



# Security Policy

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## Title: Christie IMB-S2 Security Policy

**Product(s):** Christie IMB-S2 4K Integrated Media Block (IMB)

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## Detailed Revision History

Revision	Description of Changes	Date
1	Initial public release.	05/25/2016
2	Enhanced security descriptions	08/16/2016
3	Enhanced security descriptions	09/08/2016

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## 1. SCOPE

This document is the Cryptographic Module Security Policy for the Christie IMB-S2 4K Integrated Media Block (IMB) (also referred to herein as the Christie IMB-S2, the cryptographic module, or simply the module). This policy is a specification of the security rules under which the Christie IMB-S2 operates and meets the requirements of FIPS 140-2 Level 2.

### 1.1 REFERENCE DOCUMENTS

Document No.	Description
FIPS PUB 140-2	Security Requirements For Cryptographic Modules [FIPS PUB 140-2] ( <a href="http://csrc.nist.gov/publications/fips/fips140-2/fips1402.pdf">http://csrc.nist.gov/publications/fips/fips140-2/fips1402.pdf</a> )

*Table 1 Reference Documents*

## 2. PRODUCT OVERVIEW

The Christie IMB-S2 is a multi-chip embedded cryptographic module designed for use with a Christie “Solaria” Series 2 digital cinema projector (2K or 4K projector).

### 2.1 VALIDATED MODULE VERSIONS

The validated module consists of the following:

Hardware version	Firmware version
000-102675-03	1.7.0-4209
000-102675-03	2.0.0-4398

*Table 2 Validated module versions*

### 3. SECURITY LEVELS

The IMB is tested to meet the FIPS security requirements shown in Table 3.

FIPS 140-2 Security Requirements	Security Level
1. Cryptographic Module Specification	2
2. Cryptographic Module Ports and Interfaces	2
3. Roles, Services and Authentication	3
4. Finite State Model	2
5. Physical Security	3
6. Operational Environment	N/A
7. Cryptographic Key Management	2
8. EMI/EMC	2
9. Self-Tests	2
10. Design Assurance	3
11. Mitigation of Other Attacks	N/A
FIPS Overall Level	2

*Table 3 FIPS 140-2 Security Levels*

## 4. MODES OF OPERATION

The Christie IMB-S2 provides a FIPS Approved mode of operation and a non-Approved mode of operation:

The cryptographic module is in the FIPS Approved mode of operation by default upon each power-up. To determine that the module is running in a FIPS Approved mode of operation, the operator shall power on the cryptographic module and verify that the power-up self-tests have passed successfully via the FIPS LED status (i.e. Green LED). In the FIPS Approved mode of operation, the cryptographic module provides the services listed in Section 11.1, 11.2, and 11.3 below.

The cryptographic module is in a non-Approved mode of operation when non-Approved services in Section 11.4 below are invoked.

