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Part 2: Physical characteristics

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and security devices for personal identification*.

This second edition cancels and replaces the first edition (ISO/IEC 17839-2:2015), which has been technically revised. It also incorporates ISO/IEC 17839-2:2015/Amd 1:2021.

The main changes are as follows:

— change of Biometric System-on-Card (BSoC) classes and requirements;

— replaced references to S1 and S2 with ID-1 and ID-T;

— changes to mechanical requirements and restrictions.

A list of all parts in the ISO/IEC 17839 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

A Biometric System-on-Card (BSoC) is an integrated circuit card (ICC) with full biometric capabilities as defined in ISO/IEC 17839-1. The implementation of an ICC with such specifications is subject to a number of physical constraints, which are detailed in this document. Therefore, this document provides the specifications for both type ID-1 BSoC and type ID-T BSoC.

ID-1 card dimensions are defined in ISO/IEC 7810. The specifications for this type of BSoC are limited to those related to the location of the biometric capture device, the human-machine interaction, as well as to stating certain limitations on the use of certain technologies such as not allowing embossing on this type of card.

ID-T card dimensions and other characteristics are specified in ISO/IEC 18328-2.

The ISO/IEC 17839 series is organized into three parts:

— ISO/IEC 17839-1 *Information technology — Biometric System-on-Card — Core requirements*

— ISO/IEC 17839-2 (this document) *Information technology — Biometric System-on-Card — Physical characteristics*

— ISO/IEC 17839-3 *Information technology — Biometric System-on-Card — Logical information interchange mechanism*

Information technology — Biometric System-on-Card —

Part 2:
Physical characteristics

1 Scope

This document defines:

— dimensions of a type ID-1 Biometric System-on-Card (BSoC) and type ID-T BSoC;

— position and capture area of the biometric capture device according to the needs of the biometric modality;

— minimum requirements to a BSoC with respect to:

  — mechanical durability; and

  — human-machine interface and ergonomics.

This document is not applicable to other on-card devices such as an electronic display or a keypad.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 2382-37, *Information technology — Vocabulary — Part 37: Biometrics*

ISO/IEC 7810, *Identification cards — Physical characteristics*

ISO/IEC 10373-1, *Cards and security devices for personal identification — Test methods — Part 1: General characteristics*

ISO/IEC 17839-1, *Information technology — Biometric System-on-Card — Part 1: Core requirements*

ISO/IEC 18328-2, *Identification cards — ICC-managed devices — Part 2: Physical characteristics and test methods for cards with devices*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO/IEC 2382-37, ISO/IEC 7810, ISO/IEC 17839-1, ISO/IEC 18328-2 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms and definitions

3.1.1
minutiae-based comparison algorithm
fingerprint biometric feature comparison algorithm, which relies on evaluating fingerprint minutiae data

Note 1 to entry: The fingerprint minutiae data format used can be the one defined in ISO/IEC 19794-2 or ISO/IEC 39794-2.

3.1.2
hybrid comparison algorithm
fingerprint biometric comparison algorithm, which relies on evaluating fingerprint minutiae data and extended feature data, such as ridge count data, curvature, delta and core singular points or any other proprietary vendor-specific data

Note 1 to entry: The fingerprint minutiae data format used can be the one defined in ISO/IEC 19794-2 or ISO/IEC 39794-2.

3.1.3
pattern comparison algorithm
either fingerprint biometric sample or biometric feature comparison algorithm, or both, which focuses on biometric sample image level correlation

Note 1 to entry: This category of algorithm typically tries to find a small fraction of a probe fingerprint image in a larger reference image or in a plurality of reference images obtained during a *multi-touch enrolment* (3.1.4) process. The data structures used in a pattern comparison algorithm are usually proprietary. A pattern comparison algorithm can evaluate lower level three fingerprint features, i.e. "micro-features" such as sweat pores, incipient ridges or ridge shapes.

3.1.4
multi-touch enrolment
enrolment process of multiple reference biometric samples

Note 1 to entry: Multiple reference biometric samples or biometric templates can be stored, or combined into a larger reference biometric sample or biometric template using *image stitching algorithm* (Note 3) or *template stitching algorithm* (Note 4) respectively

Note 2 to entry: Multi-touch enrolment is common in many smartphones with a small scan area fingerprint sensor.

