SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS6129

Issued 2012-12

AS6129: Interface Standard, Airborne EO/IR Systems, Electrical

RATIONALE

This document was created to standardize the data interface between aircraft and EO/IR sensors. This activity was initiated at the request of the U.S. Navy in 2009.

PREFACE

AS6129, Interface Standard, Airborne EO/IR Systems, Electrical, is a standard that defines the electrical interface between aircraft (manned and unmanned) and onboard EO/IR Systems. Its purpose is to promote platform to sensor system interface standardization by providing substantial, but not 100% commonality, interoperability, and interchangeability.

This document was prepared by the AS-1C1 Electro-Optic/Infrared Signal Sets Task Group, under the jurisdiction of the AS-1C Subcommittee, Avionic Subsystems, of the SAE AS-1 Committee, Platform Systems and System Integration.

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1. SCOPE

This standard defines a generic set of electrical interfaces between a host aircraft (“platform”) and an electro-optic/infrared (EO/IR) sensor. This includes connectors, cabling, fiber optics, signals, and power.

1.1 Relationship Between Platform/Sensor Interfaces and SAE AS-1C Standards

Figure 1 shows the relationship between the various interfaces and the various SAE standards. AS6129 (electrical) covers connectors, conductors and fiber optics signals, and power, and some aspects of data transport. AS6135 (data) covers data (e.g., imagery, metadata, as well as command, status, and response messages.). AS6135 overlaps AS6129 in the area of protocols for data transport. AS6135 and AS6129 are closely bound together because building a system based on these standards is dependent on the requirements from both standards. Also, requirements put in one standard can impact the options for updating the other standard.

NOTE: Regarding Figure 1, SAE is drafting a standard to cover maintenance and test which, if adopted, will likely overlap both AS6129 and AS6135. SAE is also drafting a standard to cover the mechanical interface which, if adopted, will overlap AS6129 with regard to connectors.

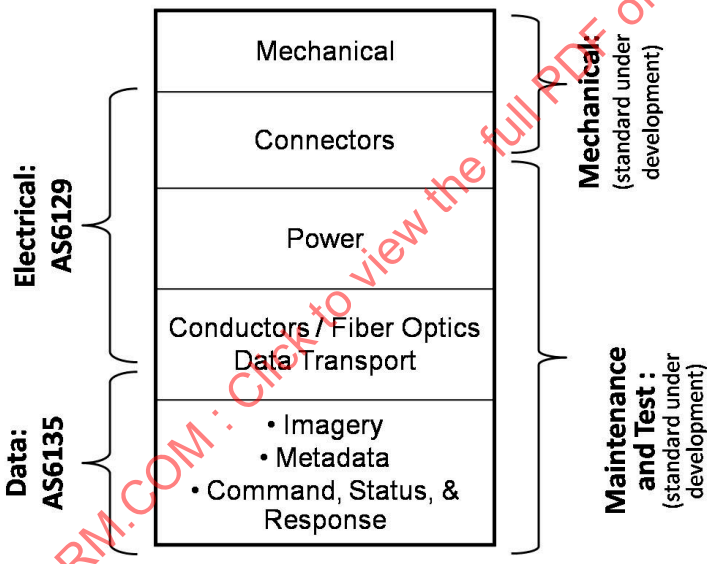

FIGURE 1 - RELATED SAE STANDARDS

1.2 Purpose

The intent of this standard is to enhance interchangeability and interoperability amongst equipment provided by various EO/IR Suppliers and avionic systems. Adoption of this standard will improve procurement flexibility for system integrators and platform providers. Platform providers include fixed wing, rotary wing, UAS (except for micro-UAS) and lighter than air vehicles. The interfaces are designed to facilitate the:

a. operation of EO/IR sensor electrical and mechanical subsystems;

b. interconnection between EO/IR sensor systems and the avionics systems hosted by the platform;

c. exchange of data and metadata between sensor systems and sensor data processing;

d. maintenance of EO/IR systems, allowing for reduction in maintenance equipment in the field and for test.

1.3 Application

This standard applies to all platforms and EO/IR sensors that interface with each other. AS6129 addresses turreted EO/IR sensor systems. Future revisions of AS6129 may address other classes of EO/IR sensor systems such as non-gimbaled sensors and podded sensors. This standard is intended for application to future sensors and platforms. This includes evolutionary modifications as well as completely new designs. This standard is intended for use by procuring agencies, and as a general guideline for industry.

2. REFERENCES

2.1 Applicable Documents

The documents listed in this section are cited in Sections 3 and 4 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in Sections 3 and 4 of this standard whether or not they are listed here in Section 2.

The following publications form a part of this document to the extent specified herein. When specified herein, the specified revision level of a document shall be used. Otherwise, the latest revision level of the specified document is implied.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AS50881 Wiring Aerospace Vehicle

AS39029/28 Contacts, Electrical Connector, Pin, Crimp Removable, Shielded, Size 12 (for MIL-DTL-38999 Series I, II, III and IV Connectors)

AS39029/56 Contacts, Electrical Connector, Socket, Crimp Removable (for MIL-DTL-38999 Series I, III, and IV Connectors)

AS39029/58 Contacts, Electrical Connector, Pin, Crimp Removable (for MIL-DTL-24308,MIL-DTL-38999 Series I, II, III, and IV, and MIL-DTL-55302/69 and MIL-DTL-83733 Connectors)

AS39029/75 Contacts, Electrical Connector, Socket, Crimp Removable, Shielded, Size 12 (for MIL-DTL-38999 Series I, III, and IV Connectors)

AS85049/80 Connector Accessories, Electrical, Dummy Contact, Sizes 16, 12 and 8, Category 7 (For MIL-DTL-38999 Connectors)

2.1.2 Government Documents

Available from http://www.navcen.uscg.gov/pdf/gps/ICD-GPS-060B.pdf.

ICD-GPS-060B GPS User Equipment (Phase III) Interface Control Document for the Precise Time and Time Interval (PTTI) Interface. 12 February 2002

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, https://assist.daps.dla.mil/quicksearch/.

MIL-DTL-38999/20G Connectors, Electrical, Circular, Receptacle, Threaded, Wall Mounting Flange, Removable Crimp Contacts, Series III, Metric

MIL-DTL-38999/24J Connectors, Electrical, Circular, Receptacle, Threaded, Jam-Nut Mounting, Removable Crimp Contacts, Series III, Metric

MIL-PRF-29504/4D Termini, Fiber Optic, Connector, Removable, Environment Resisting, Pin Terminus, Size 16, Rear Release, MIL-DTL-38999 Series III

MIL-PRF-29504/5D Termini, Fiber Optic, Connector, Removable, Environment Resisting Socket Terminus, Size 16, Rear Release, MIL-DTL-38999 Series III

MIL-PRF-39012E Connectors, Coaxial, Radio Frequency, General Specifications for

MIL-STD-464 Electromagnetic Environmental Effects, Reguirements for Systems (01 DEC 2010)

MIL-STD-704F Aircraft Electrical Power Characteristics

MIL-STD-810G Environmental Engineering Considerration and Laboratory Tests

MIL-STD-1560B Insert Arrangements for MIL-DTL-38999 Electrical Circular Connectors

MS27488 Plug, End Seal, Electrical Connector

2.1.3 Industry Documents

SMPTE ST 292-1:2011 1.5 Gb/s Signal/Data Serial Interface

SMPTE ST 297:2006 Television-Serial Digital Fiber Transmission System for SMPTE 259, SMPTE 344, SMPTE 292 and SMPTE 424 Signals

SMPTE ST 424:2006 Television-3 Gb/s - Signal/Data Serial Interface

TIA/EIA RS-422 TIA(Telecommunications Industry Association)-422 Electrical Characteristics of Balanced Voltage Differential Interface Circuits

IEEE 802.3-2008 IEEE Standard for Information technology
Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

ISO/IEC 11801:2002 International Standard: Information technology - Generic cabling for customer premises

ICD-GPS-060B GPS User Equipment (Phase III) Interface Control Document for the Precise Time and Time Interval (PTTI) Interface. 12 February 2002

2.2 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.3 Definitions

COMMAND, STATUS, AND RESPONSE INTERFACE - Defines the data elements and message sets passed between the host platform and the sensor used to control the operation of the sensor. The protocol for passing these messages is handled in co-ordination with the groups which specify the messages. The following types of information are passed through the Command, Status, and Response interface:

a. COMMANDS - The set of all digital instructions transmitted to the EO/IR Sensor from the controller which directs its operation. These instructions come from an operator, from the platform, or from a pre-programmed set of instructions. These Commands instruct the EO/IR sensor where to point, and which features to utilize in gathering images, such as: slew left; turn on stabilization; lock onto a geo-location; change magnification to X; display black as hot versus white hot; turn on image fusion; etc.

b. STATUS - Digital information returned from the EO/IR sensor back to the operator, platform, or recorder which provides feedback of sensor operation and other indications of its condition. Examples of this information include: magnification level, azimuth and elevation, stabilization setting, output scale setting for thermal imaging sensors, heading, etc. Another example is the Built-In Test information which might occur periodically, in response to a command, or only if a fault or warning is detected. Status information can overlap with metadata.

c. RESPONSES: Digital information returned from the EO/IR sensor back to the operator, platform, in reply or reaction to a command. Responses are a sub-set of Status. For example, if the command is to turn on stabilization, the response is “stabilization is on”.

ELECTRONIC CONTROL UNIT (ECU) - An electronic unit logically between the platform and the sensor, typically inside the platform, which is part of the sensor system.

EO/IR SENSOR - A sensor which generates images based on a specific region of the electromagnetic spectrum: ultraviolet, near-infrared, short-wave infrared, medium-wave infrared and/or long-wave infrared. It can be either the imager itself (e.g., a night vision camera) or a turret (gimbal) or pod which includes the imager.

EO/IR SENSOR POD - An aerodynamically shaped fixed housing containing an EO/IR Sensor external to the aircraft body typically mounted on a pylon.

EO/IR SENSOR TURRET - A motorized gimbaled mount for one or more EO/IR Sensors permitting rotation about one or more axes. This rotation allows the turret to be pointed relatively independent of the platform on which it is mounted.

IMAGE - "An optical counterpart or appearance of an object, as is produced by reflection from a mirror, refraction by a lens, or the passage of luminous rays through a small aperture and their reception on a surface."[1]

INTERCHANGEABILITY - A condition which exists when two or more items possess such functional and physical characteristics as to be equivalent in performance and durability, and are capable of being exchanged one for the other without alteration of the items themselves, or of adjoining items, except for adjustment, and without selection for fit and performance.[2]

INTEROPERABILITY - The ability of two or more systems or components to exchange information and to use the information that has been exchanged.[3]

COMMONALITY - A shared feature or attribute, or a shared set of features or attributes.[4]

[1] http://dictionary.reference.com/browse/image visited 4/1/2011
[2] Federal Standard 1037C, Telecommunications: Glossary of Telecommunication Terms. http://www.its.bldrdoc.gov/fs-1037/fs-1037c.htm Visited on March 22, 2011.
[3] IEEE Glossary
[4] Derived from definition in: the American Heritage® Dictionary of the English Language, Fourth Edition copyright ©2000 by Houghton Mifflin Company. Updated in 2009. Published by Houghton Mifflin Company. All rights reserved.

LASER FIRE ANNUNCIATION - A confirmational signal indicating that the laser has fired.

METADATA - Data about data. Imagery Metadata in this standard is the information about image(s). Examples include:

- the time the image was generated;
- the location of and information about the platform (e.g., latitude, longitude, altitude, pitch, roll, and heading of the platform);
- information about the sensor (e.g., azimuth and elevation of the gimbal, the zoom level);
- information about the target at the time the image(s) were taken (e.g., latitude and longitude);
- metadata can be incorporated into the image file and/or be sent in parallel.

MOTION IMAGERY - Multiple images of the same location or target taken close enough in time to show movement, typically one frame per second or faster.

TRANSPORT - A mechanism to move, carry, convey, or transfer data and/or electrical/optical signals from one place to another.

TURRET DIAMETER: The diameter of the turreted EO/IR sensor is defined as the best fit circle between the outer edges of the yoke containing the elevation bearings.

