse définie par l'utilisateur doit être (l'unité de position définie par l'utilisateur)/s.

Les facteurs dans les formules doivent être ajustés de manière à ce que l'unité SI de vitesse corresponde aux conditions mécaniques.

Unités d'accélération

$$\text{valeur d'accélération} = \frac{\text{valeur de vitesse}}{s} \cdot \text{facteur d'accélération}$$

La valeur d'accélération représente les objets contenant des valeurs exprimées en unités d'accélération définies par l'utilisateur, spécifiées dans l'unité SI d'accélération (objet 60AA_h). Si l'objet 60AA_h n'est pas mis en œuvre, l'unité d'accélération définie par l'utilisateur doit être (l'unité de vitesse définie par l'utilisateur)/s.

Les facteurs dans la formule doivent être ajustés de manière à ce que l'unité SI d'accélération corresponde aux conditions mécaniques.

Unités d'à-coup

$$\text{valeur d'à - coup} = \frac{\text{valeur d'accélération}}{s} \cdot \text{facteur d'à - coup}$$

La valeur d'à-coup représente les objets contenant des valeurs exprimées en unités d'à-coup définies par l'utilisateur, spécifiées dans l'unité SI d'à-coup (objet 60AB_h). Si l'objet 60AB_h n'est pas mis en œuvre, l'unité d'à-coup définie par l'utilisateur doit être (l'unité de vitesse définie par l'utilisateur)/s².

Les facteurs dans la formule doivent être ajustés de manière à ce que l'unité SI d'à-coup corresponde aux conditions mécaniques.

9.2 Définitions d'objets détaillées

9.2.1 Objet 608F_h: Résolution du codeur de position

Cet objet doit indiquer les incréments configurés du codeur et le nombre de rotations du moteur. La résolution du codeur de position doit être calculée par la formule suivante:

$$\text{résolution du codeur de position} = \frac{\text{incréments du codeur}}{\text{rotations du moteur}}$$

Toutes les valeurs doivent être adimensionnelles. Le Tableau 60 spécifie la description de l'objet et le Tableau 61 spécifie la description d'entrée.

Tableau 60 – Description de l'objet

Attribut	Valeur
Index	608F _h
Nom	Résolution du codeur de position
Code de l'objet	Matrice
Type de données	Unsigned32
Catégorie	Facultative

Tableau 61 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	Spécifique au constructeur
Sous-index	01 _h
Description	Incréments du codeur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32 (0 est égal à 2 ³²)
Valeur par défaut	Spécifique au constructeur (mais non égale à 0)
Sous-index	02 _h
Description	Rotations du moteur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32 (0 est égal à 2 ³²)
Valeur par défaut	Spécifique au constructeur (mais non égale à 0)

9.2.2 Objet 6090_h – Résolution du codeur de vitesse

Cet objet doit indiquer les incréments configurés du codeur par seconde et le nombre de rotations du moteur par seconde. La résolution du codeur de vitesse doit être calculée par la formule suivante:

$$\text{résolution du codeur de vitesse} = \frac{\text{codeur} \frac{\text{incrément}}{\text{seconde}}}{\text{moteur} \frac{\text{rotations}}{\text{seconde}}}$$

Toutes les valeurs doivent être adimensionnelles. Le Tableau 62 spécifie la description de l'objet et le Tableau 63 spécifie la description d'entrée.

Tableau 62 – Description de l'objet

Attribut	Valeur
Index	6090 _h
Nom	Résolution du codeur de vitesse
Code de l'objet	Matrice
Type de données	Unsigned32
Catégorie	Facultative

Tableau 63 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	02 _h
Sous-index	01 _h
Description	Incréments du codeur par seconde
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32 (0 est égal à 2 ³²)
Valeur par défaut	Spécifique au constructeur (mais non égale à 0)
Sous-index	02 _h
Description	Rotations du moteur par seconde
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32 (0 est égal à 2 ³²)
Valeur par défaut	Spécifique au constructeur (mais non égale à 0)

9.2.3 Objet 6091_h: Rapport d'engrenage

Cet objet doit indiquer le nombre configuré de rotations de l'arbre moteur et le nombre de rotations de l'arbre d'entraînement. Le rapport d'engrenage doit être calculé par la formule suivante:

$$\text{rapport d'engrenage} = \frac{\text{rotations de l'arbre moteur}}{\text{rotations de l'arbre d'entraînement}}$$

Toutes les valeurs doivent être adimensionnelles. Le Tableau 64 spécifie la description de l'objet et le Tableau 65 spécifie la description d'entrée.

Tableau 64 – Description de l'objet

Attribut	Valeur
Index	6091 _h
Nom	Rapport d'engrenage
Code de l'objet	Matrice
Type de données	Unsigned32
Catégorie	Facultative

Tableau 65 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	02 _h
Sous-index	01 _h
Description	Rotations de l'arbre moteur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur (mais non égale à 0)
Sous-index	02 _h
Description	Rotations de l'arbre d'entraînement
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur (mais non égale à 0)

9.2.4 Objet 6092_h: Constante d'avance

Cet objet doit indiquer la constante d'avance configurée, qui est la distance de mesure par rotation de l'arbre de sortie de la boîte d'engrenage. La constante d'avance doit être calculée par la formule suivante:

$$\text{constante d'avance} = \frac{\text{avance}}{\text{rotations de l'arbre d'entraînement}}$$

L'avance doit être donnée en unités de position définies par l'utilisateur, et la valeur de rotation de l'arbre d'entraînement doit être adimensionnelle. Le Tableau 66 spécifie la description de l'objet et le Tableau 67 spécifie la description d'entrée.

Tableau 66 – Description de l'objet

Attribut	Valeur
Index	6092 _h
Nom	Constante d'avance
Code de l'objet	Matrice
Type de données	Unsigned32
Catégorie	Facultative

Tableau 67 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	02 _h
Sous-index	01 _h
Description	Avance
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur (mais non égale à 0)
Sous-index	02 _h
Description	Rotations de l'arbre
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur (mais non égale à 0)

9.2.5 Objet 6096_h: Facteur de vitesse

Cet objet peut être utilisé pour faire correspondre les unités de vitesse avec les unités de vitesse définies par l'utilisateur. Le Tableau 68 spécifie la description de l'objet et le Tableau 69 spécifie la description d'entrée.

Tableau 68 – Description de l'objet

Attribut	Valeur
Index	6096 _h
Nom	Facteur de vitesse
Code de l'objet	Matrice
Type de données	Unsigned32
Catégorie	Facultative

Tableau 69 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	02 _h
Sous-index	01 _h
Description	Numérateur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	1 à 2 ³² - 1
Valeur par défaut	1
Sous-index	02 _h
Description	Diviseur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	1 à 2 ³² - 1
Valeur par défaut	1

9.2.6 Objet 6097_h: Facteur d'accélération

Cet objet peut être utilisé pour faire correspondre les unités d'accélération avec les unités d'accélération définies par l'utilisateur. Le Tableau 70 spécifie la description de l'objet et le Tableau 71 spécifie la description d'entrée.

Tableau 70 – Description de l'objet

Attribut	Valeur
Index	6097 _h
Nom	Facteur d'accélération
Code de l'objet	Matrice
Type de données	Unsigned32
Catégorie	Facultative

Tableau 71 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	02 _h
Sous-index	01 _h
Description	Numérateur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	1 à 2 ³² -1
Valeur par défaut	1
Sous-index	02 _h
Description	Diviseur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	1 à 2 ³² -1
Valeur par défaut	1

9.2.7 Objet 60A2_h: Facteur d'à-coup

Cet objet peut être utilisé pour faire correspondre les unités d'à-coup avec les unités d'à-coup définies par l'utilisateur. Le Tableau 72 spécifie la description de l'objet et le Tableau 73 spécifie la description d'entrée.

Tableau 72 – Description de l'objet

Attribut	Valeur
Index	60A2 _h
Nom	Facteur d'à-coup
Code de l'objet	Matrice
Type de données	Unsigned32
Catégorie	Facultative

Tableau 73 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	02 _h
Sous-index	01 _h
Description	Numérateur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	1 à 2 ³² - 1
Valeur par défaut	1
Sous-index	02 _h
Description	Diviseur
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	1 à 2 ³² - 1
Valeur par défaut	1

9.2.8 Objet 607E_h: Polarité

Cet objet doit indiquer si la valeur de demande de position doit être multipliée par 1 ou par –1. L'indicateur de polarité ne doit pas influencer sur le mode de retour à la position de référence. Le bit de polarité de position doit être utilisé uniquement pour le mode de position de profil (pp) et le mode de position à synchronisation cyclique (csp). Le bit de polarité de vitesse doit être utilisé uniquement pour le mode de vitesse de profil (pv) et le mode de vitesse à synchronisation cyclique (csv).

