

Certification Report

BSI-DSZ-CC-1113-V5-2023

for

**Infineon Technologies AG OPTIGA™ Trusted
Platform Module SLB9672_2.0 v15.20.15686.00,
v15.21.16430.00, v15.22.16832.00 und
v15.23.17664.00**

from

Infineon Technologies AG

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Deutsches  **IT-Sicherheitszertifikat**
erteilt vom Bundesamt für Sicherheit in der Informationstechnik

BSI-DSZ-CC-1113-V5-2023 (*)

Trusted Platform Module

**Infineon Technologies AG OPTIGA™ Trusted Platform Module
SLB9672_2.0 v15.20.15686.00, v15.21.16430.00, v15.22.16832.00 und
v15.23.17664.00**

from Infineon Technologies AG

PP Conformance: Protection Profile PC Client Specific TPM, TPM
Library specification Family "2.0", Level 0 Revision
1.59, Version: 1.3, Date: 2021-09-29, ANSSI-CC-
PP-2021/02

Functionality: PP conformant
Common Criteria Part 2 extended

Assurance: Common Criteria Part 3 conformant
EAL 4 augmented by AVA_VAN.4 and ALC_FLR.1

valid until: 5 July 2028



SOGIS
Recognition Agreement



Common Criteria
Recognition Arrangement
recognition for components
up to EAL 2 and ALC_FLR
only

The IT Product identified in this certificate has been evaluated at an approved evaluation facility using the Common Methodology for IT Security Evaluation (CEM), Version 3.1 extended by Scheme Interpretations and CC Supporting Documents as listed in the Certification Report for conformance to the Common Criteria for IT Security Evaluation (CC), Version 3.1. CC and CEM are also published as ISO/IEC 15408 and ISO/IEC 18045.

(*) This certificate applies only to the specific version and release of the product in its evaluated configuration and in conjunction with the complete Certification Report and Notification. For details on the validity see Certification Report part A chapter 5.

The evaluation has been conducted in accordance with the provisions of the certification scheme of the German Federal Office for Information Security (BSI) and the conclusions of the evaluation facility in the evaluation technical report are consistent with the evidence adduced.

This certificate is not an endorsement of the IT Product by the Federal Office for Information Security or any other organisation that recognises or gives effect to this certificate, and no warranty of the IT Product by the Federal Office for Information Security or any other organisation that recognises or gives effect to this certificate, is either expressed or implied.

Bonn, 6 July 2023

For the Federal Office for Information Security

Matthias Intemann
Head of Section

L.S.



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A. Certification

1. Preliminary Remarks

Under the BSIG¹ Act, the Federal Office for Information Security (BSI) has the task of issuing certificates for information technology products.

Certification of a product is carried out on the instigation of the vendor or a distributor, hereinafter called the sponsor.

A part of the procedure is the technical examination (evaluation) of the product according to the security criteria published by the BSI or generally recognised security criteria.

The evaluation is normally carried out by an evaluation facility recognised by the BSI or by BSI itself.

The result of the certification procedure is the present Certification Report. This report contains among others the certificate (summarised assessment) and the detailed Certification Results.

The Certification Results contain the technical description of the security functionality of the certified product, the details of the evaluation (strength and weaknesses) and instructions for the user.

2. Specifications of the Certification Procedure

The certification body conducts the procedure according to the criteria laid down in the following:

- Act on the Federal Office for Information Security¹
- BSI Certification and Approval Ordinance²
- BMI Regulations on Ex-parte Costs³
- Special decrees issued by the Bundesministerium des Innern und für Heimat (Federal Ministry of the Interior and Community)
- DIN EN ISO/IEC 17065 standard
- BSI certification: Scheme documentation describing the certification process (CC-Produkte) [3]
- BSI certification: Scheme documentation on requirements for the Evaluation Facility, its approval and licencing process (CC-Stellen) [3]
- Common Criteria for IT Security Evaluation (CC), Version 3.1⁴ [1] also published as ISO/IEC 15408

¹ Act on the Federal Office for Information Security (BSI-Gesetz - BSIG) of 14 August 2009, Bundesgesetzblatt I p. 2821

² Ordinance on the Procedure for Issuance of Security Certificates and approval by the Federal Office for Information Security (BSI-Zertifizierungs- und -Anerkennungsverordnung - BSIZertV) of 17 December 2014, Bundesgesetzblatt 2014, part I, no. 61, p. 2231

³ BMI Regulations on Ex-parte Costs - Besondere Gebührenverordnung des BMI für individuell zurechenbare öffentliche Leistungen in dessen Zuständigkeitsbereich (BMIBGebV), Abschnitt 7 (BSI-Gesetz) - dated 2 September 2019, Bundesgesetzblatt I p. 1365

- Common Methodology for IT Security Evaluation (CEM), Version 3.1 [2] also published as ISO/IEC 18045
- BSI certification: Application Notes and Interpretation of the Scheme (AIS) [4]

3. Recognition Agreements

In order to avoid multiple certification of the same product in different countries a mutual recognition of IT security certificates - as far as such certificates are based on ITSEC or CC - under certain conditions was agreed.

3.1. European Recognition of CC – Certificates (SOGIS-MRA)

The SOGIS-Mutual Recognition Agreement (SOGIS-MRA) Version 3 became effective in April 2010. It defines the recognition of certificates for IT-Products at a basic recognition level and, in addition, at higher recognition levels for IT-Products related to certain SOGIS Technical Domains only.

The basic recognition level includes Common Criteria (CC) Evaluation Assurance Levels EAL 1 to EAL 4. For "Smartcards and similar devices" a SOGIS Technical Domain is in place. For "HW Devices with Security Boxes" a SOGIS Technical Domains is in place, too. In addition, certificates issued for Protection Profiles based on Common Criteria are part of the recognition agreement.

The current list of signatory nations and approved certification schemes, details on recognition, and the history of the agreement can be seen on the website at <https://www.sogis.eu>.

The SOGIS-MRA logo printed on the certificate indicates that it is recognised under the terms of this agreement by the related bodies of the signatory nations. A disclaimer beneath the logo indicates the specific scope of recognition.

This certificate is recognized under SOGIS-MRA for all assurance components selected.

3.2. International Recognition of CC – Certificates (CCRA)

The international arrangement on the mutual recognition of certificates based on the CC (Common Criteria Recognition Arrangement, CCRA-2014) has been ratified on 08 September 2014. It covers CC certificates based on collaborative Protection Profiles (cPP) (exact use), CC certificates based on assurance components up to and including EAL 2 or the assurance family Flaw Remediation (ALC_FLR) and CC certificates for Protection Profiles and for collaborative Protection Profiles (cPP).

The current list of signatory nations and approved certification schemes can be seen on the website: <https://www.commoncriteriaportal.org>.

The Common Criteria Recognition Arrangement logo printed on the certificate indicates that this certification is recognised under the terms of this agreement by the related bodies of the signatory nations. A disclaimer beneath the logo indicates the specific scope of recognition.

This certificate is recognized according to the rules of CCRA-2014, i. e. up to and including CC part 3 EAL 2 and ALC_FLR components.