VIDEO - A type of Motion Imagery, typically at 30 frames per second, and typically capable of being displayed on televisions.

2.4 Acronyms

See Table 1 for a list of acronyms and their definitions.

TABLE 1 - ACRONYMS

ANSI	American National Standards Institute
ARINC	Aeronautical Radio, Incorporated
AS	Aerospace Standard
ASI	Aircraft Sensor Interface
AWG	American Wire Gauge
ECU	Electronic Control Unit
ECUI	Electronic Control Unit Interface
ECUSI	Electronic Control Unit Sensor Interface
EIA	Electronic Industry Alliance
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EO/IR	Electro Optic/Infrared
GigE	Gigabit Ethernet
GPS	Global Positioning System
HMI	Human Machine Interface
IEEE	Institute of Electrical and Electronics Engineers
INCITS	International Committee for Information Technology Standards
I/O	Input/Output
LRU	Line Replaceable Unit
NFZ	No Fire Zone
PSI	Platform Sensor Interface
PPS	Pulse Per Second
RTN	Return
SDTV	Standard Definition Television
SI	Sensor Interface
SMPTE	Society of Motion Picture and Television Engineers
SSR	Solid State Relay
STP	Shielded Twisted Pair
TBD	To Be Determined/To Be Defined
TIA	Telecommunications Industry Association
TNC	Threaded Neill Concelman
UAS	Unmanned Aircraft Systems
UTP	Unshielded Twisted Pair
VAC	Volts Alternating Current
VDC	Volts Direct Current
WDM	Wavelength Division Multiplexing

3. GENERAL REQUIREMENTS: INTERFACE CONFIGURATIONS

3.1 Platform/Sensor Configurations

AS6129 can support a variety of platforms to sensor interfacing configurations, as depicted in Figures 2a, 2b, 3a, and 3b. Figures 2a and 3a show the case where there is an Electronics Control Unit (ECU), while Figures 2b and 3b show the case where there is no ECU. Figures 2a and 2b show a configuration without an on-board hand-controller, while Figures 3a and 3b show a configuration with an on-board hand-controller. The interface between the host platform processor(s) and the sensor is called the Platform Sensor Interface (PSI). If the sensor has an ECU, then the PSI shall be located at the ECU. If the sensor does not have an ECU, then the PSI shall be located at the sensor. Either way, the PSI has been standardized to be identical. If the sensor has an ECU, then the ECU to Sensor Interface (ECUSI) shall be considered part of the sensor system; AS6129 is NOT standardizing the ECUSI. AS6129 shall be applied at the PSI. Both the platform and the sensor shall comply with AS6129 at the PSI. Unless otherwise specified all requirements shall apply to both the platform and the sensor.

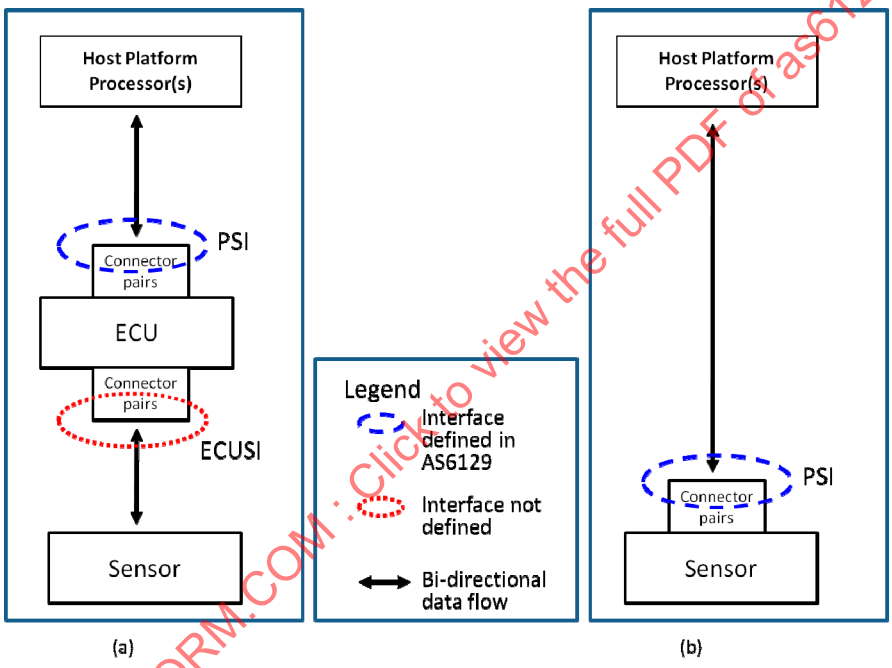

FIGURE 2 (a AND b) - CONCEPTUAL PLATFORM/SENSOR INTERFACE CONFIGURATIONS

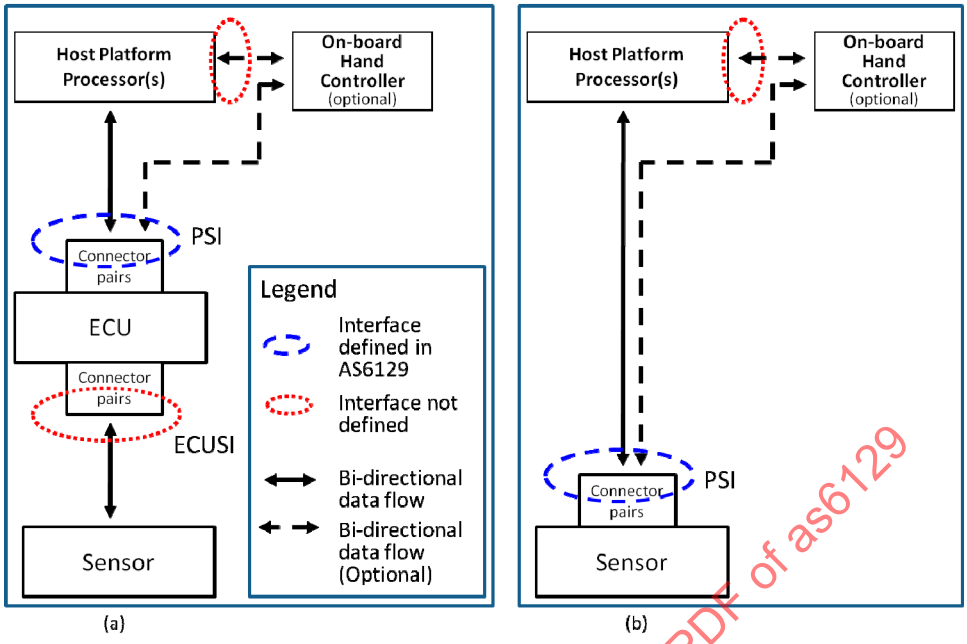

FIGURE 3 (a AND b) - LOCATIONS OF INTERFACES ASSUMING A HAND-CONTROLLER

3.2 Classes

Various EO/IR classes are defined in Table 2 based on the diameter of a given sensor package. This standard was developed to address the majority of sensor package sizes available on the market.

TABLE 2 - SIZES FOR VARIOUS CLASSES

Class	Sensor Package Diameter
Class I	>19 in
Class II	13 to 19 in
Class III	9 to 13 in
Class IV	6 to 9 in

While the classes are designed to address the majority of sensor packages, the defined class structure does not address all applications. Interfaces for a turret shall conform to the appropriate paragraph under 4.1 based on the class of the turret as defined in Table 2.

4. DETAILED REQUIREMENTS

4.1 Connector Characteristics

For Naval Aviation, only connectors which can withstand a minimum of 500 h salt spray per MIL-STD-1344 Method 1001, Test Method for Electrical Connectors shall be used.

There are four turret classes. A listing of various connectors for each class including function and sizes are detailed in Table 3.

TABLE 3 - CONNECTOR TYPE AND SIZE FOR VARIOUS TURRET CLASSES

	Connector	Type	Shell Size	Keying	Shell Insert
Turret Class I and Turret Class II	J1 - Power	MIL-DTL-38999/ Series III	21	N	21-11
	J2 - Signal	MIL-DTL-38999/ Series III	25	N	25-7
	J3 - Video (Copper)	MIL-DTL-38999/ Series III	17	N	17-8
	J4- Fiber Optics	MIL-DTL-38999/ Series III	19	N	19-11
	J5 - GPS	MIL-PRF-39012	-		TNC
	J6-Auxiliary Power	MIL-DTL-38999/ Series III	21	A	21-11
Turret Class III	J1 - Power	MIL-DTL-38999/ Series III	19	N	19-11
	J2 - Signal	MIL-DTL-38999/ Series III	19	A	19-35
	J3 - Video (Copper)	MIL-DTL-38999/ Series III	17	N	17-8
	J4- Fiber Optic	MIL-DTL-38999/ Series III	13	N	13-4
	J5 - GPS	MIL-PRF-39012	-	-	TNC
Turret Class IV	J1 - Power	MIL-DTL-38999/ Series I	13	N	13-98
	J2 - Signal	MIL-DTL-38999/ Series I	13	N	13-35
	J3 - Video (Copper)	MIL-DTL-38999/ Series I	13	N	13-4
	J4 - Fiber Optic	MIL-DTL-38999/ Series I	13	A	13-4
	J5 - Additional Signals	MIL-DTL-38999/ Series I	11	N	11-35
	J6 - GPS	MIL-PRF-39012	-		TNC

In general, the standard respects the convention that signal sinks are placed on male contacts and sources on female contacts. In the case where sinks and sources are mixed (i.e., J2 - Signal), the EO/IR system is assigned female contacts. The reason is that male contacts are at greater risk of damage, and platform cable connectors often can be repaired in-situ, whereas an EO/IR system cannot.

In general, all connectors are being specified from the same point of view as the connector manufacturers (i.e., looking at the face of the connector). In addition, connectors are specified from the sensor side of all mating pairs.

For the purposes of this standard, photonic (i.e., fiber optic) interfaces are discussed in conjunction with electrical interfaces.

For any pin or contact on a connector which is reserved, unused, or unallocated the following procedure shall be used:

Spare Contacts

When crimp contact connectors are used, the unused contacts shall be installed in unused cavities. MS27488 or applicable sealing plugs shall be inserted in unused grommet holes of environment resistant connectors. Sealing plugs shall not be installed where they interfere with the free movement of the spring loaded socket termini on connectors containing fiber optic termini. For potted connectors, each spare contact shall have a pigtail attached, consisting of a wire of the largest size that can be accommodated by the contact and extends 5 to 7 in beyond the potting material. The pigtails shall be identified and dead-ended. In firewall applications there shall be no spare contacts. All unused contact cavities shall be wired. Stub wires shall be capped with polytetrafluoroethylene insulated dead-end cap. M85049/80-XX Shielded, Coaxial and Twinax dummy contacts shall be installed in designated unused pin contact cavities in the unpressurized areas (except firewall).

Electrical connectors that contain fiber optic termini shall have empty cavities filled with either spare electrical contacts or dummy termini unless they interfere with the configuration of the mating connector. Connectors with fiber optic pin termini, whose mating connector have the alignment sleeves built-in, must use special contacts with shorter pins to preclude damage to the mating termini.

4.1.1 Turret Class I - II Interface Connectors

The electrical interface for Turret Class I and Turret Class II is partitioned into the following connector types: Power (J1), Signal (J2), Video (Copper) (J3), Fiber Optic (J4), GPS antenna (J5) and Auxiliary Power (J6). More information about each of these connectors is listed in Table 4.

TABLE 4 - TURRET CLASS I AND TURRET CLASS II CONNECTORS

	J1 Power	J6-(Class I Only) Aux Power	J2 Signal	J3 Video (Copper)	J4 Fiber Optic	J5 GPS Antenna
Type	MIL-DTL-38999/ Series III	MIL-DTL-38999/ Series III	MIL-DTL-38999/ Series III	MIL-DTL-38999/ Series III	MIL-DTL-38999/ Series III	MIL-PRF-39012
Shell Size	21	21	25	17	19	TNC
Sensor LRU Gender	Receptacle with pin inserts	Receptacle with pin inserts	Receptacle with socket inserts	Receptacle with socket inserts	Receptacle with socket inserts for Fiber Optics	Receptacle
Platform Umbilical Gender	Plug with socket inserts	Plug with socket inserts	Plug with pin inserts	Plug with pin inserts	Plug with pin inserts for Fiber Optics	Plug
Keying	N	A	N	N	N	-
Insert	21-11	21-11	25-7	17-8	19-11	-

Connector specifications shall be as listed in Table 4. The insert descriptors shall be in accordance with MIL-STD-1560B. The connectors used shall be MIL-DTL-38999/series III and gender shall be in accordance with Table 4.