La Figure 10 spécifie la définition des valeurs, le Tableau 74 spécifie la description de l'objet et le Tableau 75 spécifie la description d'entrée.

7	6	5	0
Polarité de position	Polarité de vitesse	réservé (0)	
Bit de poids fort (MSB)		Bit de poids faible (LSB)	

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Figure 10 – Définition des valeurs

Les bits de polarité doivent être codés comme suit: 0_b = multiplier par 1 et 1_b = multiplier par -1

Tableau 74 – Description de l'objet

Attribut	Valeur
Index	607E _h
Nom	Polarité
Code de l'objet	Variable
Type de données	Unsigned8
Catégorie	Facultative

Tableau 75 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Voir Figure 10
Valeur par défaut	00 _h

9.2.9 Table de codes des unités spécifiques au profil de dispositif

Le Tableau 76 spécifie la représentation des unités spécifiques supplémentaires utilisées dans ce profil.

Tableau 76 – Unités spécifiques au profil de dispositif

Nom d'unité	Symbole international	Index de notation
Seconde cubique	s ³	A0 _h
Réservé	–	A1 _h à AB _h , AD _h à B3 _h , B6 _h à BF _h
Spécifique au constructeur	–	C0 _h à FF _h
Rotation	aucun	B4 _h
Inc	aucun	B5 _h
Pas	aucun	AC _h

9.2.10 Objet 60A8_h: Unité SI de position

Cet objet doit indiquer les unités de position définies par l'utilisateur. La structure de l'objet est définie à la Figure 1 du CiA 303-2:2012. La représentation des unités SI et des préfixes

est donnée dans le CiA-303-2. La représentation des unités spécifiques au profil supplémentaires est définie dans le Tableau 76. Le champ spécifique au profil (bit 0 à bit 7) de cet objet est réservé (00_h).

La mise à l'échelle à partir des incréments de position réelle par rapport à la valeur de position dans les unités définies par l'utilisateur est réalisée en utilisant les objets 608F_h, 6091_h et 6092_h. Le Tableau 77 spécifie la description de l'objet et le Tableau 78 spécifie la description d'entrée.

Tableau 77 – Description de l'objet

Attribut	Valeur
Index	60A8 _h
Nom	Unité SI de position
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 78 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Non
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

La Figure 11 présente un exemple de la configuration de l'objet donnée en mm.

31	24	23	16	15	8	7	0
FD _h (signifie 10 ⁻³)		01 _h (signifie m)		00 _h		réservé (00 _h)	
Bit de poids fort (MSB)						Bit de poids faible (LSB)	

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Figure 11 – Exemple d'une unité de position

9.2.11 Objet 60A9_h: Unité SI de vitesse

Cet objet doit indiquer les unités de vitesse définies par l'utilisateur. Si cet objet n'est pas mis en œuvre, l'unité de vitesse définie par l'utilisateur doit être (l'unité de position définie par l'utilisateur)/s. La structure de l'objet est définie à la Figure 1 du CiA 303-2:2012. La représentation des unités SI et des préfixes est donnée dans le CiA-303-2. La représentation des unités spécifiques au profil supplémentaires est définie dans le Tableau 76. Le champ spécifique au profil (bit 0 à bit 7) de cet objet est réservé (00_h).

Cet objet est considéré comme une définition des unités de vitesse définies par l'utilisateur si l'objet 6090_h (résolution du codeur de vitesse) est mis en œuvre. Si l'objet 6090_h n'est pas mis en œuvre, un calcul fondé sur les valeurs relatives à la position est à effectuer. Le Tableau 79 spécifie la description de l'objet et le Tableau 80 spécifie la description d'entrée.

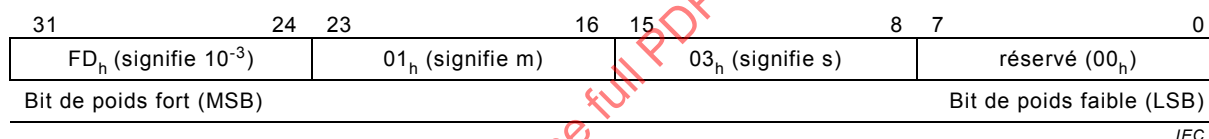
Tableau 79 – Description de l'objet

Attribut	Valeur
Index	60A9 _h
Nom	Unité SI de vitesse
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 80 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Non
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

La Figure 12 présente un exemple de la configuration de l'objet donnée en mm/s.

**Figure 12 – Exemple d'une unité de vitesse**

9.2.12 Objet 60AA_h: Unité SI d'accélération

Cet objet doit indiquer les unités d'accélération définies par l'utilisateur. Si cet objet n'est pas mis en œuvre, l'unité d'accélération définie par l'utilisateur doit être (l'unité de vitesse définie par l'utilisateur)/s. La structure de l'objet est définie à la Figure 1 du CiA 303-2:2012. La représentation des unités SI et des préfixes est donnée dans le CiA-303-2. La représentation des unités spécifiques au profil supplémentaires est définie dans le Tableau 76. Le champ spécifique au profil (bit 0 à bit 7) de cet objet est réservé (00_h).

Pour faire correspondre la valeur d'accélération avec les unités définies par l'utilisateur, un calcul fondé sur la valeur de vitesse est à effectuer. Le Tableau 81 spécifie la description de l'objet et le Tableau 82 spécifie la description d'entrée.

Tableau 81 – Description de l'objet

Attribut	Valeur
Index	60AA _h
Nom	Unité SI d'accélération
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 82 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Non
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

La Figure 13 présente un exemple de la configuration de l'objet donnée en mm/s².

31	24	23	16	15	8	7	0
FD _h (signifie 10 ⁻³)		01 _h (signifie m)		57 _h (signifie s ²)		réservé (00 _h)	
Bit de poids fort (MSB)						Bit de poids faible (LSB)	

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Figure 13 – Exemple d'une unité d'accélération

9.2.13 Objet 60AB_h: Unité SI d'à-coup

Cet objet doit indiquer les unités d'à-coup définies par l'utilisateur. Si cet objet n'est pas mis en œuvre, l'unité d'à-coup définie par l'utilisateur doit être (l'unité de vitesse définie par l'utilisateur)/s². La structure de l'objet est définie à la Figure 1 du CiA 303-2:2012. La représentation des unités SI et des préfixes est donnée dans le CiA-303-2. La représentation des unités spécifiques au profil supplémentaires est définie dans le Tableau 76. Le champ spécifique au profil (bit 0 à bit 7) de cet objet est réservé (00_h).

Le Tableau 83 spécifie la description de l'objet et le Tableau 84 spécifie la description d'entrée.

Tableau 83 – Description de l'objet

Attribut	Valeur
Index	60AB _h
Nom	Unité SI d'à-coup
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 84 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Non
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

La Figure 14 présente un exemple de la configuration de l'objet donnée en mm/s³.

31	24	23	16	15	8	7	0
FD _h (signifie 10 ⁻³)		01 _h (signifie m)		A0 _h (signifie s ³)		réservé (00 _h)	
Bit de poids fort (MSB)						Bit de poids faible (LSB)	