⁴ Proclamation of the Bundesministerium des Innern und für Heimat of 12 February 2007 in the Bundesanzeiger dated 23 February 2007, p. 3730

4. Performance of Evaluation and Certification

The certification body monitors each individual evaluation to ensure a uniform procedure, a uniform interpretation of the criteria and uniform ratings.

The product Infineon Technologies AG OPTIGA™ Trusted Platform Module SLB9672_2.0 v15.20.15686.00, v15.21.16430.00, v15.22.16832.00 und v15.23.17664.00, has undergone the certification procedure at BSI. This is a re-certification based on BSI-DSZ-CC-1113-V4-2022. Specific results from the evaluation process BSI-DSZ-CC-1113-V4-2022 were re-used.

The evaluation of the product Infineon Technologies AG OPTIGA™ Trusted Platform Module SLB9672_2.0 v15.20.15686.00, v15.21.16430.00, v15.22.16832.00 und v15.23.17664.00, was conducted by TÜV Informationstechnik GmbH. The evaluation was completed on 31 May 2023. TÜV Informationstechnik GmbH is an evaluation facility (ITSEF)⁵ recognised by the certification body of BSI.

For this certification procedure the sponsor and applicant is: Infineon Technologies AG.

The product was developed by: Infineon Technologies AG.

The certification is concluded with the comparability check and the production of this Certification Report. This work was completed by the BSI.

5. Validity of the Certification Result

This Certification Report applies only to the version of the product as indicated. The confirmed assurance package is valid on the condition that

- all stipulations regarding generation, configuration and operation, as given in the following report, are observed,
- the product is operated in the environment described, as specified in the following report and in the Security Target.

For the meaning of the assurance components and assurance levels please refer to CC itself. Detailed references are listed in part C of this report.

The Certificate issued confirms the assurance of the product claimed in the Security Target at the date of certification. As attack methods evolve over time, the resistance of the certified version of the product against new attack methods needs to be re-assessed. Therefore, the sponsor should apply for the certified product being monitored within the assurance continuity program of the BSI Certification Scheme (e.g. by a re-assessment or re-certification). Specifically, if results of the certification are used in subsequent evaluation and certification procedures, in a system integration process or if a user's risk management needs regularly updated results, it is recommended to perform a re-assessment on a regular e.g. annual basis.

In order to avoid an indefinite usage of the certificate when evolved attack methods would require a re-assessment of the products resistance to state of the art attack methods, the maximum validity of the certificate has been limited. The certificate issued on 6 July 2023 is valid until 5 July 2028. Validity can be re-newed by re-certification.

The owner of the certificate is obliged:

⁵ Information Technology Security Evaluation Facility

1. when advertising the certificate or the fact of the product's certification, to refer to the Certification Report as well as to provide the Certification Report, the Security Target and user guidance documentation mentioned herein to any customer of the product for the application and usage of the certified product,
2. to inform the Certification Body at BSI immediately about vulnerabilities of the product that have been identified by the developer or any third party after issuance of the certificate,
3. to inform the Certification Body at BSI immediately in the case that security relevant changes in the evaluated life cycle, e.g. related to development and production sites or processes, occur, or the confidentiality of documentation and information related to the Target of Evaluation (TOE) or resulting from the evaluation and certification procedure where the certification of the product has assumed this confidentiality being maintained, is not given any longer. In particular, prior to the dissemination of confidential documentation and information related to the TOE or resulting from the evaluation and certification procedure that do not belong to the deliverables according to the Certification Report part B, or for those where no dissemination rules have been agreed on, to third parties, the Certification Body at BSI has to be informed.

In case of changes to the certified version of the product, the validity can be extended to the new versions and releases, provided the sponsor applies for assurance continuity (i.e. re-certification or maintenance) of the modified product, in accordance with the procedural requirements, and the evaluation does not reveal any security deficiencies.

6. Publication

The product Infineon Technologies AG OPTIGA™ Trusted Platform Module SLB9672_2.0 v15.20.15686.00, v15.21.16430.00, v15.22.16832.00 und v15.23.17664.00, has been included in the BSI list of certified products, which is published regularly (see also Internet: <https://www.bsi.bund.de> and [5]). Further information can be obtained from BSI-Infoline +49 228 9582-111.

Further copies of this Certification Report can be requested from the developer⁶ of the product. The Certification Report may also be obtained in electronic form at the internet address stated above.

⁶ Infineon Technologies AG
Am Campeon 1-15
85579 Neubiberg

B. Certification Results

The following results represent a summary of

- the Security Target of the sponsor for the Target of Evaluation,
- the relevant evaluation results from the evaluation facility, and
- complementary notes and stipulations of the certification body.

1. Executive Summary

The Target of Evaluation (TOE) is the Trusted Platform Module SLB9672_2.0 v15 (or SLB9672_2.0 in short), version v15.20.15686.00, v15.21.16430.00, v15.22.16832.00 and v15.23.17664.00, including related guidance documentation as described in the Security Target [6].

The TOE is an integrated circuit and software platform that provides computer manufacturers with the core components of a subsystem used to assure authenticity, integrity and confidentiality in e-commerce and internet communications within a Trusted Computing Platform. The SLB9672_2.0 is a complete solution implementing the version 2.0 of the TCG Trusted Platform Module Library Family “2.0” Revision 01.59 Specification and the TCG PC Client Specific Platform TPM Profile (PTP) Family “2.0”.

The SLB9672_2.0 uses the Serial Peripheral Interface (SPI) for the integration into existing PC mainboards. The SLB9672_2.0 is basically a secure controller with the following added functionality:

- Random number generator (DRBG),
- Asymmetric key generation (RSA keys with key length 1024, 2048, 3072 and 4096 bits, EC keys with key length 256 bits and 384 bits),
- Symmetric key generation (AES keys with 128 and 256 bits),
- Symmetric and asymmetric key procedures (encryption/decryption, generation and verification of digital signatures),
- Hash algorithms (SHA-1, SHA-256, SHA-384) and MAC (HMAC),
- Secure key and data storage,
- Identification and Authorization mechanisms.

The Security Target [6] is the basis for this certification. It is based on the certified Protection Profile Protection Profile PC Client Specific TPM, TPM Library specification Family “2.0”, Level 0 Revision 1.59, Version: 1.3, Date: 2021-09-29, ANSSI-CC-PP-2021/02 [8].

The TOE Security Assurance Requirements (SAR) are based entirely on the assurance components defined in Part 3 of the Common Criteria (see part C or [1], Part 3 for details). The TOE meets the assurance requirements of the Evaluation Assurance Level EAL 4 augmented by AVA_VAN.4 and ALC_FLR.1.

The TOE Security Functional Requirements (SFR) relevant for the TOE are outlined in the Security Target [6], chapter 7.2. They are selected from Common Criteria Part 2 and some of them are newly defined. Thus the TOE is CC Part 2 extended.

The TOE Security Functional Requirements are implemented by the following TOE Security Functionality:

TOE Security Functionality	Addressed issue
SF_CRY	Cryptographic Support
SF_I&A	Identification and Authentication
SF_G&T	General and Test
SF_OBH	Object Hierarchy

TOE Security Functionality	Addressed issue
SF_TOP	TOE Operation

Table 1: TOE Security Functionalities

For more details please refer to the Security Target [6], chapter 8.1.

