Brocade® FCX 624/648, ICX™ 6610, ICX 6450, ICX 7750, ICX 7450 and SX 800/1600 Series

FIPS 140-2 Non-Proprietary Security Policy Level 2

with Design Assurance Level 3 Validation

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Revision History

Revision Date	Revision	Summary of Changes
12/10/14	1.0	Initial release
11/16/15	1.01	Providing additional clarifications

1 Introduction

The Brocade FastIron SX and Brocade FCX switches are part of Brocade's FastIron L2/L3 switch family. They are designed for medium to large enterprise backbones. The FastIron SX series chassis devices are modular switches that provide the enterprise network with a complete end-to-end Enterprise LAN solution, ranging from the wiring closet to the LAN backbone. The FCX series is an access layer Gigabit Ethernet switch designed from the ground up for the enterprise data center environment. When these switches are stacked, they appear as one switch, reducing management up to 8 times.

Brocade ICX 6610 series stackable switches are part of Brocade's ICX 6610 product family. They are designed for medium to large enterprise backbones. The ICX 6610 series is an access layer Gigabit Ethernet switch designed from the ground up for the enterprise data center environment.

Brocade ICX 6450 switches provide enterprise-class stackable LAN switching solutions to meet the growing demands of campus networks. Designed for small to medium-size enterprises, branch offices, and distributed campuses, these intelligent, scalable edge switches deliver enterprise-class functionality without compromising performance and reliability.

The Brocade ICX 7450 Switch delivers the performance, flexibility, and scalability required for enterprise Gigabit Ethernet (GbE) access deployment. It offers market-leading stacking density with up to 12 switches (576x 1 GbE and 48x 10 GbE ports) per stack and combines chassis-level performance and reliability with the flexibility, cost-effectiveness, and "pay as you grow" scalability of a stackable solution. In addition, this stackable switch is the first in its class to offer 40 GbE uplinks, enabling enterprises to dramatically increase their network capacity while using their existing optical wire infrastructure.

The Brocade ICX 7750 is a 10/40 GbE Ethernet switch delivering a chassis experience for campus LAN aggregation and core. It offers unprecedented port density and chassis-level performance, availability, and scalability. The ICX 7750 distributed chassis technology enables scale-out networking and its true hybrid-port mode OpenFlow provides a migration path to SDN.

2 Overview

The FIPS 140-2 validation includes hardware devices running the firmware version presented in Table 1. Table 2, Table 5, Table 6, Table 7, Table 9 and Table 10 list the devices included in this evaluation.

Table 2 lists the six (6) Brocade FCX 624 series and FCX 648 series devices, referred collectively for the remainder of this document as FCX 624/648 device (cryptographic module, or simply the module). Each FCX 624/648 device is a fixed-port switch, which is a multi-chip standalone cryptographic module. The power supplies, fan tray assemblies and 2X10G Ethernet uplink module (FCX-2XG) are part of the cryptographic boundary and can be replaced in the field. An unpopulated FCX-2XG slot is covered by an opaque bezel which is part of the cryptographic boundary. For each module to operate in a FIPS Approved mode of operation, the tamper evident seals, supplied in FIPS Kit (Part Number: XBR-000195) must be installed, as defined in Appendix A.

Table 5 lists the ten (10) Brocade ICX 6610 series devices, referred collectively for the remainder of this document as ICX 6610 device (cryptographic module, or simply the module). Each ICX 6610 device is a fixed-port switch, which is a multi-chip standalone cryptographic module. The installed fans either use a push or pull configuration to move the air between the back and front of the device. Each model is orderable with either fan trays or power supply side intake (-I) or power supply side exhaust (-E) airflow, therefore two SKUs per module are listed in Table 5. The power supplies and fan tray assemblies are part of the cryptographic boundary and can be replaced in the field. Unpopulated power supplies and fan trays are covered by opaque bezels, which are part of the cryptographic boundary when the secondary redundant power supplies and/or fans trays are not used. The cryptographic boundary for each ICX 6610 device is represented by the opaque enclosure (including the power supply, fan tray and bezels) with removable cover. For each module to operate in a FIPS Approved mode of operation, the tamper evident seals, supplied in FIPS Kit (Part Number: XBR-000195) must be installed, as defined in Appendix A.

Table 6 lists the five (5) Brocade ICX 6450 series devices, referred collectively for the remainder of this document as ICX 6450 device (cryptographic module, or simply the module). Each ICX 6450 device is a fixed- port switch, which is a multi-chip standalone cryptographic module. The power supplies and fan tray assemblies are part of the cryptographic boundary and cannot be replaced in the field. The cryptographic boundary for each ICX 6450 device is represented by the opaque enclosure (including the power supply, fan

tray and bezels) with removable cover. For each module to operate in a FIPS Approved mode of operation, the tamper evident seals, supplied in FIPS Kit (Part Number: XBR-000195) must be installed, as defined in Appendix A.

Table 7 lists the five (5) Brocade ICX 7450 series devices, referred collectively for the remainder of this document as ICX 7450 device (cryptographic module, or simply the module).

Each ICX 7450 device is a fixed-port switch which provides three modular slots, Four different optional port modules are offered for the Brocade ICX 7450. These modules are interchangeable and can be installed in any of the three modular slots within the Brocade ICX 7450. This environment is a multi-chip standalone cryptographic module. ICX 7450 offers a selection of PoE/non-PoE and AC/DC power supply options with front-to-back or back-to-front airflow cooling options. The DC power supply can be installed in either PoE or no-PoE switches. The power supplies and fan tray assemblies are part of the cryptographic boundary and can be replaced in the field. Unpopulated power supplies and fan trays are covered by opaque bezels, which are part of the cryptographic boundary when the secondary redundant power supplies and/or fans trays are not used. The cryptographic boundary for each ICX 7450 device is represented by the opaque enclosure (including the power supply, fan tray and bezels) with removable cover. For each module to operate in a FIPS approved mode of operation, the tamper evident seals, supplied in FIPS Kit (Part Number: XBR-000195) must be installed, as defined in Appendix A.

Table 9 lists the Brocade ICX 7750 series devices, referred collectively for the remainder of this document as ICX 7750 device (cryptographic module, or simply the module). Each ICX 7750 device is a fixed-port switch, which is a multi-chip standalone cryptographic module. The installed fans either use a push or pull configuration to move the air between the back and front of the device. Each model is orderable with either fan trays or power supply side intake (-I) or power supply side exhaust (-E) airflow. The power supplies and fan tray assemblies are part of the cryptographic boundary and can be replaced in the field. Unpopulated power supplies and fan trays are covered by opaque bezels, which are part of the cryptographic boundary when the secondary redundant power supplies and/or fans trays are not used. The cryptographic boundary for each ICX 7750 device is represented by the opaque enclosure (including the power supply, fan tray and bezels) with removable cover. For each module to operate in a FIPS approved mode of operation, the tamper evident seals, supplied in FIPS Kit (Part Number: XBR-000195) must be installed, as defined in Appendix A.

Table 10 lists the FastIron SX 800 and two (2) SX 1600 series devices, referred collectively for the remainder of this document as SX 800/1600 device (cryptographic module, or simply the module). Each SX 800/1600 device is a chassis based switch, which is a multi-chip standalone cryptographic module. The field replaceable power supplies are not part of the cryptographic boundary. The fan tray assemblies are part of the cryptographic boundary and can be replaced in the field. Unpopulated management module, switch fabric module and port blade modules slots are covered by opaque bezels. The cryptographic boundary for each SX 800/1600 device is represented by the opaque enclosure (including the management modules, switch fabric modules, fan trays and bezels) with removable cover. For each module to operate in a FIPS approved mode of operation, the tamper evident seals, supplied in FIPS Kit (Part Number: XBR-000195) must be installed, as defined in Appendix A.

3 FastIron Firmware

Each of the ICX, FCX and SX series run a different firmware image which is built from the same source code. This firmware image includes the cryptographic functionality described under Section 11. The "–I" and "–E" designations in Table 5 define the airflow direction as either intake or exhaust. The "-24" and "-48" designations in Table 5 define the port count, and the designator "P" following the port count indicate PoE+ ports; the designator "F" indicate Small Form-Factor Pluggable (SFP) ports. Otherwise, devices with similar SKUs are identical.

Table 1 Firmware Version

Firmware Version
IronWare R08.0.20a

4 Brocade FCX 624 and FCX 648 Series

Table 2 FCX Part Numbers

SKU	MFG Part Number	Brief Description
FCX624S	80-1002388-08	24-Port 1GbE, 2X16G stackable switch
FCX624S-HPOE-ADV	80-1002715-08	24-Port 1GbE, HPOE, 2X16G stackable, ADV L3 switch
FCX624S-F-ADV	80-1002727-07	24-Port, FE/GE SFP, 2X16G stackable, ADV L3 switch
FCX648S	80-1002392-08	48-Port 1GbE, 2X16 stackable switch
FCX648S-HPOE	80-1002391-10	48-Port 1GbE, HPOE, 2x16G stackable switch
FCX648S-HPOE-ADV	80-1002716-10	48-Port 1GbE, HPOE, 2x16G stackable, ADV L3 switch
XBR-000195	80-1002006-02	FIPS Kit containing tamper evident labels to be affixed to the module per Appendix A: Tamper Label Application in this document. All SKUs listed above utilize this kit to satisfy the physical security requirements

Table 3 FCX 624 and FCX 628 Optional Component Part Numbers

SKU	MFG Part Number	Brief Description
FCX-2XG	80-1002399-01	XFP Module,Uplink,2X10G,FCX

Table 4 Validated FCX 624 and FCX 648 Series Configurations

Module	Configuration 1, SKUs (Count)	Configuration 2, SKUs (Count)
FCX 624S*	Base: FCX624S Interface module: None License: None	Base: FCX624S Interface module: FCX-2XG (1)** License: None
FCX 624S-HPOE-ADV*	Base: FCX624S-HPOE-ADV Interface module: None License: Advanced L3 license	Base: FCX624S-HPOE-ADV Interface module: FCX-2XG (1)** License: Advanced L3 license
FCX 624S-F-ADV*	Base: FCX624S-F-ADV Interface module: None License: Advanced L3 license	Base: FCX624S-F-ADV Interface module: FCX-2XG (1)** License: Advanced L3 license
FCX 648S*	Base: FCX648S Interface module: None License: None	Base: FCX624S-F-ADV Interface module: FCX-2XG (1)** License: None
FCX 648S-HPOE*	Base: FCX648S-HPOE Interface module: None License: None	Base: FCX648S-HPOE Interface module: FCX-2XG (1)** License: None
FCX 648S-HPOE-ADV*	Base: FCX648S-HPOE-ADV Interface module: None License: Advanced L3 license	Base: FCX648S-HPOE-ADVV Interface module: FCX-2XG (1)** License: Advanced L3 license

*See Table 2 for MFG Part number.

**See Table 3 for MFG Part number.

Figure 1 illustrates the FCX 624S cryptographic module.

Figure 1 FCX 624S with FCX-2XG module

Figure 2 illustrates the FCX 624S-HPOE-ADV cryptographic module.

Figure 2 FCX 624S-HPOE-ADV with FCX-2XG module

Figure 3 illustrates the FCX 648S cryptographic module.

Figure 3 FCX 648S with FCX-2XG module

Figure 4 illustrates the FCX 648S-HPOE and FCX 648S-HPOE-ADV cryptographic module.

Figure 4 FCX 648S-HPOE and FCX 648-HPOE-ADV with FCX-2XG module

Figure 5 illustrates the FCX 624S-F-ADV cryptographic module.

Figure 5 FCX 624S-F-ADV with FCX-2XG module

***Note:** The following SKUs are physically equivalent to the FCX 624S, FCX 624S-F, and the FCX 648S:
FCX 624S-HPOE-ADV
FCX 624S-F-ADV
FCX 648S-HPOE
FCX 648S-HPOE-ADV

5 ICX 6610 Series

Table 5 ICX 6610 Switch Family Part Numbers of Validated Cryptographic Modules

SKU	MFG Part Number	Brief Description
ICX6610-24F-I	80-1005350-04	Stackable switch with 24 100/1000 Mbps Small Form-Factor Pluggable (SFP) ports, power supply side intake airflow ("-I" in the SKU)
ICX6610-24F-E	80-1005345-04	Stackable switch with 24 100/1000 Mbps Small Form-Factor Pluggable (SFP) ports, power supply side exhaust airflow ("-E" in the SKU)
ICX6610-24-I	80-1005348-05	Stackable switch with 24 10/100/1000 Mbps RJ-45 ports, power supply side intake airflow ("-I" in the SKU)
ICX6610-24-E	80-1005343-05	Stackable switch with 24 10/100/1000 Mbps RJ-45 ports, power supply side exhaust airflow ("-E" in the SKU)
ICX6610-24P-I	80-1005349-06	Stackable switch with 24 10/100/1000 Mbps RJ-45 PoE+ ports, power supply side intake airflow ("-I" in the SKU)
ICX6610-24P-E	80-1005344-06	Stackable switch with 24 10/100/1000 Mbps RJ-45 PoE+ ports, power supply side exhaust airflow ("-E" in the SKU)
ICX6610-48-I	80-1005351-05	Stackable switch with 48 10/100/1000 Mbps RJ-45 ports, power supply side intake airflow ("-I" in the SKU)
ICX6610-48-E	80-1005346-05	Stackable switch with 48 10/100/1000 Mbps RJ-45 ports, power supply side exhaust airflow ("-E" in the SKU)
ICX6610-48P-I	80-1005352-06	Stackable switch with 24 10/100/1000 Mbps RJ-45 PoE+ ports, power supply side intake airflow ("-I" in the SKU)
ICX6610-48P-E	80-1005347-06	Stackable switch with 24 10/100/1000 Mbps RJ-45 PoE+ ports, power supply side exhaust airflow ("-E" in the SKU)
XBR-000195	80-1002006-02	FIPS Kit containing tamper evident labels to be affixed to the module per Appendix A: Tamper Label Application in this document. All SKUs listed above utilize this kit to satisfy the physical security requirements

Figure 6 illustrates the ICX 6610-24 and ICX 6610-24P cryptographic modules (See Table 5 ICX 6610 Switch Family Part Numbers).

Figure 6 ICX 6610-24 and ICX 6610-24P cryptographic modules

Figure 7 illustrates the ICX 6610-48 and ICX 6610-48P cryptographic modules (See Table 5 ICX 6610 Switch Family Part Numbers).

Figure 7 ICX 6610-48 and ICX 6610-48P cryptographic modules

Figure 8 illustrates the ICX 6610-24F cryptographic modules (See Table 5 ICX 6610 Switch Family Part Numbers).