## 5. CRYPTOGRAPHIC BOUNDARY

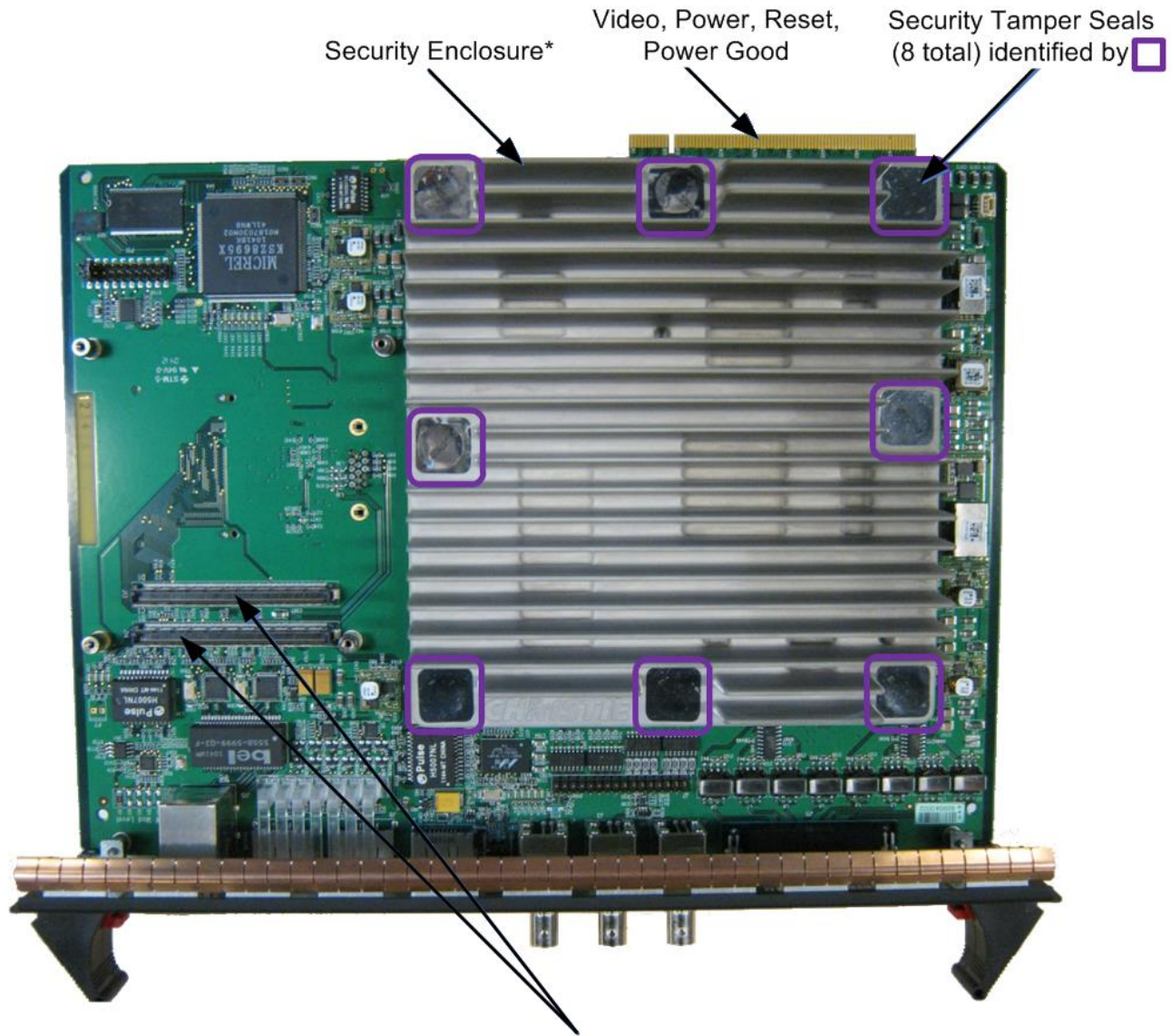
The illustrations below indicate the cryptographic boundary and the physical ports defined on the boundary.

The cryptographic boundary is the outer physical perimeter of the module's PCB board; the effective security boundary is the physical perimeter of the module's metal Security Enclosure.

Everything outside the metal Security Enclosure is excluded from FIPS 140-2 Requirements. Unlabelled connectors are not interfaces on the cryptographic boundary.