The assets to be protected by the TOE are defined in the Security Target [6], chapter 4.1. Based on these assets the TOE Security Problem is defined in terms of Assumptions, Threats and Organisational Security Policies. This is outlined in the Security Target [6], chapters 4.1, 4.2 and 4.3.

This certification covers the configurations of the TOE as outlined in chapter 8 of this report.

The vulnerability assessment results as stated within this certificate do not include a rating for those cryptographic algorithms and their implementation suitable for encryption and decryption (see BSI Section 9, Para. 4, Clause 2).

The certification results only apply to the version of the product indicated in the certificate and on the condition that all the stipulations are kept as detailed in this Certification Report. This certificate is not an endorsement of the IT product by the Federal Office for Information Security (BSI) or any other organisation that recognises or gives effect to this certificate, and no warranty of the IT product by BSI or any other organisation that recognises or gives effect to this certificate, is either expressed or implied.

2. Identification of the TOE

The Target of Evaluation (TOE) is called:

**Infineon Technologies AG OPTIGA™ Trusted Platform Module SLB9672_2.0
v15.20.15686.00, v15.21.16430.00, v15.22.16832.00 und v15.23.17664.00,**

The following table outlines the TOE deliverables:

No.	Type	Item / Identifier	Release / Version	Form of Delivery
1.	HW/SW	OPTIGA™ Trusted Platform Module SLI9672_2.0	v15.20.15686.00 and v15.21.16430.00 and v15.22.16832.00 and v15.23.17664.00	Packaged module
2.	DOC	OPTIGA™ TPM, SLB 9672 TPM2.0, Databook (for v15.20.15686.00)	Revision 1.1, 2021-02-10	PDF-file
3.	DOC	OPTIGA™ TPM, SLB 9672 TPM2.0, Databook (for v15.21.16430.00)	Revision 1.4, 2021-06-30	PDF-file
4.	DOC	OPTIGA™ TPM, SLB 9672 TPM2.0, Databook (for v15.22.16832.00)	Revision 1.6, 2022-03-09	PDF-file
5.	DOC	OPTIGA™ TPM, SLB 9672 TPM2.0, Databook (for v15.23.17664.00)	Revision 1.8, 2023-04-27	PDF-file

No.	Type	Item / Identifier	Release / Version	Form of Delivery
6.	DOC	OPTIGA™ TPM, SLB 9672 TPM2.0, Application Note User Guidance	Revision 1.02, 2021-06-08	PDF-file
7.	DOC	OPTIGA™ TPM, SLB 9672 TPM2.0 FW15.xx, Errata and Updates	Revision 1.7, 2023-03-21	PDF-file
8.	DOC	Trusted Platform Module Library, Part 1: Architecture, Family "2.0" Level 00 Revision 01.59	Revision 01.59, 2019-11-08	Public document, downloadable from https://www.trustedcomputinggroup.org
9.	DOC	Trusted Platform Module Library, Part 2: Structures, Family "2.0" Level 00 Revision 01.59	Revision 01.59, 2019-11-08	Public document, downloadable from https://www.trustedcomputinggroup.org
10.	DOC	Trusted Platform Module Library, Part 3: Commands, Family "2.0" Level 00 Revision 01.59	Revision 01.59, 2019-11-08	Public document, downloadable from https://www.trustedcomputinggroup.org
11.	DOC	Trusted Platform Module Library, Part 4: Supporting Routines, Family "2.0" Level 00 Revision 01.59	Revision 01.59, 2019-11-08	Public document, downloadable from https://www.trustedcomputinggroup.org
12.	DOC	TCG PC Client Platform TPM Profile Specification for TPM 2.0	Version 01.05, Revision 14, 2020-09-04	Public document, downloadable from https://www.trustedcomputinggroup.org
13.	DOC	Errata for TCG Trusted Platform Module Library, Family "2.0" Level 00 Revision 1.59 November 8, 2019	Version 1.1, 2020-06-18	Public document, downloadable from https://www.trustedcomputinggroup.org

Table 2: Deliverables of the TOE

TOE Identification

The TOE hardware and firmware is identified by name and version number as listed in the following table:

Type	Name	Version number
Security IC with integrated firmware	OPTIGA™ Trusted Platform Module SLB9672_2.0	v15.20.15686.00 and v15.21.16430.00 and v15.22.16832.00 and v15.23.17664.00

Table 3: Identifiers of the TOE

The fabricated modules are physically labelled with the TOE reference by printing. The labelling consists of four lines:

Line	Label	Remark
0	Infineon	Logo and name of producer
1	SLB9672	—
2	VU20 yy or XU20 yy	The <yy> is an internal FW indication (only at manufacturing due to field upgrade option)

Line	Label	Remark
3	<Lot number> H <datecode>	-

Table 4: Labelling of TOE module

The version information of the TOE can be read out electronically with the command TPM2_GetCapability. The vendor specific return values for the TOE are defined as listed in the following table:

Property	Vendor specific value
TPM_PT_MANUFACTURER	“IFX”
TPM_PT_VENDOR_STRING_1	“SLB9”
TPM_PT_VENDOR_STRING_2	“672”
TPM_PT_VENDOR_STRING_3	NULL
TPM_PT_VENDOR_STRING_4	NULL
TPM_PT_FIRMWARE_VERSION_1	Major and minor version, e.g. 0x000F0014 indicates v15.20, 0x000F0015 indicates v15.21, 0x000F0016 indicates v15.22, and 0x000F0017 indicates v15.23.
TPM_PT_FIRMWARE_VERSION_2	Build number (for instance, 0x00450000 or 0x00450002) Byte 1: reserved for future use (0x00) Byte 2 and 3: Build number (for instance, 0x4500) Byte 4: Common Criteria certification state: 0x00 = TPM operational mode/TPM is CC certified, 0x02 = TPM operational mode/TPM is not certified, 0x60 = Manually entered TPM firmware recovery mode (triggered externally for testing purposes) 0x61 = TPM firmware recovery mode (triggered by code integrity failure detection) 0x62 = TPM firmware update mode
TPM_PT_MODES	Bit 0 (FIPS_140_2) = 1 Bits 1...31 = 0

Table 5: Vendor specific properties of TPM2_GetCapability

TOE Delivery

As the TOE is a security IC product it can be delivered only in form complete mounted IC's. Only TOEs, which have undergone and passed all the production tests are delivered in the state user mode.

The production of the TOE wafers will be performed at TSMC Tainan (Fab14A), Taiwan (see [6], 2.2.5).

The TOE is delivered in form of complete chips which include the hardware, the firmware, the Endorsement Primary Seed, one RSA Endorsement Key, two ECC Endorsement Keys and three Endorsement Certificates. The delivery of the TOE is done from a distribution center by postal transfer or delivery courier.

The delivery from Infineon Technologies (the TOE Manufacturer) to the Platform manufacturer is an external delivery process and done from the site IFX Munich.

The TOE is delivered via the logistics sites: DHL Singapore, KWE Shanghai, and K&N Großostheim.

The individual TOE hardware is uniquely identified by its identification data. The identification data contains the lot number, the wafer number and the coordinates of the chip on the wafer. Each individual TOE can therefore be traced unambiguously and thus assigned to the entire development and production process.