The databus has been assigned to the J2 Signal connector, with an alternate databus connection on the fiber optic (J4) connector. This allows for a great deal of connection flexibility, that is, copper databus with fiber video, or fiber databus and video.

If various connectors are made optional, the possible number of configuration combinations would become unmanageable and would stifle attempts to achieve interoperability. Therefore, for Class I the platform shall implement, and the sensor shall be compatible with, one of the following configurations in Tables 5 and 6. Examples are shown in Table 7.

TABLE 5 - CLASS I CONFIGURATION CONTROL

Connector	Signal Group	Configuration 1	Configuration 2	Configuration 3	Configuration 4
J1	28 VDC Power channel 1	x	x	x	x
	28 VDC Power channel 2	x	x	x	x
	28 VDC Laser Power	x	x	x	x
	Safety Ground	x	x	x	x
	Reserved	do not populate			
J2	Power Enable	x	x	x	x
	Ethernet	x	x	x	x
	Serial Comms 1		x	x	x
	Serial Comms 2		x	x	x
	Serial Comms 3				x
	Serial Comms 4				x
	Laser Simple Arming (pins 2, 95)	x	x	x	x
	Laser Advanced Arming Cluster 1				x
	Laser Advanced Arming Cluster 2				x
	Safety Status 1 - 3	x	x	x	x
	Enable Gimbal Movement	x	x	x	x
	1 PPS	configured independently (see below)			
	Manufacturer 1 - 5	Not populated by platform			
	Manufacturer 6-10	Not populated by platform			
J3	Video ch 1	No J3	x	No J3	x
	Video ch 2		x		x
	Video ch 3		x		x
	Video ch 4		x		x
	Video ch 5				x
	Video ch 6				x
	Video ch 7				x
	Video ch 8				x
J4	Video ch 1	No J4	No J4	x	x
	Video ch 2			x	x
	Video ch 3			x	x
	Video ch 4			x	x
	Video ch 5				x
	Video ch 6				x
	Video ch 7				x
	Ethernet 1			x	x
	Ethernet 2				x
J5	GPS Antenna	configured independently, possibly no J5 (see below)			
J6	Aux Power	configured independently (see below)			
x = Required. " " (blank) = do not include.					

For platforms, in addition to the four configurations shown in Table 5, there are some options, such as the type of time synchronization shown in Table 6. Table 6 also shows the naming conventions for these options.

TABLE 6 - CLASS I OPTIONS AND THEIR NAMING CONVENTIONS

Independently Configured item	Configuration tagA	Configuration tagB	Configuration tagC
IEEE-1588 Synchronization	-IPN		
GPS Antenna	-GPS		
1 PPS Synchronization	-PPS		
Connector Location	-SID	-TOP	-ECU
Auxiliary Power	-AUX		
Naval Applications	-MAR		

Some examples of the use of the naming conventions are shown in Table 7.

TABLE 7 - CLASS I CONFIGURATION NAMING EXAMPLES

Configuration Number	1588 Time Sync	GPS Antenna	1 PPS Time Sync	Connector Location	Aux	Name
1	Yes	No	No	Side	No	**Class I Configuration-1-IPN-SID**
2	Yes	No	Yes	Top	No	**Class I Configuration-2-IPN-PPS-TOP**
4	No	No	Yes	Side	No	**Class I Configuration-4-PPS-SID**
4	Yes	Yes	Yes	Side	No	**Class I Configuration-4-IPN-GPS-PPS-SID**
4	No	Yes	Yes	ECU	Yes	**Class I Configuration-4-GPS-PPS-ECU-AUX**

As explained for Class I, if various connectors are made optional, the possible number of configuration combinations would become unmanageable and would stifle attempts to achieve interoperability. Therefore, for Class II the platform shall implement, and the sensor shall be compatible with one of the following configurations in Tables 8, 9, and 6. Examples are showin in Tables 10 and 7.

TABLE 8 - CLASS II CONFIGURATION CONTROL

Connector	Signal Group	Configuration			
		1	2	3	4
J1	28 VDC Power channel 1	x	x	x	x
	28 VDC Power channel 2	x	x	x	x
	28 VDC Laser Power	x	x	x	x
	Safety Ground	x	x	x	x
	Reserved	do not populate			
J2	Power Enable	x	x	x	x
	Ethernet	x	x	x	x
	Serial Comms 1		x	x	x
	Serial Comms 2		x	x	x
	Serial Comms 3				x
	Serial Comms 4				x
	Laser Simple Arming (pins 2, 5)	x	x	x	x
	Laser Advanced Arming Cluster 1				x
	Laser Advanced Arming Cluster 2				x
	Safety Status 1 - 3	x	x	x	x
	Enable Gimbal Movement	x	x	x	x
	1 PPS	configured independently (see Table 9)			
	Manufacturer 1 - 5	Not populated by platform			
	Manufacturer 6-10	Not populated by platform			
J3	Video ch 1	No J3	x	No J3	x
	Video ch 2		x		x
	Video ch 3		x		x
	Video ch 4		x		x
	Video ch 5				x
	Video ch 6				x
	Video ch 7				x
	Video ch 8				x
J4	Video ch 1	No J4	No J4	x	x
	Video ch 2			x	x
	Video ch 3			x	x
	Video ch 4			x	x
	Video ch 5				x
	Video ch 6				x
	Video ch 7				x
	Ethernet 1			x	x
	Ethernet 2				x
J5	GPS Antenna	configured independently, possibly no J5 (see Table 9)			
x = Required. " " (blank) = do not include.					

For platforms, configurations are identified by number per Table 8, and an indication of the additional options selected such as type of time synchronization per Table 9. Examples are shown in Table 10.

TABLE 9 - CLASS II NAMING CONVENTIONS FOR OPTIONS

Independently Configured Item	Configuration		
	tagA	tagB	tagC
Ieee-1588 Synchronization	-IPN		
GPS Antenna	-GPS		
1 PPS Synchronization	-PPS		
Connector Location	-SID	-TOP	-ECU
Naval Application	-MAR		

TABLE 10 - CLASS II CONFIGURATION NAMING EXAMPLES

Configuration Number	1588 Time Sync	GPS Antenna	1 PPS Time Sync	Connector Location	Aux Power	Naval Application	Name
1	Yes	No	No	Side	Yes	No	**Class II Configuration-1-IPN-SID-AUX**
2	Yes	No	Yes	Top	No	No	**Class II Configuration-2-IPN-PPS-TOP**
4	No	No	Yes	Side	No	Yes	**Class II Configuration-4-PPS-SID-MAR**
4	Yes	Yes	Yes	Side	No	No	**Class II Configuration-4-IPN-GPS-PPS-SID**
4	No	Yes	Yes	ECU	No	No	**Class II Configuration-4-GPS-PPS-ECU**

4.1.1.1 Turret Class I and Turret Class II, J1 Power Connector

For Turret Class I and Turret Class II, physical arrangement of pins for the J1 Power connector shall have a 21-11 insert pattern which is depicted in Figure 4. Signals for the Turret Class I and Turret Class II, J1 power connector shall be assigned to pins in accordance with Table 11.

NOTE: The contacts for laser power have been specifically placed such that neither pin is adjacent to one with a standing voltage for safety reasons.

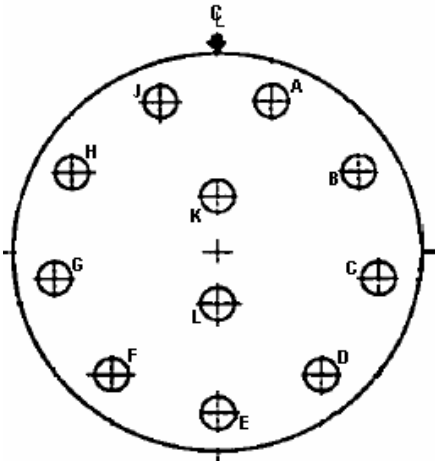

FIGURE 4 - TURRET CLASS I AND TURRET CLASS II, J1 POWER CONNECTOR PIN ARRANGEMENT

TABLE 11 - TURRET CLASS I AND TURRET CLASS II, J1 POWER CONNECTOR PIN ALLOCATION

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
28 VDC Power Channel 1	DC-1	DC Power	Platform	D	AWG 12 (UTP with E)
	DC-1 RTN	DC Power Return	Platform	E	AWG 12 (UTP with D)
28 VDC Power Channel 2	DC-2	DC Power	Platform	F	AWG 12 (UTP with L)
	DC-2 RTN	DC Power Return	Platform	L	AWG 12 (UTP with F)
28 VDC Power Channel 3	DC-3	DC Power	Platform	C	AWG 12 (UTP with G)
	DC-3 RTN	DC Power Return	Platform	G	AWG 12 (UTP with C)
Safety Ground	Chassis	Ground	Common	K	AWG 12
28 VDC Laser Power	PWRL	DC Power	Platform	A	AWG 12 (UTP with J)
	PWRL_RTN	DC Power Return	Platform	J	AWG 12 (UTP with A)
Unused	-	-	-	B, H	-
Contacts which are reserved, unused, or unallocated shall be populated by a dummy plug.					

Each signal group is described in more detail below.

4.1.1.1.1 Power

The platform shall provide to the sensor system three channels of 28 VDC power sources in accordance with MIL-STD-704F. Each of the three channels of 28 VDC shall be independently controlled.

The platform shall be capable of supplying 15 amps steady state per each 28 VDC channel. Inrush current shall be limited to 25 amps for 2 s with a 25% duty cycle.

The sensor shall isolate power returns or neutral in accordance with MIL-STD-704F from the chassis.

4.1.1.1.2 Safety Ground

This contact shall be used to provide electrical continuity between the sensor system chassis and the host platform in accordance with MIL-STD-464.

4.1.1.1.3 Laser Power

The platform shall provide 28 VDC power for the laser in accordance with MIL-STD-704F. The laser power contacts shall be used to separately power a laser device. This is intended for use with a safety-relevant device such as a laser designator.

The platform shall be capable of supplying 15 amps steady state for laser power. Inrush current shall be limited to 25 amps for 2 s with a 25% duty cycle.

4.1.1.2 Turret Class I, J6 Auxiliary Power Connector

For Turret Class I, physical arrangement of pins for the J6 Auxillary Power connector shall have a 21-11 insert pattern. Signals for the Turret Class I, J6 Auxilliary power connector shall be assigned to pins in accordance with Table 12.

This auxillary connector is used to provide additional power to turrets that require more power.

TABLE 12 - TURRET CLASS I J6 AUXILIARY POWER CONNECTOR PIN ALLOCATION

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
28 VDC Power Channel 5	DC-5	DC Power	Platform	D	AWG 12 (UTP with E)
	DC-5 RTN	DC Power Return	Platform	E	AWG 12 (UTP with D)
28 VDC Power Channel 6	DC-6	DC Power	Platform	F	AWG 12 (UTP with L)
	DC-6 RTN	DC Power Return	Platform	L	AWG 12 (UTP with F)
28 VDC Power Channel 7	DC-7	DC Power	Platform	C	AWG 12 (UTP with G)
	DC-7 RTN	DC Power Return	Platform	G	AWG 12 (UTP with C)
Safety Ground	Chassis	Ground	Common	K	AWG 12
28 VDC Power Channel 8	DC-8	DC Power	Platform	A	AWG 12 (UTP with J)
	DC-8 RTN	DC Power Return	Platform	J	AWG 12 (UTP with A)
28 VDC Power Channel 9	DC-9	DC Power	Platform	B	AWG 12 (UTP with H)
	DC-9 RTN	DC Power Return	Platform	H	AWG 12 (UTP with B)
Contacts which are reserved, unused, or unallocated shall be populated by a dummy plug.					

Each signal group is described in more detail below.

