GEOMYS

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Geomys LLC

Go Cryptographic Module

FIPS 140-3 Non-Proprietary Security Policy

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1 General

1.1 Overview

This non-proprietary FIPS 140-3 Security Policy for the Go Cryptographic Module v1.0.0 and v1.0.1 describes how the module meets the security requirements specified in FIPS 140-3 (Federal Information Processing Standard 140-3) for an overall security level 1 module and outlines the security rules and operating procedures required to maintain compliance.

1.2 Security Levels

Section	Title	Security Level
1	General	1
2	Cryptographic module specification	1
3	Cryptographic module interfaces	1
4	Roles, services, and authentication	1
5	Software/Firmware security	1
6	Operational environment	1
7	Physical security	N/A
8	Non-invasive security	N/A
9	Sensitive security parameter management	1

Section	Title	Security Level
10	Self-tests	1
11	Life-cycle assurance	1
12	Mitigation of other attacks	1
	Overall Level	1

Table 1: Security Levels

2 Cryptographic Module Specification

2.1 Description

Purpose and Use:

A software library that provides cryptographic functionality to the Go standard library and other Go applications.

Module Type: Software

Module Embodiment: Multi-Chip Standalone

Cryptographic Boundary:

The module's cryptographic boundary (represented by the red dotted line in Figure 1) consists of the entire Go Cryptographic Module executable code.

Tested Operational Environment's Physical Perimeter (TOEPP):

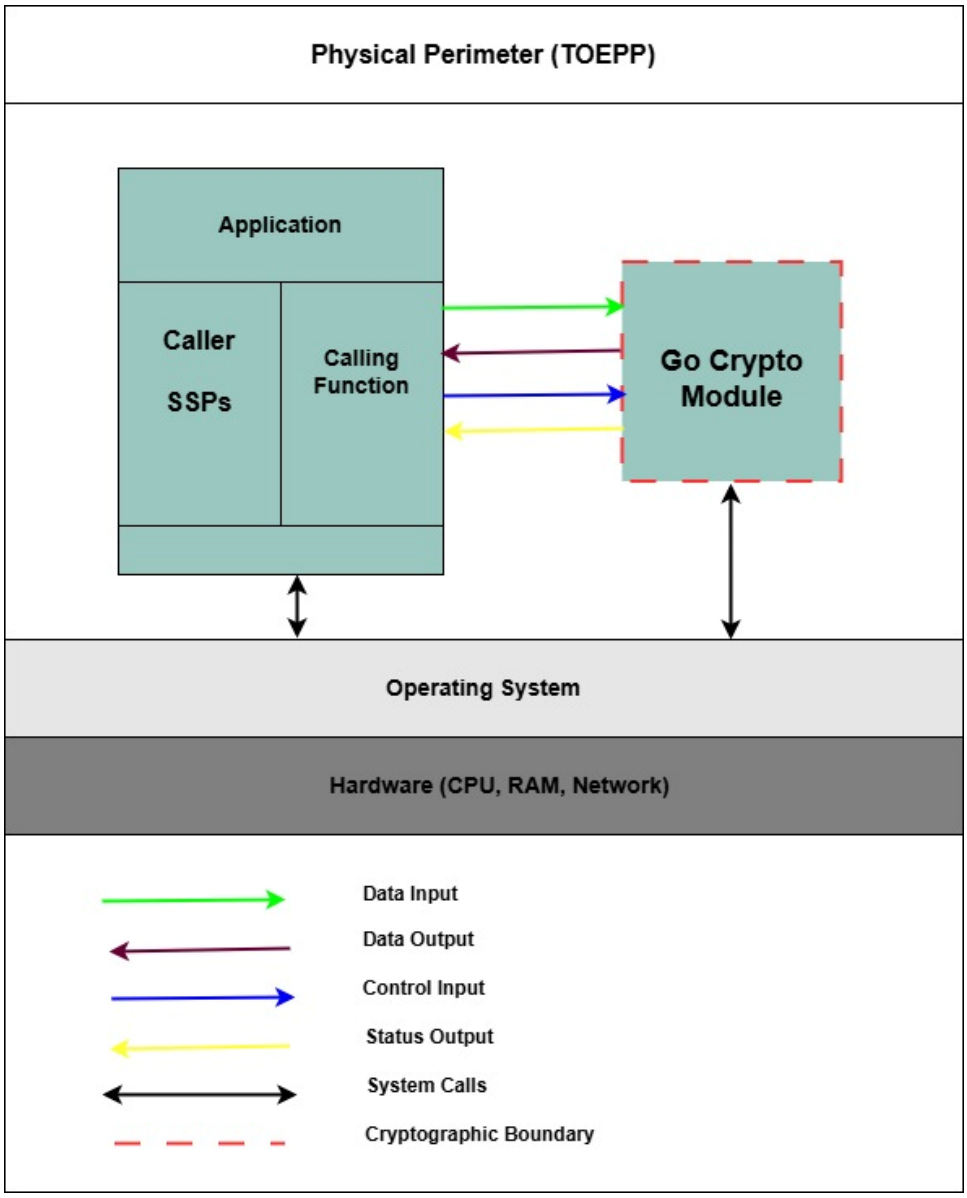

Figure 1: Block Diagram

2.2 Tested and Vendor Affirmed Module Version and Identification

Tested Module Identification – Software, Firmware, Hybrid (Executable Code Sets):

Package or File Name	Software/ Firmware Version	Features	Integrity Test
fips.o (darwin/arm64)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (freebsd/amd64)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (linux/amd64)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (linux/arm)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (linux/arm64)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (linux/mips64)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256

Package or File Name	Software/ Firmware Version	Features	Integrity Test
fips.o (linux/ppc64le)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (linux/s390x)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (windows/amd64)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (windows/arm64)	v1.0.0 and v1.0.1	Binary file compiled from the source in the v1.0.0-c2097c7c.zip or v1.0.1.zip file	HMAC-SHA2-256
fips.o (js/wasm)	v1.0.1	Binary file compiled from the source in the v1.0.1.zip file	HMAC-SHA2-256

Table 2: Tested Module Identification – Software, Firmware, Hybrid (Executable Code Sets)

Tested Operational Environments - Software, Firmware, Hybrid:

Operating System	Hardware Platform	Processors	PAA/PAI	Hypervisor or Host OS	Version(s)
Red Hat Enterprise Linux 9	Dell PowerEdge R660	Intel Xeon Silver 4410Y	Yes	N/A	v1.0.0 and v1.0.1
Red Hat Enterprise Linux 9	Dell PowerEdge R660	Intel Xeon Silver 4410Y	No	N/A	v1.0.0 and v1.0.1
Red Hat Enterprise Linux 9	ASRock Rack ALTRAD8UD-1L2T	Ampere Altra Q64-22	Yes	N/A	v1.0.0 and v1.0.1
Red Hat Enterprise Linux 9	ASRock Rack ALTRAD8UD-1L2T	Ampere Altra Q64-22	No	N/A	v1.0.0 and v1.0.1
Red Hat Enterprise Linux 9	IBM z16 3931-A01	IBM Z System z16	Yes	PR/SM Driver Level 51 with Bundle Level H29	v1.0.0 and v1.0.1
Red Hat Enterprise Linux 9	IBM z16 3931-A01	IBM Z System z16	No	PR/SM Driver Level 51 with Bundle Level H29	v1.0.0 and v1.0.1
Red Hat Enterprise Linux 9	IBM 9080-HEX	IBM Power10	Yes	PowerVM FW1040.00 with VIOS 3.1.3.00	v1.0.0 and v1.0.1
Red Hat Enterprise Linux 9	IBM 9080-HEX	IBM Power10	No	PowerVM FW1040.00 with VIOS 3.1.3.00	v1.0.0 and v1.0.1

Operating System	Hardware Platform	Processors	PAA/PAI	Hypervisor or Host OS	Version(s)
Alpine Linux 3.20 image	Dell PowerEdge R660	Intel Xeon Silver 4410Y	Yes	Podman 4 on Red Hat Enterprise Linux 9	v1.0.0 and v1.0.1
Alpine Linux 3.20 image	Dell PowerEdge R660	Intel Xeon Silver 4410Y	No	Podman 4 on Red Hat Enterprise Linux 9	v1.0.0 and v1.0.1
Alpine Linux 3.20 image	Dell PowerEdge R6615	AMD EPYC 9454P	Yes	Podman 4 on Red Hat Enterprise Linux 9	v1.0.0 and v1.0.1
Alpine Linux 3.20 image	Dell PowerEdge R6615	AMD EPYC 9454P	No	Podman 4 on Red Hat Enterprise Linux 9	v1.0.0
Alpine Linux 3.20 image	ASRock Rack ALTRAD8UD-1L2T	Ampere Altra Q64-22	Yes	Podman 4 on Red Hat Enterprise Linux 9	v1.0.0 and v1.0.1
Alpine Linux 3.20 image	ASRock Rack ALTRAD8UD-1L2T	Ampere Altra Q64-22	No	Podman 4 on Red Hat Enterprise Linux 9	v1.0.0 and v1.0.1
Amazon Linux 2023	Amazon EC2 r8g.metal-24xl	AWS Graviton4	Yes	N/A	v1.0.0 and v1.0.1
Amazon Linux 2023	Amazon EC2 r8g.metal-24xl	AWS Graviton4	No	N/A	v1.0.0 and v1.0.1

Operating System	Hardware Platform	Processors	PAA/PAI	Hypervisor or Host OS	Version(s)
Amazon Linux 2023	Amazon EC2 c6i.metal	Intel Xeon Platinum 8375C	Yes	N/A	v1.0.0 and v1.0.1
Amazon Linux 2023	Amazon EC2 c6i.metal	Intel Xeon Platinum 8375C	No	N/A	v1.0.0 and v1.0.1
Oracle Linux 9	Dell PowerEdge R660	Intel Xeon Silver 4410Y	Yes	N/A	v1.0.0 and v1.0.1
Oracle Linux 9	Dell PowerEdge R660	Intel Xeon Silver 4410Y	No	N/A	v1.0.0 and v1.0.1
Oracle Linux 9	Dell PowerEdge R6615	AMD EPYC 9454P	Yes	N/A	v1.0.0 and v1.0.1
Oracle Linux 9	Dell PowerEdge R6615	AMD EPYC 9454P	No	N/A	v1.0.0 and v1.0.1
Oracle Linux 9	ASRock Rack ALTRAD8UD-1L2T	Ampere Altra Q64-22	Yes	N/A	v1.0.0 and v1.0.1
Oracle Linux 9	ASRock Rack ALTRAD8UD-1L2T	Ampere Altra Q64-22	No	N/A	v1.0.0 and v1.0.1