The delivery documentation describes all procedures that are necessary to maintain security when distributing versions of the TOE or parts of it to the user's site including the necessary intermediate delivery procedures.

3. Security Policy

The security policy enforced is defined by the selected set of Security Functional Requirements and implemented by the TOE. It covers the following issues:

- Cryptographic Support: generation of random numbers, generation of asymmetric key pairs, RSA and ECC digital signature (generation and verification), RSA, ECC and AES data encryption and decryption, key destruction, the generation of hash values and the generation and verification of MAC values.
- Identification and Authentication: mechanisms for the identification and authentication capability to authorize the use of a Protected Object and Protected Capability using authentication values or policies.
- General and Test: provision and enforcement of the TPM role model, startup- and self tests, preservation of secure state in case of failures or shutdown, and resistance to physical manipulation or probing.
- Object Hierarchy: state control on all subjects, objects and operations, modification of security attributes, provision of TPM hierarchy model, monitoring of data storage, enforcement of object hierarchy.
- TOE Operation: access control on different subjects, objects and operations, enforcement of different rules of operation and interaction between subjects and objects, enabling and disabling of functions, enforcement of NVM restrictions, and creation of evidence of origin.

Specific details concerning the above mentioned security policies can be found in chapter 8 of the Security Target [6].

4. Assumptions and Clarification of Scope

The Assumptions defined in the Security Target and some aspects of Threats and Organisational Security Policies are not covered by the TOE itself. These aspects lead to specific security objectives to be fulfilled by the TOE-Environment. The following topics are of relevance: (Details can be found in the ST [6], chapter 5.2.)

- OE.Configuration: The TOE must be installed and configured properly for starting up the TOE in a secure state. The security attributes of subjects and objects shall be managed securely by the authorised user.
- OE.Locality: The developer of the host platform must ensure that trusted processes indicate their correct locality to the TPM and untrusted processes are able to assert just the locality 0 or Legacy only to the TPM.
- OE.Credential: The IT environment must create EK and AK credentials by trustworthy procedures for the root of trust for reporting.

- OE.Measurement: The platform part of the root of trust for measurement provides a representation of embedded data or program code (measured values) to the TPM for measurement.
- OE.FieldUpgradeInfo: The developer via AGD documentation will instruct the admin doing the upgrade how to do the upgrade and that the admin should inform the end user regarding the Field Upgrade process , its result, whether the installed firmware is certified or not, and the version of the certified TPM.
- OE.ECDAA: The ECDAA issuer must support a procedure for attestation without revealing the attestation information based on the ECDAA signing operation.

5. Architectural Information

The SLB9672_2.0 consists of **hardware** and **firmware** components.

The **hardware** of the TOE consists of the following parts: Security Peripherals (filters, sensors), Core System, Memories, Coprocessors, Random number generator (RNG), Checksum module (CRC), Interrupt module (INT), Timer (TIM), Buses (BUS), Serial Peripheral Interface (SPI), GPIO interface and the Tick Counter.

The **firmware** of the TOE includes an operating system that provides the functionality specified by the Trusted Platform Module Library specification. The chip initialisation routine with security checks and identification mode as well as test routines for production testing are located in a separate test ROM. The firmware also provides the mechanism for updating the protected capabilities once the TOE is in the field as defined in the Field Upgrade procedure in the Trusted Platform Module Library specification and User Guidance.

The entire firmware of the TOE as defined in the PP [8] is comprised of: Boot Software (BOS), Professional Secure Operating System (PSOS), Cryptographic Libraries (ACL, SCL, HCL, RCL), Hardware Support Library (HSL), FieldUpgrade (CFUL), TPM2.0 Application (APP).

6. Documentation

The evaluated documentation as outlined in table 2 is being provided with the product to the customer. This documentation contains the required information for secure usage of the TOE in accordance with the Security Target.

Additional obligations and notes for secure usage of the TOE as outlined in chapter 10 of this report have to be followed.

7. IT Product Testing

7.1. Developer's Test according to ATE_FUN

The tests performed by the **developer** according to ATE_FUN were divided into six categories: Simulation Tests (design verification), Qualification Tests, Verification Tests, Security Evaluation Tests, Production Tests, and Software Tests.

The evaluator has checked the simulation tests, qualification tests, and security evaluation tests of the developer by sampling. The evaluator's sample of developer tests performed covers all portions of the TSF (security features) and related interfaces.

Overall the TSF have been tested against the functional specification, the TOE design and the security architecture description. The tests demonstrate that the TSF performs as specified.

7.2. Evaluator Tests – Independent Testing according to ATE_IND

The **evaluator's** testing effort according to ATE_IND is described as follows, outlining the testing approach, configuration, depth and results.

The evaluator's objective regarding this aspect was to test the functionality of the TOE as described in [6], and to verify the developer's test results by repeating developer's tests and additionally add independent tests. In the course of the evaluation of the TOE the following classes of tests were carried out: Module tests, Simulation tests, Emulation tests, Tests in user mode, Tests in test mode, Hardware tests, and Software tests. With this kind of tests the entire security functionality of the TOE was tested.

TOE test configuration:

The tests are performed with the chips OPTIGA™ Trusted Platform Module SLB9672_2.0 v15, uniquely identified by their serial numbers and version information. For the tests different chip types are prepared. One of these types is the configuration which is finally delivered to the user. The others contain special download functionality for test programs or have some security mechanisms deactivated. The entire functionality is the same for all chips.

All security features (portions of the TSF) and related interfaces were tested. Therefore no selection criteria are applied. All security features and related interfaces are tested regarding their functional behavior. The tests were chosen to perform at minimum one test for each security feature of TSF and related interfaces.

Verdict for the activity:

The results of the specified and conducted independent evaluator tests confirm the TOE functionality as described. The TSF and the interfaces were found to behave as specified. The results of the developer tests, which have been repeated by the evaluator, matched the results the developer. Overall the TSF have been tested against the functional specification, the TOE design and the security architecture description. The tests demonstrate that the TSF performs as specified.

Penetration Testing according to AVA_VAN:

The penetration testing was partially performed using the developer's testing environment, partially using the test environment of the evaluation body. All configurations of the TOE being intended to be covered by the current evaluation were tested. The overall test result is that no deviations were found between the expected and the actual test results; moreover, no attack scenario with the attack potential **Moderate** was actually successful.

Systematic search for potential vulnerabilities and known attacks in public domain sources has been conducted, using a list of vulnerabilities [4, AIS26], and from a methodical analysis of the evaluation documents. Analysis has been carried out why these vulnerabilities are not exploitable in the intended environment of the TOE. If the rationale is suspect in the opinion of the evaluator penetration tests are devised. Even if the rationale is convincing in the opinion of the evaluator penetration tests are devised for some vulnerabilities, especially to support the argument of non-practicability of the exploiting time in case of SPA, DPA and FI attacks.

For implementation attacks the following test resources were used by the evaluator: Digital Oscilloscope, Passive Probe, Active Differential Probe, EM Probe, Delay Generator, Laser Fault Injection System and proprietary measuring/analyzing software.