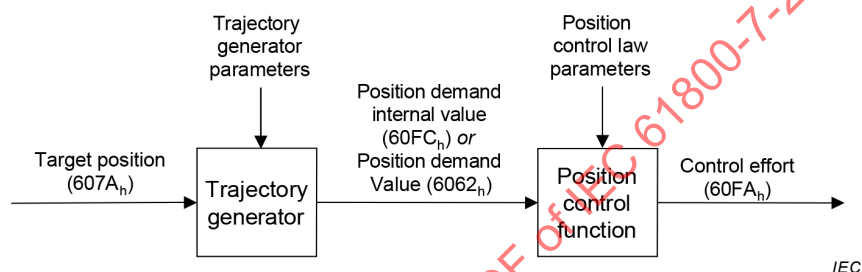
IEC

Figure 14 – Exemple d'une unité d'à-coup

10 Mode de position de profil

10.1 Informations d'ordre général

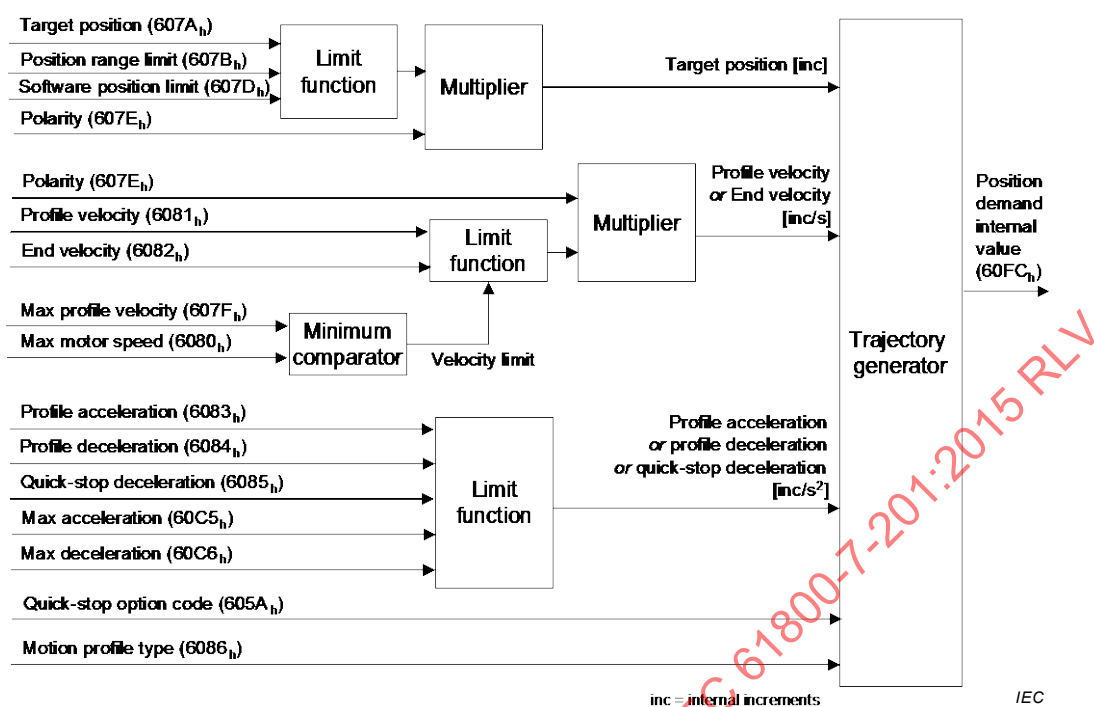
La structure globale pour ce mode est présentée à la Figure 15. Une position cible est appliquée au générateur de trajectoire. Celui-ci génère une valeur de demande de position pour la boucle d'asservissement de position décrite dans la fonction correspondante (voir 13.3.1). Ces deux blocs de fonction sont commandés éventuellement par des ensembles de paramètres individuels.



Anglais	Français
Target position	Position cible
Trajectory generator parameters	Paramètres de générateur de trajectoire
Trajectory generator	Générateur de trajectoire
Position demand internal value (60FC _h) or Position demand Value (6062 _h)	Valeur interne de demande de position (60FC _h) ou valeur de demande de position (6062 _h)
Position control law parameters	Paramètres légitimes d'asservissement de position
Position control function	Fonction d'asservissement de position
Control effort	Mesure de contrôle

Figure 15 – Générateur de trajectoire et fonction d'asservissement de position

À l'entrée du générateur de trajectoire, des limites facultatives peuvent être appliquées aux paramètres avant qu'ils ne soient normalisés en unités internes. La forme la plus simple d'un générateur de trajectoire consiste juste à transiter par une position cible et à la transformer en une valeur interne de demande de position avec des unités internes (incrément) uniquement. La Figure 16 définit la structure détaillée du générateur de trajectoire.



Anglais	Français
Target position	Position cible
Position range limit	Limite de plage de position
Software position limit	Limite de position de logiciel
Polarity	Polarité
Limit function	Fonction limite
Multiplier	Multiplicateur
Profile velocity	Vitesse de profil
Or End velocity	Ou Vitesse finale
Max profile velocity	Vitesse maximale du profil
Max. motor speed	Régime maximal du moteur
Minimum comparator	Comparateur minimum
Velocity limit	Limite de vitesse
Profile acceleration	Accélération de profil
Profile deceleration	Décélération de profil
Quick-stop deceleration	Décélération par arrêt rapide
Max. acceleration	Accélération maximale
Max. deceleration	Décélération maximale
Quick-stop option code	Code de l'option Arrêt rapide
Motion profile type	Type de profil de mouvement
Profile acceleration or profile deceleration or quick-stop deceleration	Accélération de profil ou décélération de profil ou décélération par arrêt rapide
Trajectory generator	Générateur de trajectoire
Position demand internal value	Valeur interne de demande de position
Inc = Internal increments	Inc = Incréments internes

Figure 16 – Générateur de trajectoire pour le mode de position de profil

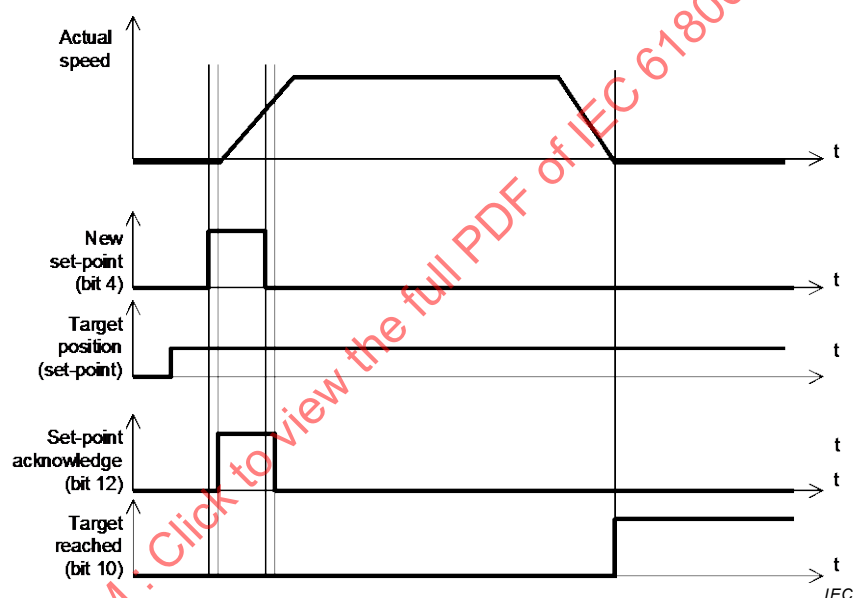
10.2 Description fonctionnelle

10.2.1 Généralités

Le réglage des points de consigne est commandé par la synchronisation du bit nouveau point de consigne et du bit changer le point de consigne immédiatement dans le mot de commande, ainsi que le bit acquitter le point de consigne dans le mot d'état.

Si le bit changer le point de consigne immédiatement du mot de commande est mis à 1, le dispositif d'entraînement attend un point de consigne unique. Si le bit changer le point de consigne immédiatement du mot de commande est mis à 0, le dispositif d'entraînement attend un ensemble de points de consigne.

Après application d'un point de consigne au dispositif d'entraînement, le dispositif de commande indique que le point de consigne est valide au moyen d'un front montant du bit nouveau point de consigne dans le mot de commande. Le dispositif d'entraînement règle le bit acquitter le point de consigne dans le mot d'état sur 1, puis, le dispositif d'entraînement indique, au moyen du bit acquitter le point de consigne mis à 0, sa capacité à accepter de nouveaux points de consigne. Un exemple est présenté à la Figure 17.



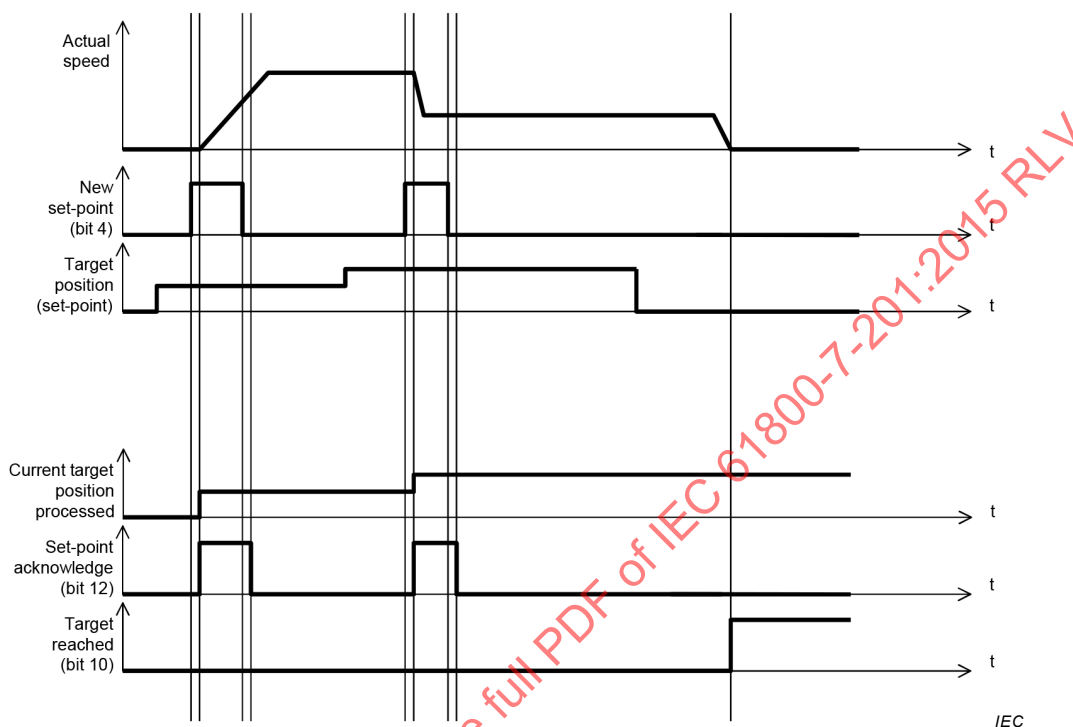
Anglais	Français
Actual speed	Vitesse instantanée
New set-point (bit 4)	Nouveau point de consigne (bit 4)
Target position (set-point)	Position cible (point de consigne)
Set-point acknowledge (bit 12)	Acquitter le point de consigne (bit 12)
Target reached (bit 10)	Cible atteinte (bit 10)