*Figure 1 Front view of Christie IMB-S2*

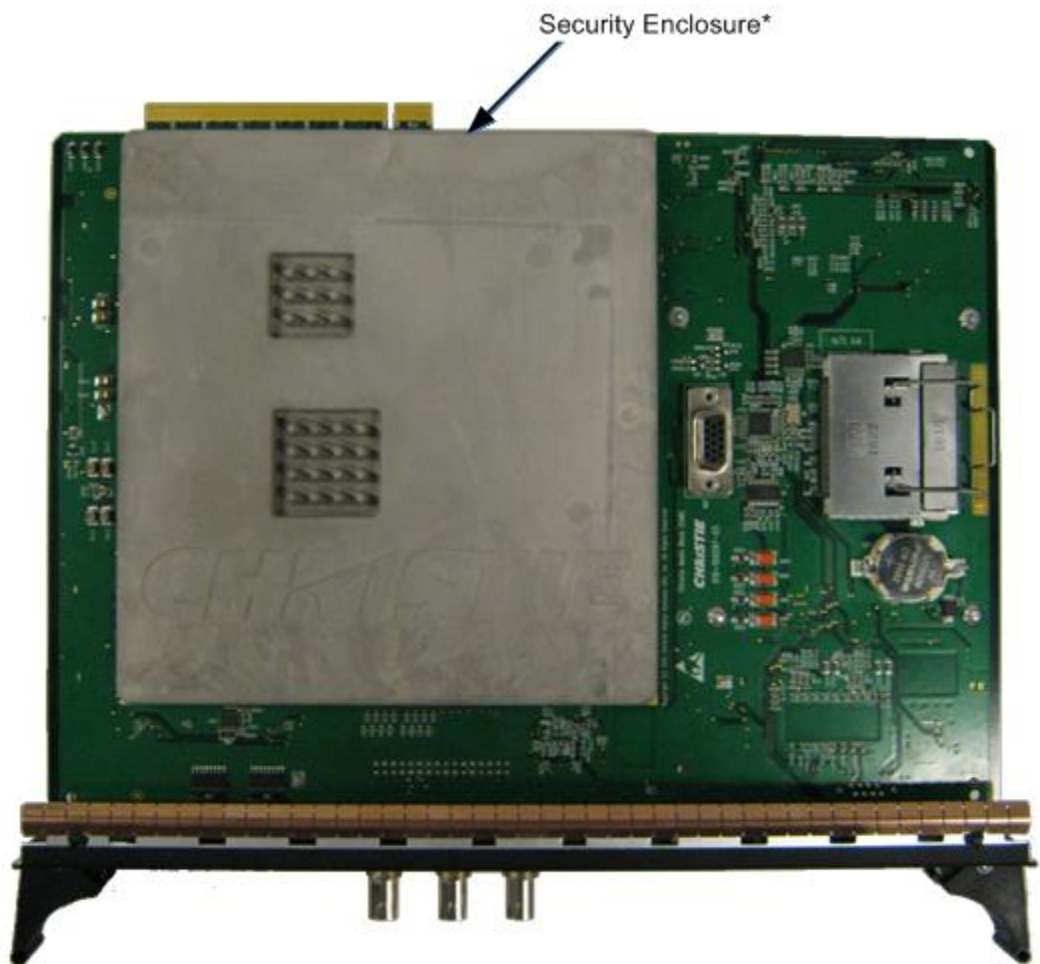


\* Note: All components which lie outside the security enclosure are not security relevant

PCIE, LPC, & Ethernet

Figure 2 Top View of Christie IMB-S2





\* Note: All components which lie outside the security enclosure are not security relevant