Note 3 to entry: An image stitching algorithm is an algorithm assembling multiple captured biometric samples of the fingerprint into a larger reference biometric sample image (as if it was captured using large scan area fingerprint sensor) using pattern comparison algorithm (3.1.3).

Note 4 to entry: A template stitching algorithm is an algorithm assembling biometric feature reference templates (e.g. ISO/IEC 19794-2 or ISO/IEC 39794-2 minutiae data) extracted from multiple captured biometric samples of the fingerprint into a larger reference biometric template (as if it was extracted from biometric sample captured using large scan area fingerprint sensor) using minutiae-based comparison algorithm (3.1.1) or hybrid comparison algorithm (3.1.2).

3.1.5
enrolment update
process of merging the current biometric probe's biometric sample data or biometric feature data into a biometric reference, e.g. enrolled using multi-touch enrolment

Note 1 to entry: In a Biometric System-on-Card (BSoC) context, an enrolment update can happen after card issuance to update biometric reference data that can be stored in a secure element. An enrolment update helps when using features that are not consistent over a longer time period or capture environment dependent.

3.1.6
capture area
area of a biometric capture device that captures biometric data, e.g. a fingerprint or dynamic signature

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms in ISO/IEC 17839-1 and the following apply.

FAR	false acceptance rate
FM	false match
FMR	false match rate
FNM	false non-match
FNMR	false non-match rate
FRR	false rejection rate
FTA	failure to acquire
IFD	interface device
LED	light emitting diode
PCB	printed circuit board
ppi	pixels per inch

4 Conformance

A BSoC claiming conformance with this document shall conform to all mandatory requirements specified herein as applicable. A BSoC using an area fingerprint biometric capture device claiming conformance to this document, shall express the class defined in Table 1 in the conformance statement, e.g. ISO/IEC 17839-2 Class C.

5 Dimensions

5.1 Overall dimensions

The overall dimensions of a type ID-1 BSoC shall be as specified in ISO/IEC 7810.

The overall dimensions of a type ID-T BSoC shall be as defined in ISO/IEC 18328-2.

5.2 Location of the biometric capture device

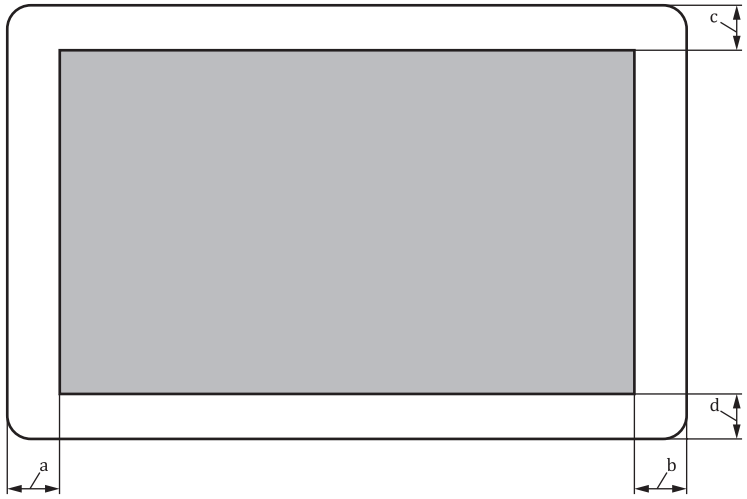
5.2.1 General requirements

The position of the biometric capture device is subject to ergonomic requirements and other reserved areas of the card body for active components. The physical position of the biometric capture device should not be in the centre of the card and should not cover defined areas for other functional elements in the card.

The biometric capture device should not be too close to the border of the ICC due to ergonomic reasons. A minimum distance of 3,5 mm (approx. 0,138 in) between the capture area and the edge of the card is recommended for embedding a biometric capture device in a card.

When combining the biometric sensor with other functional elements in a card, care shall be taken that one element does not severely affect the functionality of the other one.

Figure 1 illustrates the recommended position for the biometric capture area. The position and modality-specific type of biometric capture device can be indicated on the BSoC.