Amongst others, the following attack scenarios have been tested: Statistical tests of the TOE DRNG according to AIS 20 requirements, undocumented capabilities which are sent by the TOE as response to TPM2_GetCapability command, circumvention of access control by injecting faults through laser light (LFI attack), effectiveness of filters and detectors, effectiveness of bus and memory encryption, Differential Fault Analysis, Simple and Differential Power Analysis, EMA / SEMA / DEMA Attacks, effectiveness of deactivation of test functions, bypass of PIN counter, intentional misuse of TPM commands.

Verdict for the sub-activity:

The evaluator has performed penetration testing based on the systematic search for potential vulnerabilities and known attacks in public domain sources and from the methodical analysis of the evaluation documents. During the evaluator's penetration testing of potential vulnerabilities the TOE operated as specified. All potential vulnerabilities are not exploitable in the intended environment for the TOE. The TOE is resistant to attackers with **moderate attack potential** in the intended environment for the TOE.

8. Evaluated Configuration

This certification covers the following configurations of the TOE:

Trusted Platform Module SLB9672_2.0 in version v15.20.15686.00, v15.21.16430.00, v15.22.16832.00 and v15.23.17664.00 as described in the ST [6] and Databook [10].

9. Results of the Evaluation

9.1. CC specific results

The Evaluation Technical Report (ETR) [7] was provided by the ITSEF according to the Common Criteria [1], the Methodology [2], the requirements of the Scheme [3] and all interpretations and guidelines of the Scheme (AIS) [4] as relevant for the TOE.

The Evaluation Methodology CEM [2] was used and guidance specific for the technology of the product [4] (AIS 34).

The following guidance specific for the technology was used:

- (i) The Application of Common Criteria to Integrated Circuits.
- (ii) For RNG assessment the scheme interpretations AIS 20 and AIS 31 were used (see [4]).

As a result of the evaluation the verdict PASS is confirmed for the following assurance components:

- All components of the EAL 4 package including the class ASE as defined in the CC (see also part C of this report)
- The components AVA_VAN.4 and ALC_FLR.1 augmented for this TOE evaluation.

As the evaluation work performed for this certification procedure was carried out as a re-evaluation based on the certificate BSI-DSZ-CC-1113-V4-2022, re-use of specific evaluation tasks was possible. The current evaluation is the fourth re-certification. Compared to the previously certificated product, a new derivate was added with the version number v15.23.17664.00. There are no changes done in the derivatives with the version numbers v15.20.15686.00, v15.21.16430.00 and v15.22.16832.00.

The TOE's hardware and firmware of the new version v15.23.17664.00 remain unchanged in comparison to the forerunner certification. The new TOE version v15.23.17664.00 is identical to the already certified version v15.22.16832.00 apart from:

- i. The Operating System used by the TPM Application was updated.*
- ii. Improve overlap handling of MPU settings after interrupt; reduce power consumption in sleep mode; changed IBS control data handling; change of SecReset handling during start-up; fixes of issues in handling of commands.*
- iii. There are changes to the user guidance of the TOE.*

The evaluation has confirmed:

- PP Conformance: Protection Profile PC Client Specific TPM, TPM Library specification Family "2.0", Level 0 Revision 1.59, Version: 1.3, Date: 2021-09-29, ANSSI-CC-PP-2021/02 [8]
- for the Functionality: PP conformant
Common Criteria Part 2 extended
- for the Assurance: Common Criteria Part 3 conformant
EAL 4 augmented by AVA_VAN.4 and ALC_FLR.1

For specific evaluation results regarding the development and production environment see annex B in part D of this report.

The results of the evaluation are only applicable to the TOE as defined in chapter 2 and the configuration as outlined in chapter 8 above.

9.2. Results of cryptographic assessment

The strength of the cryptographic algorithms was not rated in the course of this certification procedure (see BSIG Section 9, Para. 4, Clause 2). But cryptographic functionalities with a security level of lower than 120 bits can no longer be regarded as secure without considering the application context. Therefore, for these functionalities it shall be checked whether the related crypto operations are appropriate for the intended system. Some further hints and guidelines can be derived from the 'Technische Richtlinie BSI TR-02102' (<https://www.bsi.bund.de>).

The table 7 in annex C of part D of this report gives an overview of the cryptographic functionalities inside the TOE to enforce the security policy and outlines its rating from cryptographic point of view. Any Cryptographic Functionality that is marked in column 'Security Level above 120 Bits' of the following table with 'no' achieves a security level of lower than 120 Bits (in general context) only. *Note that the column "Security Level" given in table 7 refers to the pure cryptographic (mathematical) strength only, and does not take into account whatever exploitable weaknesses induced by side-channel leakage, physical attacks, or implementation flaws of any kind.*

Detailed results on conformance and non-conformance have been compiled into the report [17].

10. Obligations and Notes for the Usage of the TOE

The documents as outlined in table 2 contain necessary information about the usage of the TOE and all security hints therein have to be considered. In addition all aspects of Assumptions, Threats and OSPs as outlined in the Security Target not covered by the TOE itself need to be fulfilled by the operational environment of the TOE.

The customer or user of the product shall consider the results of the certification within his system risk management process. In order for the evolution of attack methods and techniques to be covered, he should define the period of time until a re-assessment of the TOE is required and thus requested from the sponsor of the certificate.

The limited validity for the usage of cryptographic algorithms as outlined in chapter 9 has to be considered by the user and his system risk management process, too.

If available, certified updates of the TOE should be used. If non-certified updates or patches are available the user of the TOE should request the sponsor to provide a re-certification. In the meantime a risk management process of the system using the TOE should investigate and decide on the usage of not yet certified updates and patches or take additional measures in order to maintain system security.

Especially the following notice from the Security Target [6] should be taken into account:

The TPM includes two ECC Endorsement Keys (EK) and one RSA Endorsement Key (EK) and the Endorsement Primary Seed (EPS), which can be used to generate additional EKs alternatively. The two ECC Endorsement Keys, the RSA Endorsement Key and the Endorsement Primary Seed are generated outside the TPM with the TPM Personalization Certification Authority (TPM-CA) located within the secure production area of the TOE in a secure room. The RSA Endorsement Key is generated from a proved random number generator by the HSM-PDG and not derived from the Endorsement Seed.

The Endorsement Keys RSA EK and ECC EK, personalized by the TPM vendor, are not visible and changeable for the user, but can be deactivated with the TPM2_EvictControl() and TPM2_FlushContext commands, and can be activated again with the TPM2_CreatePrimary command by the user. As these personalized Endorsement Keys should be used only for the identification of the TPM vendor, the user shall not use these keys for other functions.

11. Security Target

For the purpose of publishing, the Security Target [6] of the Target of Evaluation (TOE) is provided within a separate document as Annex A of this report.

12. Regulation specific aspects (eIDAS, QES)

None.

13. Definitions

13.1. Acronyms

AIS Application Notes and Interpretations of the Scheme

BSI	Bundesamt für Sicherheit in der Informationstechnik / Federal Office for Information Security, Bonn, Germany
BSIG	BSI-Gesetz / Act on the Federal Office for Information Security
CCRA	Common Criteria Recognition Arrangement
CC	Common Criteria for IT Security Evaluation
CEM	Common Methodology for Information Technology Security Evaluation
cPP	Collaborative Protection Profile
EAL	Evaluation Assurance Level
ETR	Evaluation Technical Report
IT	Information Technology
ITSEF	Information Technology Security Evaluation Facility
PP	Protection Profile
SAR	Security Assurance Requirement
SFP	Security Function Policy
SFR	Security Functional Requirement
ST	Security Target
TOE	Target of Evaluation
TPM	Trusted Platform Module
TSF	TOE Security Functionality

13.2. Glossary

Augmentation - The addition of one or more requirement(s) to a package.

