TEST REPORT

Test report

On Behalf of

TimeTec Computing Sdn. Bhd.

For

OFIS Y Fingerprint scanner

Model No.: OFIS Y

Prepared for :	**TimeTec Computing Sdn. Bhd.** **No 6, 8 & 10, Jalan BK 3/2, Bandar Kinrara, 47180 Puchong, Selangor, Malaysia**
Prepared By :	**WST Certification & Testing (HK) Limited** **12/F., San Toi Building,137-139 Connaught Road Central,Hong Kong**
Date of Test:	**Mar. 23, 2015 to Apr. 03, 2015**
Date of Report:	**Apr. 08, 2015**
Report Number:	**WST1503102E**

.

TEST REPORT

ISO-IEC 19794-2
Information technology equipment – Safety – Part 1: General requirements

Report Number. ..... :	WST1503102E
Tested by (+ signature) ..... :	Alan Zhou
Approved by (+ signature) ..... :	Michael Ling
Date of issue..... :	Apr. 08, 2015
Testing laboratory ..... :	WST Certification & Testing (HK) Limited
Address ..... :	12/F., San Toi Building,137-139 Connaught Road Central,Hong Kong
Testing location ..... :	As above
Applicant's name..... :	TimeTec Computing Sdn. Bhd.
Address ..... :	No 6, 8 & 10, Jalan BK 3/2, Bandar Kinrara, 47180 Puchong, Selangor, Malaysia
Test specification:	
Standard..... :	ISO-IEC 19794-2:2011+Amd 1:2013
Test procedure ..... :	CB scheme
Non-standard test method..... :	N/A
Test Report Form No...... :	ISO-IEC 19794-2_A
Test Report Form(s) Originator ..... :	WST testing
Master TRF..... :	Dated 2015-02

This test report is specially limited to the above client company and product model only. It may not be duplicated without prior written consent of WST Test.

Test item description ..... :	OFIS Y Fingerprint scanner
Trade Mark..... :	FingerTec
Manufacturer ..... :	Same as applicant
Model/Type reference ..... :	OFIS Y
Ratings ..... :	Input: DC 5V, 500mA

Summary of testing:	
Tests performed (name of test and test clause): **-- ISO-IEC 19794-2:2011** The submitted samples were found to comply with the requirements of above specification.	**Testing location:** 12/F., San Toi Building,137-139 Connaught Road Central,Hong Kong

Possible test case verdicts:

- test case does not apply to the test object ..... : N/A (or N)
- test object does meet the requirement ..... : P (Pass)
- test object does not meet the requirement ..... : F (Fail)

Testing ..... :

Date of receipt of test item ..... : Mar. 23, 2015

Date(s) of performance of tests ..... : Mar. 23, 2015 to Apr. 03, 2015

General remarks:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Abbreviations used in the report:

- normal conditions	N.C.	- single fault conditions	S.F.C
- functional insulation	OP	- basic insulation	BI
- double insulation	DI	- supplementary insulation	SI
- between parts of opposite polarity	BOP	- reinforced insulation	RI

Indicate used abbreviations (if any)

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
6	**Minutiae extraction**		P
6.1	Purpose		P
	This clause defines the placement of minutiae on the fingerprint		P
6.2	Minutia description		P
	Establishment of a common feature-based representation shall rest on agreement on the fundamental notion for representing a fingerprint.		P
6.3	Minutia type		P
6.3.1	General		P
	Each minutia has a “type” associated with it. There are two major types of minutiae: a “ridge skeleton end point” and a “ridge skeleton bifurcation point” or split point.		P
6.3.2	A minutia point shall be encoded once. A minutia point is uniquely identified by the location and angle.		P
6.3.3	The location at which a ridge splits into three separate ridges is a trifurcation. If it is encoded, it shall be encoded as two bifurcations with identical (x,y) values and different orientation angle values.		N
6.4	Minutia location		P
6.4.1	General		P
	The minutia location is represented by its horizontal and vertical position.		P
6.4.2	The coordinate system used to express the minutiae of a fingerprint shall be a Cartesian coordinate system.		P
6.4.3	The minutia for a ridge ending shall be defined as the point of forking of the medial skeleton of the valley area immediately in front of the ridge ending.		P
6.4.4	The minutia for a ridge bifurcation shall be defined as the point of forking of the medial skeleton of the ridge.		P
6.4.5	The minutia for a ridge skeleton endpoint shall be defined as the center point of the ending ridge.		N
6.4.6	Usage of the minutia placement by the record and on-card biometric comparison formats		N
6.5	Minutiae direction		P
6.5.1	Angle conventions		P
	The minutia angle is measured increasing counter-clockwise starting from the horizontal axis to the right.		P