Key

recommended position for biometric capture area

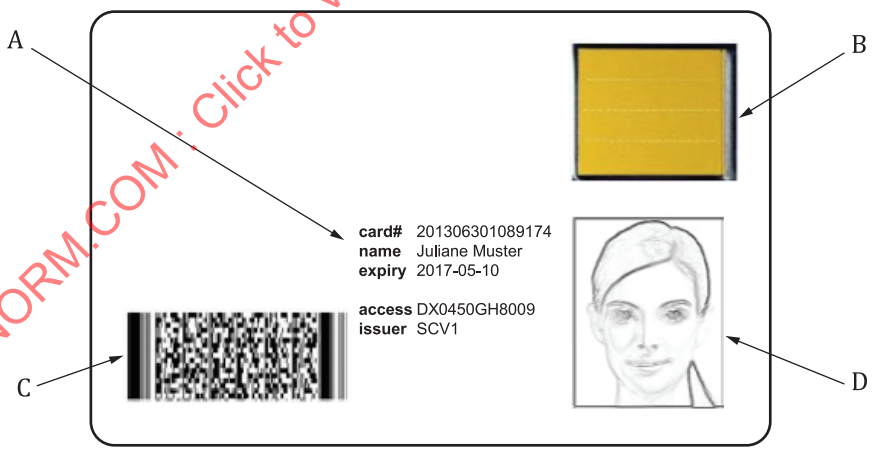
a, b, c, d 3,5 mm.

Figure 1 — Recommended position for biometric capture area on the card

5.2.2 Fingerprint biometrics

Orientation of the area or swipe sensor is not standardized. Some application scenarios may use additional card elements such as a display and require alignment for positioning the electrical card components without overlap.

Figures 2 and 3 illustrate examples of card layouts when a BSoC carries other card elements or devices. In these examples the biometric capture device is physically combined with printed information or with an electronic display on the front face.



Key

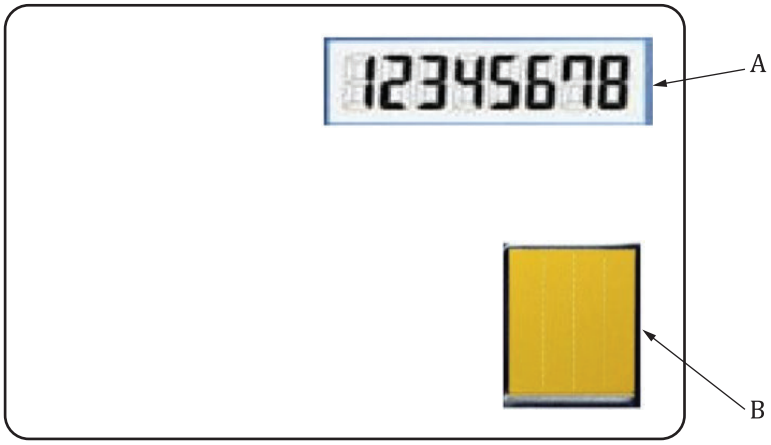
A printed data

B biometric capture device

C 2D-barcode

D picture

Figure 2 — Example of BSoC with printed information



Key

A electronic display

B biometric capture device

Figure 3 — Example of BSoC with electronic display

5.2.3 Voice biometrics

For voice biometrics, the biometric capture device is an embedded microphone. The microphone should be placed where the sound waves are not obstructed from reaching the sensing area. Therefore, in the case of a Type ID-1 BSoC with contacts, the sensor should be located in the right most edge of the recommended sensor region.

In contactless cards, the sensor may be located in any of the positions within the recommended region for a sensor defined in 5.2.1.

In any case, the location of the sensor should be visually or tactile noted so that the cardholder knows in which direction to emit the voice utterance.

5.2.4 Face biometrics

Due to ergonomic reasons in operational environments, the embedded camera required to capture the face of the cardholder is not usable while the card is fully inserted in the interface device (IFD).

The camera location should be indicated visually or tactilely.

5.2.5 Signature biometrics

Signature biometrics with a flexible BSoC shall only be considered if the IFD allows the card to lay on a rigid surface so that it does not bend during the signing process. This is because having a bending surface while signing changes the signing characteristics significantly and raises the biometric error rates. This requirement is relaxed for a type ID-T BSoC that is rigid.