Operating System	Hardware Platform	Processors	PAA/PAI	Hypervisor or Host OS	Version(s)
Linux 5.4	Ubiquiti EdgeRouter 4	Marvell OCTEON III CN7130	No	N/A	v1.0.0 and v1.0.1
Linux 5.4	CZ.NIC Turris Omnia	Marvell ARMADA-385	No	N/A	v1.0.0 and v1.0.1
Google Prodimage with Linux 5.10	APIF-824	AMD EPYC 7B12	Yes	N/A	v1.0.0 and v1.0.1
Google Prodimage with Linux 5.10	APIF-824	AMD EPYC 7B12	No	N/A	v1.0.0 and v1.0.1
Google Prodimage with Linux 5.10	APIF-738	Intel Xeon Platinum 8273CL	Yes	N/A	v1.0.0 and v1.0.1
Google Prodimage with Linux 5.10	APIF-738	Intel Xeon Platinum 8273CL	No	N/A	v1.0.0 and v1.0.1
Google Prodimage with Linux 5.10	APIF-091	ARM Neoverse-N1	Yes	N/A	v1.0.0 and v1.0.1
Google Prodimage with Linux 5.10	APIF-091	ARM Neoverse-N1	No	N/A	v1.0.0 and v1.0.1
Apple macOS 15	MacBook Air (M2, 2022)	Apple M2	Yes	N/A	v1.0.0 and v1.0.1

Operating System	Hardware Platform	Processors	PAA/PAI	Hypervisor or Host OS	Version(s)
Apple macOS 15	MacBook Air (M2, 2022)	Apple M2	No	N/A	v1.0.0 and v1.0.1
FreeBSD 14	Lenovo ThinkCentre M73	Intel Core i3-4130T	Yes	N/A	v1.0.0 and v1.0.1
FreeBSD 14	Lenovo ThinkCentre M73	Intel Core i3-4130T	No	N/A	v1.0.0 and v1.0.1
Microsoft Windows Server 2022	Lenovo ThinkCentre M73	Intel Core i3-4130T	Yes	N/A	v1.0.0 and v1.0.1
Microsoft Windows Server 2022	Lenovo ThinkCentre M73	Intel Core i3-4130T	No	N/A	v1.0.0 and v1.0.1
Microsoft Windows 11	Surface Laptop 7th Edition	Qualcomm Snapdragon X Plus	Yes	N/A	v1.0.0 and v1.0.1
Microsoft Windows 11	Surface Laptop 7th Edition	Qualcomm Snapdragon X Plus	No	N/A	v1.0.0 and v1.0.1
SUSE Linux Enterprise Server 15 SP6	Dell PowerEdge R660	Intel Xeon Silver 4410Y	Yes	N/A	v1.0.0 and v1.0.1

Operating System	Hardware Platform	Processors	PAA/PAI	Hypervisor or Host OS	Version(s)
SUSE Linux Enterprise Server 15 SP6	Dell PowerEdge R660	Intel Xeon Silver 4410Y	No	N/A	v1.0.0 and v1.0.1
SUSE Linux Enterprise Server 15 SP6	ASRock Rack ALTRAD8UD-1L2T	Ampere Altra Q64-22	Yes	N/A	v1.0.0 and v1.0.1
SUSE Linux Enterprise Server 15 SP6	ASRock Rack ALTRAD8UD-1L2T	Ampere Altra Q64-22	No	N/A	v1.0.0 and v1.0.1
JavaScriptCore WebAssembly engine	MacBook Air (M2, 2022)	Apple M2	No	Apple Safari 26 on Apple macOS 26	v1.0.1
V8 WebAssembly engine	Lenovo Thinkpad L13 Gen 2	Intel Core i3-1115G4	No	Google Chrome 150 on Microsoft Windows 11	v1.0.1
V8 WebAssembly engine	Lenovo Thinkpad L13 Gen 2	Intel Core i3-1115G4	No	Microsoft Edge 148 on Microsoft Windows 11	v1.0.1
SpiderMonkey WebAssembly engine	Lenovo Thinkpad L13 Gen 2	Intel Core i3-1115G4	No	Mozilla Firefox 152 on Microsoft Windows 11	v1.0.1

Table 3: Tested Operational Environments - Software, Firmware, Hybrid

Vendor-Affirmed Operational Environments - Software, Firmware, Hybrid:

Operating System	Hardware Platform
Linux 3.10+	x86-64 architecture
Linux 3.10+	ARMv8 architecture
Linux 3.10+	ARMv9 architecture
Linux 3.10+	ARMv7 architecture
Linux 4.x	x86-64 architecture
Linux 4.x	ARMv8 architecture
Linux 4.x	ARMv9 architecture
Linux 4.x	ARMv7 architecture
Linux 5.x	x86-64 architecture
Linux 5.x	ARMv8 architecture
Linux 5.x	ARMv9 architecture
Linux 5.x	ARMv7 architecture
Linux 6.x	x86-64 architecture

Operating System	Hardware Platform
Linux 6.x	ARMv8 architecture
Linux 6.x	ARMv9 architecture
Linux 6.x	ARMv7 architecture
Linux 7.x	x86-64 architecture
Linux 7.x	ARMv8 architecture
Linux 7.x	ARMv9 architecture
Linux 7.x	ARMv7 architecture
Apple macOS 11	Apple M series
Apple macOS 12	Apple M series
Apple macOS 13	Apple M series
Apple macOS 14	Apple M series

Operating System	Hardware Platform
Apple macOS 15	Apple M series
Apple macOS 26	Apple M series
FreeBSD 12	x86-64 architecture
FreeBSD 13	x86-64 architecture
FreeBSD 14	x86-64 architecture
FreeBSD 15	x86-64 architecture
Microsoft Windows 10	x86-64 architecture
Microsoft Windows 11	x86-64 architecture
Microsoft Windows 11	ARMv8 architecture
Microsoft Windows 11	ARMv9 architecture

Operating System	Hardware Platform
Microsoft Windows Server 2016	x86-64 architecture
Microsoft Windows Server 2019	x86-64 architecture
Microsoft Windows Server 2022	x86-64 architecture
Microsoft Windows Server 2025	x86-64 architecture
Microsoft Windows Server 2025	ARMv8 architecture
Microsoft Windows Server 2025	ARMv9 architecture
Red Hat Enterprise Linux 10	x86-64 architecture

Operating System	Hardware Platform
Red Hat Enterprise Linux 10	ARMv8 architecture
Red Hat Enterprise Linux 10	ARMv9 architecture
Red Hat Enterprise Linux 10	IBM Z System z16
Red Hat Enterprise Linux 10	IBM Power10
Oracle Linux 7 with UEK6	Oracle X series servers
Oracle Linux 7 with UEK6	Oracle E series servers
Oracle Linux 7 with UEK6	Oracle A series servers
Oracle Linux 7 with UEK6	Marvell OCTEON TX2 CN93XX

Operating System	Hardware Platform
Oracle Linux 7 with UEK6	AMD Pensando DSC2-2Q200
Oracle Linux 7 with UEK6	Marvell OCTEON III CN73XX
Oracle Linux 7 with UEK6	ARM Cortex-A7
Oracle Linux 7 with UEK6	ARM Cortex-A9
Oracle Linux 8 with UEK7	Oracle X series servers
Oracle Linux 8 with UEK7	Oracle E series servers
Oracle Linux 8 with UEK7	Oracle A series servers
Oracle Linux 9 with UEK7	Oracle X series servers
Oracle Linux 9 with UEK7	Oracle E series servers

Operating System	Hardware Platform
Oracle Linux 9 with UEK7	Oracle A series servers
Oracle Linux 9 with UEK7	Marvell OCTEON TX2 CN93XX
Oracle Linux 9 with UEK7	AMD Pensando DSC2-2Q200
Oracle Linux 9 with UEK7	Marvell OCTEON III CN73XX
Windows Server 2022	Dell XR4510c with Intel Xeon D-2776NT
Windows Server 2025	Dell XR4510c with Intel Xeon D-2776NT
Azure Local 22H2	Dell XR4510c with Intel Xeon D-2776NT
Red Hat Enterprise Linux 8.10 on Hyper-V	Dell XR4510c with Intel Xeon D-2776NT
Red Hat Enterprise	Dell XR4510c with Intel Xeon D-2776NT

Operating System	Hardware Platform
Linux 8.8 on Hyper-V	
Red Hat Enterprise Linux 8.5 on Hyper-V	Dell XR4510c with Intel Xeon D-2776NT
Red Hat Enterprise Linux 9.5 on Hyper-V	Dell XR4510c with Intel Xeon D-2776NT
Rocky Linux 8.5 on Hyper-V	Dell XR4510c with Intel Xeon D-2776NT
Ubuntu Linux 22.04 on Hyper-V	Dell XR4510c with Intel Xeon D-2776NT
Ubuntu Linux 24.04 on Hyper-V	Dell XR4510c with Intel Xeon D-2776NT
Amazon Linux 2023	x86-64 architecture
Amazon Linux 2023	ARMv8 architecture

Operating System	Hardware Platform
Amazon Linux 2023	ARMv9 architecture
Amazon Linux 2023	AWS Graviton2
Amazon Linux 2023	AWS Graviton3
HPE ANW ClearPass Policy Manager (CPPM) 6.14.0 or later	N1000
HPE ANW ClearPass Policy Manager (CPPM) 6.14.0 or later	N3000
HPE ANW ClearPass Policy Manager (CPPM)	N3001

Operating System	Hardware Platform
6.14.0 or later	
HPE ANW ClearPass Policy Manager (CPPM) 6.14.0 or later	VMware ESXi 7.0 To latest 8.x
HPE ANW ClearPass Policy Manager (CPPM) 6.14.0 or later	Microsoft HyperV 2019R2 and goes to 2024 releases
HPE ANW ClearPass Policy Manager (CPPM) 6.14.0 or later	Linux KVM Ubuntu 22.04
HPE ANW ClearPass Policy Manager (CPPM)	Nutanix AHV

Operating System	Hardware Platform
6.14.0 or later	
HPE ANW ClearPass Policy Manager (CPPM) 6.14.0 or later	HPE VM Morpheus
HPE ANW ClearPass Policy Manager (CPPM) 6.14.0 or later	Amazon Web Services
HPE ANW ClearPass Policy Manager (CPPM) 6.14.0 or later	Microsoft Azure
HPE ANW CX Switch Operating System (AOS-CX)	4100i