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
6.5.2	A ridge ending (encoded as valley skeleton bifurcation point) has three arms of valleys meeting in one point.		P
6.5.3	A ridge bifurcation (encoded as ridge skeleton bifurcation point) has three arms of ridges meeting in one point.		P
6.5.4	The direction of a ridge skeleton endpoint is defined as the angle that the tangent to the ending ridge encompasses with the horizontal axis to the right (see Figure 4).		P
6.6	Core and delta placement		P
	Core and delta points are designated points of interest in a fingerprint. A fingerprint may have 0, 1 or more cores and 0, 1 or more deltas. The core and delta are defined in ISO/IEC 19794-1.		N
6.7	Encoding of multibyte quantities		N
	All multibyte quantities are represented in Big-Endian format; that is, the more significant bytes of any multibyte quantity are stored at lower addresses in memory than (and are transmitted before) less significant bytes. All numeric values are fixed-length integer quantities, and are unsigned quantities.		N
7	**Finger minutiae format types**		P
7.1	Overview		P
	This part of 19794 defines two format types for minutiae encoding. These format types have been derived from those listed in Version 2 of this part of ISO/IEC 19794 (ISO/IEC 19794-2:2005).		P
7.2	Record format		P
	This record format (Clause 8) requires the use of a general header for each finger record and a representation header for each representation of the finger.		P
7.3	On-card comparison format		N
	This on-card biometric comparison format (Clause 9) precludes the use of a general or representation header.		N
8	**Finger minutiae record format**		P
8.1	Introduction		P
	The finger minutiae record format shall be used to achieve interoperability between finger minutiae extraction and comparison subsystems.		P
8.2	Record organization		P
8.3	There shall be one and only one general header for the minutiae record.		P

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
8.3.1	The format identifier shall be recorded in four bytes. The format identifier shall consist of three characters “FMR” followed by a zero byte as a NULL string terminator.		N
8.3.2	The number for the version of this part of ISO/IEC 19794 used for constructing the finger minutiae BDIR shall be placed in four bytes.		N
8.3.3	The length (in bytes) of the entire finger minutiae BDIR shall be recorded in four bytes.		N
8.3.4	The total number of representations contained in the BDIR shall be recorded in two bytes.		N
8.3.5	The one-byte certification flag shall indicate whether each representation header includes a certification record.		N
8.4	Finger minutiae representation format		P
8.4.1	Finger minutiae representation header		P
8.4.2	The representation-length field denotes the length in bytes of the representation including the representation header fields.		P
8.4.3	The capture date and time field shall indicate when the capture of this representation started in Coordinated Universal Time (UTC). This field is not intended to encode the time the record was instantiated.		P
8.4.4	Capture device technology ID		P
8.4.5	Capture device vendor identifier		P
8.4.6	The capture device type identifier shall identify the product type that created the BDIR.		P
8.4.7	Finger image quality		P
8.4.7.1	General		P
	The quality information of the overall finger image data, if present, shall be recorded in one or more five-byte blocks when the number of quality blocks field is greater than 0.		N
8.4.7.2	The first byte is mandatory and shall contain the number of blocks of quality information of the overall finger image data.		N
8.4.7.3	The quality score, as defined in ISO/IEC 29794-1, shall be recorded in the first byte of each of the five-byte blocks.		N
8.4.7.4	To enable the recipient of the quality score to differentiate between quality scores generated by different algorithms, the provider of quality scores shall be uniquely identified by the next two bytes.		N
8.4.7.5	The remaining two bytes shall specify an integer product code assigned by the vendor of the Quality Algorithm ID.		N
8.4.8	Capture device certifications		P

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
8.4.8.1	General		P
	This multi-byte block contains information to indicate the compliant certification procedures that were used to test the biometric capture equipment used.		P
8.4.8.2	The first byte is mandatory and shall contain the number of certification blocks as an unsigned integer for the capture device.		P
8.4.8.3	The first two bytes of each block contain the CBEFF biometric organization identifier of the certification authority (registered by IBIA or other approved registration authority).		P
8.4.8.4	This last byte of the block shall identify a certification scheme used to certify the capture device.		P
8.4.9	Finger position		P
	The finger position shall be recorded in one byte. The codes for this byte shall be chosen from Table 7 which lists single finger and multiple finger combinations.		P
8.4.10	This one byte field shall contain the specific image representation number associated with the finger.		P
8.4.11	The horizontal spatial sampling rate of the minutiae coordinate system shall be recorded in two bytes having the units of pixels per centimeter.		P
8.4.12	The vertical spatial sampling rate of the minutiae coordinate system shall be recorded in two bytes having the units of pixels per centimeter.		P
8.4.13	The impression type of the finger images from which the minutiae data was derived shall be recorded in this one byte field.		P
8.4.14	This two-byte binary field shall be used to specify the number of pixels contained on a single horizontal line of the transmitted image.		P
8.4.15	This two-byte binary field shall be used to specify the number of horizontal lines contained in the transmitted image.		N
8.4.16	The number of bytes required to describe each minutia shall be recorded in four high-order (most significant) bits of the byte.		N
8.4.17	The method used to determine the location of a ridge ending shall be recorded in four low-order (least significant) bits of the byte.		N
8.4.18	The number of minutiae extracted and encoded for the finger shall be recorded in this one byte.		N
8.4.19	Finger minutiae data		P
	The finger minutiae data for a single finger shall be recorded in blocks of six or five bytes per minutia.		P
8.4.19.1	Qualified finger minutia pixel record format		P