Figure 17 – Exemple de point de consigne

Lorsqu'un point de consigne est toujours en cours de traitement et un nouveau point de consigne est validé, deux méthodes de traitement sont prises en charge: point de consigne unique (le bit changer le point de consigne immédiatement du mot de commande est égal à 1) et ensemble de points de consigne (le bit changer le point de consigne immédiatement du mot de commande est égal à 0).

10.2.2 Point de consigne unique

Lorsqu'un point de consigne est en cours de traitement et un nouveau point de consigne est validé par le nouveau point de consigne (bit 4) dans le mot de commande, le nouveau point de consigne doit être traité immédiatement. La procédure de transfert représentée à la Figure 18 est employée pour la méthode de point de consigne unique.

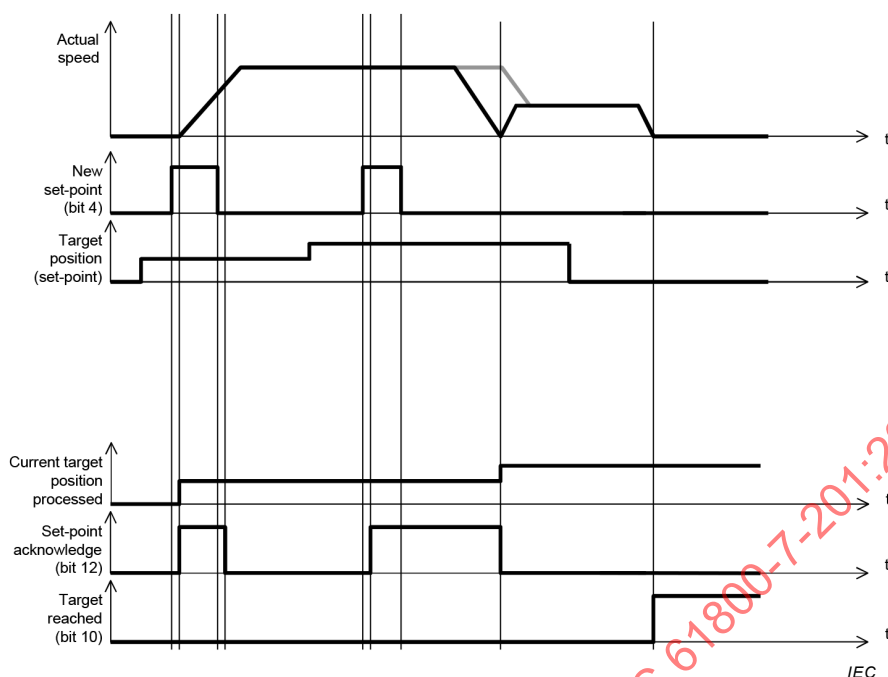


Anglais	Français
Actual speed	Vitesse instantanée
New set-point (bit 4)	Nouveau point de consigne (bit 4)
Target position (set-point)	Position cible (point de consigne)
Current target position processed	Position cible actuelle traitée
Set-point acknowledge (bit 12)	Acquitter le point de consigne (bit 12)
Target reached (bit 10)	Cible atteinte (bit 10)

Figure 18 – Procédure de transfert pour la méthode de point de consigne unique

10.2.3 Ensemble de points de consigne

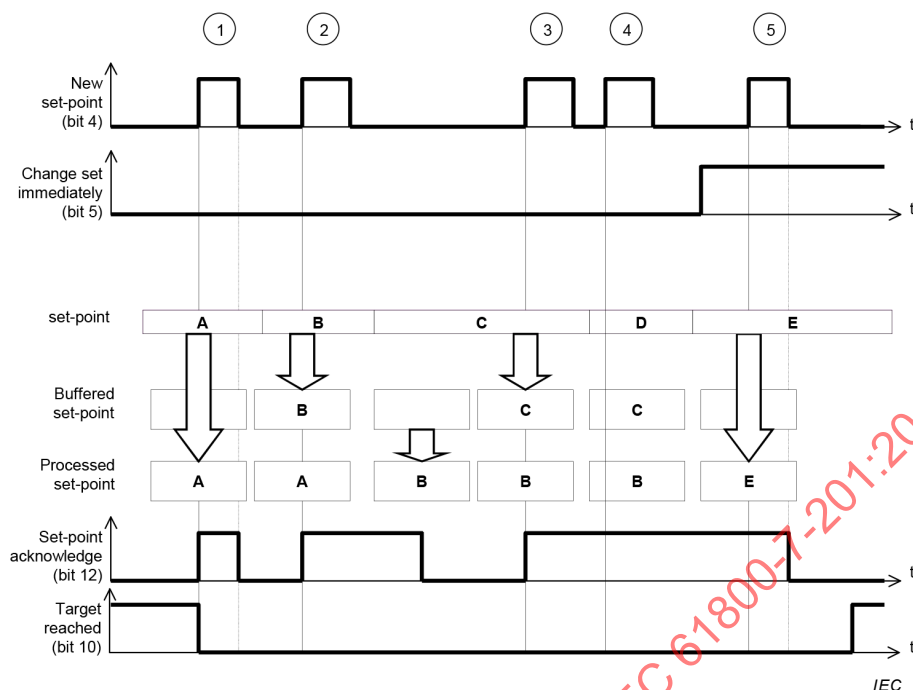
Lorsqu'un point de consigne est en cours de traitement et un nouveau point de consigne est validé par le nouveau point de consigne (bit 4) dans le mot de commande, le nouveau point de consigne doit être traité uniquement après que le point de consigne précédent a été atteint. La procédure de transfert représentée à la Figure 19 est employée pour la méthode d'ensemble de points de consigne. Le segment grisé supplémentaire qui apparaît sur le graphique "vitesse réelle" montre la vitesse réelle si le bit changement du point de consigne (bit 9) est mis à 1.



Anglais	Français
Actual speed	Vitesse réelle
New set-point (bit 4)	Nouveau point de consigne (bit 4)
Target position (set-point)	Position cible (point de consigne)
Current target position processed	Position cible actuelle traitée
Set-point acknowledge (bit 12)	Acquitter le point de consigne (bit 12)
Target reached (bit 10)	Cible atteinte (bit 10)

Figure 19 – Procédure de transfert pour la méthode d'ensemble de points de consigne

Lorsqu'un dispositif d'entraînement prend en charge un ensemble de points de consigne, deux points de consigne au minimum sont disponibles, à savoir un point de consigne en cours de traitement et un point de consigne mis en mémoire tampon. Les points de consigne sont traités comme représenté à la Figure 20.



Anglais	Français
New set-point (bit 4)	Nouveau point de consigne (bit 4)
Change set immediately	Changer le point de consigne immédiatement
Set-point	Point de consigne
Buffered set-point	Point de consigne mis en mémoire tampon
Processed set-point	Point de consigne traité
Set-point acknowledge (bit 12)	Acquitter le point de consigne (bit 12)
Target reached (bit 10)	Cible atteinte (bit 10)

Figure 20 – Traitement des points de consigne dans le cas de deux points de consigne

Les nouveaux points de consigne sont mis en mémoire tampon dans la liste des points de consigne tant que le dispositif d'entraînement dispose de points de consigne libres. Si aucun point de consigne n'est en cours de traitement, le nouveau point de consigne doit devenir actif immédiatement (1). Si un point de consigne est en cours de traitement, le nouveau point de consigne doit être archivé dans la première mémoire tampon des points de consigne qui est libre (2 + 3).