Operating System	Hardware Platform
10.18.1000 or later	
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	5420
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	6000
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	6100
HPE ANW CX Switch Operating System (AOS-CX)	6200F

Operating System	Hardware Platform
10.18.1000 or later	
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	6200M
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	6300
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	6300L
HPE ANW CX Switch Operating System (AOS-CX)	6400

Operating System	Hardware Platform
10.18.1000 or later	
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	8100
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	8360
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	8320
HPE ANW CX Switch Operating System (AOS-CX)	8325

Operating System	Hardware Platform
10.18.1000 or later	
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	8325H
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	8325P
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	8400
HPE ANW CX Switch Operating System (AOS-CX)	9300

Operating System	Hardware Platform
10.18.1000 or later	
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	9300S
HPE ANW CX Switch Operating System (AOS-CX)10.18.1000 or later	10000
HPE ANW CX Switch Operating System (AOS-CX) 10.18.1000 or later	10040
Alpine Linux v3.16 (or later)	AMD64

Operating System	Hardware Platform
Alpine Linux v3.16 (or later)	ARM64
Debian GNU/Linux 12 (or later)	AMD64
Debian GNU/Linux 12 (or later)	ARM64
Debian GNU/Linux 13 (trixie) (or later)	AMD64
Debian GNU/Linux 13 (trixie) (or later)	ARM64
Ubuntu Linux 22.04	AMD64
Ubuntu Linux 22.04	ARM64
Ubuntu Linux 24.04	AMD64

Operating System	Hardware Platform
Ubuntu Linux 24.04	ARM64
HPE Alletra Storage ArcusOS Release 10.6 (or later) on Debian GNU/Linux 12 (or later)	HPE Alletra Storage MP B10000
Ubuntu Pro 22.04 LTS x86_64	Generic Hardware Platform
Ubuntu Pro 22.04 LTS arm64	Generic Hardware Platform
Ubuntu Pro 24.04 LTS x86_64	Generic Hardware Platform
Ubuntu Pro 24.04 LTS arm64	Generic Hardware Platform

Operating System	Hardware Platform
Bottlerocket x86_64 FIPS	Generic Hardware Platform
Bottlerocket arm64 FIPS	Generic Hardware Platform
Amazon Linux 2023 x86_64	Generic Hardware Platform
Amazon Linux 2023 arm64	Generic Hardware Platform
Rocky 8.10	Generic/ Standard ProLiants
Rocky 9.7	Generic/ Standard ProLiants
Rocky 9.8	Generic/ Standard ProLiants
Rocky 9.7	Synergy Composer 2
Rocky 9.8	Synergy Composer 2
Rocky 9.7	Synergy Composer 2 Plus
Rocky 9.8	Synergy Composer 2 Plus

Operating System	Hardware Platform
Windows 2019	Generic/Standard ProLiants
Windows 2022	Generic/Standard ProLiants
Windows 2025	Generic/Standard ProLiants
Azure Stack HCI 23H2	Generic/Standard ProLiants
Azure Local 24H2	Generic/Standard ProLiants
Red Hat Enterprise Linux 9 Server	Generic/Standard ProLiants
Red Hat Enterprise Linux 10	Generic/Standard ProLiants
SUSE Linux Enterprise Server 15	Generic/Standard ProLiants

Operating System	Hardware Platform
SUSE Linux Enterprise Server 16	Generic/Standard ProLiants
Linux Kernel 6.12.62 and later	All Gen 13 and later generation of Rack Servers
Alpine Linux v3.16 (or later)	HPE Alletra Storage MP X10000
Debian GNU/Linux 12 (or later)	HPE Alletra Storage MP X10000
Red Hat Enterprise Linux 8.10 or later	HPE Alletra Storage MP X10000
Debian GNU/Linux 13 (or later)	HPE Alletra Storage MP X10000
HPE StoreOnce Software 5.2.0 or later	HPE StoreOnce

Operating System	Hardware Platform
Ubuntu 22.04/24.04	VM (amd64 based CPU)
Linux 5.15.167	AP36/AP36M, AP37, AP66/AP66D, AP17, AP27/AP27E
Linux 5.15.167	AP47/AP47D/AP47E
Junos 21.4R3-S4	EX2300/EX3400
Junos 22.4R2-S1	EX4000/EX4100
Junos 23.1R2	EX4300-MP/EX4400/EX4650/EX92xx/EX10k/QFX5110/QFX5120/QFX5200/QFX5210/MX204/MX301/MX304
Junos Evolved 23.2R1	QFX5130/QFX5220/QFX5700
Debian 11+	Mist-Edge or VM (amd64 based CPU)
Security Director Cloud 26.2.1 or	VM (VMWare/KVM/Azure…)

Operating System	Hardware Platform
later on Host OS Ubuntu 22.04 LTS and Container OS Ubuntu 24.04 LTS	
Security Director On-Prem 26.2.1 or later on Host OS Ubuntu 20.04.6 LTS and Container OS Ubuntu 24.04 LTS	VM (VMWare/KVM/Azure…)
FreeBSD 12+ based Junos	SRX1500/SRX1600/SRX4100/SRX4200/SRX4300/SRX4600/SRX4700/SRX2300
Junos EVO	SRX400

Table 4: Vendor-Affirmed Operational Environments - Software, Firmware, Hybrid

CMVP makes no statement as to the correct operation of the module or the security strengths of the generated keys when so ported if the specific operational environment is not listed on the validation certificate.

2.3 Excluded Components

There are no components excluded from the module's cryptographic boundary or the FIPS security requirements.

2.4 Modes of Operation

Modes List and Description:

Mode Name	Description	Type	Status Indicator
Approved Mode	State in which the module is performing approved cryptographic services	Approved	ServiceIndicator() returns true
Non-Approved Mode	State in which the module is performing non-approved cryptographic services	Non-Approved	ServiceIndicator() returns false

Table 5: Modes List and Description

The module provides both approved and non-approved modes of operation. The approved mode of operation is entered automatically upon invocation of an approved service and exited automatically upon invocation of a non-approved service.

2.5 Algorithms

Approved Algorithms:

The table below lists the approved cryptographic algorithms of the module and implemented modes of operation of the algorithms.

Algorithm	CAVP Cert	Properties	Reference
AES-CBC	A6650	Direction - Decrypt, Encrypt Key Length - 128, 192, 256	SP 800-38A

Algorithm	CAVP Cert	Properties	Reference
AES-CBC	A8668	Direction - Decrypt, Encrypt Key Length - 128, 192, 256	SP 800-38A
AES-CMAC	A6650	Direction - Generation, Verification Key Length - 128, 256 MAC Length - MAC Length: 8-128 Increment 8 Message Length - Message Length: 0-524288 Increment 8	SP 800-38B
AES-CMAC	A8668	Direction - Generation, Verification Key Length - 128, 256 MAC Length - MAC Length: 8-128 Increment 8 Message Length - Message Length: 0-524288 Increment 8	SP 800-38B
AES-CTR	A6650	Direction - Decrypt, Encrypt Key Length - 128, 192, 256 Payload Length - Payload Length: 8-128 Increment 8 Supports Counter larger than maximum value - Yes Incremental Counter - Yes Counter Tests Performed - Yes	SP 800-38A
AES-CTR	A8668	Direction - Decrypt, Encrypt Key Length - 128, 192, 256 Payload Length - Payload Length: 8-128 Increment 8 Supports Counter larger than maximum value - Yes Incremental Counter - Yes Counter Tests Performed - Yes	SP 800-38A
AES-GCM	A6650	Direction - Decrypt, Encrypt IV Generation - External, Internal Key Length - 128, 192, 256	SP 800-38D

Algorithm	CAVP Cert	Properties	Reference
		Tag Length - 104, 112, 120, 128, 96 IV Length - IV Length: 96 Payload Length - Payload Length: 0-65536 Increment 8 AAD Length - AAD Length: 0-65536 Increment 8 IV Generation Mode - 8.2.2	
AES-GCM	A8668	Direction - Decrypt, Encrypt IV Generation - External, Internal Key Length - 128, 192, 256 Tag Length - 104, 112, 120, 128, 96 IV Length - IV Length: 96 Payload Length - Payload Length: 0-65536 Increment 8 AAD Length - AAD Length: 0-65536 Increment 8 IV Generation Mode - 8.2.2	SP 800-38D
Counter DRBG	A6650	Prediction Resistance - No Supports Reseed - Yes Mode - AES-256 Derivation Function Enabled - No Additional Input - Additional Input: 384 Entropy Input - Entropy Input: 384 Nonce - Nonce: 0 Personalization String Length - Personalization String Length: 0 Returned Bits - 128	SP 800-90A Rev. 1
Counter DRBG	A8668	Prediction Resistance - No Supports Reseed - Yes Mode - AES-256 Derivation Function Enabled - No Additional Input - Additional Input: 384 Entropy Input - Entropy Input: 384	SP 800-90A Rev. 1

Algorithm	CAVP Cert	Properties	Reference
		Nonce - Nonce: 0 Personalization String Length - Personalization String Length: 0 Returned Bits - 128	
cSHAKE-128	A6650	Message Length - Message Length: 0-65536 Increment 8 Output Length - Output Length: 16-65536 Increment 8 Hex Customization - No	SP 800-185
cSHAKE-128	A8668	Message Length - Message Length: 0-65536 Increment 8 Output Length - Output Length: 16-65536 Increment 8 Hex Customization - No	SP 800-185
cSHAKE-256	A6650	Message Length - Message Length: 0-65536 Increment 8 Output Length - Output Length: 16-65536 Increment 8 Hex Customization - No	SP 800-185
cSHAKE-256	A8668	Message Length - Message Length: 0-65536 Increment 8 Output Length - Output Length: 16-65536 Increment 8 Hex Customization - No	SP 800-185
Deterministic ECDSA SigGen (FIPS186-5)	A6650	Curve - P-224, P-256, P-384, P-521 Hash Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512	FIPS 186-5