Figure 8 ICX 6610-24F cryptographic module

6 ICX 6450 Series

Table 6 ICX 6450 Switch Family Part Numbers of Validated Cryptographic Modules

SKU	MFG Part Number	Brief Description
ICX6450-24	80-1005997-03	24-port 1G Switch, 2x1G SFP+ (upgradable to 10G) & 2x1G/10G SFP+ Uplink/Stacking Ports
ICX6450-24P	80-1005996-04	24-port 1G Switch PoE+ 390W, 2x1G SFP+ (upgradable to 10G) & 2x1G/10G SFP+ Uplink/Stacking Ports
ICX6450-48	80-1005999-04	48-port 1G Switch, 2x1G SFP+ (upgradable to 10G) & 2x1G/10G SFP+ Uplink/Stacking Ports
ICX6450-48P	80-1005998-04	48-port 1G Switch PoE+ 780W, 2x1G SFP+ (upgradable to 10G) & 2x1G/10G SFP+ Uplink/Stacking Ports
ICX6450-C12-PD	80-1007578-01	12-port 1G Compact Switch (4 PoE+), 2X100M/1G SFP, 2X100M/1G Copper Uplinks, Fanless, Layer 3
XBR-000195	80-1002006-02	FIPS Kit containing tamper evident labels to be affixed to the module per Appendix A: Tamper Label Application in this document. All SKUs listed above utilize this kit to satisfy the physical security requirements

Figure 9 illustrates the ICX 6450-24 and ICX 6450-24P cryptographic module (See Table 6 ICX 6450 Switch Family Part Numbers)

Figure 9 ICX 6450-24 and ICX 6450-24P cryptographic module

Figure 10 illustrates the ICX 6450-48 and ICX 6450-48P cryptographic modules (See Table 6 ICX 6450 Switch Family Part Numbers).

Figure 10 ICX 6450-48 and ICX 6450-48P cryptographic modules

Figure 11 illustrates the ICX 6450-C12-PD Cryptographic module (See Table 6 ICX 6450 Switch Family Part Numbers).

Figure 11 ICX 6450-C12-PD cryptographic modules

7 ICX 7450 Series

Table 7 ICX 7450 Switch Family Part Numbers of Validated Cryptographic Modules

SKU	MFG Part Number	Brief Description
ICX-7450-24	80-1008060-01	Brocade ICX 7450 with 24-port 1 GbE, Modules, power supply & fan ordered separately
ICX-7450-24P	80-1008061-01	Brocade ICX 7450 with 24-port 1 GbE PoE+, Modules, power supply & fan ordered separately
ICX-7450-48	80-1008062-01	Brocade ICX 7450 with 48-port 1 GbE, Modules, power supply & fan ordered separately
ICX-7450-48P	80-1008063-01	Brocade ICX 7450 with 48-port 1 GbE PoE+, Modules, power supply & fan ordered separately
ICX-7450-48F	80-1008064-01	Brocade ICX 7450 with 48x 1GbE SFP ports. Modules, power supply & fan ordered separately.
XBR-000195	80-1002006-02	FIPS Kit containing tamper evident labels to be affixed to the module per Appendix A: Tamper Label Application in this document. All SKUs listed above utilize this kit to satisfy the physical security requirements

Table 7B Components of the ICX 7450 Series

SKU	MFG Part Number	Brief Description
RPS15-E	80-1005261-04	Power supply - No-PoE 250 W AC with power-supply-side exhaust airflow
RPS15-I	80-1005259-04	Power supply - No-PoE 250 W AC with power-supply-side intake airflow
RPS16-E	80-1005262-03	Power supply - PoE 1000 W AC with power-supply-side exhaust airflow
RPS16-I	80-1005260-03	Power supply - PoE 1000 W AC with power-supply-side intake airflow
RPS16DC-E	80-1007165-03	Power supply - PoE 510 W DC with power-supply-side exhaust airflow
RPS16DC-I	80-1007166-03	Power supply - PoE 510 W DC with power-supply-side intake airflow
ICX7400-4X1GF	80-1008334-01	4-port 100M/1GbE SFP module
ICX7400-4X10GF	80-1008333-01	4-port 1/10GbE SFP/SFP+ module
ICX7400-4X10GC	80-1008332-01	4-port 1/10GbE 10GBASE-T Copper module
ICX7400-1X40GQ	80-1008331-01	1-port 40GbE QSFP+ for uplink or stacking module
ICX-FAN10-E	80-1008308-01	Power-supply-side exhaust airflow fan
ICX-FAN10-I	80-1008309-01	Power-supply-side intake airflow fan
N/A	123400000829A-R01	BLANK FAN TRAY ES4627BF-HPoE-FLF-08(SPATHA)-E LT
N/A	123400000830A-R01	BLANK PSU ES4627BF-HPoE-FLF-08(SPATHA)-E LT
N/A	123400000833A-R01	BLANK BRACKET ES4651BF-HPoE-FLF-08(SPATHA)-E LT

Table 7C ICX 7450 Support Matrix

Switch Models	Components	Field Replaceable Units (max count)
ICX-7450-24 See notes 1,2,3	Modules:	3 slots could be occupied with a combination of any of these modules … see table notes: ICX7400-4X1GF (1), ICX7400-4X10GF (3), ICX7400-4X10GC (3), ICX7400-1X40GQ (3)
	Power Supply:	RPS15-E (2), or RPS16DC-E (2), or RPS15-I (2), or RPS16DC-I (2)
	Fan Tray:	ICX-FAN10-I (2), or ICX-FAN10-E (2)
	Filler Panel:	Filler Panel (5)
ICX-7450-24P See notes 1,2,3	Modules:	3 slots could be occupied with a combination of any of these modules … see table notes ICX7400-4X1GF (1), ICX7400-4X10GF (3), ICX7400-4X10GC (3), ICX7400-1X40GQ (3)
	Power Supply:	RPS16-E (2), or RPS16DC-E (2), or RPS16-I (2), or RPS16DC-I (2)
	Fan Tray:	ICX-FAN10-I (2), or ICX-FAN10-E (2)
	Filler Panel:	Filler Panel (5)
ICX-7450-48 See notes 1,2,3,4	Modules:	3 slots could be occupied with a combination of any of these modules … see table notes ICX7400-4X1GF (1), ICX7400-4X10GF (3), ICX7400-4X10GC (3), ICX7400-1X40GQ (2)
	Power Supply:	RPS15-E (2), or RPS16DC-E (2), or RPS15-I (2), or RPS16DC-I (2)
	Fan Tray:	ICX-FAN10-I (2), or ICX-FAN10-E (2)
	Filler Panel:	Filler Panel (5)
ICX-7450-48P See notes 1,2,3,4	Modules:	3 slots could be occupied with a combination of any of these modules … see table notes ICX7400-4X1GF (1), ICX7400-4X10GF (3), ICX7400-4X10GC (3), ICX7400-1X40GQ (2)
	Power Supply:	RPS16-E (2), or RPS16DC-E (2), or RPS16-I (2), or RPS16DC-I (2)
	Fan Tray:	ICX-FAN10-I (2), or ICX-FAN10-E (2)
	Filler Panel:	Filler Panel (5)
ICX-7450-48F See notes 1,2,3,4	Modules:	3 slots could be occupied with a combination of any of these modules … see table notes ICX7400-4X1GF (1), ICX7400-4X10GF (3), ICX7400-4X10GC (3), ICX7400-1X40GQ (2)
	Power Supply:	RPS15-E (2), or RPS16DC-E (2), or RPS15-I (2), or RPS16DC-I (2)
	Fan Tray:	ICX-FAN10-I (2), or ICX-FAN10-E (2)
	Filler Panel:	Filler Panel (5)

Table Notes:

1. Each Switch model shall be fully populated with a minimum of one Power Supply and one Fan unit, with every remaining slot populated with a Field Replaceable Unit (FRU) as per the table above.
2. Direction of the airflow for the Power Supply shall match the direction of the airflow of the Fan unit (e.g. ICX-FAN10-E shall be used in conjunction with RPS15-E, RPS16-E and RPS16DC-E).
3. The ICX7400-4X1GF (P/N: 80-1008334-01) FRU shall only be inserted in the front panel slot.
4.The ICX7400-1X40GQ (P/N: 80-1008331-01) FRU shall not be inserted in the front panel slot.

See Table 7 ICX 7450 Switch Family Part Numbers of Validated Cryptographic Modules

Figure 12A illustrates Brocade ICX-7450-24 shown with optional Brocade ICX7400-4X10GF SFP+ uplink module.

Figure 12B illustrates Brocade ICX-7450-24P shown with optional Brocade ICX7400-1X40GQ QSFP+ uplink module.

Figure 12C illustrates Brocade ICX-7450-48 shown with optional Brocade ICX7400-4X10GC 10GBase-T uplink module

Figure 12D illustrates Brocade ICX-7450-48P shown with optional Brocade ICX7400-4X10GF SFP+ uplink module.

Figure 12E illustrates Brocade ICX-7450-48F shown with optional Brocade ICX 7400-4X10GF SFP+ uplink module.

8 ICX 7750 Series

Each ICX 7750 Series device validated within this implementation includes the following ICX modules: RPS9+I and ICX7750-FAN-I

Table 8 Components of the ICX 7750 Series

SKU	MFG Part Number	Brief Description
RPS9+I	80-1007871-01	500 W AC power supply; power-supply-side intake (port-side exhaust) airflow
RPS9+E	80-1007870-01	500 W AC power supply; power-supply-side exhaust (port-side intake) airflow
RPS9DC+I	80-1007872-01	500 W DC power supply; power-supply-side intake (port-side exhaust) airflow
RPS9DC+E	80-1007873-01	500 W DC power supply; power-supply-side exhaust (port-side intake) airflow
ICX7750-FAN-I	80-1007738-01	Fan kit of 4; fan-side intake (port-side exhaust) airflow
ICX7750-FAN-E	80-1007737-01	Fan kit of 4; fan-side exhaust (port-side intake) airflow
ICX7750-FAN-I-SINGLE	80-1007761-01	Fan single unit; fan-side intake (port-side exhaust) airflow
ICX7750-FAN-E-SINGLE	80-1007760-01	Fan single unit; fan-side exhaust (port-side intake) airflow
ICX7750-6Q	80-1007632-01	Brocade ICX 7750 with 6 40 GbE QSFP module for use in Brocade ICX 7750- 48F, 7750-48C, or 7750-26Q

Table 9 ICX 7750 Switch Family Part Numbers of Validated Cryptographic Modules

SKU	MFG Part Number	Brief Description
ICX7750-48F	80-1007607-01	Brocade ICX 7750 with 48 1/10 GbE SFP+ ports, 6 40 GbE QSFP ports and modular interface slot. No power supplies or fan units (need to be ordered separately).
ICX7750-48C	80-1007608-01	Brocade ICX 7750 with 48 1/10 GbE RJ-45 10GBASE-T ports, 6 40 GbE QSFP ports and modular interface slot. No power supplies or fan units (need to be ordered separately).
ICX7750-26Q	80-1007609-01	Brocade ICX 7750 with 26 40 GbE QSFP ports and modular interface slot. No power supplies or fan units (need to be ordered separately).
XBR-000195	80-1002006-02	FIPS Kit containing tamper evident labels to be affixed to the module per Appendix A: Tamper Label Application in this document. All SKUs listed above utilize this kit to satisfy the physical security requirements

Figure 13 illustrates the ICX 7750-48F cryptographic module.

Figure 13 ICX 7750-48F cryptographic module

Figure 14 illustrates the ICX 7750-48C cryptographic module.

Figure 14 ICX 7750-48C cryptographic module

Figure 15 illustrates the ICX 7750-26Q cryptographic module.

Figure 15 ICX 7750-26Q cryptographic module

9 SX 800 and SX 1600 Series

Each FI-SX800-S, FI-SX1600-AC and FI-SX1600-DC device validated within this implementation includes the following SX modules: SX-FISF and SX-FIZMR or SX-FI2XGMR6

Table 10 FastIron SX Part Numbers

SKU	MFG Part Number		Brief Description
FI-SX800-S	80-1003050-03,	80-1007143-03	FastIron SX 800 CHASSIS
FI-SX1600-AC	80-1002764-02,	80-1007137-02	FastIron SX 1600, 16 slot, 2 SX-FISF, 2 AC Power Supplies
FI-SX1600-DC	80-1003005-02,	80-1007138-02	FastIron SX 1600, 16 slot, 2 SX-FISF, 2 DC Power Supplies

Table 11 Components of the SX 800 and SX 1600

SKU	MFG Part Number	Brief Description
SX-FISF	80-1002957-03	Switch Fabric module for the FI SX 800 & FI SX 1600
SX-FI-2XGMR-XL-PREM6	80-1007349-01	FISX 2PRT G3 10GE XL MGMT MOD PREM
SX-FI-2XGMR-XL	80-1006607-01	FI SX 2PRT G3 10GE XL MGMT MOD
SX-FI-ZMR-XL	80-1006486-02	FastIron SX XL management module, No 10G ports
SX-FI-ZMR-XL-PREM6	80-1007350-02	FastIron SX XL management module, No 10G ports, support for IPv4 and Ipv6 routing, SW-SX-FIL3U-6-IPV6 license
SX-ACPWR-SYS	80-1003883-02	FSX AC 90-240 VAC SYSTEM POWER SUPPLY
SX-DCPWR-SYS	80-1003886-02	FSX DC SYSTEM POWER SUPPLY
N/A	11456-005	SHEET METAL, FAB, LINE CARD SLOT BLANK, S
N/A	11457-006	SHEET METAL, FAB, MGMT BLANK, SDX, RoHS
N/A	18072-004	SHEET METAL ASSY, PU BLANK, SX/SDX

Table 12 Validated SX 800 Series Configurations

Module	Configuration 1, SKUs (Count)	Configuration 2, SKUs (Count)
SX 800*** (with AC power)	Base: FI-SX800-S* Management module: SX-FI-ZMR-XL (2) or SX-FI-2XGMR-XL (2)** Switch Fabric: SX-FISF (2)** License: None Power Supply: SX-ACPWR-SYS (1)**	Base: FI-SX800-S* Management module: SX-FI-ZMR-XL-PREM6 (2) or SX-FI-2XGMR-XI-PREM6 (2)** Switch Fabric: SX-FISF (2)** License: SW-SX-FIL3U-6-IPV6 Power Supply: SX-ACPWR-SYS (1)**
SX 800*** (with DC power)	Base: FI-SX800-S* Management module: SX-FI-ZMR-XL (2) or SX-FI-2XGMR-XL (2)** Switch Fabric: SX-FISF (2)** License: None Power Supply: SX-DCPWR-SYS (1)**	Base: FI-SX800-S* Management module: SX-FI-ZMR-XL-PREM6 (2) or SX-FI-2XGMR-XI-PREM6 (2)** Switch Fabric: SX-FISF (2)** License: SW-SX-FIL3U-6-IPV6 Power Supply: SX-DCPWR-SYS (1)**

*See Table 10 for MFG Part numbers.
**See Table 11 for MFG Part numbers.
***Any unused and open slots must be covered using filler panels, located in Table 11 (Part Numbers 11456-005, 11457-006 or 18072-004)

Table 13 Validated SX 1600 Series Configurations

Model	Configuration 1, SKUs (Count)	Configuration 2, SKUs (Count)
SX 1600 (with AC power)	Base:FI-SX1600-AC* Management module: SX-FI-ZMR-XL (2) or SX-FI-2XGMR-XL (2)** Switch Fabric: SX-FISF (2)** License: None Power Supply: SX-ACPWR-SYS (2)**	Base:FI-SX1600-AC* Management module: SX-FI-ZMR-XL-PREM6 (2) or SX-FI-2XGMR-XI-PREM6 (2)** Switch Fabric: SX-FISF (2)** License:SW-SX-FIL3U-6-IPV6 Power Supply: SX-ACPWR-SYS (2)**
SX 1600 (with DC power)	Base:FI-SX1600-DC* Management module SX-FI-ZMR-XL (2) or SX-FI-2XGMR-XL (2)** Switch Fabric: SX-FISF (2)** License: None Power Supply: SX-DCPWR-SYS (2)**	Base:FI-SX1600-DC* Management module: SX-FI-ZMR-XL-PREM6 (2) or SX-FI-2XGMR-XI-PREM6 (2)** Switch Fabric: SX-FISF (2)** License:SW-SX-FIL3U-6-IPV6 Power Supply: SX-DCPWR-SYS (2)**

*See Table 10 for MFG Part numbers.