Si toutes les mémoires tampons des points de consigne sont occupées (le bit acquitter le point de consigne est égal à 1), la réaction dépend du bit changer le point de consigne immédiatement. Si ce bit est mis à 1, le nouveau point de consigne doit être traité immédiatement comme point de consigne unique. Tous les points de consigne chargés précédemment doivent être éliminés (5).

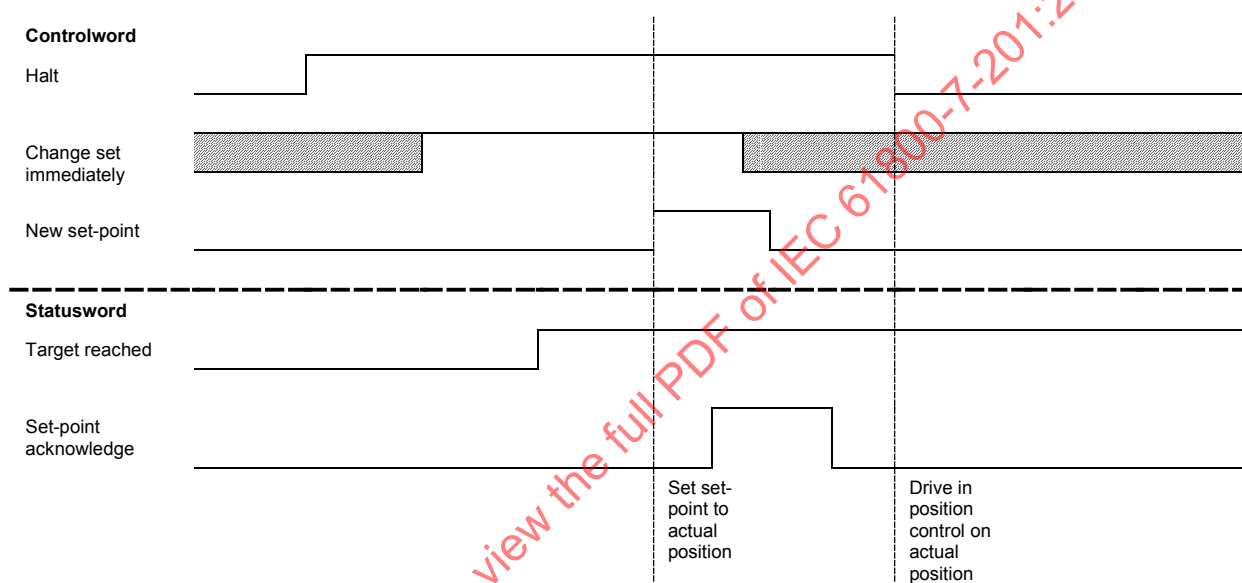
Le bit cible atteinte doit rester à 0 jusqu'à ce que tous les points de consigne soient traités.

10.2.4 Utilisation du bit Arrêt en combinaison avec le bit du nouveau point de consigne

Le bit arrêt peut être utilisé pour arrêter, définir un nouveau point de consigne et, en combinaison avec le bit du nouveau point de consigne, pour interrompre un déplacement réel, qui est décrit dans la présente section.

Si un dispositif d'entraînement traite un point de consigne, le bit arrêt (bit 8 du mot de commande) peut être utilisé pour arrêter le moteur et le maintenir en asservissement de position. Dès libération du bit arrêt, le traitement du point de consigne en cours se poursuit.

La Figure 21 décrit un mécanisme de suppression du point de consigne traité et de définition de la position réelle en tant qu'un nouveau point de consigne de sorte que le dispositif d'entraînement demeure à la position réelle en asservissement de position même après la libération du bit arrêt.



Anglais	Français
Controlword	Mot de commande
Halt	Arrêt
Change set immediately	Changer le point de consigne immédiatement
New set-point	Nouveau point de consigne
Statusword	Mot d'état
Target reached	Cible atteinte
Set-point acknowledge	Acquitter le point de consigne
Set set-point to actual position	Régler le point de consigne sur la position réelle
Drive in position control on actual position	Dispositif d'entraînement en asservissement de position sur la position réelle

Figure 21 – Suppression du point de consigne

La position d'entraînement réelle doit être enregistrée après un arrêt complet du moteur. Par conséquent, le bit 8 (arrêt) du mot de commande (6040_h) et le bit 10 (cible atteinte) du mot d'état (6041_h) sont tenus d'être égaux à 1. Le Tableau 87 donne des informations supplémentaires sur cette combinaison de bits.

Pour définir la rampe de ralentissement qui est appliquée pendant l'arrêt, l'objet de commande 605D_h (code de l'option Arrêt) peut être utilisé.

10.3 Définitions générales

Les limites logicielles internes ne doivent pas être dépassées par les réglages externes configurés par l'utilisateur.

10.4 Utilisation du mot de commande et du mot d'état

Le mode de position de profil utilise certains bits du mot de commande et du mot d'état pour des applications spécifiques au mode. La Figure 22 présente la structure du mot de commande. Si aucun positionnement n'est en cours, le front montant du bit 4 doit commencer le positionnement de l'axe. Dans le cas où un positionnement est en cours, les définitions données dans le Tableau 85 doivent être utilisées. Le Tableau 86 définit les valeurs des bits 6 et 8 du mot de commande.

NOTE Il est supposé que la position cible est déclenchée par un front d'impulsion 0->1; dans le cas contraire, le dispositif peut définir immédiatement de nouvelles valeurs, ce qui contribue à un comportement inattendu.

15	10	9	8	7	6	5	4	3	0
(voir 8.4.1)	Changer le point de consigne	Arrêt	(voir 8.4.1)	abs/rel	Changer le point de consigne immédiatement	Nouveau point de consigne	(voir 8.4.1)		
Bit de poids fort (MSB)					Bit de poids faible (LSB)				

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Figure 22 – Mot de commande pour le mode de position de profil (pp)

Tableau 85 – Définition du bit 4, du bit 5 et du bit 9

Bit 9	Bit 5	Bit 4	Définition
0	0	0 -> 1	Le positionnement doit être effectué (cible atteinte) avant que ne commence le positionnement suivant (voir Figure 17 et Figure 19)
X	1	0 -> 1	Le positionnement suivant doit commencer immédiatement (voir Figure 17 et Figure 18)
1	0	0 -> 1	Le positionnement avec la vitesse de profil actuelle atteignant le point de consigne actuel doit être effectué, puis le positionnement suivant (voir Figure 17 et Figure 19) doit alors être appliqué

Tableau 86 – Définition du bit 6 et du bit 8

Bit	Valeur	Définition
6	0	La position cible doit être une valeur absolue
	1	La position cible doit être une valeur relative (selon l'objet 60F2 _h)
8	0	Le positionnement doit être exécuté ou poursuivi
	1	Le mouvement de l'axe doit être interrompu en fonction du code de l'option Arrêt (605D _h)

La Figure 23 présente la structure du mot d'état. Le Tableau 87 définit les valeurs du bit 10, du bit 12 et du bit 13.

15	14	13	12	11	10	9	0
(voir 8.4.2)	Erreur suivante	Acquitter le point de consigne	(voir 8.4.2)	Cible atteinte	(voir 8.4.2)		
Bit de poids fort (MSB)				Bit de poids faible (LSB)			

IEC

Figure 23 – Mot d'état pour le mode de position de profil (pp)

Tableau 87 – Définition du bit 10, du bit 12 et du bit 13

Bit	Valeur	Définition
10	0	Arrêt (bit 8 dans le mot de commande) = 0: Position cible non atteinte Arrêt (bit 8 dans le mot de commande) = 1: L'axe ralentit
	1	Arrêt (bit 8 dans le mot de commande) = 0: Position cible atteinte Arrêt (bit 8 dans le mot de commande) = 1: La vitesse de l'axe est nulle
12	0	Point de consigne précédent déjà traité, attente d'un nouveau point de consigne
	1	Point de consigne précédent toujours en cours de traitement, la réécriture du point de consigne doit être acceptée
13	0	Pas d'erreur suivante
	1	Erreur suivante

10.5 Définitions d'objets détaillées

10.5.1 Objet 607A_h: Position cible

Cet objet doit indiquer la position commandée qu'il convient que le dispositif d'entraînement adopte en mode de profil de position, en utilisant les réglages actuels des paramètres de commande de mouvement tels que la vitesse, l'accélération, la décélération, le type de profil de mouvement, etc. La valeur de cet objet doit être interprétée comme valeur absolue ou relative, selon l'indicateur abs/rel du mot de commande. Elle doit être donnée en unités de position définies par l'utilisateur et doit être convertie en incréments de position. Le Tableau 88 spécifie la description de l'objet et le Tableau 89 spécifie la description d'entrée.