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Clause	Requirement + Test	Result - Remark	Verdict
8.4.19.1.1	Using the qualified finger minutia pixel record format, six bytes are needed to encode each minutia.		P
8.4.19.1.2	The type of minutia (type t) will be recorded in the first two bits of the upper byte of the X coordinate.		N
8.4.19.1.3	The X coordinate of the minutia shall be recorded in the rest of the first two bytes (fourteen bits).		N
8.4.19.1.4	The angle of the minutia shall be recorded in one byte in units of 1.40625 (360/256) degrees.		N
8.4.19.1.5	Minutia quality is the confidence that the minutia is a true minutia.		N
8.4.19.2	Finger minutia pixel record format		P
8.4.19.2.1	Using the minutia pixel record format, only five bytes are needed to encode each minutia.		N
8.4.19.2.2	The 5-byte minutia non-qualified pixel format is the same as the 6-byte minutia qualified pixel format without the quality byte.		N
8.5	Extended data		P
	The extended data section of the finger minutiae record format is provided for the storage of additional data that may be used by the comparison equipment.		P
8.5.1	Common extended data fields		P
8.5.1.1	All finger records shall contain the extended data block length.		N
8.5.1.2	The type identification code shall be recorded in two bytes, and shall distinguish the format of the extended data area.		N
8.5.1.3	The length of the extended data section shall be recorded in two bytes.		N
8.5.1.4	The data field of the extended data is defined by the equipment that is generating the finger minutiae record, or by common extended data formats contained in this part of ISO/IEC 19794; see clauses 8.5.2, 8.5.3, and 8.5.4.		N
8.5.2	If the extended data area type code is 0001_{Hex}, the extended data area contains ridge count information.		N
8.5.2.1	The ridge count data area shall begin with a single byte indicating the ridge count extraction method.		N
8.5.2.1.1	Eight-neighbour ridge count extraction method		N
8.5.2.1.2	Four- neighbour ridge count extraction method		N
8.5.2.2	The ridge count data shall be represented by a list of three-byte elements.		N
8.5.2.3	Ridge count format summary		N
8.5.3	Core and delta data format		N
8.5.3.1	General		P
	If the extended data area type code is 0002_{Hex}, the extended data area contains core and delta information.		P

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
8.5.3.2	Core information		P
8.5.3.2.1	The number of core points represented shall be recorded in the least significant four bits of this byte.		P
8.5.3.2.2	The core information type shall be recorded in the first two bits of the upper byte of the X coordinate of the core position.		N
8.5.3.2.3	The X coordinate of the core shall be recorded in the lower fourteen bits of the first two bytes of each core description.		N
8.5.3.2.4	The angle of the core shall be recorded in one byte in units of 1.40625 (360/256) degrees.		P
8.5.3.3	Delta information		P
8.5.3.3.1	The number of delta points represented shall be recorded in the least significant four bits of this byte.		P
8.5.3.3.2	The delta information type shall be recorded in the first two bits of the upper byte of the X coordinate of the delta position.		N
8.5.3.3.3	The X coordinate of the delta shall be recorded in the lower fourteen bits of the first two bytes of each delta description.		N
8.5.3.3.4	Each of the three angle attributes of the delta shall each be recorded in one byte in units of 1.40625 (360/256) degrees.		N
8.5.3.4	Core and delta format summary		P
8.5.4	Zonal quality data		P
8.5.4.1	General		P
	If the extended data area type code is 0003_{Hex}, the extended data area contains zonal quality data.		P
8.5.4.2	To enable the recipient of the zonal quality score to differentiate between quality scores generated by different algorithms, the provider of quality scores shall be uniquely identified by the next two bytes.		P
8.5.4.3	The remaining two bytes shall specify an integer product code assigned by the vendor of the Quality Algorithm ID.		N
8.5.4.4	The number of pixels in cells in the x-direction (horizontal) shall be stored in one byte.		N
8.5.4.5	The bit depth of the cell quality information shall be contained in one byte.		N
8.5.4.6	The quality of the fingerprint image in each cell shall be represented by one or more bits, as indicated in 8.5.4.5.		N
8.5.4.7	Zonal quality data format summary		N
9	**Finger minutiae on-card comparison format**		P
9.1	Purpose		P
	This clause defines the on-card biometric comparison related encoding format for a series of minutiae descriptions.		P