Algorithm	CAVP Cert	Properties	Reference
Deterministic ECDSA SigGen (FIPS186-5)	A8668	Curve - P-224, P-256, P-384, P-521 Hash Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512	FIPS 186-5
ECDSA KeyGen (FIPS186-5)	A6650	Curve - P-224, P-256, P-384, P-521 Secret Generation Mode - testing candidates	FIPS 186-5
ECDSA KeyGen (FIPS186-5)	A8668	Curve - P-224, P-256, P-384, P-521 Secret Generation Mode - testing candidates	FIPS 186-5
ECDSA KeyVer (FIPS186-5)	A6650	Curve - P-224, P-256, P-384, P-521	FIPS 186-5
ECDSA KeyVer (FIPS186-5)	A8668	Curve - P-224, P-256, P-384, P-521	FIPS 186-5
ECDSA SigGen (FIPS186-5)	A6650	Curve - P-224, P-256, P-384, P-521 Hash Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512	FIPS 186-5
ECDSA SigGen (FIPS186-5)	A8668	Curve - P-224, P-256, P-384, P-521 Hash Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512	FIPS 186-5
ECDSA SigVer (FIPS186-5)	A6650	Curve - P-224, P-256, P-384, P-521 Hash Algorithm - SHA2-224, SHA2-256, SHA2-384,	FIPS 186-5

Algorithm	CAVP Cert	Properties	Reference
		SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512	
ECDSA SigVer (FIPS186-5)	A8668	Curve - P-224, P-256, P-384, P-521 Hash Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512	FIPS 186-5
EDDSA KeyGen	A6650	Curve - ED-25519	FIPS 186-5
EDDSA KeyGen	A8668	Curve - ED-25519	FIPS 186-5
EDDSA KeyVer	A6650	Curve - ED-25519	FIPS 186-5
EDDSA KeyVer	A8668	Curve - ED-25519	FIPS 186-5
EDDSA SigGen	A6650	Curve - ED-25519 Context Length - Context Length: 0-255 Increment 1 PreHash - Yes Pure - Yes	FIPS 186-5
EDDSA SigGen	A8668	Curve - ED-25519 Context Length - Context Length: 0-255 Increment 1 PreHash - Yes Pure - Yes	FIPS 186-5
EDDSA SigVer	A6650	Curve - ED-25519 PreHash - Yes Pure - Yes	FIPS 186-5

Algorithm	CAVP Cert	Properties	Reference
EDDSA SigVer	A8668	Curve - ED-25519 PreHash - Yes Pure - Yes	FIPS 186-5
HMAC DRBG	A6650	Prediction Resistance - No Supports Reseed - No Mode - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512 Entropy Input - Entropy Input: 192, Entropy Input: 256 Nonce - Nonce: 128, Nonce: 96 Personalization String Length - Personalization String Length: 192, Personalization String Length: 256 Additional Input - Additional Input: 0 Returned Bits - 224, 256, 384, 512	SP 800-90A Rev. 1
HMAC DRBG	A8668	Prediction Resistance - No Supports Reseed - No Mode - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512 Entropy Input - Entropy Input: 192, Entropy Input: 256 Nonce - Nonce: 128, Nonce: 96 Personalization String Length - Personalization String Length: 192, Personalization String Length: 256 Additional Input - Additional Input: 0 Returned Bits - 224, 256, 384, 512	SP 800-90A Rev. 1
HMAC-SHA2-224	A6650	MAC - MAC: 32-224 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1

Algorithm	CAVP Cert	Properties	Reference
HMAC-SHA2-224	A8668	MAC - MAC: 32-224 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-256	A6650	MAC - MAC: 32-256 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-256	A8668	MAC - MAC: 32-256 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-384	A6650	MAC - MAC: 32-384 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-384	A8668	MAC - MAC: 32-384 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-512	A6650	MAC - MAC: 32-512 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-512	A8668	MAC - MAC: 32-512 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-512/224	A6650	MAC - MAC: 32-224 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-512/224	A8668	MAC - MAC: 32-224 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1

Algorithm	CAVP Cert	Properties	Reference
HMAC-SHA2-512/256	A6650	MAC - MAC: 32-256 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA2-512/256	A8668	MAC - MAC: 32-256 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA3-224	A6650	MAC - MAC: 32-224 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA3-224	A8668	MAC - MAC: 32-224 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA3-256	A6650	MAC - MAC: 32-256 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA3-256	A8668	MAC - MAC: 32-256 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA3-384	A6650	MAC - MAC: 32-384 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA3-384	A8668	MAC - MAC: 32-384 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
HMAC-SHA3-512	A6650	MAC - MAC: 32-512 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1

Algorithm	CAVP Cert	Properties	Reference
HMAC-SHA3-512	A8668	MAC - MAC: 32-512 Increment 8 Key Length - Key Length: 8-524288 Increment 8	FIPS 198-1
KAS-ECC-SSC Sp800-56Ar3	A6650	Domain Parameter Generation Methods - P-224, P-256, P-384, P-521 Scheme - ephemeralUnified - KAS Role - initiator, responder staticUnified - KAS Role - initiator, responder	SP 800-56A Rev. 3
KAS-ECC-SSC Sp800-56Ar3	A8668	Domain Parameter Generation Methods - P-224, P-256, P-384, P-521 Scheme - ephemeralUnified - KAS Role - initiator, responder staticUnified - KAS Role - initiator, responder	SP 800-56A Rev. 3
KDA HKDF Sp800-56Cr1	A6650	Fixed Info Pattern - uPartyInfo||vPartyInfo Fixed Info Encoding - concatenation Derived Key Length - 2048 Shared Secret Length - Shared Secret Length: 224-65336 Increment 8 HMAC Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512	SP 800-56C Rev. 2
KDA HKDF Sp800-56Cr1	A8668	Fixed Info Pattern - uPartyInfo||vPartyInfo Fixed Info Encoding - concatenation Derived Key Length - 2048 Shared Secret Length - Shared Secret Length: 224-65336 Increment 8	SP 800-56C Rev. 2

Algorithm	CAVP Cert	Properties	Reference
		HMAC Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512	
KDA OneStepNoCounter SP800-56Cr2	A6650	Auxiliary Function Methods - Auxiliary Function Name - HMAC-SHA2-224 MAC Salting Methods - default, random Key Length - 224 Fixed Info Pattern - uPartyInfo||vPartyInfo Fixed Info Encoding - concatenation Key Length - Key Length: 224-65336 Increment 8	SP 800-56C Rev. 2
KDA OneStepNoCounter SP800-56Cr2	A8668	Auxiliary Function Methods - Auxiliary Function Name - HMAC-SHA2-224 MAC Salting Methods - default, random Key Length - 224 Fixed Info Pattern - uPartyInfo||vPartyInfo Fixed Info Encoding - concatenation Key Length - Key Length: 224-65336 Increment 8	SP 800-56C Rev. 2
KDF SP800-108	A6650	KDF Mode - Counter, Feedback MAC Mode - CMAC-AES128, CMAC-AES192, CMAC-AES256, HMAC-SHA2-224, HMAC-SHA2-256, HMAC-SHA2-384, HMAC-SHA2-512, HMAC-SHA2-512/224, HMAC-SHA2-512/256, HMAC-SHA3-224, HMAC-SHA3-256, HMAC-SHA3-384, HMAC-SHA3-512 Supported Lengths - Supported Lengths: 256, Supported Lengths: 8-4096 Increment 8 Fixed Data Order - After Fixed Data, Before Fixed Data Counter Length - 16, 8 Supports Empty IV - No, Yes	SP 800-108 Rev. 1

Algorithm	CAVP Cert	Properties	Reference
		Custom Key In Length - 0 Requires Empty IV - Yes	
KDF SP800-108	A8668	KDF Mode - Counter, Feedback MAC Mode - CMAC-AES128, CMAC-AES192, CMAC-AES256, HMAC-SHA2-224, HMAC-SHA2-256, HMAC-SHA2-384, HMAC-SHA2-512, HMAC-SHA2-512/224, HMAC-SHA2-512/256, HMAC-SHA3-224, HMAC-SHA3-256, HMAC-SHA3-384, HMAC-SHA3-512 Supported Lengths - Supported Lengths: 256, Supported Lengths: 8-4096 Increment 8 Fixed Data Order - After Fixed Data, Before Fixed Data Counter Length - 16, 8 Supports Empty IV - No, Yes Custom Key In Length - 0 Requires Empty IV - Yes	SP 800-108 Rev. 1
KDF SSH (CVL)	A6650	Cipher - AES-128, AES-192, AES-256 Hash Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512	SP 800-135 Rev. 1
KDF SSH (CVL)	A8668	Cipher - AES-128, AES-192, AES-256 Hash Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512	SP 800-135 Rev. 1
KTS-IFC	A6650	IUT ID - C0FFEE Modulo - 2048, 3072, 4096 Key Generation Methods - rsakpg1-basic Fixed Public Exponent - 010001 Scheme - KTS-OAEP-basic - KAS Role - initiator, responder	SP 800-56B Rev. 2

Algorithm	CAVP Cert	Properties	Reference
		Key Transport Method - Hash Algorithms - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512 Supports Null Associated Data - Yes Associated Data Encoding - concatenation Key Length - 1024	
KTS-IFC	A8668	IUT ID - C0FFEE Modulo - 2048, 3072, 4096 Key Generation Methods - rsakpg1-basic Fixed Public Exponent - 010001 Scheme - KTS-OAEP-basic - KAS Role - initiator, responder Key Transport Method - Hash Algorithms - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512 Supports Null Associated Data - Yes Associated Data Encoding - concatenation Key Length - 1024	SP 800-56B Rev. 2
ML-KEM EncapDecap	A6650	Parameter Sets - ML-KEM-1024, ML-KEM-768 Functions - Decapsulation, Encapsulation	FIPS 203
ML-KEM EncapDecap	A8668	Parameter Sets - ML-KEM-1024, ML-KEM-768 Functions - Decapsulation, Encapsulation	FIPS 203
ML-KEM KeyGen	A6650	Parameter Sets - ML-KEM-1024, ML-KEM-768	FIPS 203
ML-KEM KeyGen	A8668	Parameter Sets - ML-KEM-1024, ML-KEM-768	FIPS 203

Algorithm	CAVP Cert	Properties	Reference
PBKDF	A6650	Iteration Count - Iteration Count: 1-10000 Increment 1 HMAC Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512 Password Length - Password Length: 8-64 Increment 1 Salt Length - Salt Length: 128-512 Increment 8 Key Data Length - Key Data Length: 112-4096 Increment 8	SP 800-132
PBKDF	A8668	Iteration Count - Iteration Count: 1-10000 Increment 1 HMAC Algorithm - SHA2-224, SHA2-256, SHA2-384, SHA2-512, SHA2-512/224, SHA2-512/256, SHA3-224, SHA3-256, SHA3-384, SHA3-512 Password Length - Password Length: 8-64 Increment 1 Salt Length - Salt Length: 128-512 Increment 8 Key Data Length - Key Data Length: 112-4096 Increment 8	SP 800-132
RSA KeyGen (FIPS186-5)	A6650	Key Generation Mode - probable Modulo - 2048, 3072, 4096 Primality Tests - 2powSecStr Fixed Public Exponent - 010001 Info Generated By Server - Yes Private Key Format - standard Public Exponent Mode - fixed	FIPS 186-5
RSA KeyGen (FIPS186-5)	A8668	Key Generation Mode - probable Modulo - 2048, 3072, 4096 Primality Tests - 2powSecStr Fixed Public Exponent - 010001 Info Generated By Server - Yes	FIPS 186-5