**See Table 11 for MFG Part numbers.

Figure 16 illustrates the Brocade SX800 cryptographic module. Items 1 – 4, 5 – 8 are filler panels. Items 9 and 11 are management modules, and Items 10 and 12 are switch fabrics. Lastly, Item 13 is the power supply.

Figure 16 Brocade SX800 with SX-FI-ZMR-XL (left) and Brocade SX800 with SX-FI-2XGMR-XL (right)

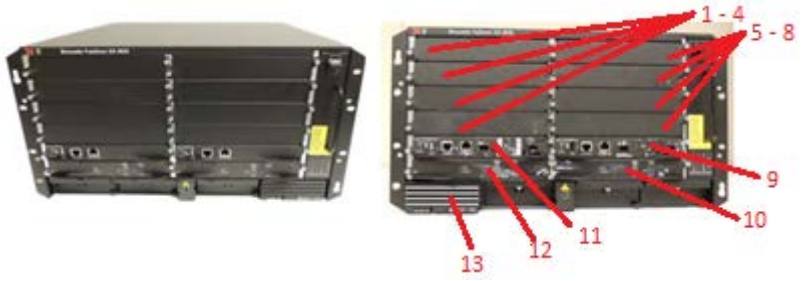
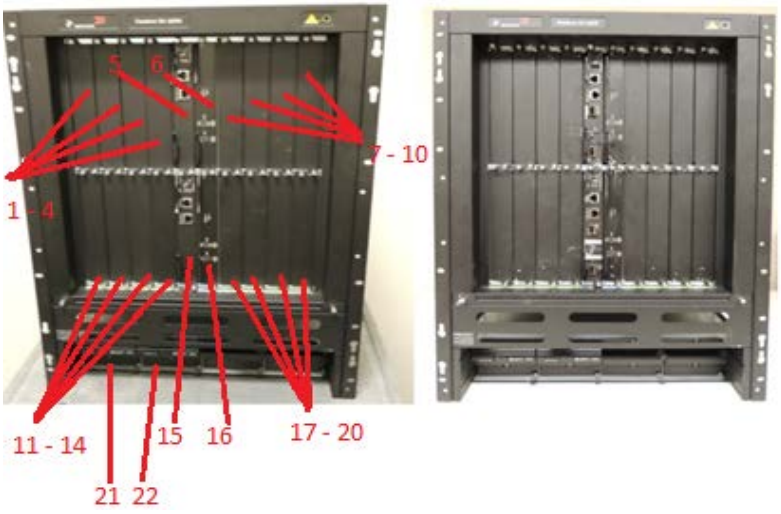


Figure 17 illustrates the Brocade SX1600 cryptographic module. Items 1 – 4, 7 – 10, 11 – 14, and 17 – 20 are filler panels. Items 5 and 15 are management modules, Items 6 and 16 are switch fabrics, and Items 21 and 22 are power supplies.

Figure 17 Brocade SX1600 with SX-FI-ZMR-XL (left) and Brocade SX1600 with SX-FX-2XGMR-XL (right)



10 Ports and Interfaces

10.1 FCX 624 and FCX 648 Series

Each FCX 624/648 device provides network ports, management connectors, and status LED. This section describes the physical ports and the interfaces that provide for Data Input, Data Output, Control Input, and Status Output.

While not part of this validation, the FCX 624/648 devices provide a range of physical network ports. The series supports both copper and fiber connectors with some models supporting combination ports. All models within the scope of this evaluation support 10G uplink ports for stacking devices. All models have an out-of-band management port and a console management port (Gigabit Ethernet RJ-45 connector and serial connector, respectively).

Table 14 summarizes the physical ports provided by FCX 624/648 devices. Table 15 shows the correspondence between the physical interfaces of a FCX 624/648 device and the logical interfaces defined in FIPS 140-2.

Table 14 FCX 624/648 Port mapping to logical interface

Physical Port	Logical Interface
SFP ports	Data input/Data output, Status output
10/100/1000 Mbps RJ-45 ports	Data input/Data output, Status output
AC socket	Power
Out of band management port	Control input, Status output
Console Port	Control input, Status output
Reset	Control input
LED	Status output

Table 15 FCX 624/648 Series Physical Port LED Status

LED	Condition	Status
Ethernet Ports 24-port and 48-port models	On (Flashing Green)	The port has established a valid link at 1000 Mbps. Flashing indicates the port is transmitting and receiving user packets.
	On (Flashing Amber)	The port has established a valid link at 10 or 100 Mbps. Flashing indicates the port is transmitting and receiving user packets.
	Off	A link is not established with a remote port.
HPOE 24-port and 48-port models	On (Green)	The port is providing HPOE power to a connected device.
	Off	The port is not providing HPOE power.
SFP (Link LED)	On (Flashing Green)	The SFP port has established a valid link. Flashing indicates that the port is transmitting and receiving user packets.
	Off	A link is not established with a remote port.
SFP (Speed LED)	On (Green)	The SFP port is operating at 1000 Mbps.
	On (Amber)	The SFP port is operating at 100 Mbps.
		A link is not established with a remote port.

Table 16 FCX 624/648 Series System LED Status

LED	Condition	Status
PS1	On (Green)	Power supply is operating normally.
	On (Amber)	Power supply fault detected.
	Off	Power supply is off or experience a system failure.
PS2	On (Green)	Power supply is operating normally.
	On (Amber)	Power supply fault detected.
	Off	Power supply is off or experience a system failure.
Diag (Diagnostic)	On (Flashing Green)	System self-diagnostic test is in progress.
	On (Green)	System self-diagnostic test successfully completed.
	On (Amber)	System self-diagnostic test detected a fault.
A (Active)	On (Green)	The device is the active controller.
	On (Amber)	The device is the standby controller.
	Off	The device is operating as a stack member or is in standalone mode.
S (Standby)	On (Green)	The device is the active controller.
	On (Amber)	The device is the standby controller.
	Off	The device is operating as a stack member or is in standalone mode.
Up link	On (Green)	Up link is operating properly.
	Off	Up link has failed or there is no link.
Down Link	On (Green)	Down link is operating properly.
	Off	Down link has failed or there is no link.
Stack ID (1-8)	On (Green)	Indicates the device stack ID.

Table 17 FCX 624/648 Series Power Module LED Status

LED	Condition	Status
DC OK	On (Green)	DC output OK.
	On (Red)	DC output failure.
AC OK	On (Green)	AC input OK.
	On (Red)	AC input failure.

10.2 ICX 6610 Series

Each ICX 6610 device provides network ports, management connectors, and status LED. This section describes the physical ports and the interfaces that provide for Data Input, Data Output, Control Input, and Status Output.

The ICX 6610 devices provide a range of physical network ports. The series supports both copper and fiber connectors with some models supporting combination ports. Some models support uplink ports for stacking devices. Most models have an out-of-band management port and a console management port (Gigabit Ethernet RJ-45 connector and serial connector, respectively).

Table 18 summarizes the network ports provided by each ICX 6610 model. Table 19 shows the correspondence between the physical interfaces of ICX 6610 devices and the logical interfaces defined in FIPS 140-2.

Table 18 ICX 6610 Series Physical Ports

Model	Dual-mode 1 GbE/10 GbE SFP/SFP+ ports	10/100/1000 Mbps RJ-45 ports	1 GbE SFP ports	40 Gbps high-performance QSFP stacking ports1	AC inlet2	Reset	Out of band management ports	LEDs													
								Ethernet		PoE+			System Status								
								Spee	Status	Speed	Status	SFP/SFP+	PSU	PSU	DIAG	XL	XL	MS	XL2-XL5	XL7-XL10	Stack ID3
ICX6610-24F-I, ICX6610-24F-E	8	N/A	24	4	2	1	2	N/A	N/A	N/A	N/A	40	1	1	1	1	1	1	1	1	10
ICX6610-24-I, ICX6610-24-E	8	24	N/A	4	2	1	2	24	24	N/A	N/A	8	1	1	1	1	1	1	1	1	10
ICX6610-24P-I, ICX6610-24P-E	8	24	N/A	4	2	1	2	N/A	N/A	24	24	8	1	1	1	1	1	1	1	1	10
ICX6610-48-I, ICX6610-48-E	8	48	N/A	4	2	1	2	48	48	N/A	N/A	8	1	1	1	1	1	1	1	1	10
ICX6610-48P-I, ICX6610-48P-E	8	48	N/A	4	2	1	2	N/A	N/A	48	48	8	1	1	1	1	1	1	1	1	10

Table 19 ICX 6610 Port mapping to logical interface

Physical Port	Logical Interface
Dual-mode 1 GbE/10 GbE SFP/SFP+ ports	Data input/Data output, Status output
10/100/1000 Mbps RJ-45 ports	Data input/Data output, Status output
1 GbE SFP ports	Data input/Data output, Status output
40 Gbps high-performance QSFP stacking ports	Data input/Data output, Status output
AC inlet	Power
Out of band management ports	Control input, Status output
Reset	Control input
LED	Status output

10.3 ICX 6450 Series

Each ICX 6450 device provides network ports, management connectors, and status LED. This section describes the physical ports and the interfaces that provide for Data Input, Data Output, Control Input, and Status Output.

The ICX 6450 devices provide a range of physical network ports. The series supports both copper and fiber connectors with some models supporting combination ports. Some models support uplink ports for stacking devices. Most models have an out-of-band management port and a console management port (Gigabit Ethernet RJ-45 connector and serial connector, respectively).

Table 20 shows the correspondence between the physical interfaces of an ICX 6450 device and the logical interfaces defined in FIPS 140-2.

Table 20 ICX 6450 Port mapping to logical interface

Physical Port	Logical Interface
SFP/SFP+ ports	Data input/Data output, Status output
10/100/1000 Mbps RJ-45 ports	Data input/Data output, Status output
AC socket	Power
External power supply connector (EPS) (The ICX 6450-24, ICX 6450-24P and ICX 6450-48 have one EPS connector. The ICX 6450-48P has two EPS connectors)	Power
Out of band management port[4]	Control input, Status output
Console Port	Control input, Status output
Reset	Control input
LED	Status output

Table 21 ICX 6450 Series Physical Port LED Status

LED	Condition	Status
Ethernet Ports 24-port and 48-port models	On/Flashing Green	The port has established a valid link at 10, 100 or 1000 Mbps. Flashing indicates the port is transmitting and receiving user packets.
	Off	A link is not established with a remote port.
PoE/PoE+ 24-port and 48-port models	On/Green	The port is providing PoE or PoE+ power to a connected device.
	Off	The port is not providing PoE or PoE+ power.
SFP/SFP+ (X1 – X4) for ICX 6450 devices	On/Flashing Green	The SFP port is operating at 10 Gbps. Flashing indicates the port is transmitting and receiving user packets at 10 Gbps.
	On/Flashing Yellow	The SFP port is operating at 1 Gbps. Flashing indicates the port is transmitting and receiving user packets at 1 Gbps.
	Off	A link is not established with a remote port.

LED	Condition	Status
Out-of-band management port (2 LEDs)	Off (both LEDs)	Offline.
	On/Flashing(left side)	Link-up. Flashing indicates the port is transmitting and receiving user packets.
	On/Green(right side)	1 Gbps Link-up.
	Right LED off, left LED on or flashing	10/100 Mbps Link-up. Flashing indicates the port is transmitting and receiving user packets.

Table 22 ICX 6450 System LED Status

LED	Condition	Status
EPS1 and EPS2 (External Power Supply status for ICX 6450-48P devices only)	Green	EPS1 and EPS2 power supplies are operating normally.
	Yellow	EPS1 and EPS2 power supply fault.
	Off	EPS1 and EPS2 off or not present.
PWR (Power)	Green	Power supply is operating normally.
	Yellow	Power supply fault.
	Off	Power supply off.
Diag (Diagnostic)	FlashingGreen	System self-diagnostic test in progress. System reloads automatically.
	SteadyYellow	System self-diagnostic test has detected a fault (fan, thermal, or any interface fault). The user must reload the system.
MS (Stacking configuration)	Green	The device is the Active controller. Flashing indicates the system is initializing.
	Yellow	Indicates the device is the Standby controller. Flashing indicates the system is in Master arbitration or selection state.
	Off	Device is operating as a stack member, or is in standalonemode.
Uplink (X1 and X2 stacking port status)	Green	Uplink port is operating normally.
	Off	Uplink failed or there is not link.
Downlink (X3 and X4, stacking port status)	Green	Downlink port is operating normally.
	Off	Downlink failed or there is not link.
1-8 (Switch ID in the stack)	Green	Indicates the switch ID in the stack. For ICX 6450 devices, 1 – 8 indicates the switch ID in the stack.

10.4 ICX 7450 Series

An ICX 7450 device provides network ports, management connectors, and status LED. This section describes the physical ports and the interfaces that provide for Data Input, Data Output, Control Input, and Status Output.

The ICX 7450 devices provide a range of physical network ports. The series supports both copper and fiber connectors. The ICX 7450 device has one RJ-45 network management port, one mini USB serial management port, and one USB storage port on the front panel

Table 23 shows the correspondence between the physical interfaces of an ICX 7450 device and the logical interfaces defined in FIPS 140-2.

Table 23 ICX 7450 Port mapping to logical interface

Physical Port	Logical Interface
SFP ports	Data input/Data output, Status output
QSFP ports	Data input/Data output, Status output
10/100/1000 Mbps RJ-45 ports	Data input/Data output, Status output
AC socket	Power
DC socket	Power
Console Port	Control input, Status output
Out of band management port	Control input, Status output
Reset	Control input
LED	Status output
USB type-A port	Data input/Data Output

Table 24A through 24H summarize the physical port LED status provided by ICX 7450 devices.