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
9.2	On-card comparison format		P
9.2.1	Minutia placement		P
	This on-card biometric comparison format requires that all ridge endings shall be encoded as either valley bifurcation points or ridge skeleton end points as defined in Clause 6.4.3 and Clause 6.4.5 respectively.		P
9.2.2	Using the on-card biometric comparison format three bytes are needed to encode each minutia.		P
9.2.3	The 8-bit X coordinate of the minutia shall be recorded in the first byte.		N
9.2.4	The type of minutia (type t) will be recorded in the most significant two bits of the byte whose less significant bits contain the angle value for the minutiae.		P
9.2.5	The angle of the minutia shall be recorded in six bits in units of 5.625 (360/64) degrees.		P
9.3	Number of minutiae and truncation		P
9.3.1	General aspects		P
9.3.2	Removing minutiae for card processing		P
9.3.3	Lack of minutiae		P
9.3.4	Biometric comparison algorithm parameters are used to indicate implementation specific values to be observed by the outside world when computing and structuring the biometric verification data.		P
9.3.5	For the indication of the minimum and maximum value of minutiae expected by the card the DO Number of minutiae as shown in Table 16 shall be used.		P
9.4	Minutiae order		N
9.4.1	Data object for minutiae ordering		N
9.4.2	Ordered ascending means, that the ordered sequence begins with the minutia from the original minutiae set, that has the smallest value of the indicated item.		N
9.4.3	Ordered descending means, that the ordered sequence begins with the minutia from the original minutiae set, that has the largest value of the indicated item.		N
9.4.4	Cartesian x-y stands for an ordering scheme, where first the x-coordinate is compared and used for ordering.		N
9.4.5	Cartesian y-x stand for an ordering scheme, where first the y-coordinate is compared and used for ordering.		N
9.4.6	Sorting a minutiae list by angle is done as follows. As defined in a previous section the angle of a minutia begins with value 0 to the right horizontal axis and increases counter-clockwise.		N

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Clause	Requirement + Test	Result - Remark	Verdict
9.4.7	Polar is an ordering sequence by ascending or descending polar coordinates.		N
9.4.8	The extracted X coordinates are sorted in ascending order and encoded in 2 bytes, but only the least significant byte is sent in the minutiae format to the card (equal to a mod(256) computation).		N
9.5	Usage of extended data for the on-card comparison format		N
9.5.1	In the card format also, extended data beyond the finger minutiae may be present. In this case the usage of the biometric data template (tag $7F2E_{Hex}$) as described in ISO/IEC 7816-11 and defined in ISO/IEC 7816-6 is mandatory.		N
9.5.2	Zonal quality data modified for on-card comparison minutiae formats		N
9.5.2.1	In the absence of a record header, for the finger minutiae card formats the image size in X and Y direction is not provided; hence, the placement of the cells described in this clause is unknown.		N
9.5.2.2	This value shall indicate the number of cells in the quality map per decimetre.		N
9.5.2.3	The number of cells in X direction shall be stored in one byte. Permissible values are 1 to 255.		N
9.5.2.4	The bit depth of the cell quality information shall be contained in one byte.		N
9.5.2.5	Refer to section 8.5.4.6 for a description of the cell quality data.		N
9.5.3	Indication of card capabilities		N
10	**Registered format type identifiers**		P
	The registrations listed in Table 21 have been made with the CBEFF Registration Authority (see ISO/IEC 19785-2) to identify the finger minutiae record format and the finger minutiae compare-on-card format. The format owner is ISO/IEC JTC 1/SC 37 with the registered format owner identifier 257 (0101_{Hex}).		P

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
A	**ANNEX A, CONFORMANCE TEST METHODOLOGY**		P
A.1	Overview		P
	This part of ISO/IEC 19794 specifies a biometric data interchange format for storing, recording, and transmitting one or more finger minutiae representations.		P
B	**ANNEX B, RECORD FORMAT DIAGRAMS**		P
B.1	Overall record format		P
B.2	General header format		P
B.3	Finger minutiae representation format		N
B.4	Qualified finger minutiae pixel record		N
B.5	Finger minutiae pixel record		N
B.6	Extended data		N
C	**ANNEX C, EXAMPLE DATA RECORD**		P
C.1	Data		P
C.2	Example data format diagrams		N
C.3	Raw data for the resulting minutiae record		N
D	**ANNEX D, HANDLING OF FINGER MINUTIAE CARD FORMATS**		N
D.1	Enrolment		N
D.1.1	Number of minutiae		N
	The number of minutiae is a security sensitive parameter and depending on the security policy of the application.		N
D.1.2	The number of required finger presentations during an enrollment process is enrollment system dependent.		N
D.2	Comparison		N
	The verification data is subject to translation (in x- and y-direction), rotation (deviation of the orientation) and distortion.		N
D.2.1	The result of the comparing process is a score, which may denote the number of comparing minutiae or any other appropriate value.		N
D.2.2	For on-card comparison, a retry counter (which is decremented by subsequent negative verifications and set to its initial value by positive verification) has to be implemented in order to limit the number of trials.		N
D.3	Security aspects of finger minutiae presentation to the card		N