4.1.1.2.1 Power

The platform shall provide four channels of 28 VDC to the sensor system in accordance with MIL-STD-704F. Each of the channels of 28 VDC shall be independently controlled.

The platform shall be capable of supplying 15 amps steady state per each 28 VDC channel. Inrush current shall be limited to 25 amps for 2 s with a 25% duty cycle. The sensor shall isolate power returns or neutral in accordance with MIL-STD-704F from the chassis.

4.1.1.2.2 Safety Ground

This contact shall be used to provide electrical continuity between the sensor system chassis and the host platform in accordance with MIL-STD-464.

4.1.1.3 Turret Class I and Turret Class II, J2 Signal Connector

For Turret Class I and Turret Class II, the J2 contact pattern shall be 25-7 as shown in Figure 5.

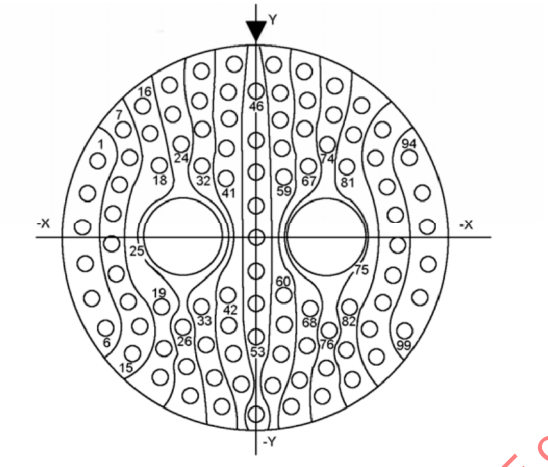

FIGURE 5 - TURRET CLASS I AND TURRET CLASS II, J2 SIGNAL INSERT PIN ARRANGEMENT

Signals shall be assigned to pins in accordance with Table 13.

NOTE: Contacts 25 and 75 are to be defined at a later date, as they are intended to be reserved for quadrax when quadrax has a standardized contact.

TABLE 13 - TURRET CLASS I AND TURRET CLASS II, J2 SIGNAL CONNECTOR PIN ALLOCATION

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
Power Enable (Discrete)	PWR_EN	open / closed circuit	Sensor	46	AWG 22 UTP w/47
	PWR_EN_RTN	open / closed circuit return	Platform	47	AWG 22 UTP w/46
Ethernet	BI_DA+	1000BaseT	Common	28	AWG 24 100Ω STP w/35
	BI_DA-	1000BaseT	Common	35	AWG 24 100Ω STP w/28
	BI_DA_SHLD		Common	36	Shield
	BI_DB+	1000BaseT	Common	44	AWG 24 100Ω STP w/53
	BI_DB-	1000BaseT	Common	53	AWG 24 100Ω STP w/44
	BI_DB_SHLD		Common	62	Shield
	BI_DC+	1000BaseT	Common	45	AWG 24 100Ω STP w/54
	BI_DC-	1000BaseT	Common	54	AWG 24 100Ω STP w/45
	BI_DC_SHLD		Common	63	Shield
	BI_DD+	1000BaseT	Common	70	AWG 24 100Ω STP w/71
	BI_DD-	1000BaseT	Common	71	AWG 24 100Ω STP w/70
	BI_DD_SHLD		Common	78	Shield
Serial Communications 1	TX1+	RS-422	Sensor	7	AWG 24 STP w/8
	TX1-	RS-422	Sensor	8	AWG 24 STP w/7
	422_1_RTN	RS-422	Common	17	AWG 24
	RX1+	RS-422	Platform	16	AWG 24 STP w/23
	RX1-	RS-422	Platform	23	AWG 24 STP w/16
Serial Communications 2	TX2+	RS-422	Sensor	22	AWG 24 STP w/30
	TX2-	RS-422	Sensor	30	AWG 24 STP w/22
	422_2_RTN	RS-422	Common	29	AWG 24
	RX2+	RS-422	Platform	37	AWG 24 STP w/38
	RX2-	RS-422	Platform	38	AWG 24 STP w/37
Serial Communications 3	TX3+	RS-422	Sensor	55	AWG 24 STP w/56
	TX3-	RS-422	Sensor	56	AWG 24 STP w/55
	422_3_RTN	RS-422	Common	64	AWG 24
	RX3+	RS-422	Platform	65	AWG 24 STP w/72
	RX3-	RS-422	Platform	72	AWG 24 STP w/65
Serial Communications 4	TX4+	RS-422	Sensor	73	AWG 24 STP w/79
	TX4-	RS-422	Sensor	79	AWG 24 STP w/73
	422_4_RTN	RS-422	Common	80	AWG 24
	RX4+	RS-422	Platform	85	AWG 24 STP w/86
	RX4-	RS-422	Platform	86	AWG 24 STP w/85
Laser Arming and Cutouts (Discretes)	MASTER_ARM	open/closed circuit (28 V)	Platform	2	AWG 22
	MASTER_ARM_RTN	open/closed circuit (28 V)	Platform	95	AWG 22
	NFZ_SELECT_BIT 0	open/closed circuit	Platform	4	AWG 24
	NFZ_SELECT_BIT 1	open/closed circuit	Platform	5	AWG 24
	NFZ_SELECT_PARITY	open/closed circuit	Platform	11	AWG 24
	NFZ_SELECT_RTN	open/closed circuit (return)	Platform	12	AWG 24
	MODE_SELECT_ BIT 0	28 V logic	Platform	89	AWG 24
	MODE_SELECT_ BIT 1	28 V logic	Platform	90	AWG 24
	MODE_SELECT_ PARITY	28 V logic	Platform	97	AWG 24
	MODE_SELECT_ RTN	28 V logic (return)	Platform	98	AWG 24
Laser Fire Annunciation (Discrete)	LF+	Isolated 28 V Logic	Sensor	20	AWG 24 UTP w/21
	LF-	Isolated 28 V Logic	Sensor	21	AWG 24 UTP w/20
Safety Status (Discretes)	SS1+	Isolated 28 V logic	Sensor	15	AWG 24 UTP w/19
	SS1-	Isolated 28 V logic	Sensor	19	AWG 24 UTP w/15
	SS2+	Isolated 28 V logic	Sensor	42	AWG 24 UTP w/60
	SS2-	Isolated 28 V logic	Sensor	60	AWG 24 UTP w/42
	SS3+	Isolated 28 V logic	Sensor	82	AWG 24 UTP w/93
	SS3-	Isolated 28 V logic	Sensor	93	AWG 24 UTP w/82
Enable Gimbal Movement (Discrete)	ENBL_GIMB	open/closed circuit (28 V)	Platform	51	AWG 22
	ENBL_GIMB_RTN	open/closed circuit (28 V)	Platform	52	AWG 22
Time Sync 1 PPS	1 PPS	10 V logic	Platform / Sensor	48	AWG 24 UTP w/49
	1 PPS RTN	10 V logic	Platform / Sensor	49	AWG 24 UTP w/48

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
Hand Controller Power	HAND_CONT_PWR	28 VDC 500 mA maximum	Sensor	68	AWG 22
	HAND_CONT_PWR_RTN	DC Power Return	Platform	69	AWG 22
Sensor Manufacturer	SENMAN_1 to SENMAN_10		Sensor (not populated by platform)	24, 31, 32, 39, 40, 57, 58, 66, 67, 74	AWG 24
Reserved	N/A	N/A	N/A	1, 3, 9, 10, 25, 75, 87, 88, 94, 96	N/A
Unused	N/A	N/A	N/A	6, 14, 18, 26, 27, 33, 34, 41, 43, 50, 59, 61, 76, 77, 81, 83, 84, 91, 92, 99	N/A
Contacts which are reserved, unused, or unallocated shall be populated by a dummy plug.					

Each signal group in Table 13 is described in more detail below. By convention of this standard, individual signal sets will have their own return line. That is done for Electromagnetic Compatibility (EMC) performance, as well as ease of platform integration.

For logic levels, unless otherwise specified, “low” is defined to be safe. A voltage of greater than or equal to 18.0 VDC shall be interpreted as logic level ‘1’. A voltage level of less than or equal to 1.5 VDC shall be interpreted as logic ‘0’.

NOTE: Some acquisition programs may allow a higher voltage levels to also be interpreted as logic '0'. A typical impetus for this would be the result of a system safety analysis. In such a case, it is recommended that the logic '0' threshold not exceed 15.0 VDC.

4.1.1.3.1 Power Enable

The Power Enable signal is used for a controlled power up and shut down of the sensor system. This control is necessary if the sensor system is required to execute a sequence of steps upon shutdown, steps that the sensor system would be precluded from executing if power were simply removed from the system. The Power Enable signal is controlled by the platform and when disabled, instructs the sensor to power down.

Power Enable is a switch, relay, or Solid State Relay (SSR) controlled by the platform (or human on the platform side of the interface). The switch goes across PWR_EN and PWR_EN_RTN. The sensor provides the voltage for this. Power Enable is disabled if an open circuit exists externally between the contacts (i.e., the switch is open). Power Enable is enabled if a closed circuit is externally applied between the contacts.

An open circuit for Power Enable shall have a resistance value greater than or equal to 100k Ω. A closed circuit for Power Enable shall have a resistance value less than 5 Ω. The maximum current shall be 100 mA. The maximum voltage shall be 30 VDC.

4.1.1.3.2 Ethernet Databus (Copper)

Gigabit Ethernet is an 8-wire (4 twisted-pair), 100 Ω connection. The J2 Ethernet databus shall be implemented as Gigabit Ethernet. Gigabit Ethernet shall comply with IEEE 802.3-2008 for a 1000BaseT channel. The maximum cable length is 100 m.

4.1.1.3.3 Serial Communications

Up to four application-configurable serial communication ports are defined. Each port shall be compliant to Telecommunications Industral Association (TIA)/Electronic Industry Alliance (EIA) RS-422. It is expected that the first port will be used for a hand controller. It is expected that the latency of communication on this interface is critical, thus a more complex multilayer protocol interface would not be practical.

These interfaces can also be used for integration with other equipment, such as moving map cueing and display systems.

Note that a separate return line is included with each serial communications port for ease of platform integration.

4.1.1.3.4 Laser Arming and Cutouts

A set of 10 pins dedicated to laser control is available for the arming of non-eyesafe laser devices, and for the selection of pre-defined laser suppression zone maps.

MASTER_ARM and MASTER_ARM_RTN are a pair of pins across a switch, relay, or SSR. In order to arm the laser, the platform closes the switch which completes the circuit. The current which goes through it, and the voltage across it, come from the sensor. The sensor doesn't generate its own voltage; it comes in from the platform via the power connector (for Class I/II, this is the 28 VDC Laser Power). The platform shall provide a switch, relay, or SSR capable of handling 30 VDC with a maximum of 100 mA current.

There are three No Fire Zone (NFZ) circuits. Each is a switch, relay, or SSR provided by, and independently controlled by the platform. The three circuits have a common return (NFZ _SELECT_RTN). The platform shall provide a switch, relay, or SSR capable of handling 30 VDC for each of the three NFZ circuits. The platform shall be capable of independently controlling each of the three NFZ circuits.

There are three mode select signals using 28 VDC logic which are independently controlled by the platform. The three signals have a common return: MODE_SELECT_RTN.

LASER SIMPLE ARMING - These pins form part of the power circuit for a non-eyesafe laser device in the turret. When the pins are open, power to the device is disabled; when close-circuited, power is enabled. The pins allow the integrator to connect a simple arming switch to these contacts. Pins 2 and 95 shall be used for laser Simple Arming.

LASER ADVANCED ARMING CLUSTER 1 - Turreted EO/IR systems have a NFZ, or Cutout Map. It's a 2-dimensional map, in azimuth and elevation, that defines where the laser can and cannot fire. It is designed to inhibit laser firing when the turret's line-of-sight is over any part of the platform. This prevents laser energy from reflecting back, posing a hazard to the aircrew. The map is stored in the turret's computer memory. Further, a turret may have several maps stored, enabling it to be mounted at several points on the platform, or on several platform models, without modification. In this case, a high reliability mechanism is needed to select which map should be used. Pins 4, 5, 11, and 12 shall be used for Laser Advanced Arming Cluster 1.