Table 24A Management port (10/100/1000 Mbps) status LED

LED state	Status of hardware
Off (no light)	Not cabled
Steady amber	Port link is up in 10/100 Mbps mode. No traffic is being transmitted
Blinking amber	There is 10/100 Mbps traffic and packets are being transmitted or received
Steady green	Port link is up in 1 Gbps mode. No traffic is being transmitted
Blinking green	There is 1 Gbps traffic and packets are being transmitted or received

Table 24B 100/1000 Mbps RJ-45 port LEDs

LED state	Status of hardware
Off (no light)	Not cabled
Steady amber	Link is up in 100 Mbps mode.
Blinking amber	There is 100 Mbps traffic and packets are being transmitted or received
Steady green	Link is up in 1 Gbps mode
Blinking green	There is 1 Gbps traffic and packets are being transmitted or received

Table 24C 100/1000 Mbps RJ-45 PoE LEDs

LED state	Status of hardware
Steady green	Port is providing POE power to a connected device.
Off	Port is not providing PoE power

Table 24D 100/1000 Mbps SFP port LEDs

LED state	Status of hardware
Off (no light)	Not cabled
Steady amber	Link is up in 100 Mbps mode.
Blinking amber	There is 100 Mbps traffic and packets are being transmitted or received
Steady green	Link is up in 1 Gbps mode
Blinking green	There is 1 Gbps traffic and packets are being transmitted or received

Table 24E 1/10 Gbps RJ-45 port LEDs

LED state	Status of hardware
Off (no light)	Not cabled
Steady amber	Link is up in 1 Gbps mode.
Blinking amber	There is 1 Gbps traffic and packets are being transmitted or received
Steady green	Link is up in 10 Gbps mode
Blinking green	There is 10 Gbps traffic and packets are being transmitted or received

Table 24F 1/10 GbE SFP+ module port LEDs

LED state	Status of hardware
Off (no light)	Not cabled
Steady amber	Link is up in 1 GbE mode.
Blinking amber	There is 1 GbE traffic and packets are being transmitted or received
Steady green	Link is up in 10 GbE mode
Blinking green	There is 10 GbE traffic and packets are being transmitted or received

Table 24G 40 GbE mode QSFP+ module port LEDs (left-side LED)

LED state	Status of hardware
Off (no light)	Not cabled
Steady green	Link is up in 40 GbE mode (MOD2 data uplink mode or MOD3/MOD4 stacking mode)
Blinking green	There is 40 GbE traffic and packets are being transmitted or received

Table 24H 4x10 GbE mode QSFP+ module port LEDs

LED state	Status of hardware
Off (no light)	Not cabled
Steady amber	Port lane link is up in 10 GbE mode (MOD2 data uplink mode)
Blinking amber	There is 10 GbE traffic and packets are being transmitted or received

Table 25A through 25F summarize the system LED status provided by ICX 7450 devices.

Table 25 ICX 7450 System LED Status

Table 25A PSU1 and PSU2 LEDs

LED state	Status of hardware
Off (no light)	System is off or there is no power
Steady green	PSU is on and functioning properly
Steady amber	PSU is missing power or in a faulty state (such as PSU fan failure)

Table 25B DIAG LED

LED state	Status of hardware
Off (no light)	Diagnostic is off
Blinking green	System self-diagnostic test is in progress
Steady green	System self-diagnostic test has successfully completed
Steady amber	System self-diagnostic test has detected a fault

Table 25C MS LED

LED state	Status of hardware
Off (no light)	Stacking mode is enabled and the switch is a stack member operating in slave mpde, or the switch is operating in standalone mode.
Blinking green	Device is initializing
Steady green	Stacking mode is enabled and the switch is the stack master
Steady amber	Stacking mode is initializing and the switch is the standby controller
Blinking amber	Stacking mode is initializing and the switch is in stacking master arbitration/selection state.

Table 25D MOD LED

LED state	Status of hardware
Off (no light)	Module is used for stacking or no module is installed. For stacking modules, this means that stacking mode is enabled and the switch is a stack member, or the switch is operating in stand-alone mode
Steady green	Module is operating normally. For stacking modules, this means that stacking mode is enabled and the switch is a stack master

Table 25E Stack ID LEDs

LED state	Status of hardware
Steady green	Indicates stack unit identifier. (Unit numbers 11 and 12 are shown by using the 10+ LED in combination with the 1 or 2 LED.)

Table 25F Module Power LED (all media/stacking modules)

LED state	Status of hardware
Off (no light)	Module is not receiving power.
Steady green	Module is on and functioning properly
Steady amber	Module is on and booting up

10.5 ICX 7750 Series

Each ICX 7750 device provides network ports, management connectors, and status LED. This section describes the physical ports and the interfaces that provide for Data Input, Data Output, Control Input, and Status Output.

The ICX 7750 devices provide a range of physical network ports. The series supports both copper and fiber connectors with some models supporting combination ports. Some models support uplink ports for stacking devices. Most models have an out-of-band management port and a console management port (Gigabit Ethernet RJ-45 connector and serial connector, respectively).

Table 26 and Table 27 show the correspondence between the physical interfaces of an ICX 7750 device and the logical interfaces defined in FIPS 140-2.

Table 26 ICX 7750 Port mapping to logical interface

Physical Port	Logical Interface
SFP ports	Data input/Data output, Status output
QSFP ports	Data input/Data output, Status output
10/100/1000 Mbps RJ-45 ports	Data input/Data output, Status output
AC socket	Power
External power supply connector	Power
Console Port	Control input, Status output
Out of band management port	Control input, Status output
Reset	Control input
LED	Status output

Table 27 ICX 7750 Series Physical Port LED Status

LED	Condition	Status
Management Port (Left or Right)	Flashing	There is traffic and packets are being transmitted and received.
Management Port (Left or Right)	Steady	No traffic is being transmitted, but the link is active.
	Off	External cable is not present.
1/10 GbE Port (RJ45 and SFP+)	Steady Green	Link is up in 10 GbE mode.
	Flashing Green	There is 10 GbE activity (traffic) and packets are being transmitted or received.
	Steady Amber	Link is up in 1 GbE mode.
	Flashing Amber	There is 1 GbE activity (traffic) and packets are being transmitted or received.
40 GbE (rear port) front port LED	Off	Disabled.
	Steady Green	Link is up in 40 GbE mode.
	Flashing Green	Active traffic. Packets are being transmitted or received.
4x10 GbE (rear port) front port LED	Off	Disabled.
	Steady Amber	Link is up in 10 GbE mode.
	Flashing Amber	Active traffic. Packets are being transmitted or received.
10/100/1000 Mbps HA Ethernet port LEDs	Off	Not Cabled.
	Steady green	Link is up in 1 GbE mode.
	Blinking Green	There is 1 GbE traffic and packets are being transmitted or received.
	Steady Amber	Link is up in 10/100 Mbps mode.
	Blinking Amber	There is 10/100 Mbps traffic and packets are being transmitted or received.

Table 28 ICX 7750 System LED Status

LED	Condition	Status
PSU1 and PSU2	Steady Green	PSU is on and operating normally.
	Steady Amber	PSU power supply fault.
	Off	PSU is off or not present.
Diag(Diagnostic)	Flashing Green	System self-diagnostic test in progress. System reloads automatically.
	Steady Amber	System self-diagnostic test has detected a fault.
	Steady Green	System self-diagnostic test completed successfully. Device reboots and turns the LED off.
	Off	Diagnostic is off.
MS LED	Off	Stacking mode is enabled and the switch is a stack member, or the switch is operating in stand-alone mode.

LED	Condition	Status
MS LED	Steady Green	Stacking mode is enabled and the switch is the stack master.
	Steady Amber	Stacking mode is enabled and the switch is in slave mode.
HA LED	Off	System high-availability mode is disabled.
	Steady Green	System is operating in high-availability mode.
	Steady Amber	System is preparing to operate in high-availability mode.
RDNT LED	Off	System does not have redundant fans or PSUs installed.
	Steady Green	System is operating in redundant mode.
	Steady Amber	System has redundant fans and PSUs, but software has disabled redundant mode.

10.6 SX800 and SX1600 Series

Each FastIron device provides network ports, management connectors, and status LED. This section describes the physical ports and the interfaces that provide for Data Input, Data Output, Control Input, and Status Output.

The Brocade FastIron devices provide a range of physical network ports. The family supports both copper and fiber connectors with some models supporting combination ports. Some models support uplink ports for stacking devices. Most models have an out-of-band management port and a console management port (Gigabit Ethernet RJ-45 connector and serial connector, respectively).

Table 29 summarizes the physical ports provided by the SX-FI-ZMR-X, SX-FI-2XGMR-XL, SX-FI-2XGMR-XL-PREM6 and SX-FI-ZMR-PREM6 management modules, and shows the correspondence between the physical interfaces of the management modules and the logical interfaces defined in FIPS 140-2.

Table 29 SX-FI-ZMR-XL, SX-FI-2XGMR-XL, SX-FI-2XGMR-XL-PREM6, and SX-FI-ZMR-PREM6 Port mapping to logical interface

Physical Port	Logical Interface
10/100/1000 Mbps Ethernet Port	Data input/Data output, Status output
Console Port	Control input, Status output
10Ge G3 Port	Data input/Data output, Status output
USB Port	Data input/Data output
Reset	Control input
LED	Status output

Table 30 SX-FI-ZMR-XL, SX-FI-2XGMR-XL, SX-FI-2XGMR-XL-PREM6, and SX-FI-ZMR-PREM6 LED Status

LED	Condition	Status
PWR (Power)	On (Green)	Module is receiving power.
	Off	Module is not receiving power.

LED	Condition	Status
Active	On (Green)	The module is the active management module.
	Off	The module is not the active management module.
MGMT-Link (Right-most Ethernet port LED)	On (Green)	10/100/1000.
	Blinking	The port is transmitting and receiving traffic.
	Off	No port connection exists.
Sync-Link (Left-most Ethernet port LED)	On (Green)	Two management modules are present.
	Blinking	Active and Standby modules are syncing.
	Off	No port connection exists.

Table 31 SX-FISF Switch Fabric LED Status

LED	Condition	Status
PWR	On (Green)	Module is receiving power.
	Off	Module is not receiving power.
Active	On (Green)	The module is functioning properly.
	Off	The module is not functioning properly.

11 Modes of Operation

FCX 624/648 devices, ICX 6610 devices, ICX 6450 devices, ICX 7450 devices, ICX 7750 devices, and SX800/1600 devices (aka Brocade cryptographic modules) have two modes of operation: FIPS Approved mode and non-Approved mode. Section 11.3 describes services and cryptographic algorithms available in FIPS-Approved mode. In non-FIPS Approved mode, the module runs without these FIPS policy rules applied. Section 14.2 FIPS Approved Mode describes how to invoke FIPS Approved mode.

11.1 Module Validation Level

The module meets an overall FIPS 140-2 compliance of Security Level 2 with Design Assurance Level 3.

Table 32 Security Requirements and Levels

Security Requirements Section	Level
Cryptographic Module Specification	2
Cryptographic Module Ports and Interfaces	2
Roles, Services, and Authentication	2
Finite State Model	2
Physical Security	2
Operational Environment	N/A
Cryptographic Key Management	2
Electromagnetic Interference/Electromagnetic Compatibility (EMI/EMC)	2
Self-Tests	2
Design Assurance	3
Mitigation of Other Attacks	N/A

11.2 Roles

In FIPS Approved mode, Brocade cryptographic modules support three roles: Crypto Officer, Port Configuration Administrator, and User:

1. Crypto Officer Role (Super User): The Crypto Officer Role on the device in FIPS Approved mode is equivalent to the administrator role super-user in non-FIPS mode the Crypto Officer Role has complete access to the system. The Crypto Officer is the only role that can perform firmware loading.
2. Port Configuration Administrator Role (Port Configuration): The Port Configuration Administrator Role on the device in FIPS Approved mode is equivalent to the port-config, a port configuration user in non-FIPS Approved mode. Hence, the Port Configuration Administrator Role has read-and-write access for specific ports but not for global (system-wide) parameters.
3. User Role (Read Only): The User Role on the device in FIPS Approved mode has read-only privileges and no configuration mode access (user).
4. MACsec Peer (supported in ICX 6610 only) - A peer device which establishes a MACsec connection with the cryptographic module using AES 128-bit pre-shared key.

The User role has read-only access to the cryptographic module while the Crypto Officer role has access to all device commands. Brocade cryptographic modules do not have a maintenance interface or maintenance role.

Section 12.2 describes the authentication policy for user roles.

11.3 Services

The services available to an operator depend on the operator's role. Unauthenticated operators may view externally visible status LED. LED signals indicate status that allows operators to determine if the network connections are functioning properly. Unauthenticated operators can also perform self-tests via a power-cycle. They can also view the module status via "fips show".

For all other services, an operator must authenticate to the device as described in section 12.2 Authentication.

Brocade cryptographic modules provide services for remote communication (SSHv2, Secure Web Management over TLS v1.0/1.1 and v1.2, SNMPv3 and Console) for management and configuration of cryptographic functions. The following subsections describe services available to operators based on role. Each description includes lists of cryptographic functions and critical security parameters (CSP) associated with the service. Table 33 summarizes the available FIPS Approved cryptographic functions. Table 34 lists cryptographic functions that while not FIPS Approved are allowed in FIPS Approved mode of operation.

Table 33 FIPS Approved Cryptographic Functions

Label	Cryptographic Function
AES	Advanced Encryption Algorithm (CBC, ECB, CTR, CMAC, CFB, GCM, and Key Wrap modes)
SHA	Secure Hash Algorithm
HMAC	Keyed-Hash Message Authentication code
DRBG	Deterministic Random Bit Generator
RSA	Rivest Shamir Adleman Signature Algorithm
CVL	SSHv2, TLS v1.0/1.1 and v1.2 and SNMPv3 Key Derivation Function
TDES	3-key Triple Data Encryption Standard
KBKDF	SP800-108 KDF

Table 34 FIPS Non-Approved Cryptographic Functions Allowed in FIPS Approved Mode

Label	Cryptographic Functions
KW	RSA (key wrapping; key establishment methodology provides 112 bits of encryption strength.)
HMAC-MD5	Message-Digest algorithm (not exposed to the operator: internal to TLS v1.0 KDF, TACACS+ and RADIUS)
NDRNG	Generation of seeds for DRBG
DH KA	Diffie-Hellman (key agreement; key establishment methodology provides 112 bits of encryption strength)

Table 35 Roles, FIPS non-Approved Cryptographic Functions and Protocols only available in non-FIPS Approved Mode

Role	Service / Function	Description
This is not a user accessible service	HTTPS Cipher Suites	Hyper Text Transport Protocol in secure connection mode
Crypto Officer Role, User Role	HTTP	Hyper Text Transport Protocol (plaintext; no cryptography)
Crypto Officer Role, User Role	SSHv2	2-key Triple-DES (non-compliant)
Crypto Officer Role, User Role	SNMP (Simple Network Management Protocol v1, v2 and v3 with MD5 / DES, AES / SHA)	MD5 and DES, AES (non-compliant) / SHA-1 (non-compliant)… SNMPv1, SNMPv2c and SNMPv3 in noAuthNoPriv, authNoPriv modes … Modes – DES in authPriv mode for SNMPV3 … Key sizes: DES 56 bits, AES-128 (non-compliant)
Crypto Officer Role, User Role	TACACS	TACACS (Terminal Access Controller Access Control System) is an authentication protocol which allows a remote access server to forward a user's logon password to an authentication server to determine whether access can be allowed to a given system. … HMAC-MD5
Crypto Officer Role	TFTP (Trivial File Transfer Protocol)	Trivial File Transfer Protocol (TFTP) is a file transfer protocol notable for its simplicity. It is generally used for automated transfer of configuration or boot files between machines in a local environment. Compared to FTP, TFTP is extremely limited, providing no authentication, and is rarely used interactively by a user. … Modes – Not Applicable … Key sizes – Not Applicable (plaintext; no cryptography)
This is not a user accessible service	“Two way encryption”	Base64
This is not a user accessible service	MD5	Message Digest 5 algorithm is used as cryptographic hash function to check for verification of data integrity and wide variety of cryptographic applications … Modes – Not Applicable … Key sizes – Not Applicable (plaintext; no cryptography)