Collaborative Protection Profile - A Protection Profile collaboratively developed by an International Technical Community endorsed by the Management Committee.

Extension - The addition to an ST or PP of functional requirements not contained in CC part 2 and/or assurance requirements not contained in CC part 3.

Formal - Expressed in a restricted syntax language with defined semantics based on well-established mathematical concepts.

Informal - Expressed in natural language.

Object - A passive entity in the TOE, that contains or receives information, and upon which subjects perform operations.

Package - named set of either security functional or security assurance requirements

Protection Profile - A formal document defined in CC, expressing an implementation independent set of security requirements for a category of IT Products that meet specific consumer needs.

Security Target - An implementation-dependent statement of security needs for a specific identified TOE.

Semiformal - Expressed in a restricted syntax language with defined semantics.

Subject - An active entity in the TOE that performs operations on objects.

Target of Evaluation - An IT Product and its associated administrator and user guidance documentation that is the subject of an Evaluation.

TOE Security Functionality - Combined functionality of all hardware, software, and firmware of a TOE that must be relied upon for the correct enforcement of the SFRs.

14. Bibliography

- [1] Common Criteria for Information Technology Security Evaluation, Version 3.1, Part 1: Introduction and general model, Revision 5, April 2017
Part 2: Security functional components, Revision 5, April 2017
Part 3: Security assurance components, Revision 5, April 2017
<https://www.commoncriteriaportal.org>
- [2] Common Methodology for Information Technology Security Evaluation (CEM), Evaluation Methodology, Version 3.1, Rev. 5, April 2017,
<https://www.commoncriteriaportal.org>
- [3] BSI certification: Scheme documentation describing the certification process (CC-Produkte) and Scheme documentation on requirements for the Evaluation Facility, approval and licencing (CC-Stellen), <https://www.bsi.bund.de/zertifizierung>
- [4] Application Notes and Interpretations of the Scheme (AIS) as relevant for the TOE⁷
<https://www.bsi.bund.de/AIS>
- [5] German IT Security Certificates (BSI 7148), periodically updated list published also on the BSI Website, <https://www.bsi.bund.de/zertifizierungsreporte>
- [6] Security Target BSI-DSZ-CC-1113-V5-2023, Version 1.5, April 28, 2023, "Security Target OPTIGA™ Trusted Platform Module SLB9672_2.0 v15", Infineon Technologies AG (public document)
- [7] Evaluation Technical Report, Version 2, May 30, 2023, "Evaluation Technical Report Summary", TÜV Informationstechnik GmbH, (confidential document)

⁷specifically

- AIS 20, Version 3, Funktionalitätsklassen und Evaluationsmethodologie für deterministische Zufallszahlengeneratoren
- AIS 25, Version 9, Anwendung der CC auf Integrierte Schaltungen including JIL Document and CC Supporting Document
- AIS 26, Version 10, Evaluationsmethodologie für in Hardware integrierte Schaltungen including JIL Document and CC Supporting Document
- AIS 31, Version 3, Funktionalitätsklassen und Evaluationsmethodologie für physikalische Zufallszahlengeneratoren
- AIS 32, Version 7, CC-Interpretationen im deutschen Zertifizierungsschema
- AIS 34, Version 3, Evaluation Methodology for CC Assurance Classes for EAL 5+ (CCv2.3 & CCv3.1) and EAL 6 (CCv3.1)
- AIS 35, Version 2, Öffentliche Fassung des Security Targets (ST-Lite) including JIL Document and CC Supporting Document and CCRA policies
- AIS 36, Version 5, Kompositionsevaluierung including JIL Document and CC Supporting Document
- AIS 38, Version 2, Reuse of evaluation results

- [8] Protection Profile PC Client Specific TPM, TPM Library specification Family “2.0”, Level 0 Revision 1.59, Version: 1.3, Date: 2021-09-29, ANSSI-CC-PP-2021/02
- [9] “Eckpunkte der Bundesregierung zu Trusted Computing”, by the German Federal Government, April 2017
- [10] OPTIGA™ TPM, SLB 9672 TPM2.0, Databook (for v15.20.15686.00), Revision 1.1, February 10, 2021, Infineon Technologies AG; and
OPTIGA™ TPM, SLB 9672 TPM2.0, Databook (for v15.21.16430.00), Revision 1.4, June 30, 2021, Infineon Technologies AG
OPTIGA™ TPM, SLB 9672 TPM2.0, Databook (for v15.22.16832.00), Revision 1.6, March 09, 2022, Infineon Technologies AG
OPTIGA™ TPM, SLB 9672 TPM2.0, Databook (for v15.23.17664.00), Revision 1.8, April 27, 2023, Infineon Technologies AG
- [11] OPTIGA™ TPM, SLB 9672 TPM2.0 FW15.xx, Errata and Updates, Revision 1.7, March 21, 2023
- [12] OPTIGA™ TPM, SLB 9672 TPM2.0, Application Note User Guidance Revision 1.02, June 8, 2021, Infineon Technologies AG (confidential developer document)
- [13] Trusted Platform Module Library Part 1: Architecture, Family “2.0”, Level 00 Revision 01.59, 2019-11-08, Trusted Computing Group (TCG)
- [14] Trusted Platform Module Library Part 2: Structures, Family “2.0”, Level 00 Revision 01.59, 2019-11-08, Trusted Computing Group (TCG)
- [15] Trusted Platform Module Library Part 3: Commands, Family “2.0”, Level 00 Revision 01.59, 2019-11-08, Trusted Computing Group (TCG)
- [16] Trusted Platform Module Library Part 4: Supporting Routines, Family “2.0”, Level 00 Revision 01.59, 2019-11-08, Trusted Computing Group (TCG)
- [17] SINGLE EVALUATION REPORT ADDENDUM to ETR-Part ADV Cryptographic Standards Compliance Verification; Version 1, February 24, 2023, TÜV Informationstechnik GmbH, (confidential document)

C. Excerpts from the Criteria

For the meaning of the assurance components and levels the following references to the Common Criteria can be followed:

- On conformance claim definitions and descriptions refer to CC part 1 chapter 10.5
- On the concept of assurance classes, families and components refer to CC Part 3 chapter 7.1
- On the concept and definition of pre-defined assurance packages (EAL) refer to CC Part 3 chapters 7.2 and 8
- On the assurance class ASE for Security Target evaluation refer to CC Part 3 chapter 12
- On the detailed definitions of the assurance components for the TOE evaluation refer to CC Part 3 chapters 13 to 17
- The table in CC part 3 , Annex E summarizes the relationship between the evaluation assurance levels (EAL) and the assurance classes, families and components.