Assuming that three of the four pins allocated to this function are used to select a map, up to 8 maps can be defined in the turret. The fourth pin would be used as a parity check for safety.

LASER ADVANCED ARMING CLUSTER 2 - These pins can be used in a number of ways. They determine under what conditions or states the laser will be used. For example, if there are multiple non-eyesafe lasers in a turret, these pins could be used to select one or more devices (secondary arm). Pins 89, 90, 97, and 98 shall be used for laser advanced arming Cluster 2.

4.1.1.3.5 Laser Fire

The Laser Fire signal shall be used to annunciate the firing of a non-eyesafe laser. This signal shall be a 28 VDC isolated signal. The maximum voltage shall be 30 VDC with a maximum current of 100 mA.

4.1.1.3.6 Safety Status

A set of three signal pairs is available to indicate the status of safety relevant functions in the EO/IR system. These shall be 28 VDC isolated signals. These signals are controlled by the sensor. The maximum voltage shall be 30 VDC with a maximum current of 100 mA.

4.1.1.3.7 Enable Gimbal Movement

The Enable Gimbal Movement signal shall be used to indicate that the sensor system's outer gimbal motors are to be enabled. This control is necessary to ensure that the turret does not move in azimuth and/or elevation at high speeds endangering individuals that may be working in close proximity to the sensor. The Enable Gimbal Movement signal originates from the sensor with the platform opening and closing the circuit. An open circuit shall indicate that the motors shall not be powered.

NOTE: The maintainer may need to move the gimbal by hand.

4.1.1.3.8 Time Synchronization - 1 PPS

Wiring for a 1 PPS signal for time synchronization shall be provided. This signal shall be in accordance with the input time roll-over pulse (1 PPS) per ICD-GPS-060B. See also Figure 6.

Input pulse
Leading edge is rollover (time being synchronized)
Logical high: 10 +1/-2 Vdc into 50 ohms
Logical low: 0 +2/-1 Vdc into 50 ohms
Rise time: < 50 nanosec from 10% amplitude to 90% amplitude
Fall time: < 1 microsec from 90% amplitude to 10% amplitude
Total pulse time: 20 microsec (+50%, -20%)

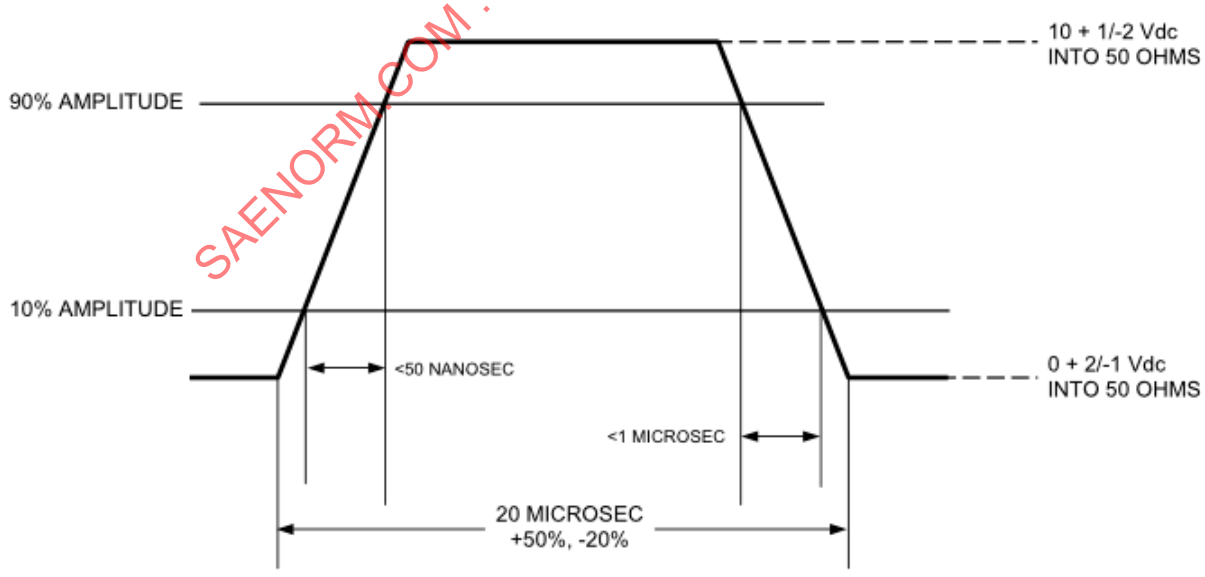

FIGURE 6 - INPUT TIME ROLLOVER PULSE (1 PPS) SIGNAL CHARACTERISTICS

4.1.1.3.9 Hand Controller Power

Power may be provided by the sensor to the hand controller. The maximum voltage shall be 30 VDC with a maximum current of 500 mA.

4.1.1.3.10 Sensor Manufacturer Pins

A set of 10 pins are reserved for use by individual EO/IR sensor system suppliers, primarily for maintenance purposes when the sensor is not connected to the platform. The platform shall not populate these pins.

4.1.1.4 Turret Class I and Turret Class II, J3 Video (Copper) Connector

The video connection consists of two variants, one that is based on copper wire (J3) and shall be video only, and one that is based on fiber optic (J4) for both video and other data signals. This standard does not mix copper and fiber connections on a single connector.

For Turret Class I and Turret Class II the J3 Video connector contact pattern shall be 17-8 as shown in Figure 7. Signals shall be asssigned to pins in accordance with Table 14.

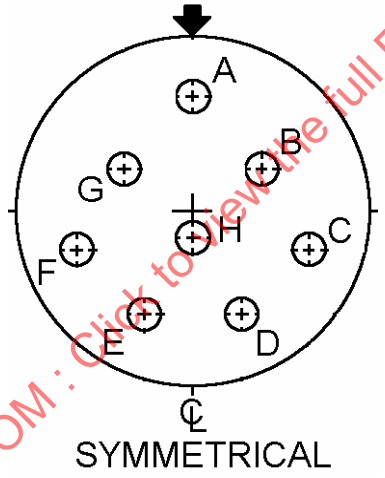

FIGURE 7 - TURRET CLASS I AND TURRET CLASS II, J3 VIDEO (COPPER) CONNECTOR INSERT PIN ARRANGEMENT

TABLE 14 - TURRET CLASS I AND TURRET CLASS II, J3 VIDEO CONNECTOR PIN ALLOCATION

Signal Name	Signal Type	Source	Contact
Video Ch 1	SMPTE292/424M	Sensor	A
Video Ch 2	SMPTE292/424M	Sensor	B
Video Ch 3	SMPTE292/424M	Sensor	C
Video Ch 4	SMPTE292/424M	Sensor	D
Video Ch 5	SMPTE292/424M	Sensor	E
Video Ch 6	SMPTE292/424M	Sensor	F
Video Ch 7	SMPTE292/424M	Sensor	G
Video Ch 8	SMPTE292/424M	Sensor	H

Each channel shall comply with SMPTE292, driving into 75 Ω #16 coaxial cable, per the standard. Video channels can also be SMPTE 424M over the same wiring.

NOTE: This interface has a maximum cable length of approximately 50 ft before significant signal degradation occurs.

The application defines the number of active channels.

4.1.1.5 Turret Class I and Turret Class II, J4 Fiber Optics Connector

Fiber optic shall be multimode fiber. The core diameter shall be 50 µm ± 3 µm and the cladding diameter shall be 125 µm ± 2 µm. The termini shall be butt end MIL-PRF-29504/4 (Pin) or MIL-PRF-29504/5 (Socket) which fit into size 16 entry holes.

Ethernet Channels shall transmit and receive at 850 nm per IEEE 802. 3-2008 for 10GBASE-SR applications.

SMPTE 297 Channels shall transmit low power SMPTE 292 or 424M signals at 1310 nm specifically according to call out L-PC-CD-1310.

Fiber used shall be OM2 compliant or better, as defined by ISO/IEC 11801. It is recommended that for longer path applications that the cable be bend-insensitive OM4.

For Turret Class I and Turret Class II the J4 Fiber Optic Connector contact pattern 19-11 is depicted in Figure 8. Signals shall be assigned to each pin and fiber in accordance with Table 15.

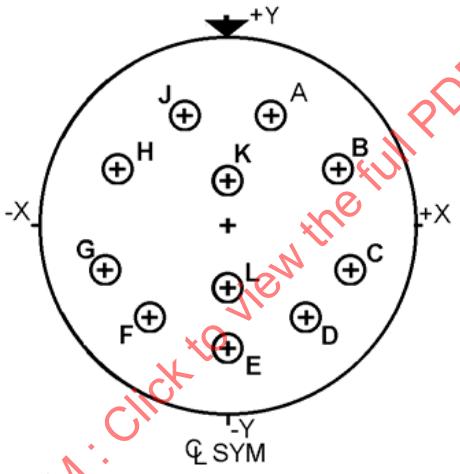

FIGURE 8 - TURRET CLASS I AND TURRET CLASS II, J4 FIBER OPTIC INSERT PIN ARRANGEMENT

TABLE 15 - TURRET CLASS I AND TURRET CLASS II, J4 FIBER OPTIC CONNECTOR PIN ALLOCATION

Signal Name	Signal Type	Source	Contact
Sensor Transmit 1	10GBASE-SR	Sensor	A
Sensor Receive 1	10GBASE-SR	Platform	B
Sensor Transmit 2	10GBASE-SR	Sensor	C
Sensor Receive 2	10GBASE-SR	Platform	D
Video Ch 1	SMPTE 297	Sensor	E
Video Ch 2	SMPTE 297	Sensor	F
Video Ch 3	SMPTE 297	Sensor	G
Video Ch 4	SMPTE 297	Sensor	H
Video Ch 5	SMPTE 297	Sensor	J
Video Ch 6	SMPTE 297	Sensor	K
Video Ch 7	SMPTE 297	Sensor	L

4.1.1.6 Turret Class I and Turret Class II, J5 GPS Antenna

When a GPS receiver internal to the sensor is being used and requires an external antenna, the J5 connector shall be used. These signals shall have characteristics that comply with Appendix A (Additional Interface Requirements for GPS RF Signals) of this standard.

4.1.2 Turret Class III, Interface Connectors

Turret Class III connectors shall be allocated as described in Table 16.

TABLE 16 - TURRET CLASS III CONNECTORS

	J1 Power	J2 Signal	J3 Video (Copper)	J4 Fiber Optic	J5 GPS Antenna
Type	MIL-DTL-38999/III	MIL-DTL-38999/III	MIL-DTL-38999/III	MIL-DTL-38999/III	MIL-PRF-39012
Shell Size	19	19	17	13	TNC-
Sensor LRU Gender	Receptacle with pin inserts	Receptacle with socket inserts	Receptacle with socket inserts	Receptacle with socket inserts	Receptacle
Platform Umbilical Gender	Plug with socket inserts	Plug with pin inserts	Plug with pin inserts	Plug with pin inserts	Plug
Keying	N	A	N	N	-
Insert	19-11	19-35	17-8	13-4	-

If various connectors are made optional the possible number of configuration combinations would become unmanageable and will stifle any attempt toward interoperability. Therefore, for Class III the platform shall implement, and the sensor shall be compatible with, one of the following configurations in Table 17.

TABLE 17 - TURRET CLASS III CONFIGURATION CONTROL

Connector	Signal Group	Configuration 1	2	3	4
J1	28 VDC Power channel 1	x	x	x	x
	28 VDC Power channel 2	x	x	x	x
	28 VDC Laser Power	x	x	x	x
	Safety Ground	x	x	x	x
	Reserved	do not populate			
J2	Power Enable	x	x	x	x
	Ethernet	x	x	x	x
	Serial Comms 1		x	x	x
	Serial Comms 2		x	x	x
	Serial Comms 3				x
	Serial Comms 4				x
	Laser Simple Arming (pins 2, 95)	x	x	x	x
	Laser Advanced Arming Cluster 1				x
	Laser Advanced Arming Cluster 2				x
	Safety Status 1 - 3	x	x	x	x
	Enable Gimbal Movement	x	x	x	x
	1 PPS	configured independently (see below)			
J3	Video ch 1	No J3	x	No J3	x
	Video ch 2		x		x
	Video ch 3		x		x
	Video ch 4		x		x
	Video ch 5				x
	Video ch 6				x
	Video ch 7				x
	Video ch 8				x
J4	Video ch 1	No J4	No J4	x	x
	Video ch 2			x	x
	Ethernet			x	x
J5	GPS Antenna	configured independently, possibly no J5 (see below)			
x = Required. " " (blank) = do not include.					