The signature pad may be placed in any of the two sides of the card, and within the recommended area for the biometric capture device.

In the case of a contact card inserted in an IFD, the signature pad should be located to be accessible to operate by the cardholder within the recommended area for the biometric capture device defined in 5.2.1.

5.3 Size of the biometric capture device

5.3.1 Fingerprint biometrics

The industry provides two different categories of fingerprint capture devices with respect to shape: area fingerprint sensors and swipe fingerprint sensors. Area fingerprint sensors are operated by touching the sensor with a finger. Swipe fingerprint sensors require the user to move their finger over the biometric capture device. In the case of a swipe sensor, the effective area of fingerprint capture is bigger than the sensor size.

NOTE The rolled impressions acquired using a rolling motion over the scanning area are not considered for area fingerprint sensors in this document due to lack of usability and applicability for a BSoC use case. Only plain (flat) live-scan fingerprints being acquired via scan area touch without any rolling motion are considered for area fingerprint sensors defined within this document for BSoC.

The size of the capture area and the resolution of a fingerprint biometric capture device have an influence on the biometric performance of the BSoC.

A BSoC using a fingerprint capture device and claiming conformance to this document shall indicate the class of the sensor specified in Table 1. To claim conformity to a given class, both the minimum capture area and minimum resolution requirements shall be met.

Table 1 — Area fingerprint sensor class

Class	Minimum capture area in mm^2	Minimum native resolution in ppi
B	other	other
C	169 (approx. 0,262 in^2)	320
D	210 (approx. 0,326 in^2)	500
NOTE 1 Annex A shows detailed rationale of the classes. NOTE 2 Class A is deprecated.		

The classes do not specify a ranking. Conformance with a certain class does not guarantee superior biometric performance over another class.

Swipe fingerprint sensors shall have a minimum width of 13 mm (approx. 0,512 in).

5.3.2 Voice biometrics

The size of the microphone shall be designed not to limit the acquisition of voice without distortion in the 50 Hz to 8 kHz band.

5.3.3 Face biometrics

The minimum requirements for a facial image in size, resolution, colour depth and contrast should be according to ISO/IEC 39794-5 or ISO/IEC 19794-5 and the size of the camera shall be designed not to limit the possibility of acquiring a facial image meeting the defined requirements.

5.3.4 Signature biometrics

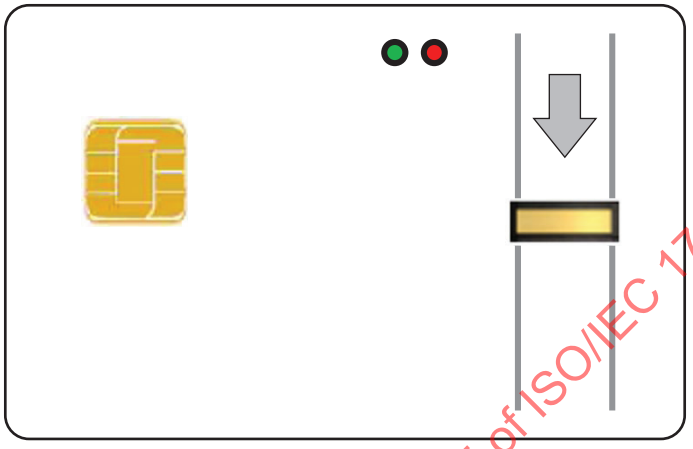
The size of the signature pad is limited by ergonomics and cultural differences in the signing process, as different countries have a different expectation on how a signature is written. A minimum area of 35 mm × 35 mm (approx. 1,378 in × 1,378 in) shall be allowed for the signature pad.

5.4 Orientation

5.4.1 Finger biometrics

The biometric capture device should be placed within the recommended biometric capture device area in Figure 1. The biometric capture device orientation is not standardized in a BSoC. If the ICC contacts are used in a Type ID-1 BSoC using a swipe sensor, the swipe direction should be aligned parallel to the short edge of the card. Otherwise, it is almost impossible to swipe the finger over the biometric capture device when it is inserted into an interface device.