Tableau 88 – Description de l'objet

Attribut	Valeur
Index	607A _h
Nom	Position cible
Code de l'objet	Variable
Type de données	Integer32
Catégorie	Facultative; obligatoire si pp, pc ou csp est pris en charge

Tableau 89 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Integer32
Valeur par défaut	Spécifique au constructeur

10.5.2 Objet 607B_h: Limite de plage de position

Cet objet doit indiquer les limites maximale et minimale configurées de plage de position. Il doit limiter la plage numérique de la valeur d'entrée. Lorsqu'elle atteint ou dépasse ces limites, la valeur d'entrée doit boucler automatiquement vers l'autre extrémité de la plage. Le bouclage de la valeur d'entrée peut être évité en réglant les limites de position de logiciel comme cela est défini dans l'objet de limite de position de logiciel (607D_h). Pour désactiver

les limites de la plage de position, la limite minimale de plage de position (sous-index 01_h) et la limite maximale de plage de position (sous-index 02_h) doivent être définies à 0. Les valeurs doivent être données en unités de position définies par l'utilisateur. Le Tableau 90 spécifie la description de l'objet et le Tableau 91 spécifie la description d'entrée.

Tableau 90 – Description de l'objet

Attribut	Valeur
Index	607B _h
Nom	Limite de plage de position
Code de l'objet	Matrice
Type de données	Integer32
Catégorie	Facultative

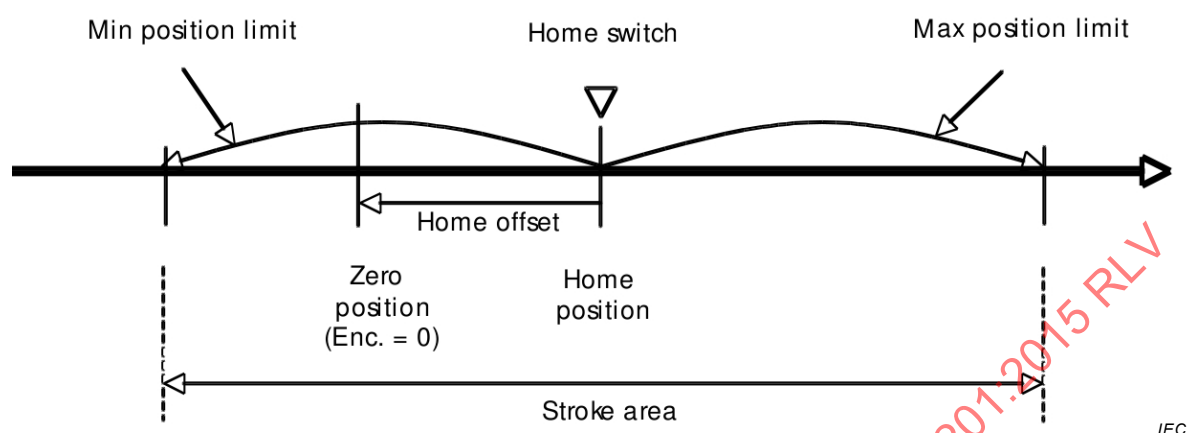
Tableau 91 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	02 _h
Sous-index	01 _h
Description	Limite minimale de plage de position
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Integer32
Valeur par défaut	Spécifique au constructeur
Sous-index	02 _h
Description	Limite maximale de plage de position
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Integer32
Valeur par défaut	Spécifique au constructeur

10.5.3 Objet 607D_h: Limite de position de logiciel

Cet objet doit indiquer les limites maximale et minimale configurées de position de logiciel. Ces paramètres doivent définir les limites de position absolues pour la valeur de demande de

position et la valeur instantanée de position comme spécifiées à la Figure 24. Chaque nouvelle position de cible doit être vérifiée par rapport à ces limites.



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Anglais	Français
Min position limit	Limite de position minimale
Home switch	Interrupteur d'origine
Max position limit	Limite de position maximale
Home offset	Décalage d'origine
Zero position	Position zéro
Home position	Position d'origine
Stroke area	Zone de mouvement

Figure 24 – Limites de position de logiciel

Les positions limites doivent être données en unités de position définies par l'utilisateur (même cas de figure que la position cible). Le Tableau 92 spécifie la description de l'objet et le Tableau 93 spécifie la description d'entrée.

La supervision des limites de position de logiciel nécessite une position d'origine définie.

Tableau 92 – Description de l'objet

Attribut	Valeur
Index	607D _h
Nom	Limite de position de logiciel
Code de l'objet	Matrice
Type de données	Integer32
Catégorie	Facultative

Tableau 93 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	02 _h
Valeur par défaut	02 _h
Sous-index	01 _h
Description	Limite de position minimale
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Integer32
Valeur par défaut	Spécifique au constructeur
Sous-index	02 _h
Description	Limite de position maximale
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Integer32
Valeur par défaut	Spécifique au constructeur

10.5.4 Objet 607F_h – Vitesse maximale du profil

Cet objet doit indiquer la vitesse maximale admise configurée dans toutes les directions au cours d'un mouvement de profil. La valeur doit être donnée dans la même unité physique que l'objet vitesse de profil (6081_h). Le Tableau 94 spécifie la description de l'objet et le Tableau 95 spécifie la description d'entrée.

Tableau 94 – Description de l'objet

Attribut	Valeur
Index	607F _h
Nom	Vitesse maximale du profil
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 95 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

10.5.5 Objet 6080_h: Régime maximal du moteur

Cet objet doit indiquer le régime maximal admis configuré du moteur dans toutes les directions. Il permet de protéger le moteur et provient de la fiche technique de ce dernier. La valeur doit être donnée en tours par minute (r/min) ou en unités de vitesse définies par l'utilisateur. Le Tableau 96 spécifie la description de l'objet et le Tableau 97 spécifie la description d'entrée.

Tableau 96 – Description de l'objet

Attribut	Valeur
Index	6080 _h
Nom	Régime maximal du moteur
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 97 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

10.5.6 Objet 6081_h: Vitesse de profil

Cet objet doit indiquer la vitesse configurée normalement atteinte à la fin de la rampe d'accélération au cours d'un mouvement de profil, et doit être valide pour les deux directions de mouvement. La valeur doit être donnée en unités de vitesse définies par l'utilisateur. Les unités de vitesse peuvent dépendre des unités de position définies par l'utilisateur (unités de position par seconde). Le calcul des unités de position définies par l'utilisateur est réalisé à l'aide du groupe de facteurs (voir Article 9). Le Tableau 98 spécifie la description de l'objet et le Tableau 99 spécifie la description d'entrée.

Tableau 98 – Description de l'objet

Attribut	Valeur
Index	6081 _h
Nom	Vitesse de profil
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Conditionnelle: obligatoire si pp est pris en charge

Tableau 99 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

10.5.7 Objet 6082_h: Vitesse finale

Cet objet doit indiquer la vitesse configurée à laquelle le dispositif d'entraînement doit fonctionner lorsqu'il atteint la position cible. Normalement, le dispositif d'entraînement s'arrête à la position cible, c'est-à-dire la vitesse finale est 0. La valeur doit être donnée dans les mêmes unités physiques que l'objet vitesse de profil (6081_h). Le Tableau 100 spécifie la description de l'objet et le Tableau 101 spécifie la description d'entrée.

Tableau 100 – Description de l'objet

Attribut	Valeur
Index	6082 _h
Nom	Vitesse finale
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 101 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	0000 0000 _h

10.5.8 Objet 6083_h: Accélération de profil

Cet objet doit indiquer l'accélération configurée. La valeur doit être donnée en unités d'accélération définies par l'utilisateur. Le Tableau 102 spécifie la description de l'objet et le Tableau 103 spécifie la description d'entrée.

Tableau 102 – Description de l'objet

Attribut	Valeur
Index	6083 _h
Nom	Accélération de profil
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Conditionnelle: obligatoire si pp ou pv est pris en charge

Tableau 103 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

10.5.9 Objet 6084_h: Décélération de profil

Cet objet doit indiquer la décélération configurée. Si ce paramètre n'est pas pris en charge, la valeur de l'objet accélération de profil (6083_h) doit être utilisée également pour la décélération. La valeur doit être donnée dans les mêmes unités physiques que l'objet accélération de profil (6083_h). Le Tableau 104 spécifie la description de l'objet et le Tableau 105 spécifie la description d'entrée.

Tableau 104 – Description de l'objet

Attribut	Valeur
Index	6084 _h
Nom	Décélération de profil
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 105 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

10.5.10 Objet 6085_h: Décélération par arrêt rapide

Cet objet doit indiquer la décélération configurée utilisée pour arrêter le moteur lorsque la fonction d'arrêt rapide est activée et l'objet code d'arrêt rapide (605A_h) est réglé sur 2 ou 6. La décélération par arrêt rapide est également utilisée si l'objet code de réaction au défaut (605E_h) est égal à 2 et l'objet code de l'option Arrêt (605D_h) est aussi égal 2. La valeur doit être donnée dans la même unité physique que l'objet Accélération de profil (6083_h). Le Tableau 106 spécifie la description de l'objet et le Tableau 107 spécifie la description d'entrée.