Algorithm	CAVP Cert	Properties	Reference
		Private Key Format - standard Public Exponent Mode - fixed	
RSA SigGen (FIPS186-5)	A6650	Hash Pair - Hash Algorithm - SHA2-224 Modulo - 2048, 3072, 4096 Signature Type - pkcs1v1.5, pss Mask Function - mgf1	FIPS 186-5
RSA SigGen (FIPS186-5)	A8668	Hash Pair - Hash Algorithm - SHA2-224 Modulo - 2048, 3072, 4096 Signature Type - pkcs1v1.5, pss Mask Function - mgf1	FIPS 186-5
RSA SigVer (FIPS186-5)	A6650	Hash Pair - Hash Algorithm - SHA2-224 Modulo - 2048, 3072, 4096 Signature Type - pkcs1v1.5, pss Mask Function - mgf1 Fixed Public Exponent - 010001 Public Exponent Mode - fixed	FIPS 186-5
RSA SigVer (FIPS186-5)	A8668	Hash Pair - Hash Algorithm - SHA2-224 Modulo - 2048, 3072, 4096 Signature Type - pkcs1v1.5, pss Mask Function - mgf1 Fixed Public Exponent - 010001 Public Exponent Mode - fixed	FIPS 186-5

Algorithm	CAVP Cert	Properties	Reference
SHA2-224	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-224	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-256	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-256	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-384	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-384	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-512	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-512	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-512/224	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4

Algorithm	CAVP Cert	Properties	Reference
SHA2-512/224	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-512/256	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA2-512/256	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 180-4
SHA3-224	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 202
SHA3-224	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 202
SHA3-256	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 202
SHA3-256	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 202
SHA3-384	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 202
SHA3-384	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 202

Algorithm	CAVP Cert	Properties	Reference
SHA3-512	A6650	Message Length - Message Length: 0-65528 Increment 8	FIPS 202
SHA3-512	A8668	Message Length - Message Length: 0-65528 Increment 8	FIPS 202
SHAKE-128	A6650	Supports Bit-Oriented Messages - No Supports Empty Message - Yes Supports Bit-Oriented Output - No Output Length - Output Length: 16-65536 Increment 8	FIPS 202
SHAKE-128	A8668	Supports Bit-Oriented Messages - No Supports Empty Message - Yes Supports Bit-Oriented Output - No Output Length - Output Length: 16-65536 Increment 8	FIPS 202
SHAKE-256	A6650	Supports Bit-Oriented Messages - No Supports Empty Message - Yes Supports Bit-Oriented Output - No Output Length - Output Length: 16-65536 Increment 8	FIPS 202
SHAKE-256	A8668	Supports Bit-Oriented Messages - No Supports Empty Message - Yes Supports Bit-Oriented Output - No Output Length - Output Length: 16-65536 Increment 8	FIPS 202
TLS v1.2 KDF RFC7627 (CVL)	A6650	Hash Algorithm - SHA2-256, SHA2-384, SHA2-512 Key Block Length - Key Block Length: 1024	SP 800-135 Rev. 1

Algorithm	CAVP Cert	Properties	Reference
TLS v1.2 KDF RFC7627 (CVL)	A8668	Hash Algorithm - SHA2-256, SHA2-384, SHA2-512 Key Block Length - Key Block Length: 1024	SP 800-135 Rev. 1
TLS v1.3 KDF (CVL)	A6650	HMAC Algorithm - SHA2-256, SHA2-384 KDF Running Modes - DHE, PSK, PSK-DHE	SP 800-135 Rev. 1
TLS v1.3 KDF (CVL)	A8668	HMAC Algorithm - SHA2-256, SHA2-384 KDF Running Modes - DHE, PSK, PSK-DHE	SP 800-135 Rev. 1

Table 6: Approved Algorithms

Vendor-Affirmed Algorithms:

The vendor affirms the approved implementation of the following algorithms.

Name	Properties	Implementation	Reference
CKG	Key Type:Symmetric and Asymmetric	Go Cryptographic Module	SP 800-133rev2 Section 4, Section 6.3

Table 7: Vendor-Affirmed Algorithms

Non-Approved, Allowed Algorithms:

N/A for this module.

The module does not implement any non-approved or allowed algorithms in the approved mode of operation.

Non-Approved, Allowed Algorithms with No Security Claimed:

N/A for this module.

The module does not implement any non-approved or allowed algorithms in the approved mode of operation, with no security claimed.

Non-Approved, Not Allowed Algorithms:

The table below lists the non-approved and not allowed cryptographic algorithms.

Name	Use and Function
AES ECB	Using Block.Encrypt, Block.Decrypt for encryption/decryption
AES GCM	Using arbitrary nonces for encryption
GHASH	MAC generation
Ed25519ctx	Signature generation/verification
HKDF	Using secrets shorter than 112 bits for key derivation; using a non-approved hash function for key derivation
HMAC	Using keys shorter than 112 bits for MAC generation; using a non-approved hash function for MAC generation
PBKDF	Using random salts shorter than 128 bits for key derivation; using a non-approved hash function for key derivation
TLS KDF	Using a non-approved hash function for key derivation
SSH KDF	Using a non-approved hash function for key derivation
RSA	Using key sizes smaller than 2048 bits or with odd bit length for key generation/verification, signature generation/verification, key encapsulation/decapsulation; using a non-approved hash function for signature

Name	Use and Function
	generation/verification, key encapsulation/decapsulation; using public exponent smaller than 65537 for signature generation/verification, key encapsulation/decapsulation; primitive operation without padding; using non-approved DRBG for signature generation, key decapsulation; using primes of different lengths for signature generation, key decapsulation; using PSS salt longer than hash output for signature generation/verification
ECDH	Using non-approved DRBG for shared secret computation
ECDSA	Using non-approved DRBG for key/signature generation; using a non-approved hash function for signature generation/verification

Table 8: Non-Approved, Not Allowed Algorithms

2.6 Security Function Implementations

Name	Type	Description	Properties	Algorithms
Data Encryption	BC-Auth BC-UnAuth	Symmetric Encryption	Publication:FIPS 197	AES-CBC: (A6650, A8668) AES-CTR: (A6650, A8668) AES-GCM: (A6650, A8668)
Key Derivation Function	KAS-135KDF KAS-56CKDF PBKDF	Key Derivation Function	Publication 1:SP80056Cr1 Publication 2:SP80056Cr2 Publication 3:SP800-108	KDA HKDF Sp800-56Cr1: (A6650, A8668) KDA OneStepNoCounter SP800-56Cr2: (A6650, A8668) KDF SP800-108: (A6650, A8668)

Name	Type	Description	Properties	Algorithms
				KDF SSH: (A6650, A8668) PBKDF: (A6650, A8668) TLS v1.2 KDF RFC7627: (A6650, A8668) TLS v1.3 KDF: (A6650, A8668)
Deterministic Random Bit Generation	DRBG	Deterministic Random Bit Generation	Publication:SP800-90Ar1	Counter DRBG: (A6650, A8668) HMAC DRBG: (A6650, A8668)
Digital Signature	DigSig-SigGen DigSig-SigVer	RSA, ECDSA SigGen/SigVer, EDDSA SigGen/SigVer	Publication:FIPS186-5	Deterministic ECDSA SigGen (FIPS186-5): (A6650, A8668) ECDSA SigGen (FIPS186-5): (A6650, A8668) ECDSA SigVer (FIPS186-5): (A6650, A8668) EDDSA SigGen: (A6650, A8668) EDDSA SigVer: (A6650, A8668) RSA SigGen (FIPS186-5): (A6650, A8668) RSA SigVer (FIPS186-5): (A6650, A8668)

Name	Type	Description	Properties	Algorithms
Message Authentication	MAC	Generate or verify data integrity	Publication 1:SP800-38B Publication 2:FIPS 198-1	AES-CMAC: (A6650, A8668) HMAC-SHA2-224: (A6650, A8668) HMAC-SHA2-256: (A6650, A8668) HMAC-SHA2-384: (A6650, A8668) HMAC-SHA2-512: (A6650, A8668) HMAC-SHA2-512/224: (A6650, A8668) HMAC-SHA2-512/256: (A6650, A8668) HMAC-SHA3-224: (A6650, A8668) HMAC-SHA3-256: (A6650, A8668) HMAC-SHA3-384: (A6650, A8668) HMAC-SHA3-512: (A6650, A8668)
Key Agreement ECC	KAS-SSC	Perform key agreement primitives on behalf of the calling process (does not establish keys into the module)	Security Strength:Key establishment methodology provides between 112 and 256 bits of encryption strength. Publication : NIST SP 800-56Arev3 IG :	KAS-ECC-SSC Sp800-56Ar3: (A6650, A8668)

Name	Type	Description	Properties	Algorithms
			D.F - Scenario 2, Path (1)	
Message digest	SHA	Hashing	Publication:FIPS 180-4	SHA2-224: (A6650, A8668) SHA2-256: (A6650, A8668) SHA2-384: (A6650, A8668) SHA2-512: (A6650, A8668) SHA2-512/224: (A6650, A8668) SHA2-512/256: (A6650, A8668) SHA3-224: (A6650, A8668) SHA3-256: (A6650, A8668) SHA3-384: (A6650, A8668) SHA3-512: (A6650, A8668)
Key Generation	AsymKeyPair-DomPar AsymKeyPair-KeyGen AsymKeyPair-KeyVer AsymKeyPair-PubKeyVal	Key Generation (asymmetric)	Publication 1:NIST SP 800-133rev2 - Section 4 Publication 2:NIST SP 800-133rev2 - Section 6.2.2 Publication 3:NIST FIPS 203	ECDSA KeyGen (FIPS186-5): (A6650, A8668) ECDSA KeyVer (FIPS186-5): (A6650, A8668) EDDSA KeyGen: (A6650, A8668) EDDSA KeyVer: (A6650, A8668) KAS-ECC-SSC Sp800-56Ar3:

Name	Type	Description	Properties	Algorithms
				(A6650, A8668) RSA KeyGen (FIPS186-5): (A6650, A8668) CKG: (A6650, A8668) Key Type: Symmetric ML-KEM KeyGen: (A6650, A8668)
Key Encapsulation	KTS-Encap	Key Encapsulation	Security Strength:Key establishment methodology provides between 112 and 256 bits of encryption strength.	KTS-IFC: (A6650, A8668) ML-KEM EncapDecap: (A6650, A8668)
Data Decryption	BC-Auth BC-UnAuth	Symmetric Encryption	Publication:FIPS 197	AES-CBC: (A6650, A8668) AES-CTR: (A6650, A8668) AES-GCM: (A6650, A8668)
Extendable Output Function	XOF	Output message with variable length	Publication:FIPS 202	cSHAKE-128: (A6650, A8668) cSHAKE-256: (A6650, A8668) SHAKE-128: (A6650, A8668) SHAKE-256: (A6650, A8668)

Table 9: Security Function Implementations

2.7 Algorithm Specific Information

HMAC:

Per FIPS 140-3 IG C.M, key lengths below 112 bits are only allowed for legacy use (i.e. verification only) and the module does not allow them. However, HKDF uses the HMAC key for the salt, and PBKDF2 uses it for the password, which are allowed to be shorter.