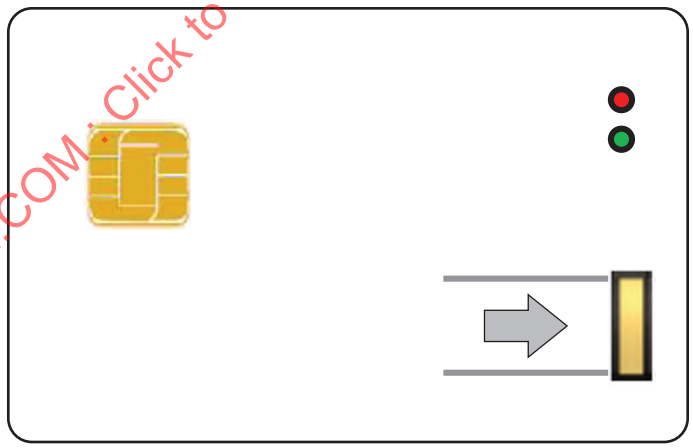
Figures 4 and 5 illustrate the recommended and other swipe directions in a BSoC with a fingerprint sensor.



Key

swipe direction

Figure 4 — BSoC swipe direction and biometric capture device orientation



Key

swipe direction

Figure 5 — BSoC other swipe direction and biometric capture device orientation

A visible or tactile indication should be placed within the card to show the user how to operate the biometric capture device, i.e. orientation of the finger and, in the case of swipe sensors, the direction of the movement.

5.4.2 Voice biometrics

Voice biometrics, once the location of the sensor on the ICC is indicated, do not have any additional orientation requirements.

5.4.3 Face biometrics

The embedded camera for face biometrics may be oriented in any direction. The orientation of the card in relation to the vertical axis of the face of the cardholder should be indicated visually or tactilely.

5.4.4 Signature biometrics

The signature pad can be oriented in any direction. However, it is preferable to mark visually or tactilely the location of the bottom of the signature pad.

6 Card characteristics

6.1 Mechanical durability

A type ID-1 BSoC shall be in accordance with all requirements of an ID-1 card as specified in ISO/IEC 7810 and bending stiffness tests specified in ISO/IEC 10373-1.

A type ID-T BSoC shall be in accordance with all requirements of an ID-T card defined in ISO/IEC 18328-2.

6.2 Human-machine interface

A BSoC should support a feedback mechanism, which could indicate the status of the biometric process to a cardholder. This may be through either an IFD or other device on the card (e.g. an LED, a display or a buzzer), or both, indicating the status of the scanning process.

NOTE Such a feedback mechanism can be the one specified in ISO/IEC 17839-3 or a physical connection to an embedded device in the ICC.

The biometric capture device can form a uniform surface with the card body. Alternatively, the biometric capture device can be felt by the user with a height profile. In both cases, the total thickness shall be in accordance with the dimensions specified in 5.1.

Annex A
(informative)

Rational for introducing classes of fingerprint capturing devices in a BSoC

BSoC applications can have different requirements. The class descriptions give guidance on which sensor is best suited to satisfy each requirement.

Class D sensor characteristics are a subset of typical requirements for government applications, such as national IDs, border control, law enforcement and healthcare. Sensors conforming with this requirement typically allow a high level of biometric performance across distinct environmental conditions, e.g. humidity and temperature. The minimum resolution and area defined for Class D is based on a FAP 10 fingerprint acquisition profile as specified in ANSI/NIST-ITL 1-2011[7].

Class C sensors typically have a proven biometric performance, meeting market requirements based on interoperable minutiae-based comparison algorithms and hybrid comparison algorithms with independent third-party tests on plausible size private data sets (see References [8], [9] and [10] for details).

A Class B sensor can be substantially smaller than an adult subject fingerprint. Two distinct captured biometric samples (images) from the same subject captured using a Class B sensor can have a low common overlap area. Therefore, Class B sensors should use a multi-touch enrolment. A Class B BSoC can require a combination of a proprietary pattern comparison algorithm and regular enrolment updates to operate reliably. Class B sensors using a multi-touch enrolment have been proven to allow reliable biometric performance in a controlled environment (see Annex B).