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
	Fingerprints are left everywhere and therefore this kind of biometric data are considered to be public.		N
E	**Annex E, Capture device certifications**		N
E.1	Image quality specification for AFIS systems		N
E.1.1	General		N
	These specifications apply to: (1) systems that scan and capture fingerprints1 in digital, softcopy form, including hardcopy scanners such as card scanners, and live scan devices, altogether called “fingerprint scanners”; and (2) systems utilizing a printer to print digital fingerprint images to hardcopy called “fingerprint printers.”		N
E.1.2	The fingerprint scanner shall be capable of producing images that exhibit good geometric fidelity,sharpness, detail rendition, gray-level uniformity, and gray-scale dynamic range, with low noise characteristics.		N
E.1.2.1	Linearity		N
E.1.2.1.1	Requirement		N
E.1.2.1.2	All targets used in this image quality specification compliance verification are expected to be scanned with the scanner operating in a linear input/output mode.		
E.1.2.2	Geometric accuracy		N
E.1.2.2.1	Requirement (across-bar)		N
E.1.2.2.2	Requirement (along-bar)		N
E.1.2.2.3	The phrase: *multiple, parallel bar target* refers to a Ronchi target, which consists of an equal-width bar and space square wave pattern at 1,0 cy/mm, with high contrast ratio and fine edge definition.		N
E.1.2.3	Spatial frequency response		N
E.1.2.3.1	Requirements		N
E.1.2.3.2	For MTF assessment, the single, representative sine wave modulation in each imaged sine wave frequency pattern is determined from the sample modulation values collected from within that pattern.		N
E.1.2.4	Signal-to-noise ratio		N
E.1.2.4.1	Requirement		N
	The white signal-to-noise ratio and black signal-to-noise ratio shall each be greater than or equal to 125,0 in at least 97,0 percent of respective cases within each print block measurement area.		N
E.1.2.4.2	Background		N
E.1.2.5	Gray-level uniformity		N
E.1.2.5.1	Requirement – adjacent row, column uniformity		N
E.1.2.5.2	Requirement – pixel-to-pixel uniformity		N

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Clause	Requirement + Test	Result - Remark	Verdict
E.1.2.5.3	Requirement – small area uniformity		N
E.1.2.5.4	Measurements are made over multiple, independent test areas on a print block-by-print block basis.		N
E.1.2.6	The scanner shall provide high quality fingerprint images; the quality will be assessed with respect to the following requirements.		N
E.1.2.6.1	Requirement – Fingerprint gray range		N
E.1.2.6.2	Card and live scan systems at a booking station have some control over dynamic range on a subject-bysubject or card-by-card basis, e.g., by rolling an inked finger properly or by adjusting gain on a livescanner.		N
E.1.2.6.3	Requirement – Fingerprint artifacts and anomalies		N
E.1.2.6.4	Background		N
E.1.2.6.5	Requirement – Fingerprint sharpness & detail rendition		N
E.1.2.6.6	Fingerprint sharpness and detail rendition that is due to the scanner or image processing may be investigated by employing suitable, objective image quality metrics, as well as by visual observation of the softcopydisplayed image.		N
E.1.3	Identification flats		N
	Traditional fingerprint sets contain both rolled and plain fingerprint images.		N
E.1.3.1	The system shall provide a simple capture protocol.		N
E.1.3.2	A simple capture protocol supports the inexperienced user's ability to more consistently capture high quality fingerprints.		N
E.1.3.3	The method of capturing the fingers shall result in very low probability of error in the finger numbers.		N
E.1.3.4	The fingerprinting system's capture protocol will be evaluated for its ability to capture verifiable finger sequence data.		N
E.2	Image quality specification for personal verification		N
E.2.1	General		N
	These specifications apply to fingerprint capture devices which scan and capture at least a single fingerprint in digital, softcopy form.		N
E.2.2	The compliance test procedures are out of scope of this Annex.		N
E.2.2.1	Geometric accuracy		N
E.2.2.1.1	A multiple, parallel bar target with a one cy/mm frequency is captured in vertical bar and horizontal bar orientations.		N
E.2.2.1.2	A multiple, parallel bar target with a one cy/mm frequency is captured in vertical bar and horizontal bar orientations.		N

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Clause	Requirement + Test	Result - Remark	Verdict
E.2.2.1.3	The phrase: *multiple, parallel bar target* refers to a Ronchi target, which consists of an equal width bar and space square wave pattern at 1,0 cy/mm, with high contrast ratio and fine edge definition.		N
E.2.2.2	Spatial frequency response (SFR)		N
E.2.2.2.1	Requirements		N
	The spatial frequency response shall normally be measured by either using a bi-tonal, high contrast bar target, which results in the device's Contrast Transfer Function (CTF), or by using a continuous-tone sine wave target, which results in the device's Modulation Transfer Function (MTF).		N
E.2.2.2.2	The 1,12 upper limit for modulation is to discourage image processing that produces excessive edge sharpening, which can add false detail to an image and/or excessive noise.		N
E.2.2.3	Gray-level uniformity		N
E.2.2.3.1	Requirement #1 - adjacent row, column uniformity		N
E.2.2.3.2	Requirement #2 - pixel to pixel uniformity		N
E.2.2.3.3	Requirement #3- small area uniformity		N
E.2.2.3.4	Requirement #4 - Noise		N
E.2.2.3.5	Any suitable uniform light gray target and dark gray target may be used for measuring requirements #1 to #4, including a pseudo-target.		N
E.2.2.4	Fingerprint image quality		N
E.2.2.4.1	At least 80,0 % of the captured individual fingerprint images shall have a gray-scale dynamic range of at least 150 gray-levels.		N
E.2.2.4.2	Dynamic range is computed in terms of number of gray-levels present that have signal content, measuring within the fingerprint area and substantially excluding non-uniform background areas.		N
E.2.2.4.3	Requirement #2 - Fingerprint Artifacts and Anomalies		N
E.2.2.4.4	Background		N
E.2.2.4.5	The sharpness and detail rendition of the fingerprint images, due to the device or image processing, shall be high enough to support the intended applications.		N
E.2.2.4.6	Background		N
E.3	Requirements and test procedures for optical fingerprint scanners		N
E.3.1	This annex details requirements and testing procedures for high quality optical fingerprint scanners.		N
E.3.2	Testing prerequisites		N
E.3.2.1	All measurements have to be performed within a completely darkened optical laboratory without the influence of external light sources.		N