Crypto Officer Role, User Role	Syslog	Syslog is a standard for message logging. It permits separation of the software that generates messages, the system that stores them, and the software that reports and analyzes them. … Modes – Not Applicable …. Key sizes – Not Applicable (plaintext; no cryptography)
Crypto Officer Role, User Role	VSRP	Virtual Switch Redundancy Protocol … Modes – Layer 2 mode … Key sizes – Not Applicable (plaintext; no cryptography)
Crypto Officer Role, User Role	VRRP/VRRP-E	Virtual Router Redundancy Protocol (VRRP) and Virtual Router Redundancy Protocol (VRRP-E) Enhancement … Modes – Layer 3 mode … Key sizes – Not Applicable (plaintext; no cryptography)
Crypto Officer Role, User Role	MSTP	Multiple Spanning Tree Protocol … Modes – Not Applicable … Key sizes – Not Applicable (plaintext; no cryptography)
Crypto Officer Role, User Role	NTP	Network Time Protocol … Modes – MD5 and SHA- 1 (non-compliant) for authentication … Key sizes – 20 bytes
Crypto Officer Role, User Role	BGP	Border Gateway Protocol (BGP) is a standardized exterior gateway protocol. ... Modes – Not Applicable … Key sizes – Not Applicable (plaintext; no cryptography)
This is not a user accessible service	AES-192 (non-compliant)	AES-192 (non-compliant) encryption/decryption is only available in non-FIPS mode
This is not a user accessible service	DSA	DSA (non-compliant) digital signature generation/verification only available in non-FIPS mode

11.4 User Role Services

11.4.1 SSHv2

This service provides a secure session between a Brocade cryptographic module and an SSHv2 client using SSHv2 protocol. Brocade cryptographic modules authenticate an SSHv2 client and provides an encrypted communication channel. An operator may use an SSHv2 session for managing the device via the command line interface.

Brocade cryptographic modules support three kinds of SSHv2 client authentication: password, client public key and keyboard interactive. For password authentication, an operator attempting to establish an SSHv2 session provides a password through the SSHv2 client. The Brocade cryptographic module authenticates operator with passwords stored on the device, on a TACACS+ server, or on a RADIUS server. Section 12.2 Authentication provides authentication details.

The keyboard interactive (KI) authentication goes one step ahead. It allows multiple challenges to be issued by the Brocade cryptographic module, using the backend RADIUS or TACACS+ server, to the SSHv2 client. Only after the SSHv2 client responds correctly to the challenges, will the SSHv2 client get authenticated and proper access is given to the Brocade cryptographic module.

SSHv2 supports Diffie-Hellman (DH) to configure the modulus size on the SSHv2 server for the purpose of key-exchange.

The following encryption algorithms are available for negotiation during the key exchange with an SSHv2 client:
AES-CBC with a 128-bit key (aes128-cbc),
AES-CBC with a 256-bit key (aes256-cbc),
AES-CTR with a 128-bit key (aes128-ctr),
AES-CTR with a 192-bit key (aes192-ctr), and
AES-CTR with a 256-bit key (aes256-ctr),

All secure hashing is done with SHA 256.

The following MAC algorithms are available for negotiation during the key exchange with an SSHv2 client:
(hmac- sha1) HMAC-SHA1 (digest length = key length = 20 bytes)

In User role access, the client is given access to three commands: enable,exit and terminal. The enable command allows user to re-authenticate using a different role. If the role is the same, based on the credentials given during the enable command, the user has access to a small subset of commands that can perform ping traceroute in addition to show commands.

11.4.2 HTTPS

This service provides a graphical user interface for managing a Brocade cryptographic module over a secure communication channel. Using a web browser, an operator connects to a designated management port on a Brocade cryptographic module. The device negotiates a TLS v1.0/1.1 and v1.2 connection with the browser and authenticates the operator. The device uses HTTP over TLS v1.0/1.1 and v1.2 with cipher suites TLS_RSA_WITH_AES_128_CBC_SHA, TLS_RSA_WITH_AES_256_CBC_SHA, TLS_DHE_RSA_WITH_AES_128_CBC_SHA, TLS_DHE_RSA_WITH_AES_256_CBC_SHA, TLS_RSA_WITH_AES_128_CBC_SHA256, TLS_RSA_WITH_AES_256_CBC_SHA256, TLS_DHE_RSA_WITH_AES_128_CBC_SHA256, and TLS_DHE_RSA_WITH_AES_256_CBC_SHA256. Brocade switches have the ability to generate RSA 2048 certificates signed with SHA 256.

In User role, after successful login, the default HTML page is the same for any role. The user can surf to any page after clicking on any URL. However, this user will not be allowed to make any modifications. If the user presses the 'Modify' button within any page, he will be challenged to re-enter his credentials. The challenge dialog box will not be closed without proper access credentials of the Crypto Officer. After default three attempts, the page 'Protected Object' is displayed, in effect disallowing any changes from the web.

11.4.3 SNMP

SNMPv1 and SNMPv2 services are disabled in FIPS mode and the SNMPv3 service with authentication as MD5 and privacy as DES are also disabled. The SNMPv3 service within User role allows read-only access to the SNMP MIB within the FastIron device. The device does not provide SNMP MIB access to CSPs when operating in FIPS Approved mode. All other MIB objects are made available for use in approved FIPS mode. These other MIB objects provide capability to monitor the various functional entities in the module which are non-security relevant.

11.4.4 Console

Console connection occurs via a directly connected RS-232 serial cable. Once authenticated as the User, the module provides console commands to display information about a Brocade cryptographic module and perform basic tasks (such as pings). The User role has read-only privileges and no configuration mode access. The list of commands available are the same as the list mentioned in the SSHv2 service.

11.5 Port Configuration Administrator Role Services

11.5.1 SSHv2

This service is described in Section 11.4.1 above.

The Port Configuration Administrator will have seven commands, which allows this user to run show commands, run ping or trace route. The enable command allows the user to re-authenticate as described in Section 11.4.1. Within the configuration mode, this role provides access to all the port configuration commands, e.g. all sub-commands within “interface eth 1/1” command. This operator can transfer and store firmware images and configuration files between the network and the system, and review the configuration.

11.5.2 HTTPS

This service is described in Section 11.4.2 above.

Like the User role, this user will get to view all the web pages. In addition, this operator will be allowed to modify any configuration that is related to an interface. For example, the Configuration->Port page will allow this operator to make changes to individual port properties within the page.

11.5.3 SNMP

The SNMP service is not available for a Port Configuration Administrator Role Service.

11.5.4 Console

This service is described in Section 11.4.4 above. Console access as the Port Configuration Administrator provides an operator with the same capabilities as User Console commands plus configuration commands associated with a network port on the device. EXEC commands. The list of commands available are the same as those mentioned in the SSHv2 service.

11.6 Crypto Officer Role Services

11.6.1 SSHv2

In addition to the two methods of authentication, password and keyboard interactive, described in Section 11.4.1, SSHv2 service in this role supports RSA public key authentication, in which the device stores a collection of client public keys. Only clients with a private key that corresponds to one of the stored public keys can gain access to the device using SSHv2. After a client's public key is found to match one of the stored public keys, the device will give Crypto Officer access to the entire module.

The Crypto Officer can perform configuration changes to the module (including enabling and disabling MACsec on a per-port basis). This role has full read and write access to the Brocade cryptographic module.

When firmware download is desired, the Crypto Officer shall download firmware download in the primary image and secondary image.

The Crypto Officer can perform zeroization by invoking the firmware command "fips zeroize all" or session termination.

11.6.2 SCP

This is a secure copy service. The service supports both outbound and inbound copies of configuration, binary images, or files. Binary files can be copied and installed similar to TFTP operation (that is, upload from device to host and download from host to device, respectively). SCP automatically uses the authentication methods, encryption algorithm, and MAC algorithm configured for SSHv2. For example, if password authentication is enabled for SSHv2, the user is prompted for a user name and password before SCP allows a file to be transferred. One use of SCP on Brocade cryptographic modules is to copy user digital certificates and host public-private key pairs to the device in support of HTTPS. Other use could be to copy configuration to/from the cryptographic module.

11.6.3 HTTPS

This service is described in section 11.4.2 HTTPS.

In addition to Port Configuration Administrator-role capabilities, the Crypto Officer has complete access to all the web pages and is allowed to make configuration updates through the web pages that support configuration changes.

11.6.4 SNMP

Section 11.4.3, above, describes this service. The SNMP service within Crypto Officer role allows read- write access to only Non-Security Relevant elements of the SNMP MIB within the FastIron device.

11.6.5 Console

Logging in through the CLI service is described in Section 11.4.4 above. Console commands provide an authenticated Crypto Officer complete access to all the commands within the Brocade cryptographic module. This operator can enable, disable and perform status checks. This operator can also enable any service by configuring the corresponding command. For example, to turn on SSHv2 service, the operator creates a pair of RSA host keys, to configure the authentication scheme for SSHv2 access; afterwards the operator may securely import additional pairs of RSA host keys as needed over a secured SSHv2 connection. To enable the Web Management service, the operator would securely import a pair of RSA host keys and a digital certificate using corresponding commands (over a secured SSHv2 connection), and enable the HTTPS server.

NOTICE: The cryptographic module "does not" support DSA key generation in FIPS mode.

11.7 MACsec Peer Role Services (available in ICX 6610 only)

11.7.1 MACsec

Establishes and maintains MACsec sessions with the cryptographic module using AES 128-bit pre-shared keys.

12 Policies

12.1 Security Rules

The Brocade cryptographic module's design corresponds to the cryptographic module's security rules. This section documents the security rules enforced by the cryptographic module to implement the FIPS 140-2 Level 2 security requirements. After configuring a FastIron device to operate in FIPS Approved mode, the Crypto Officer must execute the "fips self-tests" command to validate the integrity of the firmware installed on the device. If an error is detected during the self-test, the error must be corrected prior to rebooting the device.

1) The cryptographic module provides role-based authentication.
2) Until the module is placed in a valid role, the operator does not have access to any Critical Security Parameters (CSP).
3) The cryptographic module performs the following tests:
    a) Power up Self-Tests: [Update as needed with new changes]
        i) Cryptographic Known Answer Tests (KAT):
            (1) Triple-DES KAT (encrypt)
            (2) Triple-DES KAT (decrypt)
            (3) AES-128,192,256-bit key sizes KAT (encrypt) in CBC, ECB, CTR and CFB modes
            (4) AES-128,192,256-bit key sizes KAT (decrypt) in CBC, ECB, CTR and CFB modes
            (5) AES-CMAC KAT (ICX 6610 only)
            (6) AES-KW KAT (ICX 6610 only)
            (7) SHA-1,256,384,512 KAT (Hashing)
            (8) HMAC-SHA-1,256 KAT (Hashing)
            (9) RSA 2048 bit key size KAT (encrypt)
            (10) RSA 2048 bit key size KAT (decrypt)
            (11) RSA 2048 bit key size, SHA-256,384,512 Hash KAT (signature generation)
            (12) RSA 2048 bit key size, SHA-256,384,512 Hash KAT (signature verification)
            (13) DSA 1024 bit key size, SHA-1 KAT (signature generation)
            (14) DSA 1024 bit key size, SHA-1 KAT (signature verification)
            (15) DRBG KAT
            (16) SP800-135 TLS v1.0 KDF KAT
            (17) SP800-135 SSHv2 KDF KAT
            (18) SP800-135 TLS v1.2 KDF KAT
            (19) SP800-135 SNMPv3 KDF KAT
            (20) SP800-108 KBKDF KAT (ICX 6610 only)
            (21) GCM KAT (ICX 6610 only)

ii) Firmware Integrity Test (CRC 32)

iii) If the module does not detect an error during the Power on Self-Test (POST), at the conclusion of the test, the console displays the message shown below.

Crypto module initialization and Known Answer Test (KAT) Passed.

iv) If the module detects an error during the POST, at the conclusion of the test, the console displays the message shown below. After displaying the failure message, the module reboots.

Crypto Module Failed <Reason String>

b) Conditional Self-Tests:

i) Continuous Random Number Generator (RNG) test – performed on NDRNG

ii) Continuous Random Number Generator test – performed on DRBG

iii) RSA 2048 SHA-256 Pairwise Consistency Test (Sign/Verify)

iv) RSA 2048 SHA-256 Pairwise Consistency Test (Encrypt/Decrypt)

v) Firmware Load Test: RSA 2048 bit, SHA-256 Signature Verification

NOTICE: The module supports a pairwise consistency test for RSA key generation.

vi) Alternating Bypass Test (ICX 6610 only)

vii) Manual Key Entry Test: N/A

4) At any time the cryptographic module is in an idle state, the operator can command the module to perform the power-up self-test by executing the "fips self-tests" command.

5) Data output to services defined in Section 11.3 Services is inhibited during key generation, self-tests, zeroization, and error states.

6) Status information does not contain CSPs or sensitive data that if used could compromise the module.

7) The following protocols have not been reviewed or tested by the CAVP nor CMVP:

a) TLS v1.0

b) SSHv2

c) TLS v1.2

d) SNMPv3

12.1.1 FIPS Fatal Cryptographic Module Failure.

When POST is successful, the following messages will be displayed on the console:

Running fips Power on Self tests and Software/Firmware Integrity Test

fips Power on Self tests and Software/Firmware Integrity tests successful

Running continuous DRBG check

Running continuous DRBG check successful

Running Pairwise consistency check

RSA key pair generation succeeded

Pairwise consistency check successful

Crypto module initialization and Known Answer Test (KAT) Passed.

In order to operate a Brocade cryptographic module securely, an operator should be aware of the following rules for FIPS Approved mode of operation:

External communication channels / ports shall not be available before initialization of a Brocade cryptographic module.

Brocade cryptographic modules shall use a FIPS Approved random number generator implementing Algorithm CTR_DRBG based on hash functions.

Brocade cryptographic modules shall ensure the random number seed and seed key input do not have the same value. The devices shall generate seed keys and shall not accept a seed key entered manually.

Brocade cryptographic modules shall use FIPS Approved key generation methods:

1. RSA public and private keys in accordance with [RSA PKCS #1, ANSI X9.31]

Brocade cryptographic modules shall test prime numbers generated for RSA keys using Miller-Rabin test. See [RSA PKCS #1, ANSI X9.31]

Brocade cryptographic modules shall use Approved key establishment techniques:

1. Diffie-Hellman
2. RSA Key Wrapping

Brocade cryptographic modules shall restrict key entry and key generation to authenticated roles.

Brocade cryptographic modules shall not display plaintext secret or private keys. The device shall display "..." in place of plaintext keys.