Tableau 106 – Description de l'objet

Attribut	Valeur
Index	6085 _h
Nom	Décélération par arrêt rapide
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 107 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

10.5.11 Objet 6086_h: Type de profil de mouvement

Cet objet doit indiquer le type configuré de profil de mouvement utilisé pour effectuer un mouvement de profil. Le Tableau 108 spécifie la définition des valeurs, le Tableau 109 spécifie la description de l'objet et le Tableau 110 spécifie la description d'entrée.

Tableau 108 – Définition des valeurs

Valeur	Définition
-32 768 à -1	Spécifique au constructeur
0	Rampe linéaire (profil trapézoïdal)
+1	Rampe Sin ²
+2	Rampe exempte d'à-coups
+3	Rampe à limitation d'à-coups
+4 à +32 767	Réservé

Tableau 109 – Description de l'objet

Attribut	Valeur
Index	6086 _h
Nom	Type de profil de mouvement
Code de l'objet	Variable
Type de données	Integer16
Catégorie	Facultative

Tableau 110 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Integer16
Valeur par défaut	0

10.5.12 Objet 60A3_h : Utilisation de profil par à-coup

Cet objet doit indiquer le nombre configuré de sous-index utilisés dans l'objet profil par à-coup (60A4_h) pour le mouvement de profil par à-coup. Lorsque cet objet n'est pas mis en œuvre, l'objet profil par à-coup doit être utilisé comme il est mis en œuvre. La valeur doit être adimensionnelle, et la valeur de FF_h doit indiquer que l'utilisation de profil par à-coup n'est pas configurée. Le Tableau 111 spécifie la description de l'objet et le Tableau 112 spécifie la description d'entrée.

Tableau 111 – Description de l'objet

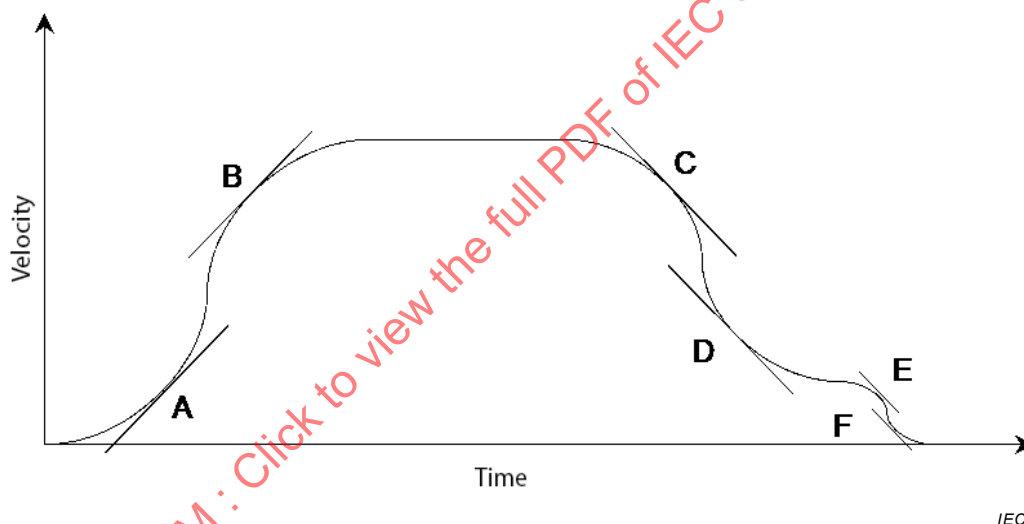
Attribut	Valeur
Index	60A3 _h
Nom	Utilisation de profil par à-coup
Code de l'objet	Variable
Type de données	Unsigned8
Catégorie	Facultative

Tableau 112 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	01 _h à 06 _h et FF _h
Valeur par défaut	Spécifique au constructeur

10.5.13 Objet 60A4_h: Profil par à-coup

Cet objet doit indiquer l'ensemble configuré de paramètres par à-coup qui doivent être utilisés lors du mouvement de profil. La Figure 25 montre les à-coups définis (A, B, C, D, E et F). Les valeurs doivent être données en unités d'à-coup définies par l'utilisateur. Le Tableau 113 spécifie l'assignation de valeurs aux à-coups selon la valeur de l'objet utilisation de profil par à-coup (60A3_h). Lorsque l'objet 60A3_h n'est pas mis en œuvre, le sous-index 00_h doit servir à attribuer aux à-coups les valeurs données dans les autres sous-index. Le Tableau 114 spécifie la description de l'objet et le Tableau 115 spécifie la description d'entrée.



Anglais	Français
Velocity	Vitesse
Time	Temps

Figure 25 – Diagramme vitesse/temps avec les positions d'à-coup

Tableau 113 – Assignations de valeurs

Valeur de l'objet 60A3 _h ou du sous-index 00 _h de l'objet 60A4 _h si 60A3 _h n'est pas mis en œuvre	Assignation de valeurs aux à-coups					
	A	B	C	D	E	F
01 _h	01 _h	01 _h	01 _h	01 _h	-	-
02 _h	01 _h	01 _h	02 _h	02 _h	-	-
04 _h	01 _h	03 _h	02 _h	04 _h	-	-
06 _h	01 _h	03 _h	02 _h	04 _h	05 _h	06 _h

Tableau 114 – Description de l'objet

Attribut	Valeur
Index	60A4 _h
Nom	Profil par à-coup
Code de l'objet	Matrice
Type de données	Unsigned32
Catégorie	Facultative

Tableau 115 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Description	Plus grand sous-index pris en charge
Catégorie d'entrée	Obligatoire
Accès	c
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	01 _h , 02 _h , 04 _h ou 06 _h ,
Valeur par défaut	Spécifique au constructeur
Sous-index	01 _h
Description	Profil par à-coup 1
Catégorie d'entrée	Obligatoire
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur
Sous-index	02 _h
Description	Profil par à-coup 2
Catégorie d'entrée	Facultative
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur
à	
Sous-index	06 _h
Description	Profil par à-coup 6
Catégorie d'entrée	Facultative
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

10.5.14 Objet 60C5_h: Accélération maximale

Cet objet doit indiquer l'accélération maximale configurée. Il permet de limiter l'accélération à une valeur acceptable afin d'empêcher la destruction du moteur et des pièces mécaniques mobiles. La valeur doit être donnée en unités physiques d'accélération définies par l'utilisateur. Le Tableau 116 spécifie la description de l'objet et le Tableau 117 spécifie la description d'entrée.

Tableau 116 – Description de l'objet

Attribut	Valeur
Index	60C5 _h
Nom	Accélération maximale
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 117 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

10.5.15 Objet 60C6_h: Décélération maximale

Cet objet doit indiquer la décélération maximale configurée. Il permet de limiter l'accélération à une valeur acceptable afin d'empêcher la destruction du moteur et des pièces mécaniques mobiles. La valeur doit être donnée dans la même unité physique que l'objet accélération maximale (60C5_h). Le Tableau 118 spécifie la description de l'objet et le Tableau 119 spécifie la description d'entrée.

Tableau 118 – Description de l'objet

Attribut	Valeur
Index	60C6 _h
Nom	Décélération maximale
Code de l'objet	Variable
Type de données	Unsigned32
Catégorie	Facultative

Tableau 119 – Description d'entrée

Attribut	Valeur
Sous-index	00 _h
Accès	rw
Mise en correspondance PDO	Voir IEC 61800-7-301
Plage de valeurs	Unsigned32
Valeur par défaut	Spécifique au constructeur

11 Mode de retour à la position de référence

11.1 Informations d'ordre général

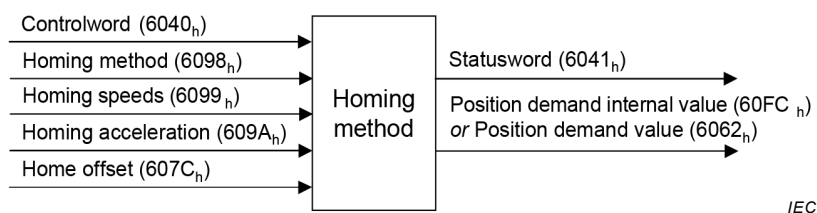
Le présent article décrit la méthode qu'utilise un dispositif d'entraînement pour rechercher la position d'origine (également appelée, le référentiel, le point de référence ou le point zéro). Diverses méthodes permettent d'atteindre cette position en utilisant des interrupteurs de fin de course aux extrémités de la course ou un interrupteur d'origine (interrupteur à tension nulle) à mi-course; la plupart des méthodes utilisent également le train d'impulsions à index (zéro) d'un codeur incrémental.