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Clause	Requirement + Test	Result - Remark	Verdict
E.3.2.2	For the test of the fingerprint scanner the manufacturer has to state the exact optical principle of the scanner, including necessary drawings (or pictures, tables).		N
E.3.2.3	The software to evaluate the fingerprint digital image data has to compute image quality based on the twodimensional spatial frequency power spectrum of the fingerprint digital image.		N
E.3.2.4	Demands on the test targets		N
E.3.2.4.1	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the bright field		N
E.3.2.4.2	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the dark field		N
E.3.3	Requirements and test procedures		N
E.3.3.1	Investigation of the grayscale linearity		N
E.3.3.1.1	Requirements		N
E.3.3.1.2	All targets used within this test case are expected to be scanned with the scanner operating in a linear input/output mode.		N
E.3.3.1.3	Used targets		N
E.3.3.1.3.1	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the bright field		N
E.3.3.1.3.2	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the dark field		N
E.3.3.1.4	Test procedure		N
E.3.3.1.4.1	A series of fields with different reflection values have to be placed one after another on the fingerprint scanner and an image of each target has to be recorded.		N
E.3.3.1.4.2	Adjacent the average gray value of each target image shall be determined with a suitable software.		N
E.3.3.1.4.3	For those pairs of values a linear regression shall be performed.		N
E.3.3.1.5	None of the calculated differences in test step 3 is allowed to be larger than 7,65 gray values.		N
E.3.3.2	Investigation of the spatial sampling rate and geometrical accuracy		N
E.3.3.2.1	Requirements		N
	Spatial sampling rate: The scanner's final output fingerprint image shall have a spatial sampling rate, in both sensor detector row and column directions, in the range: (R – 0,01R) to (R + 0,01R).		N
E.3.3.2.2	A multiple parallel bar target refers to a Ronchi target, which consists of an equal-width bar and space square wave pattern with high contrast ratio and sharp edge definition.		N
E.3.3.2.3	Used targets		N

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Clause	Requirement + Test	Result - Remark	Verdict
E.3.3.2.3.1	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the bright field		N
E.3.3.2.3.2	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the dark field		N
E.3.3.2.4	Test procedure		N
E.3.3.2.4.1	The targets have to be placed with immersion liquid or similar on the recording surface of the fingerprint scanner.		N
E.3.3.2.4.2	The pixels coordinates of the edges of the stripe field in the recorded image are determined.		N
E.3.3.2.4.3	Based on the results of test step 2 and the well known grating period of the test target (1 mm) the spatial sampling rate of the scanner at different positions within the image can be determined.		N
E.3.3.2.5	The values listed under “Requirements” within this test case have to be completely met.		N
E.3.3.3	Investigation of the contrast transfer function		N
E.3.3.3.1	The spatial frequency response shall be measured using a binary grid target (Ronchi-Grating), denoted as contrast transfer function (CTF) measurement.		N
E.3.3.3.2	A multiple parallel bar target refers to a Ronchi target, which consists of an equal-width bar and space square wave pattern with high contrast ratio and sharp edge definition.		N
E.3.3.3.3	Used targets		N
E.3.3.3.3.1	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the bright field		N
E.3.3.3.3.2	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the dark field		N
E.3.3.3.4	Test procedure		N
E.3.3.3.4.1	The targets have to be placed on the recording surface (see ’Demands on the tast targets’ section).		N
E.3.3.3.4.2	Adjacent within the recorded images the coordinates of the edges of a rectangular surrounding all gratings are determined.		N
E.3.3.3.4.3	The determined CTF values have to be corrected by using the real/measured modulation of the target (see ’Target’ section).		N
E.3.3.3.5	The values listed under “Requirements” within this test case have to be completely met.		N
E.3.3.4	Investigation of the signal-to-noise ratio and the gray–level uniformity		N
E.3.3.4.1	The white signal-to-noise ratio (SNR) and black SNR shall each be greater than or equal to 125,0, in at least 97% of respective cases, within each measurement area.		N