For platforms, configurations are identified by number per Table 17 and an indication of the additional options selected, such as type of time synchronization, per Table 18. Examples are shown in Table 19.

TABLE 18 - TURRET CLASS III NAMING CONVENTIONS FOR OPTIONS

Independently Configured Item	Configuration		
	tagA	tagB	tagC
IEEE-1588 Synchronization	-IPN		
GPS Antenna	-GPS		
1 PPS Synchronization	-PPS		
Connectors	-SID	-TOP	-ECU
Naval Application	-MAR		

TABLE 19 - TURRET CLASS III CONFIGURATION NAMING EXAMPLES

Configuration Number	1588 Time Sync	GPS Antenna	1 PPS Time Sync	Connector Location	Name
1	Yes	No	No	Side	**Class III Configuration-1-IPN-SID**
2	Yes	No	Yes	Top	**Class III Configuration-2-IPN-PPS-TOP**
4	No	No	Yes	Side	**Class III Configuration-4-PPS-SID**
4	Yes	Yes	Yes	Side	**Class III Configuration-4-IPN-GPS-PPS-SID**
4	No	Yes	Yes	ECU	**Class III Configuration-4-GPS-PPS-ECU**

4.1.2.1 Turret Class III, J1 Power Connector

J1 Connector functions shall be assigned to pins in accordance with Figure 9 and Table 20 for Turret Class III. The connector pattern shall be 19-11. Note that, for safety reasons, the contacts for laser power have been specifically placed such that neither pin is adjacent to one with a standing voltage.

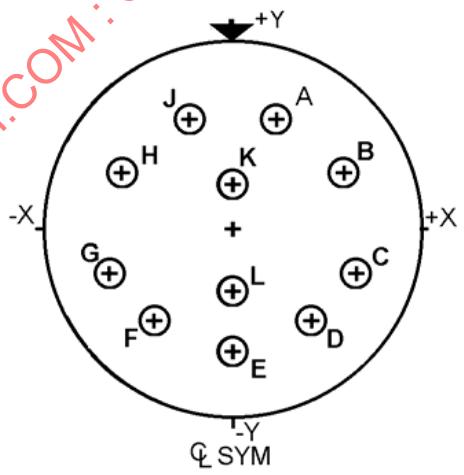

FIGURE 9 - TURRET CLASS III, J1 POWER CONNECTOR PIN ARRANGEMENT

TABLE 20 - TURRET CLASS III, J1 POWER CONNECTOR PIN ALLOCATION

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
Primary DC Power	DC1	DC Power	Platform	D	AWG 16 (UTP with E)
	DC1_RTN	DC Power Return	Platform	E	AWG 16 (UTP with D)
Secondary DC Power	DC2	DC Power	Platform	F	AWG 16 (UTP with L)
	DC2_RTN	DC Power Return	Platform	L	AWG 16 (UTP with F)
Safety Ground	Chassis	Ground	Common	K	AWG 16
Laser Power	PWRL	DC Power	Platform	A	AWG 16 (UTP with J)
	PWRL_RTN	DC Power Return	Platform	J	AWG 16 (UTP with A)
Reserved, do not use	-	-	-	B, H	-
Unused	-	-		C, G	-

Each signal group is described in more detail below.

4.1.2.1.1 Power

The platform shall provide to the sensor system two channels of 28 VDC power sources in accordance with MIL-STD-704F. Each of the two channels of 28 VDC shall be independently controlled.

The platform shall be capable of supplying 10 amps steady state per each 28 VDC channel. Inrush current shall be limited to 14 amps for 2 s with a 25% duty cycle.

The sensor shall isolate power returns or neutral in accordance with MIL-STD-704F from the chassis.

4.1.2.1.2 Safety Ground

This contact shall be used to provide electrical continuity between the sensor system chassis and the host platform in accordance with MIL-STD-464.

4.1.2.1.3 Laser Power

The platform shall be capable of supplying 10 amps steady state of 28 VDC power for the laser in accordance with MIL-STD-704F. Inrush current shall be limited to 14 amps for 2 s with a 25% duty cycle. The laser power contacts shall be used to separately power a laser device. The sensor shall isolate power returns or neutral in accordance with MIL-STD-704F from the chassis.

This is intended for use with a safety-relevant device such as a laser designator.

4.1.2.2 Class III, J2 Signal Connector

For Turret Class III the J2 contact pattern shall be 19-35 as shown in Figure 10.

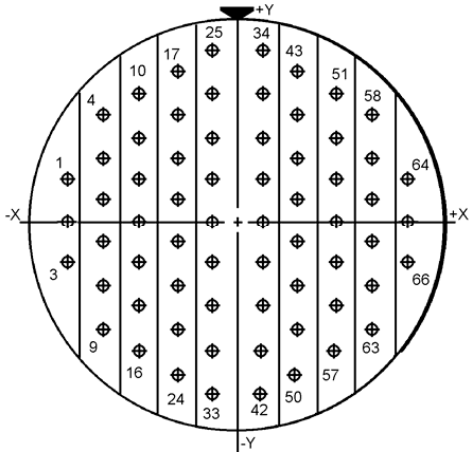

FIGURE 10 - TURRET CLASS III, J2 SIGNAL INSERT PIN ARRANGEMENT

Signals for the Turret Class III, J2 Signal connector shall be assigned to pins in accordance with Table 21.

TABLE 21 - TURRET CLASS III, J2 SIGNAL CONNECTOR PIN ALLOCATION

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
Power Enable (Discrete)	PWR_EN	open / closed circuit	Platform	19	AWG 22 UTP w/27
	PWR_EN_RTN	open / closed circuit	Platform	27	AWG 22 UTP w/19
Ethernet	BI_DA+	1000BaseT	Common	22	AWG 24 100 Ω STP w/23
	BI_DA-	1000BaseT	Common	23	AWG 24 100 Ω STP w/22
	BI_DA_SHLD		Common	31	Shield
	BI_DB+	1000BaseT	Common	32	AWG 24 100 Ω STP w/33
	BI_DB-	1000BaseT	Common	33	AWG 24 100 Ω STP w/32
	BI_DB_SHLD		Common	24	Shield
	BI_DC+	1000BaseT	Common	48	AWG 24 100 Ω STP w/49
	BI_DC-	1000BaseT	Common	49	AWG 24 100 Ω STP w/48
	BI_DC_SHLD		Common	40	Shield
	BI_DD+	1000BaseT	Common	41	AWG 24 100 Ω STP w/42
	BI_DD-	1000BaseT	Common	42	AWG 24 100 Ω STP w/41
	BI_DD_SHLD		Common	50	Shield
Serial Communications 1	TX1+	RS-422	Sensor	8	AWG 24 STP w/14
	TX1-	RS-422	Sensor	14	AWG 24 STP w/8
	422_1_RTN	RS-422	Common	15	AWG 24
	RX1+	RS-422	Platform	9	AWG 24 STP w/16
	RX1-	RS-422	Platform	16	AWG 24 STP w/9
Serial Communications 2	TX2+	RS-422	Sensor	20	AWG 24 STP w/28
	TX2-	RS-422	Sensor	28	AWG 24 STP w/20
	422_2_RTN	RS-422	Common	29	AWG 24
	RX2+	RS-422	Platform	21	AWG 24 STP w/30
	RX2-	RS-422	Platform	30	AWG 24 STP w/21

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
Serial Communications 3	TX3+	RS-422	Sensor	37	AWG 24 STP w/46
	TX3-	RS-422	Sensor	46	AWG 24 STP w/37
	422_3_RTN	RS-422	Common	38	AWG 24
	RX3+	RS-422	Platform	47	AWG 24 STP w/39
	RX3-	RS-422	Platform	39	AWG 24 STP w/47
Serial Communications 4	TX4+	RS-422	Sensor	55	AWG 24 STP w/62
	TX4-	RS-422	Sensor	62	AWG 24 STP w/55
	422_4_RTN	RS-422	Common	56	AWG 24
	RX4+	RS-422	Platform	57	AWG 24 STP w/63
	RX4-	RS-422	Platform	63	AWG 24 STP w/57
Laser Arming and Cutouts (Discretes)	MASTER_ARM	open/closed circuit (28 V)	Platform	2	AWG 22
	MASTER_ARM_RTN	open/closed circuit (28 V)	Platform	5	AWG 22
	NFZ_SELECT_BIT 0	open/closed circuit	Platform	11	AWG 24
	NFZ_SELECT_BIT 1	open/closed circuit	Platform	12	AWG 24
	NFZ_SELECT_PARITY	open/closed circuit	Platform	13	AWG 24
	NFZ_SELECT_RTN	open/closed circuit (return)	Platform	52	AWG 24
	MODE_SELECT_ BIT 0	28 V logic	Platform	53	AWG 24
	MODE_SELECT_ BIT 1	28 V logic	Platform	54	AWG 24
	MODE_SELECT_ PARITY	28 V logic	Platform	59	AWG 24
	MODE_SELECT_ RTN	28 V logic (return)	Platform	65	AWG 24
Laser Fire Annunciation (Discrete)	LF+	Isolated 28 V logic	Sensor	51	AWG 24 UTP w/58
	LF-	Isolated 28 V logic	Sensor	58	AWG 24 UTP w/51
Safety Status (Discretes)	SS1+	Isolated 28 V logic	Sensor	4	AWG 24 UTP w/10
	SS1-	Isolated 28 V logic	Sensor	10	AWG 24 UTP w/4
	SS2+	Isolated 28 V logic	Sensor	17	AWG 24 UTP w/25
	SS2-	Isolated 28 V logic	Sensor	25	AWG 24 UTP w/17
	SS3+	Isolated 28 V logic	Sensor	34	AWG 24 UTP w/43
	SS3-	Isolated 28 V logic	Sensor	43	AWG 24 UTP w/34
Enable Gimbal Movement (Discrete)	LOCK_GIMB	open/closed circuit (28 V)	Platform	60	AWG 22
	LOCK_GIMB_RTN	open/closed circuit (28 V)	Platform	61	AWG 22
Time Synch 1PPS	1_PPS	10 V logic	Platform	36	AWG 24 UTP w/45
	1_PPS_RTN	10 V logic	Platform	45	AWG 24 UTP w/36
Hand Controller Power	HAND_CONT_PWR	28 VDC 500 mA maximum	Sensor	36	AWG 22
	HAND_CONT_PWR_Return	DC Power Return	Sensor	37	AWG 22
Reserved	N/A	N/A	N/A	1, 3, 6, 7, 64, 66	N/A
NOTE: Some of the reserved pins are reserved in order to buffer the Master Arm pins **Contacts which are reserved, unused, or unallocated shall be populated by a dummy plug.**					

By convention of this standard, individual signal sets will have their own return line. That is done for EMC performance, as well as ease of platform integration. For logic levels, unless otherwise specified, “low” is defined to be safe. A voltage of greater than or equal to 18.0 VDC shall be interpreted as logic level ‘1’. A voltage level of less than or equal to 1.5 VDC shall be interpreted as logic ‘0’.

NOTE: Some acquistion programs, may allow a higher voltage levels to also be interpreted as logic '0'. A typical impetus for this would be the result of a system safety analysis. In such a case, it is recommended that the logic '0' threshold not exceed 15.0 VDC.

4.1.2.2.1 Power Enable

The Power Enable signal is used for a controlled power up and shut down of the sensor system. This control is necessary if the sensor system is required to execute a sequence of steps upon shutdown, steps that the sensor system would be precluded from executing if power were simply removed from the system. The Power Enable signal comes from the platform and instructs the sensor to power down.

Power Enable is a switch, relay, or SSR controlled by the platform (or human on the platform side of the interface). The switch goes across PWR_EN and PWR_EN_RTN. The sensor provides the voltage for this. Power Enable is enabled is disabled if an open circuit exists externally between the contacts (i.e., the switch is open). Power Enable is enabled if a closed circuit is externally applied between the contacts.