11.2 Description fonctionnelle

La Figure 26 présente les objets d'entrée définis, ainsi que les objets de sortie. L'utilisateur peut spécifier les vitesses, l'accélération et la méthode de retour à la position de référence. Il existe un décalage d'origine d'objet supplémentaire, qui permet à l'utilisateur de déplacer la valeur zéro dans le système de coordonnées de l'utilisateur par rapport à la position d'origine.

Il n'existe pas de données de sortie, sauf pour les bits du mot d'état, qui renvoient l'état ou le résultat du processus de retour à la position de référence, ainsi que la demande aux boucles d'asservissement de position.

Il existe deux vitesses de retour à la position de référence; dans un cycle type, la vitesse la plus élevée permet de déterminer l'interrupteur d'origine, et la vitesse la moins élevée permet de déterminer l'impulsion d'index. Une certaine liberté d'utilisation de ces vitesses est accordée au constructeur dans la mesure où la réponse aux signaux peut dépendre du matériel employé.



IEC

Anglais	Français
Controlword	Mot de commande
Homing method	Méthode de retour à la position de référence
Homing speeds	Vitesses de retour à la position de référence
Homing acceleration	Accélération de retour à la position de référence
Home offset	Décalage d'origine
Statusword	Mot d'état
Position demand internal value <i>or</i> Position demand value	Valeur interne de demande de position <i>ou</i> valeur de demande de position

Figure 26 – Fonction du mode de retour à la position de référence

Le choix d'une méthode de retour à la position de référence permet de déterminer le comportement suivant: Le signal de retour à la position de référence (interrupteur de fin de course positif, interrupteur de fin de course négatif, interrupteur d'origine), la direction d'activation et, le cas échéant, la position de l'impulsion d'index.

La position d'origine et la position zéro sont décalées par le décalage d'origine; voir la définition de décalage d'origine pour déterminer la méthode d'application de ce décalage.

Le nombre cerclé de la Figure 27 à la Figure 34 indique le code de sélection de cette position de retour à la position de référence. Le sens de déplacement est également indiqué.

Quatre sources de signal de retour à la position de référence sont disponibles: Il s'agit des interrupteurs de fin de course négatif et positif, de l'interrupteur d'origine et de l'impulsion d'index d'un codeur. Dans le cas où un interrupteur de fin de course a atteint la position de référence, le dispositif d'entraînement doit se déplacer dans l'autre direction afin de quitter la position.

Dans les diagrammes des séquences de retour à la position de référence présentés ci-dessous, le comptage du codeur augmente à mesure du déplacement de la position de l'axe vers la droite, en d'autres termes, la partie gauche est la position minimale et la partie droite est la position maximale.

Le fonctionnement des dispositifs d'entraînement de positionnement requiert normalement de connaître exactement la position absolue. Étant donné que, pour des raisons de coût, les dispositifs d'entraînement ne comportent souvent pas de codeur absolu, une opération de retour à la position de référence est nécessaire. Il existe plusieurs méthodes spécifiques à l'application. La méthode de retour à la position de référence est utilisée pour la sélection.

La méthode décrit clairement la séquence exacte de l'opération de retour à la position de référence. Dans certaines situations, un dispositif d'entraînement comporte plusieurs méthodes de sélection qui utilisent la méthode de retour à la position de référence.

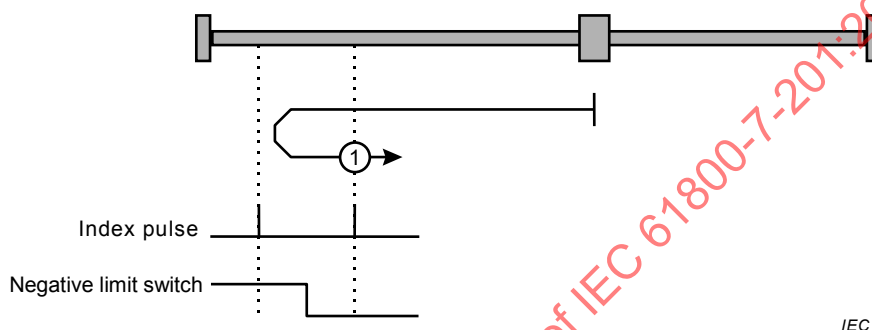
11.3 Définitions générales

11.3.1 Généralités

Les modes de retour à la position de référence fonctionnent avec les valeurs logiques des interrupteurs de fin de course et de retour à la position de référence (objet 60FD_h).

11.3.2 Méthode 1: Retour à la position de référence avec l'interrupteur de fin de course négatif et l'impulsion d'index

En utilisant cette méthode comme le représente la Figure 27, le sens de déplacement initial doit s'effectuer de droite à gauche si l'interrupteur de fin de course négatif est inactif (ici: bas). La position d'origine doit se situer à la première impulsion d'index à droite de la position où l'interrupteur de fin de course négatif devient inactif.

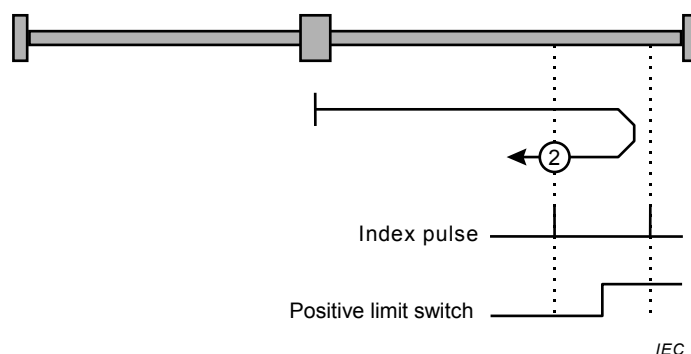


Anglais	Français
Index pulse	Impulsion d'index
Negative limit switch	Interrupteur de fin de course négatif

Figure 27 – Retour à la position de référence avec l'interrupteur de fin de course négatif et l'impulsion d'index

11.3.3 Méthode 2: Retour à la position de référence avec l'interrupteur de fin de course positif et l'impulsion d'index

En utilisant cette méthode comme le représente la Figure 28, le sens de déplacement initial doit s'effectuer de gauche à droite si l'interrupteur de fin de course positif est inactif (ici: bas). La position d'origine doit se situer à la première impulsion d'index à gauche de la position où l'interrupteur de fin de course positif devient inactif.

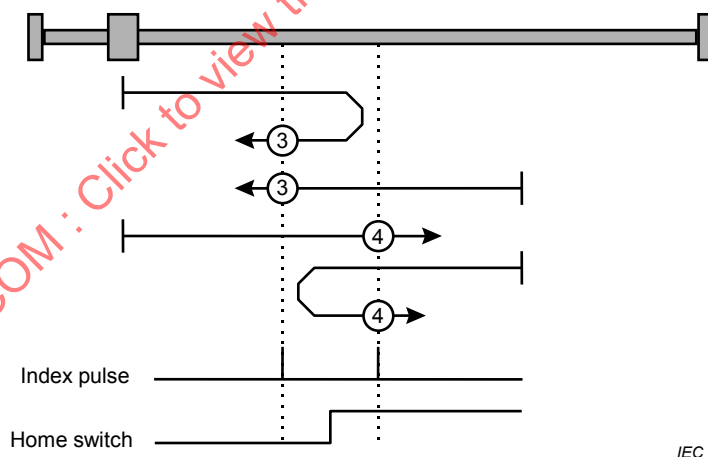


Anglais	Français
Index pulse	Impulsion d'index
Positive limit switch	Interrupteur de fin de course positif

Figure 28 – Retour à la position de référence avec l'interrupteur de fin de course positif et l'impulsion d'index

11.3.4 Méthodes 3 et 4: Retour à la position de référence avec l'interrupteur d'origine positif et l'impulsion d'index

En utilisant ces méthodes comme le représente la Figure 29, le sens de déplacement initial doit être dépendant de l'état de l'interrupteur d'origine. La position d'origine doit se situer à l'impulsion d'index à gauche ou à droite du point de changement d'état de l'interrupteur d'origine. Si la position initiale est située de sorte que le sens de déplacement doit s'inverser au cours du retour à la position de référence, le point d'inversion effectif est tout point existant après un changement d'état de l'interrupteur d'origine.



Anglais	Français
Index pulse	Impulsion d'index
Home switch	Interrupteur d'origine

Figure 29 – Retour à la position de référence avec l'interrupteur d'origine positif et l'impulsion d'index