The CC are published at <https://www.commoncriteriaportal.org/cc/>

D. Annexes

List of annexes of this certification report

- Annex A: Security Target provided within a separate document.
- Annex B: Evaluation results regarding development and production environment
- Annex C: Overview and rating of cryptographic functionalities implemented in the TOE

Annex B of Certification Report BSI-DSZ-CC-1113-V5-2023

Evaluation results regarding development and production environment



The IT product Infineon Technologies AG OPTIGA™ Trusted Platform Module SLB9672_2.0 v15.20.15686.00, v15.21.16430.00, v15.22.16832.00 und v15.23.17664.00, Target of Evaluation, TOE) has been evaluated at an approved evaluation facility using the Common Methodology for IT Security Evaluation (CEM), Version 3.1 extended by Scheme Interpretations and CC Supporting Documents for conformance to the Common Criteria for IT Security Evaluation (CC), Version 3.1.

As a result of the TOE certification, dated 6 July 2023, the following results regarding the development and production environment apply. The Common Criteria assurance requirements ALC – Life cycle support (i.e. ALC_CMC.4, ALC_CMS.4, ALC_DEL.1, ALC_DVS.1, ALC_FLR.1, ALC_LCD.1, ALC_TAT.1) are fulfilled for the development and production sites.

Besides the production and development sites, the relevant TOE distribution centers are as listed below:

Site ID	Company name and address
DHL Singapore	DHL Supply Chain Singapore Pte Ltd., Advanced Regional Center Tampines LogisPark 1 Greenwich Drive Singapore 533865
K&N Großostheim	Kühne & Nagel Stockstädter Strasse 10 63762 Großostheim Germany
KWE Shanghai	KWE Kintetsu World Express (China) Co., Ltd. Shanghai Pudong Airport Pilot Free Trade Zone No. 530 Zheng Ding Road Shanghai, P.R. China

Table 6: List of relevant TOE distribution sites

For the sites listed above, the requirements have been specifically applied in accordance with the Security Target [6]. The evaluators verified, that the threats, security objectives and requirements for the TOE life cycle phases up to delivery (as stated in the Security Target [6]) are fulfilled by the procedures of these sites.

Annex C of Certification Report BSI-DSZ-CC-1113-V5-2023

Overview and rating of cryptographic functionalities implemented in the TOE

No.	Cryptographic Mechanism	Standard of Implementation	Key Size in Bits	Comments	Security Level above 120 Bits
1.	Authenticity RSA signature generation / verification	[RFC3447]	Modulus = 1024	[Main_1, B.1 – B.7] and [Main_3, 20.2]	no
	RSASSA-PKCS1-v1_5	[RFC3447, 8.2]			no
	RSASSA_PSS	[RFC3447, 8.1]			no
	SHA-1, SHA-256, SHA-384	[FIPS180-4]			no
2.	Authenticity RSA signature generation / verification	[RFC3447]	Modulus = 2048 Modulus = 3072 Modulus = 4096	[Main_1, B.1 – B.7] and [Main_3, 20.2]	(2048: Sec.Lev. > 100 Bits) yes yes
	RSASSA-PKCS1-v1_5	[RFC3447, 8.2]			yes
	RSASSA_PSS	[RFC3447, 8.1]			yes
	SHA-1, SHA-256, SHA-384	[FIPS180-4]			no, yes, yes
3.	Authenticity EC signature generation/ verification according to	[FIPS186-4]	k = 256 k = 384	[Main_1, C.4.2]	yes
	ECDSA	[ISO_14888-3]	ECC_NIST_P256 ECC_NIST_P384		yes
	SHA-1, SHA-256, SHA-384	[FIPS180-4]			no, yes, yes
4.	Authenticity EC signature generation according to	[ISO_15946-5]	k = 256	[Main_1, C.4.2]	yes
	ECDA	[Main_1, C.4.2]	ECC_BN_P256		
	SHA-1, SHA-256, SHA-384	[ISO_10118-3]			no, yes, yes

No.	Cryptographic Mechanism	Standard of Implementation	Key Size in Bits	Comments	Security Level above 120 Bits
5.	EC signature verification ECDSA SHA-512 XMSS SHA-256	[FIPS186-4] [FIPS180-4] [N8208] [FIPS180-4]	k = 521 ECC_NIST_P521	TPM-FieldUpgrade	yes yes
6.	Authentication HMAC with SHA-1 ECDEC RSA decryption RSAES-PKCS1-v1_5 AES decryption in CFB mode	[ISO_9797-2], [ISO_10118-3] [N856, 6.2.2.2] [FIPS186-4] [RFC3447, 7.2] [ISO_18033-3], [ISO_10116]	k = 160 k = 256 k = 384 ECC_NIST_P256 ECC_NIST_P384 Modulus = 2048 k = 128 k = 256	[Main_1, 11.4.3] [Main_1, C7]	no yes Sec.Lev. > 100 Bits yes
7.	Authentication HMAC with SHA-256 and SHA-384 ECDEC RSA decryption RSAES-PKCS1-v1_5 AES decryption in CFB mode	[ISO_9797-2], [ISO_10118-3] [N856, 6.2.2.2] [FIPS186-4] [RFC3447, 7.2] [ISO_18033-3], [ISO_10116]	k = 256 k = 384 k = 256 k = 384 ECC_NIST_P256 ECC_NIST_P384 Modulus = 2048 Modulus = 3072 Modulus = 4096 k = 128 k = 256	[Main_1, 11.4.3] [Main_1, C7]	yes yes (2048: Sec.Lev. > 100 Bits) yes yes yes
8.	Key Agreement Diffie-Hellmann (ECDH) KDFe HMAC with SHA-256, SHA-384 and SHA-1	[N856, 6.2.2.2] [FIPS186-4] [N856] [ISO_9797-2], [ISO_10118-3]	k = 256 k = 384 ECC_NIST_P256 ECC_NIST_P384 k = 256 k = 384 k = 160	[Main_1, 11.4.9.3] [Main_1, C7]	yes yes yes no
9.	Key Agreement KDFa HMAC with SHA-256, SHA-384 and	[Main_1, 11.4.9.1], [N808] [ISO_9797-2], [ISO_10118-3]	k = 256 k = 384	[Main_1, 11.4.9.1]	yes yes