*Figure 3 Bottom View of Christie IMB-S2*

## 6. BLOCK DIAGRAM

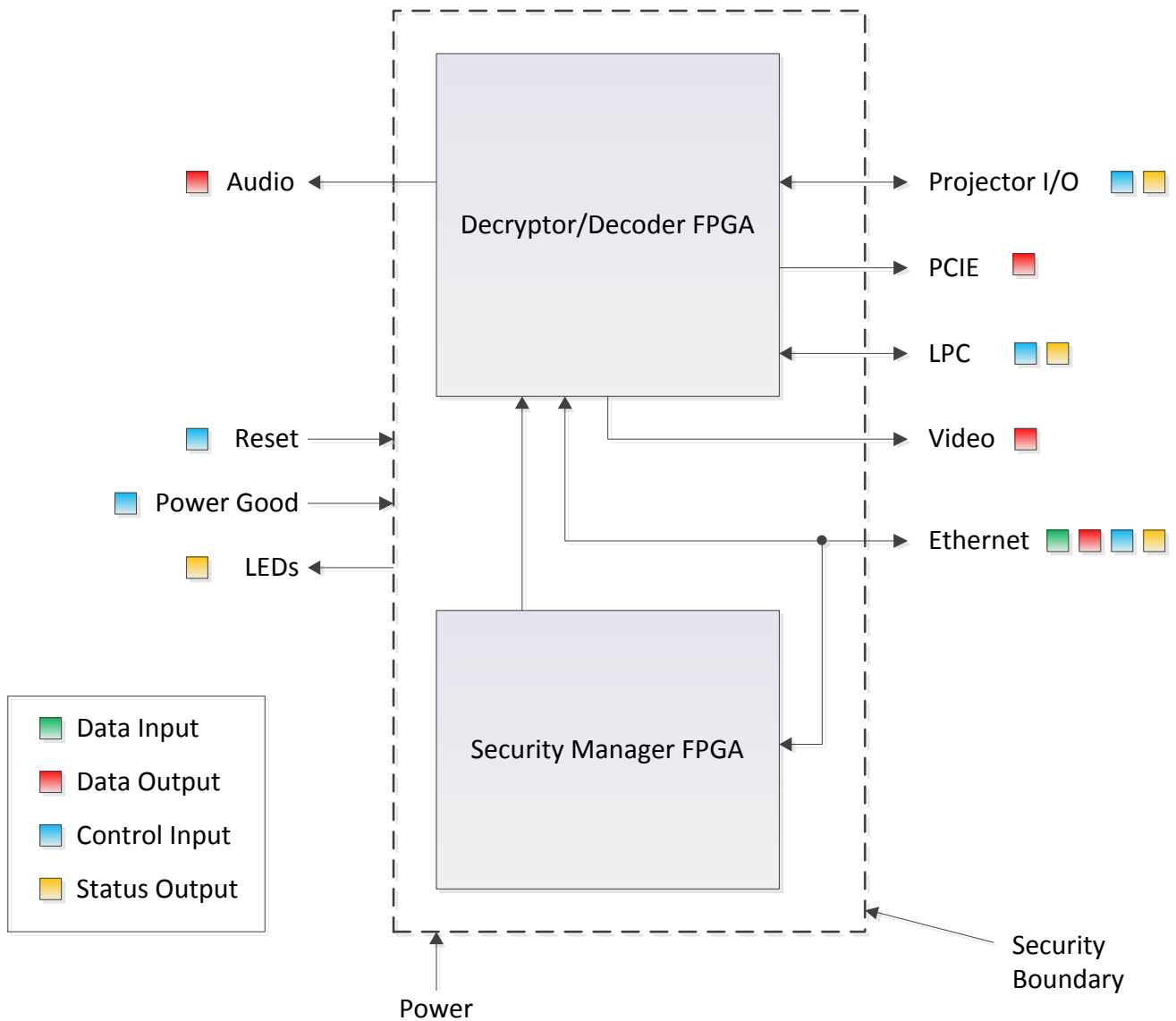


Figure 4 Module Block Diagram

## 7. APPROVED ALGORITHMS

The cryptographic module supports the following Approved algorithms in the FIPS Approved mode of operation:

- Asymmetric Key Signature Verification
  - RSA (2048 bits) – Cert #1062
- Secure Hash Standard (SHS)
  - SHA-256 – Cert #1788

## 8. NON-APPROVED ALGORITHMS

The cryptographic module supports the following non-Approved algorithms in the non-Approved mode of operation, and shall not be used in FIPS Approved mode of operation:

- AES-128-CBC (non-compliant)
- AES-128-ECB (non-compliant)
- ANSI X9.31 PRNG
- FIPS 186-2 PRNG
- HMAC-SHA-1 (non-compliant)
- MD5
- NDRNG
- RSA 2048 (non-compliant: Digital Signature Generation: RSA-2048 with SHA-1 and RSA-2048 with SHA-256; Digital Signature Verification: RSA-2048 with SHA-1; RSA-2048 Decryption)
- SHA-1 (non-compliant)
- SP800-135 TLS v1.0 KDF (non-compliant) [Note: Any keys derived using this protocol shall not be used in the FIPS Approved mode of operation.]
- TI ECDH – considered as non-security relevant data obfuscation (plaintext) and only used to interoperate with legacy equipment

## 9. PORTS AND INTERFACES

The following table maps the logical interfaces to the physical ports:

Logical Interface	Physical Ports
Data Input	Ethernet
Data Output	Ethernet, PCIE, Audio, Video
Control Input	Ethernet, Projector I/O, LPC, Reset, Power Good
Status Output	Ethernet, Projector I/O, LPC, LEDs
Power	Power

*Table 4 Roles and Required Identification and Authentication*

## 10. AUTHENTICATION

The Christie IMB-S2 shall support the following distinct operator roles: Crypto Officer and User. The Christie IMB-S2 does not support a Maintenance role. The cryptographic module shall enforce the separation of roles using identity-based operator identification.