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Clause	Requirement + Test	Result - Remark	Verdict
E.3.3.4.2	Background		N
E.3.3.4.3	Used targets		N
E.3.3.4.3.1	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the bright field		N
E.3.3.4.3.2	Test targets for optical fingerprint scanner working on the principle of frustrated total internal reflection in the dark field		N
E.3.3.4.4	Test procedure		N
E.3.3.4.4.1	For optical fingerprint scanners working on the principle of disturbed total reflection in the bright field: The filters have to be inserted in the optical beam path of the scanner (opened housing of the scanner) or the exposure time of the scanner has to be accordingly adjusted.		N
E.3.3.4.4.2	For determining the SNR the acquired pictures is divided into test fields of the size 0,25 inch *0,25 inch and the mean gray value, the number of false pixels, and the standard deviation of the gray values of all rows and columns of this test field are determined.		N
E.3.3.4.5	The values listed under “Requirements” within this test case have to be completely fulfilled.		N
E.3.3.5	Investigation of the gray scale range of fingerprint images		N
E.3.3.5.1	Requirements		N
E.3.3.5.2	This test shows the scanner performance in normal operation mode.		N
E.3.3.5.3	No targets are used in this test case.		N
E.3.3.5.4	Test procedure		N
E.3.3.5.4.1	The test persons have to place their finger one after another on the image capture area of the fingerprint scanner.		N
E.3.3.5.4.2	The histograms of all images are evaluated according to the previously listed requirements.		N
E.3.3.5.5	The values listed under “Requirements” within this test case have to be completely met.		N
F	**Annex F, Detailed description of finger minutiae location, direction, and type**		N
F.1	General		N
	Even if all conform to this part of ISO/IEC 19794, different minutiae data blocks extracted from the same finger image may differ not only in the exact locations, the directions, and the types of those minutiae that they have in common, but also in the number of minutiae they contain, especially in blurred fingerprint regions where even the "manual" detection of minutiae is hard.		N
F.2	Terms and definitions		N
	For the purposes of this informative annex, the following terms and definitions apply.		N

ISO-IEC-19794-2			
Clause	Requirement + Test	Result - Remark	Verdict
F.3	Minutiae detection strategy		N
F.3.1	Minutia detection algorithms may use different discriminative practices in the minutia detection strategy.		N
F.3.2	No minutia should be set outside the fingerprint boundary.		N
F.3.3	No minutia should be set at a sweat pore.		N
F.3.4	No minutia should be set where thick ridges touch each other.		N
F.3.5	No minutia should be set at an incipient (very short and thin) ridge.		N
F.3.6	No minutia should be set at a crease (accidental interruption of ridges).		N
F.3.7	No minutia should be set at a core.		N
F.3.8	No minutia should be set at a delta.		N
F.4	Minutia characteristics		N
F.4.1	This document should not standardize certain algorithms as laid down in the scope.		N
F.4.2	The minutia type cannot be determined reliably in some occasions.		N
F.4.3	Minutia location tools		N
F.4.3.1	Consideration of the spatial sampling rate of the underlying finger image		N
F.4.3.2	Every gray scale fingerprint image can be transformed into a binary image.		N
F.4.3.3	Skeletonization is a standard procedure in graphing practice.		N
F.4.3.4	Every fingerprint image has a well defined directional image expressing the local dominant ridge flow direction.		N
F.4.4	The ridge gradient method relies on moving along the ridge line until a minutia condition occurs, which is either forking or ending of the ridge.		N
F.4.4.1	Minutia location at a ridge skeleton endpoint		N
F.4.4.2	The border at a ridge bifurcation is well defined.		N
F.4.4.3	Analogical rules as for ridge skeleton bifurcation points apply also for valley skeleton bifurcation points.		N
F.4.4.4	This part of 19794 defines the minutia direction at a ridge skeleton endpoint as the angle measured counterclockwise from the positive X axis to the tangent to the skeleton, at the ridge skeleton endpoint.		N
F.4.4.5	Minutia direction at a ridge skeleton bifurcation point		N
F.4.4.6	Minutia direction at a valley skeleton bifurcation point		N
F.4.5	Valley skeletal bifurcation method		N
F.4.5.1	Minutia location at a valley skeleton bifurcation		N
F.4.5.2	Minutia location at a ridge skeleton bifurcation		N

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Clause	Requirement + Test	Result - Remark	Verdict
F.4.5.3	Determination of the minutia direction can be extracted from each skeleton bifurcation.		N
F.4.5.4	Determination of the minutia direction can be extracted from each skeleton bifurcation.		N
F.4.6	The value should correspond to the likelihood that the current minutia is not a false minutia.		N
F.5	The following shows a sample image with extracted minutia data.		N