Brocade cryptographic modules shall use automated methods to realize session keys for SSHv2 and HTTPS.

Brocade cryptographic modules shall only perform "get" operations using SNMP.

12.2 Authentication

Brocade cryptographic modules support role-based authentication. A device can perform authentication and authorization (that is, role selection) using TACACS+, RADIUS and local configuration database. Moreover, Brocade cryptographic modules support multiple authentication methods for each service.

To implement one or more authentication methods for securing access to the device, an operator in the Crypto Officer role configures authentication-method lists that set the order in which a device consults authentication methods. In an authentication-method list, an operator specifies an access method (Console, SSHv2, Web, SNMP) and the order in which the device tries one or more of the following authentication methods:

1. Line password authentication,
2. Enable password authentication,
3. Local user authentication,
4. RADIUS authentication with exec authorization and command authorization, and
5. TACACS+ authentication with exec authorization and command authorization
6. Pre-shared keys

When a list is configured, the device attempts the first method listed to provide authentication. If that method is not available, (for example, the device cannot reach a TACACS+ server) the device tries the next method until a method in the list is available or all methods have been tried.

Brocade cryptographic modules allow multiple concurrent operators through SSHv2 and the console, only limited by the system resources.

12.2.1 Line Authentication Method

The line method uses the Telnet password to authenticate an operator.

To use line authentication, a Crypto Officer must set the Telnet password. Please note that when operating in FIPS mode, Telnet is disabled and Line Authentication is not available.

12.2.2 Enable Authentication Method

The enable method uses a password corresponding to each role to authenticate an operator. An operator must enter the read-only password to select the User role. An operator enters the port-config password to the Port Configuration Administrator role. An operator enters the super-user password to select the Crypto Officer Role.

To use enable authentication, a Crypto Officer must set the password for each privilege level.

12.2.3 Local Authentication Method

The local method uses a password associated with a user name to authenticate an operator. An operator enters a user name and corresponding password. Brocade cryptographic modules assign the role associated with the user name to the operator when authentication is successful.

To use local authentication, a Crypto Officer must define user accounts. The definition includes a user name, password, and privilege level (which determines role).

12.2.4 RADIUS Authentication Method

The RADIUS method uses one or more RADIUS servers to verify user names and passwords. Brocade cryptographic modules prompt an operator for user name and password. The device sends the user name and password to the RADIUS server. Upon successful authentication, the RADIUS server returns the operator's privilege level, which determines the operator's role. If a RADIUS server does not respond, a Brocade cryptographic module will send the user name and password information to the next configured RADIUS server.

Brocade cryptographic modules support additional command authorization with RADIUS authentication. The following events occur when RADIUS command authorization takes place.

1. A user previously authenticated by a RADIUS server enters a command on a Brocade cryptographic module.
2. A Brocade cryptographic module looks at its configuration to see if the command is at a privilege level that requires RADIUS command authorization.
3. If the command belongs to a privilege level that requires authorization, the Brocade cryptographic modules looks at the list of commands returned to it when RADIUS server authenticated the user.

NOTE: After RADIUS authentication takes place, the command list resides on the Brocade cryptographic module. The device does not consult the RADIUS server again once the operator has been authenticated. This means that any changes made to the operator's command list on the RADIUS server are not reflected until the next time the RADIUS server authenticates the operator, and the server sends a new command list to the Brocade cryptographic module.

To use RADIUS authentication, a Crypto Officer must configure RADIUS server settings along with authentication and authorization settings.

12.2.5 TACACS+ Authentication Method

The TACACS+ method uses one or more TACACS+ servers to verify user names and passwords. For TACACS+ authentication, Brocade cryptographic modules prompt an operator for a user name, which the device uses to get a password prompt from the TACACS+ server. The operator enters a password, which the device relays to the server for validation. Upon successful authentication, the TACACS+ server supports both exec and command authorization similar to RADIUS authorization described above.

To use TACACS+ authentication, a Crypto Officer must configure TACACS+ server settings along with authentication and authorization settings.

12.2.6 Pre-shared keys Method

The MACsec Peer role establishes and maintains MACsec sessions using AES 128-bit pre-shared keys that are configured by the Crypto Officer.

12.2.6 Strength of Authentication

Brocade cryptographic modules minimize the likelihood that a random authentication attempt will succeed. The module supports minimum 7 character passwords selected from the following character set: digits (Qty. 10), lowercase (Qty. 26) and uppercase (26) letters, and punctuation marks (18) in passwords. Therefore the probability of a random attempt is 1/ 80^7 which is less than 1/1,000,000.

The module enforces a one second delay for each attempted password verification, therefore maximum of 60 attempts per minute, thus the probability of multiple consecutive attempts within a one minute period is 60/80^7 which is less than 1/100,000.

The probability of a successful random guess of a RADIUS or TACACS+ password during a one-minute period is less than 3 in 1,000,000 as the authentication message needs to go to the server from the switch and then the response needs to come back to the switch.

The probability of a successful random guess of AES 128-bit pre-shared key is 1/ 2^128 for a random attempt and the module only supports a maximum of 60 attempts during a one minute period due to the timing of the protocol which means that the probability of multiple consecutive attempts during a one minute period is 60 / 2^128 which is less than 1/100,000.

Table 36 summarizes the access operators in each role have to critical security parameters. The table entries have the following meanings:

1. r – operator can read the value of the item,
2. w - operator can write a new value for the item,
3. x - operator can use the value of the item without direct access (for example encrypt with an encryption key)
4. d - operator can delete the value of the item (zeroize).

Table 36 Access Control Policy and CSP & Public Key access

		User				Port Configuration Administrator			Crypto Officer				
	Services / CSP & Public Keys	SSHv2	HTTPS	SNMP	Console	SSHv2	HTTPS	Console	SSHv2	SCP	HTTPS	SNMP	Console
1	SSHv2 Host RSA Private Key (2048 bit)	x				x			xwd	x			wd
2	SSHv2 DH Private Key (2048 bit)	x				x			xwd	x			wd
3	SSHv2 DH Shared Secret Key (2048 bit)	x				x			x	x			xd
4	SSHv2/SCP Session Keys (128 and 256 bit AES CBC)	x				x			x	x			xd
5	SSHv2/SCP Authentication Key (HMAC-SHA-1)	x				x			x	x			xd
6	SSHv2 KDF Internal State	x				x			x	x			xd
7	TLS Host RSA Private Key (RSA 2048 bit)		x				x		rwd		x		rwd
8	TLS Pre-Master Secret		x				x				x		xd
9	TLS Master Secret		x				x				x		xd
10	TLS KDF Internal State		x				x		xd		x		xd
11	TLS Session Key		x				x				x		xd
12	TLS Authentication Key		x				x				xd		xd
13	DRBG Seed	x	x			x	x		x	x	x		xd
14	DRBG Value V	x	x			x	x		x	x	x		xd
15	DRBG Key	x	x			x	x		x	x	x		xd
16	DRBG Internal State	x	x			x	x		xd	x	x		xd
17	User Password	x	x	x	x				xrwd	xrwd	xrwd	x	xrwd
18	Port Administrator Password					x	x	x	xrwd	xrwd	rwd		xrwd
19	Crypto Officer Password								xrwd	xrwd	xrwd		xrwd
20	RADIUS Secret	x	x		x	x	x	x	xrwd	xrwd	xrwd		xrwd
21	TACACS+ Secret	x	x		x	x	x	x	xrwd	xrwd	xrwd		xrwd
22	Firmware Integrity / Firmware Load RSA Public Key								x		x		xd
23	SSHv2 Host RSA Public key	x				x			xrwd	xrw			rwd
24	SSHv2 Client RSA Public Key	x				x			xrwd	xrwd			xrwd
25	SSHv2 DH Public Key	x				x			x	x			xd

		User				Port Configuration Administrator			Crypto Officer				
	Services / CSP & Public Keys	SSHv2	HTTPS	SNMP	Console	SSHv2	HTTPS	Console	SSHv2	SCP	HTTPS	SNMP	Console
26	SSHv2 DH Peer Public Key	x				x			x	x			xd
27	TLS Host Public Key (RSA 2048 bit)		x				x		rwd		x		rwd
28	TLS Peer Public Key (RSA 2048 bit)		x				x		rwd		x		rwd
29	CAK (ICX 6610 only)								rwd	rwd			rwd
30	CKN (ICX 6610 only)								rwd	rwd			rwd
31	ICK (ICX 6610 only)								d				d
32	KEK (ICX 6610 only)								d				d
33	SAK (ICX 6610 only)								dx				dx
34	SP800-108 KDF Internal State (ICX 6610 only)								rwd				rwd

Table 36B Access Control Policy and CSP access for MACsec Peer role (ICX 6610 only)

		MACsec Peer
	CSP	MACsec Service
1	CAK	xd
2	CKN	xd
3	ICK	xd
4	KEK	xd
5	SAK	rwdx
6	SP800-108 KDF Internal State	xd

13 Physical Security

In order for a FCX 624/648 device, ICX 6610 device, ICX 6450 device, ICX 7450 device, ICX 7750 device or SX 800/1600 device to meet FIPS 140-2 Level 2 Physical Security requirements the Crypto Officer must install tamper evident seals. Tamper evident seals are available for order from Brocade under FIPS Kit (Part Number: XBR-000195). The Crypto Officer shall follow the Brocade FIPS Security Seal application procedures defined in Appendix A of this document prior to operating the module in FIPS mode.

The Crypto Officer is responsible for storing and controlling the inventory of any unused seals. The unused seals shall be stored in plastic bags in a cool, dry environment between 60° and 70° F (15° to 20° C) and less than 50% relative humidity. Rolls should be stored flat on a slit edge or suspended by the core

The Crypto Officer shall maintain a serial number inventory of all used and unused tamper evident seals. The Crypto Officer shall periodically monitor the state of all applied seals for evidence of tampering. A seal serial number mismatch, a seal placement change, a checkerboard destruct pattern that appears in peeled film and adhesive residue on the substrate are evidence of tampering. The security officer shall periodically view each applied seal under a UV light to verify the presence of a UV wallpaper pattern. The lack of a wallpaper pattern is evidence of tampering, and in such circumstance where tampering is suspected, the Crypto Officer shall assume that the cryptographic module is compromised and shall be required to remove the cryptographic module from service immediately and permanently. The Crypto Officer is responsible for returning a module to a FIPS approved state after any intentional or unintentional reconfiguration of the physical security measures.

Please refer to Appendix A of this Security Policy document for specific tamper evident seal application instructions.

14 Mode Status

Brocade cryptographic modules provide the `fips show` command to display status information about the device's FIPS mode. This information includes the status of administrative commands for security policy, the status of security policy enforcement, and security policy settings. The fips enable command changes the status of administrative commands; see also section 14.1 FIPS Approved Mode.

The following example shows the output of the fips show command before an operator enters a fips enable command. Administrative commands for security policy are unavailable (administrative status is off) and the device is not enforcing a security policy (operational status is off).

FIPS mode: Administrative Status: OFF, Operational Status: OFF

The following example shows the output of the fips show command after an operator enters the fips enable command. Administrative commands for security policy are available (administrative status is on) but the device is not enforcing a security policy yet (operational status is off). The command displays the security policy settings.

1. FIPS mode: Administrative Status: ON, Operational Status: OFF
    a. Some shared secrets inherited from non-Approved mode may not be fips compliant and has to be zeroized. The system needs to be reloaded to operate in FIPS mode.
2. System Specific:
    a. OS monitor mode access: Disabled
3. Management Protocol Specific:
    a. Telnet server: Disabled
    b. TFTP Client: Disabled
    c. HTTPS SSL 3.0: Disabled
    d. SNMP Access to security objects: Disabled
4. Critical Security Parameter Updates across FIPS Boundary:

a. Protocol shared secret and host passwords: Clear

b. SSHv2 RSA Host Keys: Clear

c. HTTPS RSA Host Keys and Signature: Clear

The following example shows the output of the fips show command after the device reloads successfully in the default strict FIPS mode. Administrative commands for security policy are available (administrative status is on) and the device is enforcing a security policy (operational status is on). The command displays the policy settings.

1. FIPS mode: Administrative Status: ON, Operational Status: ON
2. System Specific:
    a. OS monitor mode access: Disabled
3. Management Protocol Specific:
    a. Telnet server: Disabled
    b. TFTP Client: Disabled
    c. HTTPS SSL 3.0: Disabled
    d. SNMP Access to security objects: Disabled
4. Critical Security Parameter Updates across FIPS Boundary:
    a. Protocol shared secret and host passwords: Clear
    b. SSHv2 RSA Host Keys: Clear
    c. HTTPS RSA Host Keys and Signature: Clear

14.1 FIPS Approved Mode

This section describes FIPS Approved mode of operation and the sequence of actions that place a Brocade cryptographic module in FIPS Approved mode. The first action is to apply tamper evident seals to the chassis at the locations specified in the Appendix A of this document.

FIPS Approved mode disables the following:

1. Telnet access including the *telnet server* command
2. Command *ip ssh scp disable*
3. TFTP access
4. SNMP access to CSP MIB objects
5. Access to all commands within the monitor mode
6. HTTP access including the web-management http command
7. Port 280
8. HTTPS SSL 3.0 access Command web-management allow-no-password

Entering FIPS Approved mode also clears:

1. Protocol shared secret and host passwords
2. SSHv2 RSA host keys
3. HTTPS RSA host keys and certificate

FIPS Approved mode enables:

1. SCP
2. HTTPS TLS v1.0/1.1 and v1.2

Table 37a Algorithm Certificates for the FCX624/648 Devices

Algorithm	Supports	Certificate
Advanced Encryption Algorithm (AES) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	ECB, CBC (128, 192, 256 bits); CTR (int only; 128, 192, 256 bits); CFB (128 bits) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	#2697, #3139 NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.
Triple Data Encryption Algorithm (Triple-DES)	KO 1,2 ECB and CBC mode	#1617
Secure Hash Algorithm (SHA)	SHA-1, SHA-256, SHA-384, and SHA-512	#2265
Keyed-Hash Message Authentication code (HMAC)	HMAC SHA-1, HMAC SHA-256	#1679
Deterministic Random Bit Generator (DRBG)	SP800-90A CTR_DRBG; Hash_Based DRBG	#442
Digital Signature Algorithm (DSA) NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	1024-bit keys NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	#819 NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.
Rivest Shamir Adleman Signature Algorithm (RSA) NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	1024-bit and 2048-bit keys NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	#1396 NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.
Component Test Key Derivation Function (CVL)	TLS v1.0/1.1 and v1.2, SSHv2 and SNMP	#161, 386, 388