An open circuit for Power Enable shall have a resistance value greater than 100k Ω. A closed circuit for Power Enable shall have a resistance value less than 5 Ω. The maximum current shall be 100 mA. The maximum voltage shall be 30 VDC.

4.1.2.2.2 Ethernet Databus (Copper)

Gigabit Ethernet is an 8-wire (4 twisted-pair), 100 Ω connection. The J2 Ethernet databus shall be implemented as Gigabit Ethernet. Gigabit Ethernet shall comply with IEEE 802.3-2008 for a 1000BaseT channel. The maximum cable length is 100 m.

4.1.2.2.3 Serial Communications

Up to four application-configurable serial communication ports are defined. Each port shall be compliant to Telecommunications Industry Association (TIA)/Electronic Industry Alliance (EIA) RS-422. It is expected that the first port will be used for a handcontroller. It's expected that the latency of communication on this interface is critical, thus a more complex multi-layer protocol interface would not be practical.

These interfaces can also be used for integration with other equipment, such as Moving Map cueing and display systems.

Note that a separate return line is included with each serial communications port for ease of platform integration.

4.1.2.2.4 Laser Arming and Cutouts

A set of 10 pins dedicated to laser control is available for the arming of non-eyesafe laser devices, and for the selection of pre-defined laser suppression zone maps.

MASTER_ARM and MASTER_ARM_RTN are a pair of pins across a switch, relay, or SSR. In order to arm the laser, the platform closes the switch which completes the circuit. The current which goes through it, and the voltage across it, come from the sensor. The sensor doesn't generate its own voltage; it comes in from the platform via the power connector (For Class I/II, this is the 28 VDC Laser Power). The platform shall provide a switch, relay, or SSR capable of handling 30 VDC with a maximum current of 100 mA current.

There are three NFZ circuits. Each is a switch, relay, or SSR provided by, and independently controlled by the platform. The three circuits have a common return (NFZ _SELECT_RTN). The platform shall provide a switch, relay, or SSR capable of handling 30 VDC for each of the three NFZ circuits. The platform shall be capable of independently controlling each of the three NFZ circuits.

There are three mode select signals using 28 VDC logic which are independently controlled by the platform. The three signals have a common return: MODE_SELECT_RTN.

LASER SIMPLE ARMING - These pins form part of the power circuit for a non-eyesafe laser device in the turret. When the pins are open, power to the device is disabled, and when close-circuited, power is enabled. The pins allow the integrator to connect a simple arming switch to these contacts. Pins 2 and 5 shall be used for laser Simple Arming.

LASER ADVANCED ARMING CLUSTER 1 - Turreted EO/IR systems have a NFZ, or Cutout Map. It is a 2-dimensional map, in azimuth and elevation, that defines where the laser is allowed to fire, and where it's not. It's designed to inhibit laser firing when the turret's line-of-sight is over any part of the platform. This prevents laser energy from reflecting back, posing a hazard to the aircrew. The map is stored in the turret's computer memory. Further, a turret may have several maps stored, enabling it to be mounted at several points on the platform, or on several platform models, without modification. In this case, a high reliability mechanism is needed to select which map should be used. Pins 11,12,13, and 52 shall be used for Laser Advanced Arming Cluster 1.

Assuming that three of the four pins allocated to this function are used to select a map, up to 8 maps can be defined in the turret. The fourth pin would be used as a parity check for safety.

LASER ADVANCED ARMING CLUSTER 2 - These pins can be used in a number of ways. They determine under what conditions or states the laser will be used. For example, if there are multiple non-eyesafe lasers in a turret, these pins could be used to select one or more devices (secondary arm). Pins 53, 54, 59, and 65 shall be used for laser advanced arming Cluster 2.

4.1.2.2.5 Laser Fire

The Laser Fire signal shall be used to annunciate the firing of a non-eyesafe laser. These shall be 28 VDC isolated signals. The maximum voltage shall be 30 VDC with a maximum current of 100 mA.

4.1.2.2.6 Safety Status

A set of three signal pairs is available to indicate the status of safety relevant functions in the EO/IR system. These shall be 28 VDC isolated signals. These signals are controlled by the sensor. The maximum voltage shall be 30 VDC with a maximum current of 100 mA.

4.1.2.2.7 Enable Gimbal Movement

The Enable Gimbal Movement signal shall be used to indicate that the sensor system's outer gimbal motors are to be enabled. This control is necessary to ensure that the turret does not move in azimuth and/or elevation at high speeds endangering individuals that may be working in close proximity to the sensor. The Enable Gimbal Movement signal originates from the sensor with the platform opening and closing the circuit. An open circuit shall indicate that the motors shall not be powered.

NOTE: The maintainer may need to move the gimbal by hand.

4.1.2.2.8 Time Synchronization - 1 PPS

Wiring for a 1 PPS signal for time synchronization shall be provided. This signal shall be in accordance with the input time roll-over pulse (1 PPS) per ICD-GPS-060B.

4.1.2.3 Turret Class III, J3 Video (Copper) Connector

For Turret Class III, the J3 Video (Copper) connector contact pattern shall be 17-8 as shown in Figure 11. Signals for the Turret Class III, J3 Video (Copper) connector shall be assigned to pins in accordance with Table 22.

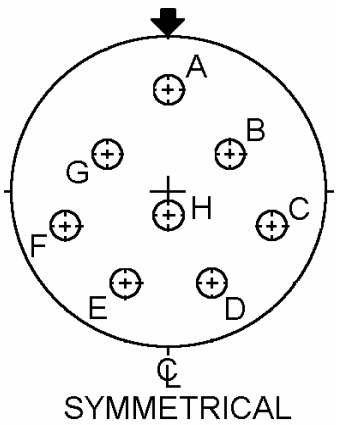

FIGURE 11 - TURRET CLASS III, J3 VIDEO (COPPER) CONNECTOR INSERT PIN ARRANGEMENT

TABLE 22 - TURRET CLASS III, J3 VIDEO (COPPER) CONNECTOR PIN ALLOCATION

Signal Name	Signal Type	Source	Contact
Video Ch 1	SMPTE292/424M	Sensor	A
Video Ch 2	SMPTE292/424M	Sensor	B
Video Ch 3	SMPTE292/424M	Sensor	C
Video Ch 4	SMPTE292/424M	Sensor	D
Video Ch 5	SMPTE292/424M	Sensor	E
Video Ch 6	SMPTE292/424M	Sensor	F
Video Ch 7	SMPTE292/424M	Sensor	G
Video Ch 8	SMPTE292/424M	Sensor	H

Each channel shall comply with SMPTE292M, driving into 75 Ω #16 coaxial cable, per the standard. Video channels can also be SMPTE 424M over the same wiring.

NOTE: This interface has a maximum cable length of approximately 50 ft before significant signal degradation occurs.

The application defines the number of active channels.

4.1.2.4 Turret Class III, J4 Fiber Optic Connector

Fiber optic shall be multimode fiber. The core diameter shall be 50 µm ± 3 µm and the cladding diameter shall be 125 µm ± 2 µm. The termini shall be butt end MIL-PRF-29504/4 (Pin) or MIL-PRF-29504/5 (Socket) to fit into size 16 entry holes.

Ethernet Channels shall transmit and receive at 850 nm per IEEE 802.3-2008 for 10GBASE-SR applications.

SMPTE 297 Channels shall transmit SMPTE 292 or 424M signals at 1310 nm specifically according to call out L-PC-CD-1310.

Fiber used shall be OM2 compliant or better, as defined by ISO/IEC 11801. It is recommended that for longer path applications that the cable be bend-insensitive OM4.

For Turret Class III, the J4 Fiber Optic Connector contact pattern 13-4 is depicted in Figure 12. Signals shall be assigned to each contact and fiber in accordance with Table 23.

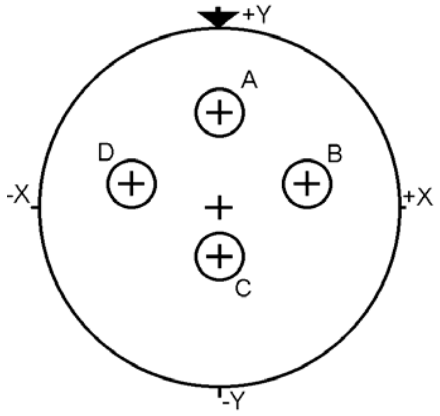

FIGURE 12 - TURRET CLASS III FIBER OPTIC INSERT PIN ARRANGEMENT

TABLE 23 - TURRET CLASS III, J4 FIBER OPTIC VIDEO CONNECTOR PIN ALLOCATION

Signal Name	Signal Type	Source	Contact
Sensor Transmit	10GBASE-SR	Sensor	A
Sensor Receive	10GBASE-SR	Platform	B
Video Ch 1	SMPTE 297	Sensor	C
Video Ch 2	SMPTE 297	Sensor	D

4.1.2.5 Turret Class III, J5 GPS Antenna Connector

When a GPS receiver internal to the sensor is being used and requires an external antenna, the J5 connector shall be used. These signals shall have characteristics that comply with Appendix A (Additional Interface Requirements for GPS RF Signals) of this standard.

4.1.3 Turret Class IV Interface Connectors

Class IV Turret connectors shall be partitioned into the following connector types:Power (J1), Signal (J2), Video Copper (J3), Fiber Optic (J4) and Additional Signals (J5). Connector specifications shall be as listed in Table 24. The insert descriptors shall be in accordance with MIL-STD-1560B.

TABLE 24 - TURRET CLASS IV CONNECTORS

	J1 Power	J2 Signal	J3 Video (Copper)	J4 Fiber Optic	J5 Additional Signals (Optional)	J6 GPS
Type	MIL-DTL-38999 / Series I	MIL-DTL-38999 / Series I	MIL-DTL-38999 / Series I	MIL-DTL-38999 / Series I	MIL-DTL-38999 / Series I	TNC
Shell Size	13	13	13	13	11	NA
Sensor LRU Gender	Receptacle with pin inserts	Receptacle with socket inserts	Receptacle with socket inserts	Receptacle with socket inserts	Receptacle with socket inserts	
Platform Umbilical Gender	Plug with socket inserts	Plug with pin inserts	Plug with pin inserts	Plug with pin inserts	Plug with pin inserts	
Keying	N	N	N	A	N	NA
Insert	13-98	13-35	13-4	13-4	11-35	

For Class IV sensor systems, the platform shall implement, and the sensor shall be compatible with, one of the following configurations in Table 25.

TABLE 25 - CLASS IV CONFIGURATION CONTROL

Connector	Signal Group	Configuration			
		1	2	3	4
J1	Power (See below for level)	x	x	x	x
	Laser Power (See below for level)	x	x	x	x
J2	Power Enable	x	x	x	x
	Ethernet	x	x	x	x
	Serial Comms		x	x	x
	Enable Gimbal Movement	x	x	x	x
J3	Video ch 1	No J3	x	No J3	x
	Video ch 2		x		x
	Video ch 3		x		x
	Video ch 4		x		x
J4	Video ch 1	No J4	No J4	x	x
	Video ch 2			x	x
	Ethernet			x	x
J5	Laser Arming	x	x	x	x
	Laser Fire	x	x	x	x
	Safety Status	x	x	x	x
	1 PPS	configured independently (see below)			
J6	GPS Antenna	configured independently (see below)			

For platforms, configurations are identified by number per the table above, an indication of the additional options selected, such as type of time synchronization, per Table 26.

TABLE 26 - TURRET CLASS IV NAMING CONVENTIONS FOR OPTIONS

Independently Configured Item	Configuration		
	tagA	tagB	tagC
IEEE-1588 Synchronization	-IPN		
GPS Antenna	-GPS		
1 PPS Synchronization	-PPS		
Connector Location	-SID	-TOP	-ECU
Power	-12V	-28V	
Naval Application	-MAR		

Examples are shown in Table 27. In the first example, the sensor has the characteristics of Configuration number 1, has 1588 for handling time synchronization, does not have a GPS antenna, does not have 1 PPS time synch signal, has connectors located on the side, has 12 V power, and is not a Naval application. In this case it is labeled Class IV Configuration-1-IPN-SID-12V. Regarding power, 12 V or 28 V can be selected, but not both.