PBKDF2:

Per FIPS 140-3 IG D.N, keys derived from passwords can only be used in storage applications.

AES-GCM:

The module implements the following APIs to generate Initialization Vectors (IV) used in AES-GCM encryption:

- SealWithRandomNonce: 96 bits random nonces generated internally by Counter DRBG, complying with IG C.H Scenario 2;
- NewGCMForSSH: enforced construction of deterministic nonces as specified in RFC 5647, complying with IG C.H Scenario 1.d;
- NewGCMForTLS12: enforced construction of deterministic nonces as specified in RFC 5288, Section 3 and RFC 9325, Section 7.2.1, complying with C.H Scenario 1.a;
- NewGCMForTLS13: enforced construction of deterministic nonces as specified in RFC 8446, Section 5.3, complying with IG C.H Scenario 1.a;
- NewGCMWithCounterNonce: enforced construction of deterministic nonces where the first 32 bits must be an encoding of the module name and the last 64 bits must be a counter, complying with IG C.H Scenario 3;

The IVs generated using NewGCMForSSH, NewGCMForTLS12, NewGCMForTLS13 should be used in the context of the respective protocols. The counter portion of the IVs generated deterministically is strictly incremented and no more than 2^{64} - 1 encryptions may be performed in the same session. If the module's power is lost and then restored, the calling application is responsible for establishing new keys for AES-GCM encryption. No more than 2^{32} encryptions may be performed with SealWithRandomNonce with the same key.

2.8 RBG and Entropy

The module's entropy source is located within the TOEPP, but outside the cryptographic boundary of the module. The module passively receives entropy based on request by the calling applications and exercises no control over the amount or quality of the obtained entropy.

2.9 Key Generation

When generating asymmetric keys, the module uses the output of CTR_DRBG to generate random numbers and keying material, per the guidance in NIST SP 800-133rev2, Section 5. ECDSA SigGen additionally generates the nonce according to FIPS 186-5, Appendix A.3.2 using a per-invocation instance of HMAC DRBG seeded with 256, 384, or 528 bits (for P-256, P-384, and P-521 respectively, per SP 800-90Ar1, Section 8.6.7) of entropy input from the global DRBG according to the IETF draft-irtf-cfrg-det-sigs-with-noise-03 document. This is analogous to Deterministic ECDSA specified in FIPS 186-5.

2.10 Key Establishment

The module implements the following approved key agreement method:

- KAS-ECC-SSC – NIST SP 800-56A Rev. 3 (FIPS 140-3 IG D.F, Scenario 2, Path (1))

While the module implements the protocol-specific KDFs in support of key agreement operations, the module only offers cryptographic services at the API level to calling applications and does not implement full key agreement within the module boundary.

The module implements the following key transport method:

- KTS-IFC – NIST SP 800-56B Rev. 2 (FIPS 140-3 IG D.G, Key Encapsulation/Decapsulation)

The module implements the following KEM method:

- ML-KEM – NIST FIPS 203

2.11 Industry Protocols

The module implements approved cryptography to support the following industry-specific protocols:

- SSH
- TLS v1.2
- TLS v1.3

However, the module only offers cryptographic services to calling applications and does not contain full implementations of industry protocols.

No parts of the SSH or TLS protocol, other than the approved cryptographic algorithms and the KDFs, have been tested by the CAVP and CMVP.

3 Cryptographic Module Interfaces

3.1 Ports and Interfaces

Physical Port	Logical Interface(s)	Data That Passes
N/A	Data Input	The module accepts data input through the input arguments of the API functions.
N/A	Data Output	The module produces data output through the parameters of the API functions.
N/A	Control Input	The module accepts control input through the input arguments of the API functions used to control the module.
N/A	Status Output	The module produces status output through the return values from function calls and error messages.

Table 10: Ports and Interfaces

As a software cryptographic toolkit, all of the module's interfaces are defined at the Software/Firmware Module Interface (SFMI). The logical interfaces are mapped to specific calls via a well-defined API, with which the operator interacts.

The data output interface is inhibited when the module is performing self-tests, performing zeroisation, or while in an error state.

4 Roles, Services, and Authentication

4.1 Authentication Methods

The module does not implement an authentication mechanism. The operator role of Crypto Officer is assumed implicitly.

4.2 Roles

Name	Type	Operator Type	Authentication Methods
Crypto Officer	Role	Crypto Officer	None

Table 11: Roles

The module only supports one role: Crypto Officer (CO). This role is assumed implicitly by the operator when performing an approved service.

4.3 Approved Services

The module performs the following approved services:

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
Data Encryption, Decryption	Encrypt or decrypt data	ServiceIndicator() returns true	Parameters, plaintext or ciphertext, key	Status, ciphertext or plaintext	Data Encryption Data Decryption	Crypto Officer - AES Key: W,E - AES GCM IV: W,E

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
Key Derivation Function	Perform key derivation using a key derivation function	ServiceIndicator() returns true	Parameters, key/password	Status, derived key	Key Derivation Function	Crypto Officer - KDF Derived Key: G,R - TLS Pre-Master Secret: G,R - TLS Master Secret: G,R - PBKDF Password: W,E - PBKDF Derived Key: G,R
Deterministic Random Bit Generation	Generate random numbers with SP800-90A Rev 1	ServiceIndicator() returns true	Parameters, entropy	Status, random number	Deterministic Random Bit Generation	Crypto Officer - Entropy Input: W,E,Z - DRBG 'V' Value: W,E - DRBG 'K'

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						Value: W,E - DRBG Seed: G,E,Z - HMAC DRBG Entropy: W,E
Digital Signature	Generate or verify RSA or ECDSA digital signatures	ServiceIndicator() returns true	Parameters, RSA / ECDSA keys, message	Status, digital signature	Digital Signature	Crypto Officer - RSA Public Key: W,E - RSA Private Key: W,E - ECDSA Public Key: W,E - ECDSA Private Key: W,E
Message Authentication	Generate or verify data integrity	ServiceIndicator() returns true	Parameters, message, key	Status, message authentication code	Message Authentication	Crypto Officer - AES GCM Key: W,E

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						- AES CMAC Key: W,E - HMAC Key: W,E
Key Agreement	Perform key agreement primitives on behalf of the calling process (does not establish keys into the module)	ServiceIndicator() returns true	Parameters, ECDH keys	Status, shared secret	Key Agreement ECC	Crypto Officer - ECDH Peer Public Key: W,E - ECDH Private Key: W,E - ECDH Shared Secret: G,R
Key Generation	Generate and verify an asymmetric keypair	ServiceIndicator() returns true	Parameters, ECDH/ECDSA/EDDSA/RSA keys	Status, keypair	Key Generation	Crypto Officer - RSA Public Key: G,R - RSA Private Key: G,R - ECDSA

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						Public Key: G,R - ECDSA Private Key: G,R - EDDSA Private Key: G,R - EDDSA Public Key: G,R - ECDH Public Key: G,R - ECDH Private Key: G,R
Key Transport	Transport CSPs	ServiceIndicator() returns true	Parameters, plaintext or ciphertext key, transport key(s)	Status, plaintext or ciphertext key	Key Encapsulation	Crypto Officer - Key Transport Key: W,E
Message Digest	Generate a	ServiceIndicator() returns true	Parameters, Message	Status, Digest of	Message digest	Crypto Officer

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
	message digest			the message		
Zeroize	Zeroize all SSPs	N/A	N/A	N/A	None	Crypto Officer - AES Key: Z - AES GCM IV: Z - AES GCM Key: Z - AES CMAC Key: Z - HMAC Key: Z - Entropy Input: Z - DRBG 'K' Value: Z - DRBG 'V' Value: Z - DRBG Seed: Z - RSA Public Key: Z - RSA Private Key: Z - ECDSA

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						Public Key: Z - ECDSA Private Key: Z - ECDH Public Key: Z - ECDH Private Key: Z - ECDH Shared Secret: Z - Key Transport Key: Z - KDF Secret: Z - KDF Derived Key: Z - TLS Pre-Master Secret: Z - TLS Master Secret: Z - PBKDF Password: Z

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
						- PBKDF Derived Key: Z - EDDSA Private Key: Z - EDDSA Public Key: Z - ECDH Peer Public Key: Z - HMAC DRBG Entropy: Z
Self-tests	Perform the module self-tests	ServiceIndicator() returns true	N/A	Status	None	Crypto Officer
Show Status	Show status of the module	ServiceIndicator() returns true	N/A	Status	None	Crypto Officer
Show module's versioning information	Show module's versioning	Module version	N/A	Status	None	Crypto Officer

Name	Description	Indicator	Inputs	Outputs	Security Functions	SSP Access
	information					
Extendable Output Function	Output message with desired length	ServiceIndicator() returns true	Parameters, message, desired length	Status, message with desired length	Extendable Output Function	Crypto Officer

Table 12: Approved Services

4.4 Non-Approved Services

The module provides the following non-approved services. Upon invocation of any non-approved services, `fips140.ServiceIndicator()` will return false until reset, and the module will exit the approved mode of operation.

Name	Description	Algorithms	Role
Data Encryption, Decryption	Encrypt or decrypt data	AES ECB	Crypto Officer
Data Encryption	Encrypt data	AES GCM	Crypto Officer
Message Authentication	Generate MAC	GHASH HMAC	Crypto Officer
Digital Signature	Generate or verify digital signatures	Ed25519ctx RSA ECDSA	Crypto Officer

Name	Description	Algorithms	Role
Key Derivation Function	Perform key derivation using a key derivation function	HKDF PBKDF TLS KDF SSH KDF	Crypto Officer
Key Agreement	Perform key agreement primitives on behalf of the calling process	ECDH	Crypto Officer

Table 13: Non-Approved Services

4.5 External Software/Firmware Loaded

The module does not support loading of external software.