Role	Type of Authentication	Authentication Data
Crypto Officer	Identity-based operator authentication	RSA Digital Signature Verification
User	Identity-based operator authentication	RSA Digital Signature Verification

*Table 5 Roles and Required Identification and Authentication*

Authentication Mechanism	Strength of Mechanism
RSA Digital Signature Verification	<p>The authentication is based on RSA 2048 which provides an equivalent encryption strength of 112 bits. The probability that a random attempt will succeed or a false acceptance will occur is <math>1/2^{112}</math> which is less than 1/1,000,000.</p> <p>There is a 1 second retry delay after each attempt which limits the number of attempts that can be launched per minute. The probability that a random attempt will successfully authenticate to the module within one minute is <math>60/2^{112}</math> which is less than 1/100,000.</p>

*Table 6 Strength of Authentication Mechanism*

## 11. ROLES AND SERVICES

### 11.1 CRYPTO OFFICER SERVICES

Table 7 summarizes the services that are only available to the Crypto Officer role.

Services	Description	Public Key(s)	Type(s) of Access
Upgrade	Update the firmware via RSA signature verification	Christie Root CA Key, Certificate Chain, Christie Firmware Update Key	Read

*Table 7 Crypto Officer Services*

### 11.2 USER SERVICES

Table 8 summarizes the services that are only available to the User role.

Services	Description	Public Key(s)	Type(s) of Access
Upgrade	Update the firmware via RSA signature verification	Christie Root CA Key, Certificate Chain, Christie Firmware Update Key	Read

*Table 8 User Services*

### 11.3 UNAUTHENTICATED SERVICES

Table 9 summarizes the unauthenticated services that are available.

Services	Description	Public Key(s)	Type(s) of Access
Power On Self-Tests	Self-tests performed at Power On	N/A	N/A
Status	Status Output	N/A	N/A

*Table 9 Unauthenticated Services*

## 11.4 NON-APPROVED SERVICES

The following services are supported only in the non-Approved mode of operation:

Roles	Services	Description	Non-Approved Algorithms
Crypto Officer/ User	Projector Status	Monitor Projector status	TI-ECDH
Crypto Officer/ User	Zeroization	Zeroizes keys used in the non-Approved mode of Operation	N/A
Crypto Officer/ User	System Management	System Management functions for the module	ANSI X9.31 DRNG NDRNG MD5 RSA 2048 (non-compliant) AES-128-CBC (non-compliant) HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-Compliant)
Crypto Officer/ User	Digital Cinema Authentication	Authenticate Digital Cinema	ANSI X9.31 DRNG NDRNG MD5 RSA 2048 (non-compliant) AES-128-CBC (non-compliant) HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-Compliant)
Crypto Officer/ User	KDM Management	Service for managing KDM information	MD5 HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-

			Compliant) RSA 2048 (non-compliant) AES-128-CBC (non-compliant) AES-128-ECB (non-compliant) ANSI X9.31 DRNG FIPS 186-2 DRNG NDRNG
Crypto Officer/ User	CPL Management	Service for managing CPL information	ANSI X9.31 DRNG NDRNG MD5 RSA 2048 (non-compliant) AES-128-CBC (non-compliant) HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-Compliant)
Crypto Officer/ User	Encrypted Playback	Service for decrypting encrypted content	ANSI X9.31 DRNG NDRNG MD5 RSA 2048 (non-compliant) AES-128-CBC (non-compliant) HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-Compliant)
Crypto Officer/ User	Log Management	Service for retrieving log data	ANSI X9.31 DRNG NDRNG MD5 RSA 2048 (non-compliant) AES-128-CBC (non-compliant)

			HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-Compliant)
Crypto Officer/ User	Atmos Management	Service for managing decryption keys on Atmos Server	ANSI X9.31 DRNG NDRNG MD5 RSA 2048 (non-compliant) AES-128-CBC (non-compliant) HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-Compliant)
Crypto Officer/ User	Suite Management	Initiate, monitor and manage projector suite	ANSI X9.31 DRNG NDRNG MD5 RSA 2048 (non-compliant) AES-128-CBC (non-compliant) HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-Compliant)
Crypto Officer/ User	Marriage Verification	Verify projector marriage	ANSI X9.31 DRNG NDRNG MD5 RSA 2048 (non-compliant) AES-128-CBC (non-compliant) HMAC-SHA-1 (non-compliant) SHA-1 (non-compliant) SP800-135 TLS v1.0 KDF (non-Compliant)

**Table 10 Non-Approved Services**



## 12. CRITICAL SECURITY PARAMETERS & PUBLIC KEYS

### 12.1 CRITICAL SECURITY PARAMETERS (CSPS)

The module does not contain secret, private keys and/or CSPs in the Approved mode of operation.

### 12.2 PUBLIC KEYS

#	Name	Description
1.	Christie Root CA Key	RSA 2048 – Christie Root CA key
2.	Certificate Chain	RSA 2048 – Christie Certificate Chain
3.	Christie Firmware Update Key	RSA 2048 – Christie firmware verification key

*Table 11 Public Keys*

## 13. PHYSICAL SECURITY

The Christie IMB-S2 is a multi-chip embedded cryptographic module which is composed of production-grade components.

The physical security mechanisms of the module includes a hard, opaque and tamper-evident metal enclosure that is monitored 24/7 by battery backed-up tamper detection and response mechanisms. Any attempt to remove the metal enclosure results in instantaneous active zeroization. Zeroization also occurs if the battery becomes discharged. The module includes tamper-evident labels covering the screws that secure the metal enclosure to the module; said tamper-evident labels are installed as part of the manufacturing process and shall not be removed (i.e. maintenance role is not supported, maintenance interface is not supported).

The tamper-evident metal enclosure and the tamper-evident labels shall be periodically inspected to ensure the physical security of the module is maintained. There are a total of 8 tamper-evident labels that are installed onto the module during manufacturing. Please see Figure 2 for the tamper-evident label placement.

All components which lie outside the metal enclosure are not security relevant and are excluded from the FIPS 140-2 requirements. The excluded components are the non-security relevant data input and data output, passive components (capacitors, resistors, inductors), voltage regulators, traces and signals routed to these components, the PCB lying outside the metal enclosure, connectors and the faceplate.

Note: The module hardness testing was only performed at a single temperature and no assurance is provided for Level 3 hardness conformance at any other temperature.

Physical Security Mechanism	Recommended Frequency of Inspection/Test	Inspection/Test Guidance Details
Metal enclosure	Upon receipt of module and as often as feasible.	Visually inspect metal enclosure for scratches, gouges, deformation and other signs of visible signs of tamper.
Tamper Responsive Switches	N/A	N/A
Tamper Evident Seals	Upon receipt of module and as often as feasible.	Visually inspect the tamper evident seals for scratches, gouges, deformation or other physical signs of tampering.

*Table 12 Inspection/Testing of Physical Security Mechanisms*

Tampering of the module will result in a “Red” FIPS LED Status, in which the module will enter the error state; all cryptographic operations are inhibited. If any tampering of the module is observed or suspected, remove the module from service and return it to Christie Digital.

## 14. OPERATIONAL ENVIRONMENT

The Christie IMB-S2 operates in a limited operational environment that only allows the loading of trusted and validated firmware binary images through an authenticated service. Firmware binary images are signed by an

RSA key which is part of the Christie certificate chain. The RSA signature verification algorithm has been validated (RSA Cert. #1062).

## 15. SELF-TESTS

The module performs the following self-tests:

- Power-Up Self-Tests
  - Cryptographic algorithm tests:
    - SHA-256 KAT
    - RSA 2048 Signature Verification KAT
  - Firmware Integrity Test: EDC that meets requirements of AS09.24
  - Critical Functions Tests: N/A
- Conditional Self-Tests
  - Firmware Load Test (RSA signature verification – RSA 2048 with SHA-256)

## 16. MITIGATION OF OTHER ATTACKS

The cryptographic module does not mitigate any specific attacks beyond the scope of FIPS 140-2.