Table 37b Algorithm Certificates for the ICX 6610 Devices

Algorithm	Supports	Certificate
Advanced Encryption Algorithm (AES) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	ECB, CBC (128, 192, 256 bits); CTR (int only; 128, 192, 256 bits); CFB (128 bits) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	#2697, #3139 NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.
Triple Data Encryption Algorithm (Triple-DES)	KO 1,2 ECB and CBC mode	#1617
Secure Hash Algorithm (SHA)	SHA-1, SHA-256, SHA-384, and SHA-512	#2265
Keyed-Hash Message Authentication code (HMAC)	HMAC SHA-1, HMAC SHA-256	#1679
Deterministic Random Bit Generator (DRBG)	SP800-90A CTR_DRBG; Hash_Based DRBG	#442
Digital Signature Algorithm (DSA) NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	1024-bit keys NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	#819 NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.
Rivest Shamir Adleman Signature Algorithm (RSA) NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	1024-bit and 2048-bit keys NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	#1396 NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.
Component Test Key Derivation Function (CVL)	TLS v1.0/1.1 and v1.2, SSHv2 and SNMP	#161, 386, 388
AES-CMAC	AES-CMAC	#3008
SP800-108 KDF	KBKDF	#36
AES Key Wrap	AES-KW	#2984
AES GCM	GCM	#1276
AES	ECB (128 bits)	#1197

Table 38 Algorithm Certificates for the SX800/1600 Devices

Algorithm	Supports	Certificate
Advanced Encryption Algorithm (AES) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	ECB, CBC (128, 192, 256 bits); CTR (int only; 128, 192, 256 bits); CFB (128 bits) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	#2688, #3141 NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.
Triple Data Encryption Algorithm (Triple-DES)	KO 1,2 ECB and CBC mode	#1614
Secure Hash Algorithm (SHA)	SHA-1, SHA-256, SHA-384, and SHA-512 NOTICE: SHA -224 listed on Cert#2259 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	#2259
Keyed-Hash Message Authentication Code (HMAC)	HMAC SHA-1, HMAC SHA-256	#1675
Deterministic Random Bit Generator (DRBG)	SP800-90A CTR_DRBG; Hash_Based DRBG	#438
Digital Signature Algorithm (DSA) NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	1024-bit keys NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	#817 NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.
Rivest Shamir Adleman Signature Algorithm (RSA) NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	1024-bit and 2048-bit keys NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	#1388 NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.
Component Test Key Derivation Function (CVL)	TLS v1.0/1.1 and v1.2, SSHv2 and SNMP	#156, #392, #398

Table 39 Algorithm Certificates for ICX 6450 Devices

Algorithm	Supports	Certificate
Advanced Encryption Algorithm (AES) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	ECB, CBC (128, 192, 256 bits); CTR (int only; 128, 192, 256 bits); CFB (128 bits) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	#2690, #3133 NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.
Triple Data Encryption Algorithm (Triple-DES)	KO 1,2 ECB and CBC mode	#1615
Secure Hash Algorithm (SHA)	SHA-1, SHA-256, SHA-384, and SHA-512	#2260
Keyed-Hash Message Authentication code (HMAC)	HMAC SHA-1, HMAC SHA-256	#1676
Deterministic Random Bit Generator (DRBG)	SP800-90A CTR_DRBG; Hash_Based DRBG	#439
Digital Signature Algorithm (DSA) NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	1024-bit keys NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	#818 NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation
Rivest Shamir Adleman Signature Algorithm (RSA) NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	1024 and 2048-bit Keys NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	#1391 NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.
Component Test Key Derivation Function (CVL)	TLS v1.0/1.1 and v1.2, SSHv2 and SNMP	#159, #387, #389

Table 40 Algorithm Certificates for the ICX 7450 Devices

Algorithm	Supports	Certificate
Advanced Encryption Algorithm (AES) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	ECB, CBC (128, 192, 256 bits); CTR (int only; 128, 192, 256 bits); CFB (128 bits) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	#2981, #3142 NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.
Triple Data Encryption Algorithm (Triple-DES)	KO 1,2 ECB and CBC mode	#1764
Secure Hash Algorithm (SHA)	SHA-1, SHA-256, SHA-384, and SHA-512	#2505
Keyed-Hash Message Authentication code (HMAC)	HMAC SHA-1, HMAC SHA-256	#1890
Deterministic Random Bit Generator(DRBG)	SP800-90A CTR_DRBG; Hash_Based DRBG	#569
Digital Signature Algorithm (DSA) NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	1024-bit keys NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	#887 NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation
Rivest Shamir Adleman Signature (RSA) NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approve mode of operation.	1024 and 2048-bit keys NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approve mode of operation.	#1565 NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approve mode of operation.
Component Test Key Derivation Function (CVL)	TLS v1.0/1.1 and v1/2, SSHv2 and SNMP	#362, 390, 400

Table 41 Algorithm Certificates for the ICX 7750 Devices

Algorithm	Supports	Certificate
Advanced Encryption Algorithm (AES) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	ECB, CBC (128, 192, 256 bits); CTR (int only; 128, 192, 256 bits); CFB (128 bits) NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.	#2687, #3140 NOTICE: AES 192 is latent functionality that "IS NOT" available within any service in the Approved mode of operation.
Triple Data Encryption Algorithm (Triple-DES)	KO 1,2 ECB and CBC mode	#1613
Secure Hash Algorithm (SHA)	SHA-1, SHA-256, SHA-384, and SHA-512	#2258
Keyed-Hash Message Authentication code (HMAC)	HMAC SHA-1, HMAC SHA-256	#1674
Deterministic Random Bit Generator (DRBG)	SP800-90A CTR_DRBG; Hash_Based DRBG	#437
Digital Signature Algorithm (DSA) NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	1024-bit keys NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.	#816 NOTICE: Latent functionality "IS NOT" available within any service in the Approved mode of operation.
Rivest Shamir Adleman Signature Algorithm (RSA) NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	1024-bit and 2048-bit keys NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.	#1387 NOTICE: RSA 1024 and any signature using SHA-1 is latent functionality and "IS NOT" available within any service in the Approved mode of operation.
Component Test Key Derivation Function (CVL)	TLS v1.0/1.1 and v1.2, SSHv2 and SNMP	#155, #391, #399

Users should reference the transition tables that will be available at the CMVP Web site (http://csrc.nist.gov/groups/STM/cmvp/). The data in the tables will inform users of the risks associated with using a particular algorithm and a given key length.

The following non-Approved but allowed cryptographic methods are allowed within limited scope in the FIPS Approved mode of operation:

1) RSA key transport (key wrapping; key establishment methodology provides 112 bits of encryption strength)
2)HMAC-MD5 (non-compliant)
3) NDRNG (non-compliant)
4) Diffie Hellman (key agreement; key establishment provides 112 bits of encryption strength)

The following non-Approved and not allowed cryptographic methods are not allowed within limited scope in the FIPS Approved mode of operation:

1) DES

2) Base64

14.2 Invoke FIPS Approved Mode

To invoke the FIPS Approved mode of operation, perform the following steps:

1. Assume Crypto Officer role.
2. Enter command: *fips enable*

The device enables FIPS administrative commands. The device is not in FIPS Approved Mode of operation yet. Do not change the default strict FIPS security policy, which is required for FIPS Approved mode.

3. Enter command: *fips zeroize all*

The device zeros out the shared secrets used by various networking protocols including host access passwords, SSHv2 host keys, and HTTPS host keys with the digital signature.

4. Enter command *no web-management hp-top-tools* in order to turn off access by HP ProCurve Manager via port 280.

5. Save the running configuration: *write memory*.

6. The device saves the running configuration as the startup configuration.

7. Reload the device (Notice: Do not press B as the module is reloading). *Reload*

   The device resets and begins operation in FIPS Approved mode.

8. Enter command: *fips show* (This device displays the FIPS-related status, which should confirm the security policy is the default security policy.)

9. Inspect the physical security of the module, including placement of tamper evident labels according to Appendix A.

15 Glossary

Term/Acronym	Description
AES	Advanced Encryption Standard
CBC	Cipher-Block Chaining
CLI	Command Line Interface
CSP	Critical Security Parameter
DES	Data Encryption Standard
DH	Diffie-Hellman
DRBG	Deterministic Random Bit Generator
DSA	Digital Signature Algorithm
ECB	Electronic Codebook mode
FI	FastIron
GbE	Gigabit Ethernet
GCM	Galois/Counter Mode symmetric key cryptographic
GMAC	Galois Message Authentication Code (GMAC): an authentication-only variant of the GCM
HMAC	Keyed-Hash Message Authentication Code
KDF	Key Derivation Function
LED	Light-Emitting Diode
LP	Line Processor
MACsec	MAC Security standard
Mbps	Megabits per second
MP	Management Processor
NDRNG	Non-Deterministic Random Number Generator
NI	NetIron
OC	Optical Carrier
POE	Power over Ethernet
POE+	High Power over Ethernet
RADIUS	Remote Authentication Dial in User Service
RSA	Rivest Shamir Adleman
SCP	Secure Copy
SFM	Switch Fabric Module
SHA	Secure Hash Algorithm
SNMP	Simple Network Management Protocol
SSHv2	Secure Shell
TACACS+	Terminal Access Control Access-Control System
TDEA	Triple-DES Encryption Algorithm
TFTP	Trivial File Transfer Protocol
TLS	Transport Layer Security

16 References

[FIPS 186-2+] Federal Information Processing Standards Publication 186-2 (+Change Notice), Digital Signature Standard (DSS), 27 January 2000

[RSA PKCS #1] PKCS #1: RSA Cryptography Specifications Version 2.1

[SP800-90A] National Institute of Standards and Technology Special Publication 800-90A, Recommendation for Random Number Generation Using Deterministic Random Bit Generators (Revised), March 2007

[ANSI X9.31] ANSI X9.31:1998 Digital Signatures Using Reversible Public Key Cryptography for the Financial Services Industry

Appendix A: Tamper Label Application

The FIPS Kit (Part Number: XBR-000195) contains the following items:

1. Tamper Evident Security Seals
    a. Count 120
    b. Checkerboard destruct pattern with ultraviolet visible “Secure” image

Use 99% isopropyl or ethyl alcohols to clean the surface area at each tamper evident seal placement location. Cleaning alcohol is not provided in the kit. However, cleaning alcohol is readily available for purchase from a chemical supply company. Prior to applying a new seal to an area, that shows seal residue, use consumer strength adhesive remove to remove the seal residue. Then use additional alcohol to clean off any residual adhesive remover before applying a new seal.

The Cryptographic Officer is responsible for securing and having control of any unused seals at all times.

ICX 6610-24F Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 6610-24F devices. Each device requires the placement of eighteen (18) seals:

- **Front:** Affix one (1) seal over the console port on the left side of the front panel. The seal should be centered on port and adhere to the front panel above and below the port. See Figure 18 and Figure 19 for correct seal orientation and positioning.

- **Top**: Affix five seals between the top of the front panel and the top removable metal cover of the device. Apply each seal flat over the seam between the top cover and front panel so that part of the seal is on the metal cover and other part is affixed to the front panel as shown. See Figure 19 for correct seal orientation and positioning.

- **Right and left sides**: Affix two seals to each side of the device. Place the seals in a 90 degree bend, so that part of the seal is affixed to the side of the device and the other part is affixed to the removable top cover as shown. The orientation and placement of seals on the left side of the device mirrors the orientation and placement of seals on the right side of the device. Refer to Figure 19 for correct seal orientation and positioning on the side of the device.

Figure 18 Front view of a Brocade ICX 6610-24F device with security seals

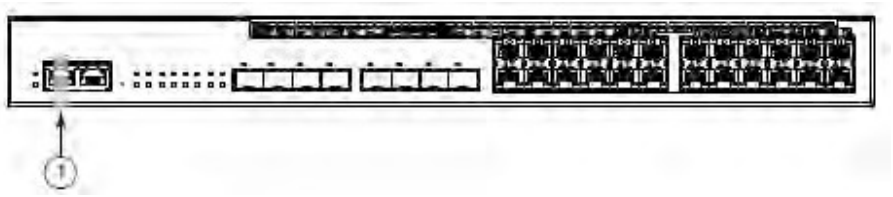
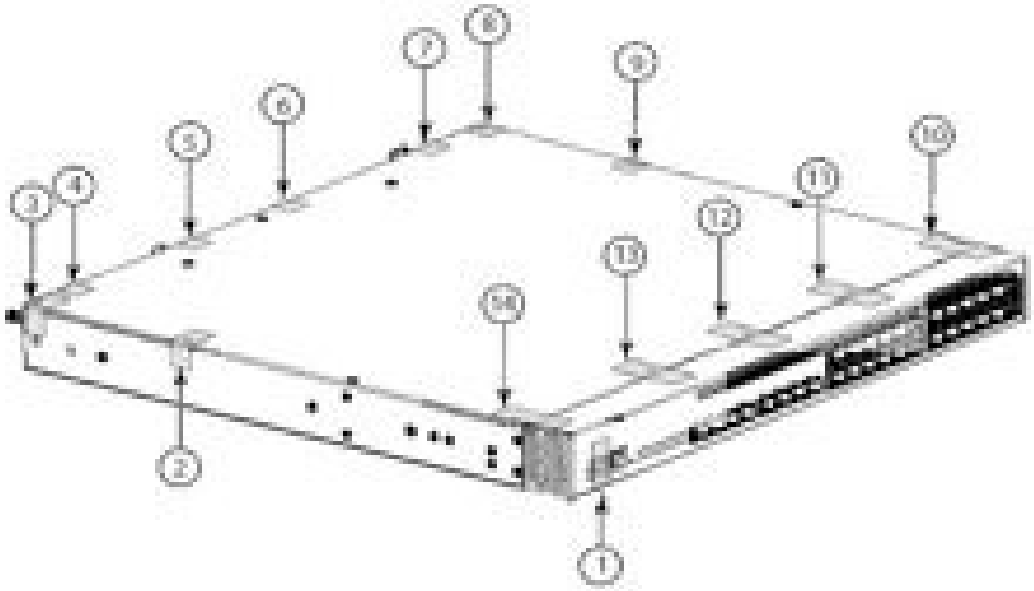


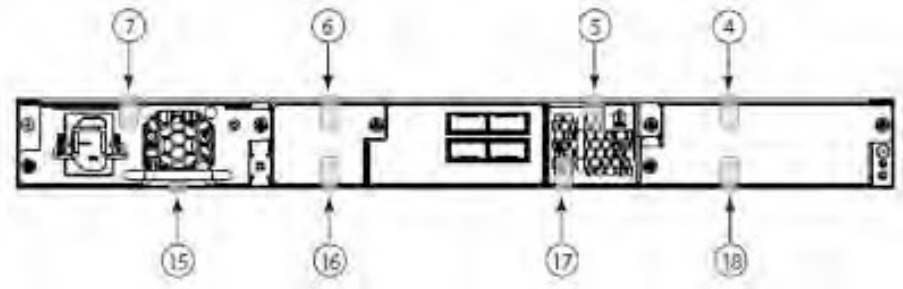
Figure 19 Top, front, and left side view of a Brocade ICX 6610-24F device with security seals



- **Rear**: Affix eight seals to the backside of the device. Place four seals between the top removable cover and the rear panel and 4 between the bottom of the chassis and the rear panel. Place the seals in a 90 degree bend, so that part of the seal is affixed to the rear panel of the device and the other part is affixed to the top cover or chassis bottom. Refer to Figure 20 for correct seal orientation and positioning.

Note the placement of the seal (15) below the power supply handle.