5 Software/Firmware Security

5.1 Integrity Techniques

The module verifies the integrity of all software components within the cryptographic boundary using an HMAC-SHA2-256-based integrity technique. It applies HMAC-SHA2-256 to all components of the `fips.o` binary and compares it to the expected value embedded into the binary.

The module's pre-operational integrity check is performed automatically at module power-up.

5.2 Initiate on Demand

The module integrity check can be performed on demand by the module operator by rebooting the host platform or by reinitializing the module.

5.3 Open-Source Parameters

The source code of the module is part of the latest release of the open-source Go Programming Language distributed by the Go project or by Geomys under a BSD-style license.

The module can be built using the Go toolchain which is also part of the Go Programming Language distribution. The version of the Go toolchain used to build the module should be the same as the one of the Go Programming Language distribution which contains the `lib/fips140/v1.0.0-c2097c7c.zip` or `lib/fips140/v1.0.1.zip` file.

6 Operational Environment

6.1 Operational Environment Type and Requirements

Type of Operational Environment: Modifiable

How Requirements are Satisfied:

Operating systems provide process/memory isolation to prevent unauthorized access to CSPs and uncontrolled modifications of SSPs while the module is in process space. The module does not spawn processes or persistently store SSPs.

7 Physical Security

The cryptographic module is a multi-chip standalone software module and does not include any physical components. Therefore, no physical security mechanisms or protections are implemented, and the section 7 requirements do not apply to the module.

8 Non-Invasive Security

The module does not claim any mitigations against non-invasive attacks. Additionally, there are no non-invasive attack mitigations outlined in Annex F of ISO/IEC 19790:2012.

9 Sensitive Security Parameters Management

9.1 Storage Areas

Storage Area Name	Description	Persistence Type
RAM	System Memory	Dynamic

Storage Area Name	Description	Persistence Type
External	Calling Application	Dynamic

Table 14: Storage Areas

The table above lists the SSP storage areas implemented by the module. The module does not implement persistent storage of SSPs, and only stores keys temporarily in RAM, within the process space of the module.

9.2 SSP Input-Output Methods

Name	From	To	Format Type	Distribution Type	Entry Type	SFI or Algorithm
SSP Input	External	RAM	Plaintext	Manual	Electronic	
SSP Output	RAM	External	Plaintext	Manual	Electronic	

Table 15: SSP Input-Output Methods

The table above lists the SSP Input-Output methods implemented by the module. The module only inputs or outputs SSPs using automated, electronic means to and from within the module TEOPP.

9.3 SSP Zeroization Methods

Zeroization Method	Description	Rationale	Operator Initiation
Reboot Host	Reboot	Memory is zeroized upon reboot	Operator Initiated (Procedural)

Zeroization Method	Description	Rationale	Operator Initiation
Module Unload	Module Unload	Module unloaded from memory	Operator Initiated (Procedural)

Table 16: SSP Zeroization Methods

The module does not persistently store keys; therefore, all keys are held in the module's process space in volatile memory and are effectively zeroized upon reboot of the host platform.

9.4 SSPs

The module supports the keys and other SSPs listed in the table below:

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
AES Key	AES Key (CBC, CTR, GCM)	128,192, 256 - 128,192, 256	Symmetric Key - CSP	Deterministic Random Bit Generation		Data Encryption Data Decryption
AES GCM IV	AES-GCM Initialization Vector	96 bits -	Key Component - CSP	Deterministic Random Bit Generation		Data Encryption Data Decryption
AES GCM Key	AES-GCM Key	128,192, 256 - 128,192, 256	Symmetric Key - CSP	Key Derivation Function		Data Encryption Data Decryption

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
AES CMAC Key	CMAC Key	128, 192, 256 - 128, 192, 256	Symmetric Key - CSP	Deterministic Random Bit Generation		Data Encryption Data Decryption
HMAC Key	Key used for HMAC Operations	>= 112 bits - >= 112 bits	HMAC Key - CSP	Deterministic Random Bit Generation		Message Authentication
Entropy Input	Externally generated entropy used to seed the DRBG	512 bits - 512 bits	Entropy - CSP			Deterministic Random Bit Generation
DRBG 'K' Value	CTR-DRBG Internal Value	256 bits - 256 bits	DRBG Internal State - CSP			Deterministic Random Bit Generation
DRBG 'V' Value	CTR-DRBG Internal Value	128 bits - 128 bits	DRBG Internal State - CSP			Deterministic Random Bit Generation
DRBG Seed	DRBG Internal State Value	384 bits - 384 bits	DRBG Internal State - CSP			Deterministic Random Bit Generation
HMAC DRBG Entropy	Input to HMAC DRBG	256 - 528 bits - 256 - 528 bits	Entropy - CSP	Deterministic Random Bit Generation		Deterministic Random Bit Generation

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
RSA Public Key	Public Key used for RSA operations	>= 2048 bits - >= 112 bits	RSA Keypair - PSP	Deterministic Random Bit Generation		Digital Signature
RSA Private Key	Private Key used for RSA operations	>= 2048 bits - >= 112 bits	RSA Keypair - CSP	Deterministic Random Bit Generation		Digital Signature
ECDSA Public Key	Public Key used for EC operations	224 to 521 bits - 112 to 256 bits	EC Keypair - PSP	Deterministic Random Bit Generation		Digital Signature
ECDSA Private Key	Private Key used for EC operations	224 to 521 bits - 112 to 256 bits	EC Keypair - CSP	Deterministic Random Bit Generation		Digital Signature
ECDH Public Key	ECDH Public Key	224 to 521 bits - 112 to 256 bits	ECDH Keypair - PSP	Deterministic Random Bit Generation		Key Agreement ECC
ECDH Private Key	ECDH Private Key	224 to 521 bits - 112 to 256 bits	ECDH Keypair - CSP	Deterministic Random Bit Generation		Key Agreement ECC

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
ECDH Shared Secret	ECDH Shared Secret	224 to 521 bits - 112 to 256 bits	ECDH Shared Secret - CSP		Key Agreement ECC	Key Derivation Function
EDDSA Public Key	EDDSA Public Key	255 bits - 128 bits	EDDSA Keypair - PSP	Deterministic Random Bit Generation		Digital Signature
EDDSA Private Key	EDDSA Private Key	253 bits - 128 bits	EDDSA Keypair - CSP	Deterministic Random Bit Generation		Digital Signature
Key Transport Key	Key Transport Key	>= 2048 bits - >= 112 bits	Key Transport - CSP	Key Derivation Function		Key Encapsulation
KDF Secret	Secret used for KDF operations	>= 112 bits - >= 112 bits	Keying material - CSP		Key Agreement ECC	Key Derivation Function
KDF Derived Key	Key resulting from the module's SP 800-135rev1 KDFs	>= 112 bits - >= 112 bits	KDF Key - CSP	Key Derivation Function		
TLS Pre-Master Secret	Shared Secret used for TLS	112 to 256 bits -	KDF Secret - CSP		Key Agreement ECC	Key Derivation Function

Name	Description	Size - Strength	Type - Category	Generated By	Established By	Used By
	session establishment	112 to 256 bits				
TLS Master Secret	Master Secret used for TLS session	112 to 256 bits - 112 to 256 bits	KDF Secret - CSP	Key Derivation Function		Data Encryption
PBKDF Password	Password used for password based key derivation	- - -	KDF Key - CSP	Deterministic Random Bit Generation		Key Derivation Function
PBKDF Derived Key	Key resulting from the module's PBKDF	>= 112 bits - >= 112 bits	Symmetric Key - CSP	Key Derivation Function		Key Derivation Function
ECDH Peer Public Key	ECDH Peer Public Key	224 to 521 bits - 112 - 256 bits	Asymmetric - PSP		Key Agreement ECC	KAS-ECC-SSC Sp800-56Ar3 (A6650)

Table 17: SSP Table 1

Name	Input - Output	Storage	Storage Duration	Zeroization	Related SSPs
AES Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	
AES GCM IV	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	
AES GCM Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	AES GCM IV:Derived From
AES CMAC Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	
HMAC Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	
Entropy Input	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	

Name	Input - Output	Storage	Storage Duration	Zeroization	Related SSPs
DRBG 'K' Value	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	DRBG 'V' Value:Used With
DRBG 'V' Value	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	DRBG 'K' Value:Used With
DRBG Seed	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	
HMAC DRBG Entropy	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	
RSA Public Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	RSA Private Key:Paired With
RSA Private Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	RSA Public Key:Paired With

Name	Input - Output	Storage	Storage Duration	Zeroization	Related SSPs
ECDSA Public Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	ECDSA Private Key:Paired With
ECDSA Private Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	ECDSA Public Key:Paired With
ECDH Public Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	ECDH Private Key:Paired With
ECDH Private Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	ECDH Public Key:Paired With
ECDH Shared Secret	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	ECDH Public Key:Used With ECDH Private Key:Used With
EDDSA Public Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	ECDSA Private Key:Paired With

Name	Input - Output	Storage	Storage Duration	Zeroization	Related SSPs
EDDSA Private Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	ECDSA Public Key:Paired With
Key Transport Key	SSP Input SSP Output	RAM:Encrypted External:Encrypted	Until Reboot	Reboot Host Module Unload	
KDF Secret	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	
KDF Derived Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	KDF Secret:Derived From
TLS Pre-Master Secret	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	TLS Master Secret:Used With
TLS Master Secret	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	TLS Pre-Master Secret:Derived From

Name	Input - Output	Storage	Storage Duration	Zeroization	Related SSPs
PBKDF Password	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	PBKDF Salt:Used With
PBKDF Derived Key	SSP Input SSP Output	RAM:Plaintext External:Plaintext	Until Reboot	Reboot Host Module Unload	PBKDF Password:Derived From PBKDF Salt:Derived From
ECDH Peer Public Key	SSP Input SSP Output	RAM:Plaintext	Until Reboot	Reboot Host Module Unload	ECDH Private Key:Used With

Table 18: SSP Table 2

10 Self-Tests

10.1 Pre-Operational Self-Tests

The module performs the following pre-operational self-test:

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details
HMAC-SHA2-256 (A6650)	HMAC-SHA2-256	KAT	SW/FW Integrity	status output	Verify the integrity of the module

Table 19: Pre-Operational Self-Tests

The pre-operational self-tests are always performed on module instantiation and the HMAC-SHA2-256 CAST is performed before the integrity test, and therefore before the first operational use of the algorithm. If the self-tests fail, the module terminates.