No.	Cryptographic Mechanism	Standard of Implementation	Key Size in Bits	Comments	Security Level above 120 Bits
	SHA-1		k = 160		no
10.	Key Agreement AES CMAC	[N808] [ISO_18033-3], [ISO_9797-1]	k = 256	TPM- FieldUpgr ade	yes
11.	Integrity HMAC with SHA-256, SHA-384 and SHA-1	[ISO_9797-2], [ISO_10118-3]	k = 256 k = 384 k = 160	[Main_1, 11.4.3]	yes no
12.	Integrity XMSS with SHA-256	[N8208] [ISO_10118-3]	-	TPM- FieldUpgr ade	yes
13.	Confidentiality AES in CFB mode	[ISO_18033-3], [ISO_10116]	k = 128 k = 256	[TPM]	yes
14.	Confidentiality RSA encryption / decryption RSAES -PKCS1-v1_5 RSAES-OAEP	[RFC3447] [RFC3447, 7.2] [RFC3447, 7.1]	Modulus = 1024	[Main_1, B.1 – B.7] [Main_3, 14]	no no no
15.	Confidentiality RSA encryption / decryption RSAES -PKCS1-v1_5 RSAES-OAEP	[RFC3447] [RFC3447, 7.2] [RFC3447, 7.1]	Modulus = 2048 Modulus = 3072 Modulus = 4096	[Main_1, B.1 – B.7] [Main_3, 14]	(2048: Sec.Lev. > 100 Bits) yes yes yes yes
16.	Cryptographic Primitive SHA-384	[FIPS180-4]	none	[Main_1, 11.4.2]	yes
17.	Cryptographic Primitive SHA-256	[FIPS180-4]	none	[Main_1, 11.4.2]	yes
18.	Cryptographic Primitive SHA-1	[FIPS180-4]	none	[Main_1, 11.4.2]	no
19.	Cryptographic Primitive HMAC with SHA-1	[ISO_9797-2], [ISO_10118-3]	k = 160	[Main_1, 11.4.3]	no
20.	Cryptographic Primitive HMAC with SHA-256	[ISO_9797-2], [ISO_10118-3]	k = 256	[Main_1, 11.4.3]	yes
21.	Cryptographic Primitive HMAC with SHA-384	[ISO_9797-2], [ISO_10118-3]	k = 384	[Main_1, 11.4.3]	yes
22.	Cryptographic Primitive Deterministic RNG DRG.3	[AIS20], [N890A]	CTR_DRBG implemented	[Main_1, 11.4.10]	yes

No.	Cryptographic Mechanism	Standard of Implementation	Key Size in Bits	Comments	Security Level above 120 Bits
23.	Trusted Channel HMAC with SHA-256 and SHA-384	[ISO_9797-2], [ISO_10118-3]	k = 256 k = 384	[TPM]	yes
24.	Trusted Channel AES in CFB mode RSA ECC HMAC with SHA-256, SHA-384 and SHA-1	[ISO_18033-3], [ISO_10116] [RFC3447] [FIPS186-4], [N856] [ISO_9797-2], [ISO_10118-3]	k = 128 k = 256 k = 1024, k = 2048 k = 3072 k = 4096 ECC_NIST_P256, ECC_NIST_P384, k = 256 k = 384 k = 256 k = 384 k = 160	[TPM]	yes no (1024), (2048: Sec.Lev. > 100 Bits) yes yes yes yes no
25.	Key Generation RSA primary keys	[TPM], [FIPS186-4], [N890A] using CRT_DRBG	k = 2048 k = 3072 k = 4096	—	(2048: Sec.Lev. > 100 Bits) yes yes
26.	Key Generation RSA	[TPM], [FIPS186-4], [N890A] using CRT_DRBG	k = 2048 k = 3072 k = 4096		(2048: Sec.Lev. > 100 Bits) yes yes
27.	Key Generation RSA	[TPM],	k = 1024	Infineon key generation method "TPM_RS AGEN2"	<i>Not rated</i>
28.	Key Generation ECC ECC_NIST_P256 ECC_NIST_P384 ECC_BN_P256	[TPM], [FIPS186-4], [N890A] using CRT_DRBG [FIPS186-4] [ISO_15946-5]	k = 256 k = 384	—	yes yes yes no
29.	Key Generation AES	[TPM], [N8133], [N808], [N890A]	k = 128 k = 256	—	yes

Table 7: TOE cryptographic functionality

Reference of Legislatives and Standards specified in Table 7 above:

[FIPS180-4] *Federal Information Processing Standards Publication, Secure Hash Standard (SHS)*, 2015-08, U.S. department of Commerce / National Institute of Standards and Technology (NIST).

[FIPS186-4] *Federal Information Processing Standards Publication FIPS PUB 186-4, Digital Signature Standard (DSS)*, 2013-07, U.S. department of Commerce / National Institute of Standards and Technology (NIST).

[FIPS186-5] *Federal Information Processing Standards Publication FIPS PUB 186-5 (Draft), Digital Signature Standard (DSS)*, 2019-10, U.S. department of Commerce / National Institute of Standards and Technology (NIST).

[ISO_10116] ISO/IEC 10116: *Information technology - Security techniques – Modes of operation for an n-bit block cipher*, 2006, ISO/IEC.

[ISO_10118-3] ISO 10118-3: *Information technology - Security techniques – Hash-functions – Part 3: Dedicated hash-functions*, 2004, ISO/IEC.

[ISO_14888-3] ISO 14888-3: *Information technology - Security techniques – Digital signatures with appendix -- Part 3: Discrete logarithm based mechanisms*, 2006, ISO/IEC.

[ISO_15946-5] ISO 15946-5: *Information technology – Security techniques – Cryptographic techniques based on elliptic curves – Part 5: Elliptic curve generation*, 2009, ISO/IEC.

[ISO_18033-3] ISO 18033-3: *Information technology – Security techniques – Encryption algorithms -- Part 3: Block ciphers*, 2005, ISO/IEC.

[ISO_9797-2] *Information technology - Security techniques- Message Authentication Codes (MACs) - Part 2: Mechanisms using a dedicated hash-function*, 2011-05, ISO/IEC.

[Main_1] *Trusted Platform Module Library Part 1: Architecture, Family “2.0”, Level 00 Revision 01.59*, 2019-11-08, Trusted Computing Group (TCG).

[Main_2] *Trusted Platform Module Library Part 2: Structures, Family “2.0”, Level 00 Revision 01.59*, 2019-11-08, Trusted Computing Group (TCG).

[Main_3] *Trusted Platform Module Library Part 3: Commands, Family “2.0”, Level 00 Revision 01.59*, 2019-11-08, Trusted Computing Group (TCG).

[Main_4] *Trusted Platform Module Library Part 4: Supporting Routines, Family “2.0”, Level 00 Revision 01.59*, 2019-11-08, Trusted Computing Group (TCG).

[N8133] NIST Special Publication 800-133 Revision 1, *Recommendation for Cryptographic Key Generation*, 2019-03, National Institute of Standards and Technology (NIST).

[N8133_2012] NIST Special Publication 800-133, *Recommendation for Cryptographic Key Generation*, 2012-12, National Institute of Standards and Technology (NIST).

[N8208] Draft NIST Special Publication 800-208, *Recommendation for Stateful Hash-Based Signature Schemes*, 2019-12, National Institute of Standards and Technology (NIST).

[N856] NIST SP800-56A, *Recommendation for Pair-Wise Key Establishment Schemes Using Discrete Logarithm Cryptography*, (revised), Revision 1, 2007-03, National Institute of Standards and Technology (NIST).

[N890A] NIST Special Publication 800-90A: *Recommendation for Random Number Generation Using Deterministic Random Bit Generators*, 2015-06, National Institute of Standards and Technology (NIST).

[RFC3447] RFC 3447 - *Public-Key Cryptography Standards (PKCS) #1: RSA Cryptography Specifications*, Version 2.1, published by The Internet Society, 2003-02, <http://www.ietf.org/rfc/rfc3447>.

[RFC8391] RFC 8391 – *XMSS: eXtended Merkle Signature Scheme*, 2018-05, *Internet Research Task Force (IRTF)*, <http://www.ietf.org/rfc/rfc8391>

[TPM] *Trusted Platform Module Library*, consisting of [Main_1], [Main_2], [Main_3] and [Main_4].

Note: End of report