Other Attacks	Mitigation Mechanism	Specific Limitations
N/A	N/A	N/A

*Table 13 Mitigation of Other Attacks*

## 17. SECURITY RULES

The following specifies the security rules under which the cryptographic module shall operate:

- The module does not support a bypass capability or a maintenance interface.
- The module supports concurrent operators. However, the module does not support more than one operator per role. The operators may not switch roles without re-authenticating.
- The operator must re-authenticate on each power-up event.
- The module inhibits data output during an error state and during the power-up self-tests.
- The module shall enforce identity-based authentication.
- The module does not provide feedback of authentication data.
- An error state may be cleared by power-cycling the module.
- The FIPS LED provides the following status output via the “Status” service:
  - Orange – cryptographic module is running power-up self-tests.
  - Green – cryptographic module has successfully performed power-up self-tests.
  - Red – failure of power-up self-tests.
- Failure of Power Up Self-Tests, described in Section 15, will result in a “Red” FIPS LED Status. The module will enter the error state; all cryptographic operations are inhibited.
- Failure of conditional Self-Tests, described in Section 15, will result in a “soft” error. The error is indicated via the Status service as follows:

[ERR ][16384] [SM UPGRADE] Signature verification failed.

[ERR ][16384] [SM UPGRADE] Upgrade package integrity check failed.

- The module provides logical separation between all the data input, control input, data output and status output interfaces.
- The module protects all public keys from unauthorized modification and unauthorized substitution.
- The module does not support manual key entry. A manual key entry test is not implemented.
- The module does not support split-knowledge processes.
- The operator may perform on-demand power-on self-test by recycling power to the module.
- The status output does not contain CSPs or sensitive data that if misused could lead to a compromise of the module.

## 18. ACRONYMS

Acronym	Definition
AES	Advanced Encryption Standard
CSP	Critical Security Parameter
DAS	Direct Attached Storage
DCI	Digital Cinema Initiatives, LLC
DCP	Digital Cinema Package
DRNG	Deterministic Random Number Generator
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FCC	Federal Communications Commission
FIPS	Federal Information Processing Standards
FPGA	Field Programmable Gate Array
HMAC	Hashed Message Authentication Code
ICP	Integrated Cinema Processor
IMB	Image Media Block
KAT	Known Answer Test
KDM	Key Delivery Message – as per SMPTE 430-1
MAC	Media Access Control
NAS	Network Attached Storage
RSA	Rivest-Shamir-Adleman
SHA	Secure Hash Algorithm
TI	Texas Instruments Incorporated
TI ECDH	Considered as non-security relevant data obfuscation (plaintext) and only used to interoperate with legacy equipment
TLS	Transport Layer Security

## 19. APPENDIX A: CRITICAL SECURITY PARAMETERS

The module does not contain secret, private keys and CSPs in the Approved mode of operation.

## 20. APPENDIX B: PUBLIC KEYS

The module supports the following public keys:

1. Christie Root CA Key

Description: digitally signed and thus authorizes other public keys to be used by the module for a defined purpose

Type: RSA 2048

Generation: N/A - Installed into the module within the secure factory during manufacturing

Storage: Stored in Flash in self-signed certificate; RAM

Entry: N/A - Installed into the module within the secure factory during manufacturing

Output: In X.509 certificate upon request

Establishment: N/A

Key-to-entity: via memory location and CRC-16

2. Certificate Chain

Description: digitally verify public keys

Type: RSA 2048

Generation: N/A - Installed into the module within the secure factory during manufacturing

Storage: Stored in Flash in certificate signed by Christie Root CA Key; RAM

Establishment: N/A

Entry: N/A - Installed into the module within the secure factory during manufacturing

Output: In X.509 certificate upon request

Key-to-entity: via memory location and CRC-16

### 3. Christie Firmware Update Key

Description: Used to securely update the firmware via RSA signature verification via the Upgrade service.

Type: RSA 2048

Generation: N/A - generated outside of the crypto boundary by Christie

Storage: RAM

Establishment: N/A

Entry: Entered into the module via a certificate signed by the Certificate Chain

Output: In X.509 certificate upon request

Key-to-entity: via memory location and CRC