10.2 Conditional Self-Tests

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details	Conditions
KAS-ECC-SSC Sp800-56Ar3 PCT	P-256	PCT	PCT	status output	KAS-ECC-SSC P-256, ECDH public key computation	Private key generation
ECDSA KeyGen (FIPS186-5) (A6650)	P-256, SHA2-512	PCT	PCT	status output	ECDSA sign and verify PCT	ECDSA private key generation
EDDSA KeyGen (A6650)	Ed25519	PCT	PCT	status output	ECDSA sign and verify PCT	EDDSA private key generation
ML-KEM KeyGen (A6650)	ML-KEM-768, ML-KEM-1024	PCT	PCT	status output	ML-KEM encap and decap PCT	ML-KEM-768/ML-KEM-1024 encapsulation key generation
RSA KeyGen (FIPS186-5) (A6650)	2048	PCT	PCT	status output	RSA sign and verify PCT	RSA private key generation
KAS-ECC-SSC Sp800-	P256	KAT	CAST	status output	KAS-ECC-SSC P-256, ECDH	Secret key computation

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details	Conditions
56Ar3 (A6650)					secret key computation	
ECDSA SigGen (FIPS186-5) (A6650)	P256, SHA2-512	KAT	CAST	status output	ECDSA P-256 SHA2-512 sign and verify	Signature generation and signature verification
Deterministic ECDSA SigGen (FIPS186-5) (A6650)	P256, SHA2-512	KAT	CAST	status output	DetECDSA P-256 SHA2-512 sign	DetECDSA/ECDSA sign with HMAC-DRBG
EDDSA SigGen (A6650)	Ed25519, HashEd25519	KAT	CAST	status output	Ed25519 sign and verify	Signature generation and signature verification
RSA SigGen (FIPS186-5) (A6650)	2048 bits	KAT	CAST	status output	RSASSA-PKCS-v1.5 2048-bit sign and verify	Signature generation and signature verification
AES-CBC (A6650)	Key size: 128 bits	KAT	CAST	status output	AES-CBC encrypt and decrypt	First time calling AES-CBC or AES-CTR
KDF SP800-108 (A6650)	Counter KDF AES-CMAC Key size: 128 bits	KAT	CAST	status output	AES-128 CMAC Counter KDF	First time calling AES-GCM or AES-CMAC or Counter KDF

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details	Conditions
Counter DRBG (A6650)	Entropy input: 384 bits	KAT	CAST	status output	ctrDRBG AES-256 KAT	First time calling Counter DRBG
cSHAKE-128 (A6650)	Security strength: 128 bits	KAT	CAST	status output	cSHAKE128 KAT	First time calling SHA3
HMAC DRBG (A6650)	hash: SHA2-512	KAT	CAST	status output	HMAC_DRBG SHA2-512 (Init, Reseed, Generate)	First time calling HMAC-DRBG API
TLS v1.3 KDF (A6650)	Extract: SHA2-256, Expand: SHA2-256	KAT	CAST	status output	TLS 1.3 KDF SHA2-256 KAT	First time calling TLS 1.3
TLS v1.2 KDF RFC7627 (A6650)	hash: SHA2-256	KAT	CAST	status output	TLS 1.2 RFC 7627 KDF SHA2-256 KAT	First time calling TLS 1.2
SHA2-512 (A6650)	Output size: 512 bits	KAT	CAST	status output	SHA2-512 KAT	First time calling SHA2-512
SHA2-256 (A6650)	Output size: 256 bits	KAT	CAST	status output	SHA2-256 KAT	First time calling SHA2-256
ML-KEM EncapDecap (A6650)	ML-KEM-768	KAT	CAST	status output	ML-KEM-768 KAT	First time calling ML-KEM

Algorithm or Test	Test Properties	Test Method	Test Type	Indicator	Details	Conditions
HMAC-SHA2-256 (A6650)	HMAC-SHA2-256	KAT	CAST	status output	HMAC-SHA2-256	First self-test that runs before module integrity check
HKDF Extract and Expand	HKDF Extract and Expand	KAT	CAST	status output	HKDF Extract and Expand	First time calling KDA HKDF, KDA OneStepNoCounter, or Feedback KDF
PBKDF (A6650)	SHA2-256	KAT	CAST	status output	HKDF2 KAT	First time calling PBKDF2

Table 20: Conditional Self-Tests

Conditional CASTs are performed at module initialization, after the module integrity test, and before the first operational use of the algorithms. Pairwise consistency tests are performed conditionally upon generation of an asymmetric keypair.

10.3 Periodic Self-Test Information

Algorithm or Test	Test Method	Test Type	Period	Periodic Method
HMAC-SHA2-256 (A6650)	KAT	SW/FW Integrity	User initiated module reinitialization	User initiated module reinitialization

Table 21: Pre-Operational Periodic Information

Algorithm or Test	Test Method	Test Type	Period	Periodic Method
KAS-ECC-SSC Sp800-56Ar3 PCT	PCT	PCT	User initiated module reinitialization	User initiated module reinitialization
ECDSA KeyGen (FIPS186-5) (A6650)	PCT	PCT	User initiated module reinitialization	User initiated module reinitialization
EDDSA KeyGen (A6650)	PCT	PCT	User initiated module reinitialization	User initiated module reinitialization
ML-KEM KeyGen (A6650)	PCT	PCT	User initiated module reinitialization	User initiated module reinitialization
RSA KeyGen (FIPS186-5) (A6650)	PCT	PCT	User initiated module reinitialization	User initiated module reinitialization
KAS-ECC-SSC Sp800-56Ar3 (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
ECDSA SigGen (FIPS186-5) (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
Deterministic ECDSA SigGen	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization

Algorithm or Test	Test Method	Test Type	Period	Periodic Method
(FIPS186-5) (A6650)				
EDDSA SigGen (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
RSA SigGen (FIPS186-5) (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
AES-CBC (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
KDF SP800-108 (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
Counter DRBG (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
cSHAKE-128 (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
HMAC DRBG (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization

Algorithm or Test	Test Method	Test Type	Period	Periodic Method
TLS v1.3 KDF (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
TLS v1.2 KDF RFC7627 (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
SHA2-512 (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
SHA2-256 (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
ML-KEM EncapDecap (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
HMAC-SHA2-256 (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
HKDF Extract and Expand	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization
PBKDF (A6650)	KAT	CAST	User initiated module reinitialization	User initiated module reinitialization

Table 22: Conditional Periodic Information

The module can perform the periodic pre-operational, and conditional self-tests procedurally by power cycling the host platform.

10.4 Error States

Name	Description	Conditions	Recovery Method	Indicator
Error	The module's error state.	POST, PCT or CAST failure	Reinitialize module	fatal error

Table 23: Error States

The module terminates after any self-test failure, therefore no further requests to the module are available. To recover the module from error states, the host platform must be power cycled, or the module be reinitialized. Power cycling or module reinitialization will cause the module to perform the pre-operational self-tests and transition to the approved mode of operation.

10.5 Operator Initiation of Self-Tests

The module operator can initiate the pre-operational and conditional self-tests by power cycling the host platform or reinitializing the module.

11 Life-Cycle Assurance

11.1 Installation, Initialization, and Startup Procedures

The module `fips.o` can be obtained by building the source code in the `lib/fips140/v1.0.0-c2097c7c.zip` or `lib/fips140/v1.0.1.zip` archive (for v1.0.0 and v1.0.1, respectively), included in the latest Go source distribution available at https://go.dev/dl or at https://geomys.org/fips140-wasm.

The v1.0.0 archive can be verified by issuing the command

```
sha256sum lib/fips140/v1.0.0-c2097c7c.zip
```

and ensuring the SHA2-256 digest matches

```
daf3614e0406f67ae6323c902db3f953a1effb199142362a039e7526dfb9368b
```

The v1.0.1 archive can be verified by issuing the command

```
sha256sum lib/fips140/v1.0.1.zip
```

and ensuring the SHA2-256 digest matches

```
0a9bfccef9f8011257e3303788d3420dee2677b2ceafc38b81450cc60799d007
```

The set of files in the archive verified as specified above is the complete set of source files of the validated module, and it shall be used unmodified in the build process.

Once the zip file has been obtained and verified, and the latest version of Go for your distribution was obtained and installed (for bootstrap), the following steps (or equivalent) can be executed to compile it as part of an application (at `$SRCROOT`, with the Go source distribution at `$GOROOT`).

```
cd "$GOROOT/src"
./make.bash
cd "$SRCROOT"
GOFIPS140=v1.0.0 "$GOROOT/bin/go" build # or equivalent, for v1.0.0
GOFIPS140=v1.0.1 "$GOROOT/bin/go" build # or equivalent, for v1.0.1
```

Alternatively, the GOFIPS140 variable can be specified when building the toolchain:

```
cd "$GOROOT/src"
GOFIPS140=v1.0.0 ./make.bash # for v1.0.0
GOFIPS140=v1.0.1 ./make.bash # for v1.0.1
cd "$SRCROOT"
"$GOROOT/bin/go" build # or equivalent
```

(On Windows, `make.bat` is used to build the toolchain instead of `make.bash`.)

Once the application (at `$APPBIN`) is compiled, the status of the module can be verified with the following command (or equivalent).

```
"$GOROOT/bin/go" version -m "$APPBIN"
```

If the output includes a line matching either of the following (for v1.0.0 and v1.0.1 respectively), the module has been configured correctly and can be operated in approved mode.

```
build GOFIPS140=v1.0.0-c2097c7c
```

```
build GOFIPS140=v1.0.1
```

If running in a WebAssembly Operating Environment (`GOARCH=wasm`), the module and source must be provided to the `run()` function at startup, with code equivalent to the following. This is only supported by module v1.0.1.

```
const go = new Go();
const source = await (await fetch("main.wasm")).arrayBuffer();
const result = await WebAssembly.instantiate(source, go.importObject);
await go.run(result.instance, result.module, source);
```

12 Mitigation of Other Attacks

The module implements the following mitigations:

1. During RSA signature generation processes, countermeasures are implemented to protect against vulnerabilities related to the Chinese Remainder Theorem (CRT), such as those exploited by Lenstra's attack.

2. The ECDSA scheme implements mitigation against both RNG failures (like Deterministic ECDSA) and fault attacks (like the RSA CRT attack mitigation).