Annex B
(informative)

Plugfest BSoC evaluation results

Tables B.1 to B.7 describe the biometric performance results of BSoC Class B sensors[6].

Table B.1 — Performance results of sensor #1

Sensor #1		
Company	A	
Size	4 mm × 4 mm	
Resolution	363 dpi	
# Subjects	142	
# Fingers / subject	4	Left, right, index, thumb
# Enrol / finger	12	Enrol captures per finger
# Verify / finger	50	Verify captures per finger
# FNM candidates	28 400	142 × 4 × 50
# FM candidates	16 017 600	(142 × 4) × (141 × 4 × 50)
FRR#1	0,97 %	@FAR < = 1/10 000
FRR#2	1,12 %	@FAR < = 1/100 000
FRR#3	2,20 %	@FAR < = 1/1 000 000
Remarks	Sensor on PCB. All images used, no FTA consideration to exclude images.	

Table B.2 — Performance results of sensor #2

Sensor #2		
Company	A	
Size	4 mm × 4 mm	
Resolution	508 dpi	
# Subjects	142	
# Fingers / subject	4	Left, right, index, thumb
# Enrol / finger	12	Enrol captures per finger
# Verify / finger	50	Verify captures per finger
# FNM candidates	28 400	142 × 4 × 50
# FM candidates	16 017 600	(142 × 4) × (141 × 4 × 50)
FRR#1	1,15 %	@FAR < = 1/10 000
FRR#2	1,27 %	@FAR < = 1/100 000
FRR#3	144 %	@FAR < = 1/1 000 000
Remarks	Sensor on PCB. All images used, no FTA consideration to exclude images.	

Table B.3 — Performance results of sensor #3

Sensor #3		
Company	A	
Size	4,8 mm × 4,8 mm	
Resolution	508 dpi	
# Subjects	141	One subject skipped this station
# Fingers / subject	4	Left, right, index, thumb
# Enrol / finger	8	Enrol captures per finger
# Verify / finger	50	Verify captures per finger
# FNM candidates	28 200	141 × 4 × 50
# FM candidates	15 792 000	(141 × 4) × (140 × 4 × 50)
FRR#1	0,67 %	@FAR < = 1/10,000
FRR#2	0,74 %	@FAR < = 1/100,000
FRR#3	0,88 %	@FAR < = 1/1,000,000
Remarks	Sensor on PCB. All images used, no FTA consideration to exclude images.	

Table B.4 — Performance results of sensor #4

Sensor #4		
Company	B	
Size	9,5 mm × 9,5 mm	
Resolution	345 dpi	
# Subjects	142	
# Fingers / subject	2	Left thumb, right thumb
# Enrol / finger	10	Enrol captures per finger
# Verify / finger	40	Verify captures per finger
# FNM candidates	5 664	142 × 2 × 20 = 5 680, less 16 (FTA) = 5 664
# FM candidates	3 193 650	(142 × 2) × (141 × 2 × 40) = 3 203 520, less 9,870 (FTA) = 3 193 650
FNMR (with FTA exclusion)	0,918 % (52 / 5 664)	@FMR < = 1/93 931 (34 / 3 193 650)
FRR (no FTA exclusion)	1,197 % ((52 + 16) / 5 680)	@FAR < = 1/94 221 (34 / 3 203 520)
Remarks	Sensor on card. Enrolment template consists of six images from the enrolment database and 10 from the verification database. For FNMR calculation, only 20 images were used from the verification database. These images were not used for the enrolment template.	

Table B.5 — Performance results of sensor #5 with full data and FTA included

Sensor #5 — full data, no FTA exclusion		
Company	C	
Size	9,5 mm x 9,5 mm	
Resolution	345 dpi	
# Subjects	142	
# Fingers / subject	2	Left thumb, right thumb
# Enrol / finger	2 × (2 × 10) = 40	Enrol captures per finger
# Verify / finger	2 × (2 × 10) = 40	Verify captures per finger
# FNM candidates	45 440	(142 × 2 × 4 enrol) × (4 verify × 10)
# FM candidates	12 814 080	(142 × 2 × 4 enrol) × (141 × 2 × 4 verify × 10)