Attachment No. 2: PHOTO

Fig. 1

Fig. 2

Fig. 3

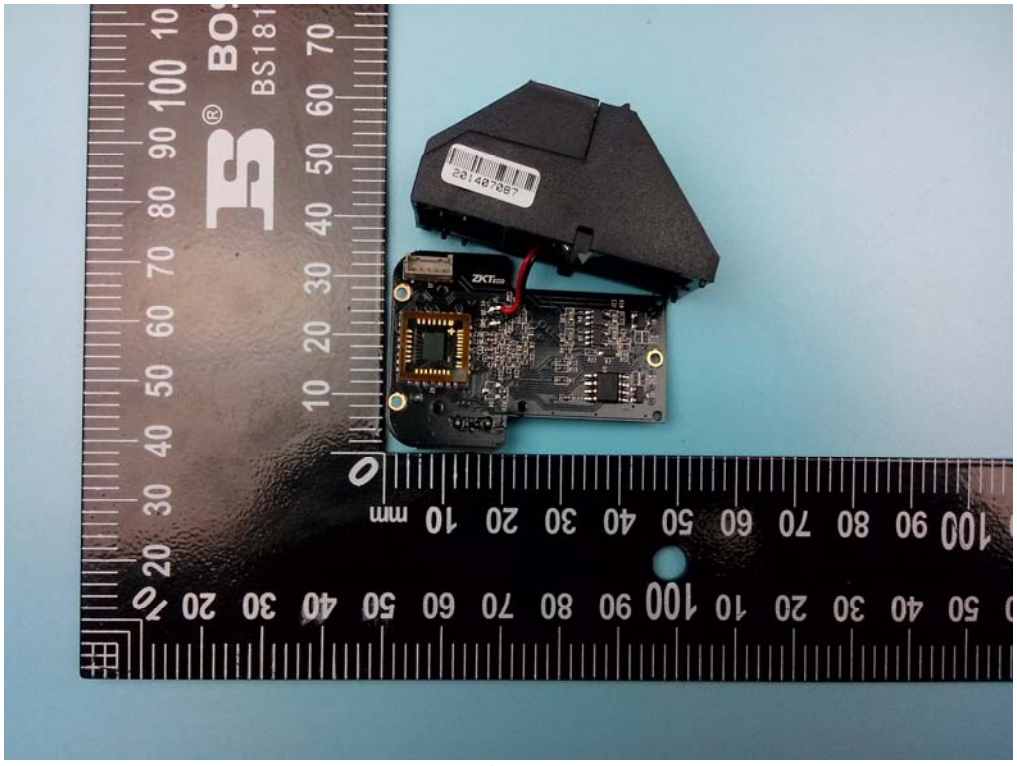

Fig. 4

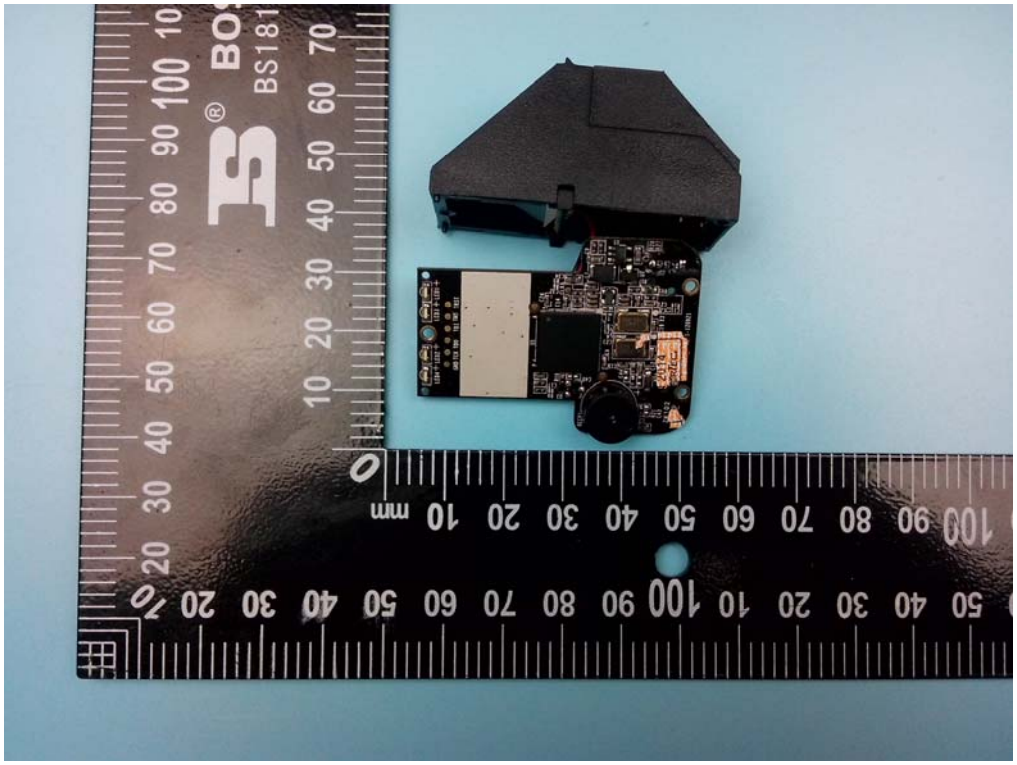

Fig. 5

===== End of Test Report =====