TABLE 27 - CLASS IV CONFIGURATION NAMING EXAMPLES

Configuration Number	1588 Time Sync	GPS Antenna	1 PPS Time Sync	Connector Location	Power	Naval Application	Name
1	Yes	No	No	Side	12 V	**No**	**Class IV Configuration-1-IPN-SID-12V**
2	Yes	No	Yes	Top	12 V	**No**	**Class IV Configuration-2-IPN-PPS-TOP-12V**
4	No	No	Yes	Side	28 V	**Yes**	**Class IV Configuration-4-PPS-SID-28V-MAR**
4	Yes	Yes	Yes	Side	12 V	**No**	**Class IV Configuration-4-IPN-GPS-PPS-SID-12V**
2	Yes	Yes	No	ECU	28 V	**No**	**Class IV Configuration-2-IPN-GPS-ECU-28V**

4.1.3.1 Turret Class IV, J1 Power Connector

For Turret Class IV, the physical arrangement of pins for the J1 Power Connector shall have a 13-98 insert pattern which is depicted in Figure 13. Turret Class IV J1 Power Connector signals shall be assigned to pins in accordance with Table 28.

The platform shall provide either 12 VDC power or 28 VDC power to the sensor system. The outer shell of the connector shall be chassis ground.

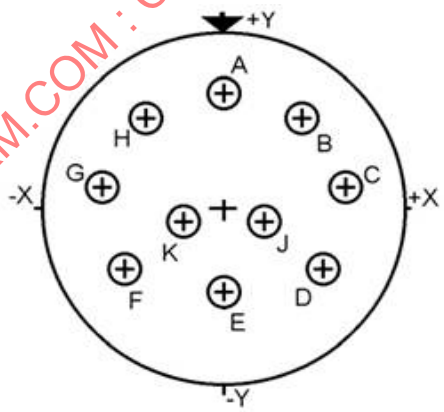

FIGURE 13 - TURRET CLASS IV, J1 POWER CONNECTOR PIN ARRANGEMENT

TABLE 28 - TURRET CLASS IV, J1 POWER CONNECTOR PIN ALLOCATION

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
28 VDC Power Channel 1	DC28-1	28 VDC Power	Platform	A	AWG 20 (UTP w/B)
	DC28-1 RTN	Power return	Platform	B	AWG 20 (UTP w/A)
28 VDC Power Channel 2	DC28-2	28 VDC Power	Platform	C	AWG 20 (UTP w/D)
	DC28-2 RTN	Power return	Platform	D	AWG 20 (UTP w/C)
12 VDC Power Channel 1	DC12-1	12 VDC Power	Platform	E	AWG 20 (UTP w/F)
	DC12-1 RTN	Power return	Platform	F	AWG 20 (UTP w/E)
12 VDC Power Channel 2	DC12-2	12 VDC Power	Platform	G	AWG 20 (UTP w/H)
	DC12-2 RTN	Power return	Platform	H	AWG 20 (UTP w/G)
Unused				J	
Safety Ground	Chassis	Ground	Common	K	AWG 20

4.1.3.1.1 28 VDC Power

When the platform provides 28 VDC power to the sensor, it shall provide two channels, each in accordance with MIL-STD-704F. Each of the two channels shall be independently controlled.

The platform shall be capable of supplying 5 amps steady state per each 28 VDC channel. Inrush current shall be limited to 8 amps for 2 s with a 25% duty cycle.

4.1.3.1.2 12 VDC Power

When the platform provides 12 VDC power, the voltage limits shall be 12 VDC +3/-1 VDC. Each of the two channels shall be independently controlled.

The platform shall be capable of supplying 5 amps steady state per each 12 VDC channel. Inrush current shall be limited to 8 amps for 2 s with a 25% duty cycle.

4.1.3.2 Turret Class IV, J2 Signal Connector

For Turret Class IV the J2 Signal contact pattern shall be 13-35 as shown in Figure 14.

FIGURE 14 - TURRET CLASS IV, J2 SIGNAL CONNECTOR PIN ARRANGEMENT

Signals for the Turret Class IV, J2 Signal connector shall be assigned to pins in accordance with Figure 14. Each signal group is described in more detail in Table 29.

TABLE 29 - TURRET CLASS IV, J2 SIGNAL CONNECTOR PIN ASSIGNMENT

Signal Group	Signal Name	Signal Type	Source	Contact	Wire Type
Power Enable (Discrete)	PWR_EN	open / closed circuit	Platform	1	AWG 22 UTP w/2
	PWR_EN_RTN	open / closed circuit	Platform	2	AWG 22 UTP w/1
Ethernet	BI_DA+	1000BaseT	Common	3	AWG 24 100 Ω STP w/4
	BI_DA-	1000BaseT	Common	4	AWG 24 100 Ω STP w/3
	BI_DA_SHLD		Common	16	Shield
	BI_DB+	1000BaseT	Common	5	AWG 24 100 Ω STP w/6
	BI_DB-	1000BaseT	Common	6	AWG 24 100 Ω STP w/5
	BI_DB_SHLD		Common	17	Shield
	BI_DC+	1000BaseT	Common	7	AWG 24 100 Ω STP w/8
	BI_DC-	1000BaseT	Common	8	AWG 24100 Ω STP w/7
	BI_DC_SHLD		Common	18	Shield
	BI_DD+	1000BaseT	Common	9	AWG 24 100 Ω STP w/10
	BI_DD-	1000BaseT	Common	10	AWG 24 100 Ω STP w/9
	BI_DD_SHLD		Common	19	Shield
Serial Communications	TX1+	RS-422	Sensor	11	AWG 24 STP w/20
	TX1-	RS-422	Sensor	20	AWG 24 STP w/11
	422_1_Ret	RS-422	Common	12	AWG 24
	RX1+	RS-422	Platform	13	AWG 24 STP w/21
	RX1-	RS-422	Platform	21	AWG 24 STP w/13
Enable Gimbal Movement (Discrete)	LOCK_GIMB	open/closed circuit	Platform	22	AWG 22 UTP w/14
	LOCK_GIMB_RTN	open/closed circuit	Platform	14	AWG 22 UTP w/22
Reserved	Reserved			15	
Contacts which are reserved, unused, or unallocated shall be populated by a dummy plug.					

4.1.3.2.1 Power Enable

The Power Enable signal is used for a controlled power up and shut down of the sensor system This control is necessary if the sensor system is required to execute a sequence of steps upon shutdown, steps that the sensor system would be precluded from executing if power were simply removed from the system. The Power Enable signal comes from the platform and instructs the sensor to power down.

Power Enable is a switch, relay, or SSR controlled by the platform (or human on the platform side of the interface). The switch goes across PWR_EN and PWR_EN_RTN. The sensor provides the voltage for this. Power Enable is enabled is disabled if an open circuit exists externally between the contacts (i.e., the switch is open). Power Enable is enabled if a closed circuit is externally applied between the contacts.

An open circuit for Power Enable shall have a resistance value greater than 100k Ω. A closed circuit for Power Enable shall have a resistance value less than 5 Ω.

4.1.3.2.2 Ethernet Databus (Copper)

The J2 Ethernet databus shall be implemented as Gigabit Ethernet. Gigabit Ethernet is an 8-wire (4 twisted-pair), 100 Ω connection. Gigabit Ethernet shall comply with IEEE 802.3-2008 for a 1000BaseT channel.

4.1.3.2.3 Serial Communications

One application-configurable serial communication port is defined. The port shall be compliant to Telecommunications Industral Association (TIA)/Electronic Industry Alliance (EIA) RS-422.

4.1.3.2.4 Enable Gimbal Movement

The Enable Gimbal Movement signal shall be used to indicate that the sensor system's outer gimbal motors are to be enabled. This control is necessary to ensure that the turret does not move in azimuth and/or elevation at high speeds endangering individuals that may be working in close proximity to the sensor. The Enable Gimbal Movement signal originates from the sensor with the platform opening and closing the circuit. An open circuit shall indicate that the motors shall not be powered.

NOTE: The maintainer may need to move the gimbal by hand.

4.1.3.3 Turret Class IV, J3 Video (Copper) Connector

For Turret Class IV the J3 Video (Copper) contact pattern shall be 13-4 as shown in Figure 15.

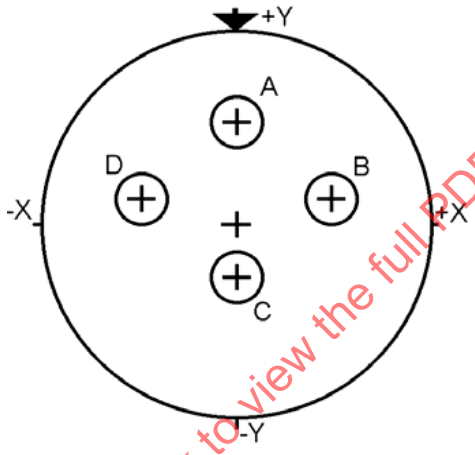

FIGURE 15 - TURRET CLASS IV, J3 VIDEO (COPPER) CONNECTOR INSERT PIN ARRANGEMENT

Signals for the Turret Class IV, J3 Video (Copper) connector shall be assigned to pins in accordance with Table 30.

TABLE 30 - TURRET CLASS IV, J3 VIDEO (COPPER) CONNECTOR PIN ASSIGNMENT

Signal Name	Signal Type	Source	Contact
Video Ch 1	SMPTE292/424M	Sensor	A
Video Ch 2	SMPTE292/424M	Sensor	B
Video Ch 3	SMPTE292/424M	Sensor	C
Video Ch 4	SMPTE292/424M	Sensor	D

Each channel shall comply with SMPTE 292, driving into 75 Ω coaxial cable, per the standard. Video channels can also be SMPTE 424M over the same wiring.

NOTE: This interface has a maximum cable length of approximately 16.5 m.

4.1.3.4 Turret Class IV, J4 Fiber Optic Connector

For Turret Class IV the J4 Fiber Optic contact pattern shall be 13-4 as shown in Figure 16.

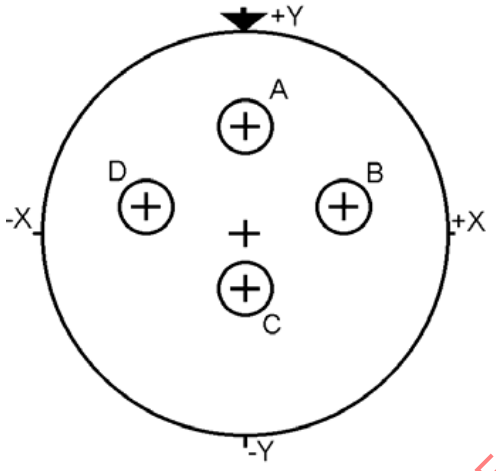

FIGURE 16 - TURRET CLASS IV, J4 FIBER OPTIC INSERT PIN ARRANGEMENT

Signals for the Turret Class IV, J4 Fiber Optic connector shall be assigned to pins in accordance with Table 31.

TABLE 31 - TURRET CLASS IV, J4 FIBER OPTIC CONNECTOR PIN ALLOCATION

Signal Name	Signal Type	Source	Contact
Sensor Transmit	10GBASE-SR	Sensor	A
Sensor Receive	10GBASE-SR	Platform	B
Video Ch 1	SMPTE 297	Sensor	C
Video Ch 2	SMPTE 297	Sensor	D

Fiber optic shall be multimode fiber. The core diameter shall be 50 µm ± 3 µm and the cladding diameter shall be 125 µm ± 2 µm. The termini shall be butt end MIL-PRF-29504/4 (Pin) or MIL-PRF-29504/5 (Socket) to fit into size 16 entry holes.

Ethernet Channels shall transmit and receive at 850 nm per IEEE 802.3-2008 for 10GBASE-SR applications.

SMPTE 297 Channels shall transmit low power SMPTE 292 or 424M signals at 1310 nm specifically according to call out L-PC-CD-1310.

Fiber used shall be OM2 compliant or better, as defined by ISO/IEC 11801. It is recommended that for longer path applications that the cable be bend-insensitive OM4.