Figure 20 Rear view of a Brocade ICX 6610-24F device with security seals



ICX 6610-24 and ICX 6610-24P Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 6610-24 and ICX 6610-24P devices. Each device requires the placement of eighteen (18) seals:

- **Front:** Affix one seal (1) over the console port on the left side of the front panel. The seal should be centered on port and adhere to the front panel above and below the port. See Figure 21 and Figure 22 for correct seal orientation and positioning.
- **Top:** Affix five seals between the top of the front panel and the top removable metal cover of the device. Apply each seal flat over the seam between the top cover and front panel so that part of the seal is on the metal cover and other part is affixed to the front panel as shown. See Figure 22 for correct seal orientation and positioning.
- **Right and left sides:** Affix two seals to each side of the device. Place the seals in a 90 degree bend, so that part of the seal is affixed to the side of the device and the other part is affixed to the removable top cover as shown. The orientation and placement of seals on the left side of the device mirrors the orientation and placement of seals on the right side of the device. Refer to Figure 22 for correct seal orientation and positioning on the side of the device.

Figure 21 Front view of Brocade ICX 6610-24 and ICX 6610-24P devices with security seals

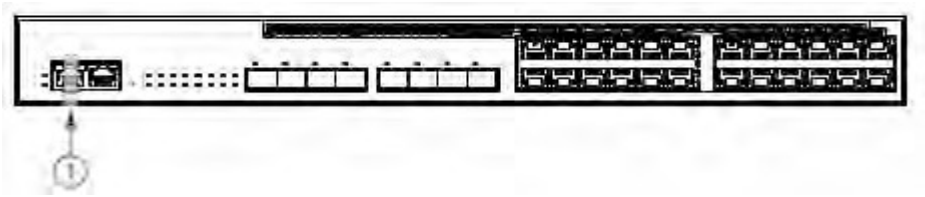
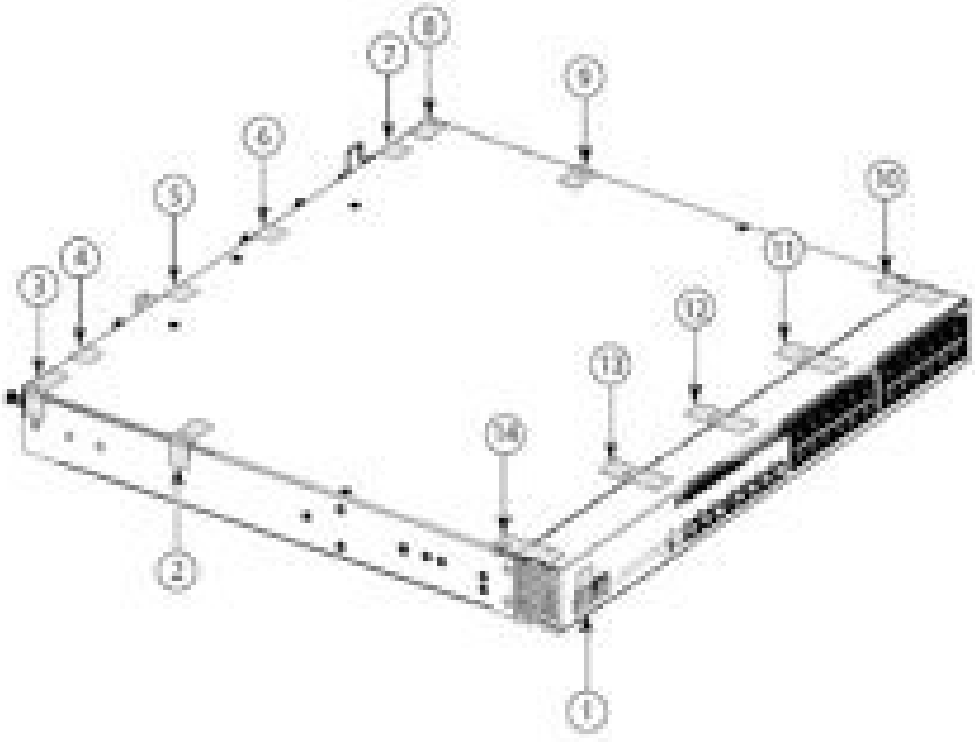


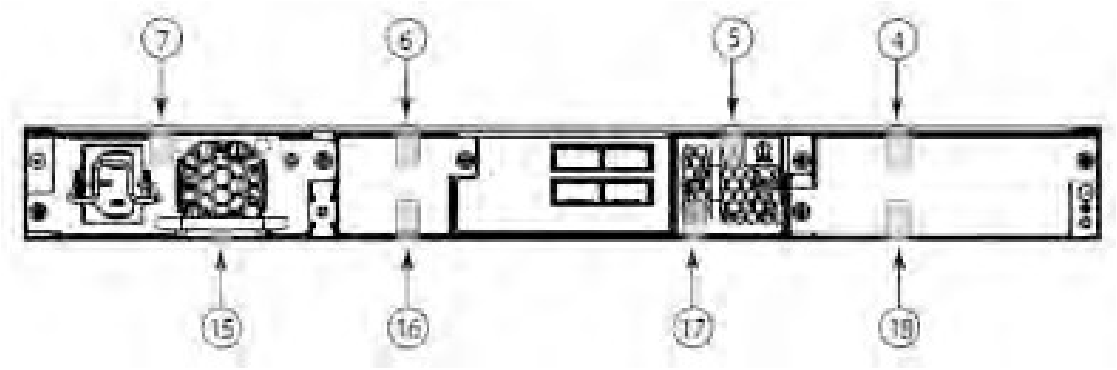
Figure 22 Front, top, and left side view of Brocade ICX 6610-24 and ICX 6610-24P devices with security seals



- **Rear:** Affix eight seals to the rear of the device. Place four seals between the top removable cover and the rear panel and four between the bottom of the chassis and the rear panel. Place the seals in a 90-degree bend, so that part of the seal is affixed to the rear panel of the device and the other part is affixed to the top cover or chassis bottom as shown. Refer to Figure 23 for correct seal orientation and positioning.

Note the placement of the seal (15) below the power supply handle.

Figure 23 Rear view of Brocade ICX 6610-24 and ICX 6610-24P devices with security seals

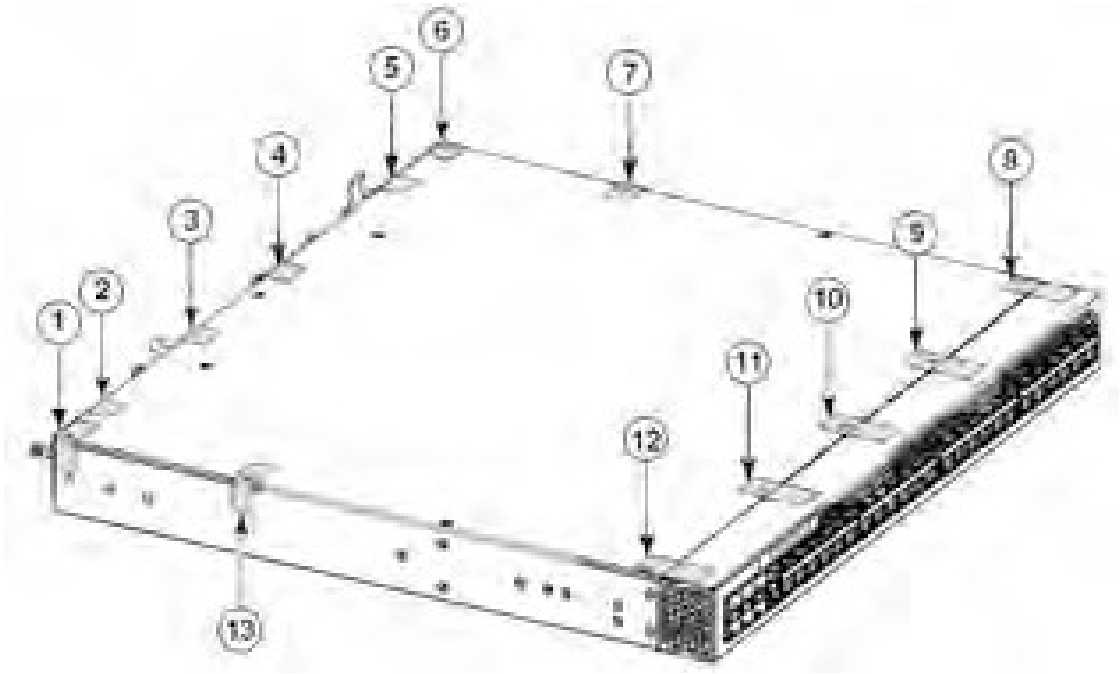


ICX 6610-48 and ICX 6610-48P Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 6610-48 and ICX 6610-48P devices. Each device requires the placement of eighteen (18) seals.

- **Top:** Affix five seals between the top of the front panel and the top removable metal cover of the device. Apply each seal flat over the seam between the top cover and front panel so that part of the seal is on the metal cover and other part is affixed to the front panel as shown. See Figure 24 for correct seal orientation and positioning.
- **Right and left sides:** Affix two seals to each side of the device. Place the seals in a 90-degree bend, so that part of the seal is affixed to the side of the device and the other part is affixed to the removable top cover as shown. The orientation and placement of seals on the left side of the device mirrors the orientation and placement of seals on the right side of the device. Refer to Figure 24 for correct seal orientation and positioning on the side of the device.

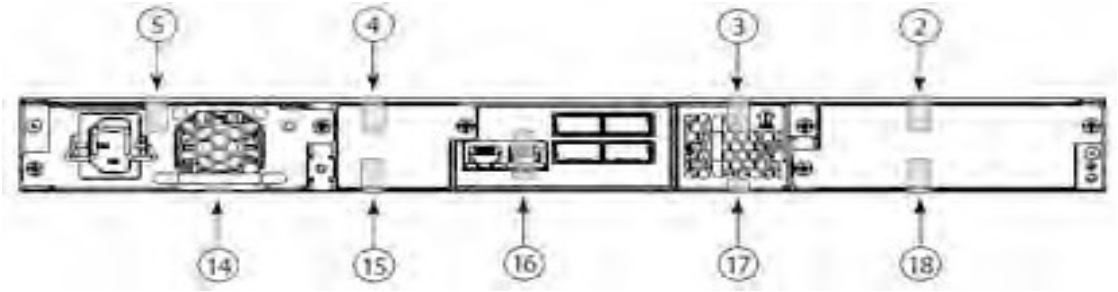
Figure 24 Front, top, and left side view of Brocade ICX 6610-48 and ICX 6610-48P devices with security seals



- **Rear:** Affix nine seals to the rear of the device. Place four seals between the top removable cover and the rear panel and four between the bottom of the chassis and the rear panel. Place the seals in a 90-degree bend, so that part of the seal is affixed to the rear panel of the device and the other part is affixed to the top cover or chassis bottom. Affix one seal (16) so that it covers the console port in the center of the rear panel and is oriented vertically. The seal should be centered on port and adhere to the rear panel above and below the port. Refer to Figure 25 for correct seal orientation and positioning.

Note the placement of the seal (14) below the power supply handle.

Figure 25 Rear view of Brocade ICX 6610-48 and ICX 6610-48P devices with security seals



FCX 624S-F-ADV, Brocade FCX 624S and Brocade FCX 624S-HPOE-ADV devices

Use the figures in this section as a guide for security seal placement on the following Brocade FastIron devices:

- Brocade FCX 624S-F-ADV
- Brocade FCX 624S
- Brocade FCX 624S-HPOE-ADV

Note: The following SKUs are physically equivalent to the FCX 624S, FCX 624S-F, and the FCX 648S:
FCX 624S-HPOE-ADV
FCX 624S-F-ADV
FCX 648S-HPOE
FCX 648S-HPOE-ADV

The connectors on the faceplates of your particular device might vary from the connectors shown on the figures, but the placement of the seals will be the same. Figure 26 and Figure 27 display a Brocade FCX 624S with seals as a model for the seal placement on the Brocade FCX 624S-F-ADV, FCX 624S and FCX 624S-HPOE-ADV. Each of these devices requires the placement of Fourteen (14) seals:

- **Top:** Affix 4 total seals to the top panel of the device. Affix two seals so that they cover the left and right front most screws on the top panel of the device. Affix two seals so that they cover the two screws adjacent to the front most screws on the top panel. See Figure 26 for correct seal orientation and positioning.
- **Right and left sides**: Affix 4 total seals to the left and right sides of the device--two seals on the right side and two seals on the left side. Each seal should cover two holes on either side of the first vent section. See Figure 26 for correct seal orientation and positioning on the right side of the device. The orientation and placement of seals on the left side mirrors the orientation and placement of seals on the right side of the device (visible in Figure 26).
- **Front:** Affix one seal horizontally aligned with half affixed to the front panel and half affixed to the bottom panel. You must bend this seal to place it correctly. See Figure 26 for correct seal orientation and positioning. Affix one seal over the console port covering it and adhering it on the left side. See Figure 26 for correct seal orientation and positioning.
    - **Rear:** Affix 4 total seals to the rear panel of the device. Affix one seal from the rear panel to the bottom panel and three seals from the rear panel to the top panel. You must bend these seals to place them correctly. See Figure 27 for correct seal orientation and positioning.

Figure 26 Front, top, and right side views of a Brocade FCX624S-F-ADV, FCX 624S and FCX 624S-HPOE-ADV device with security seals

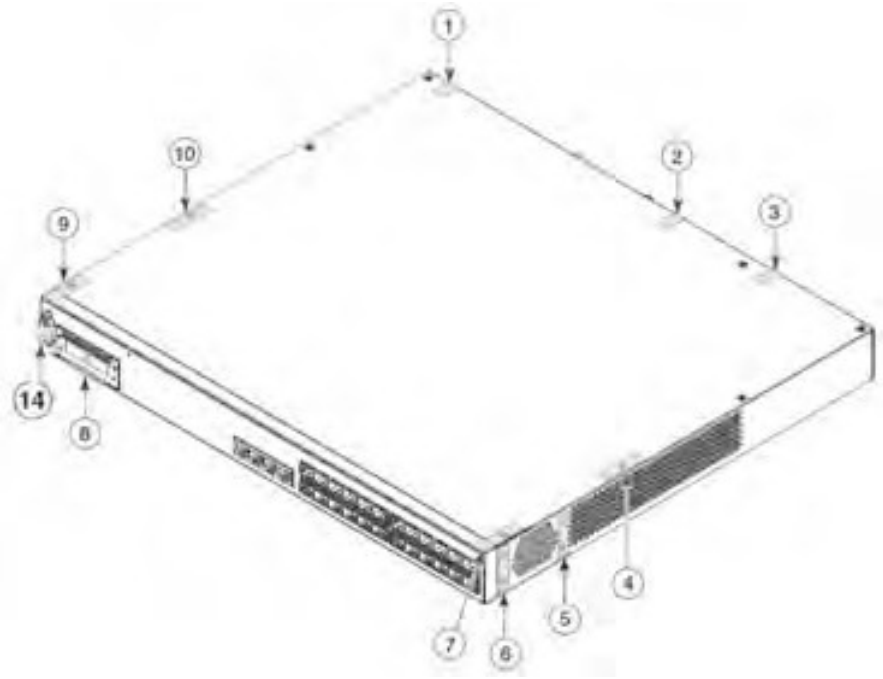
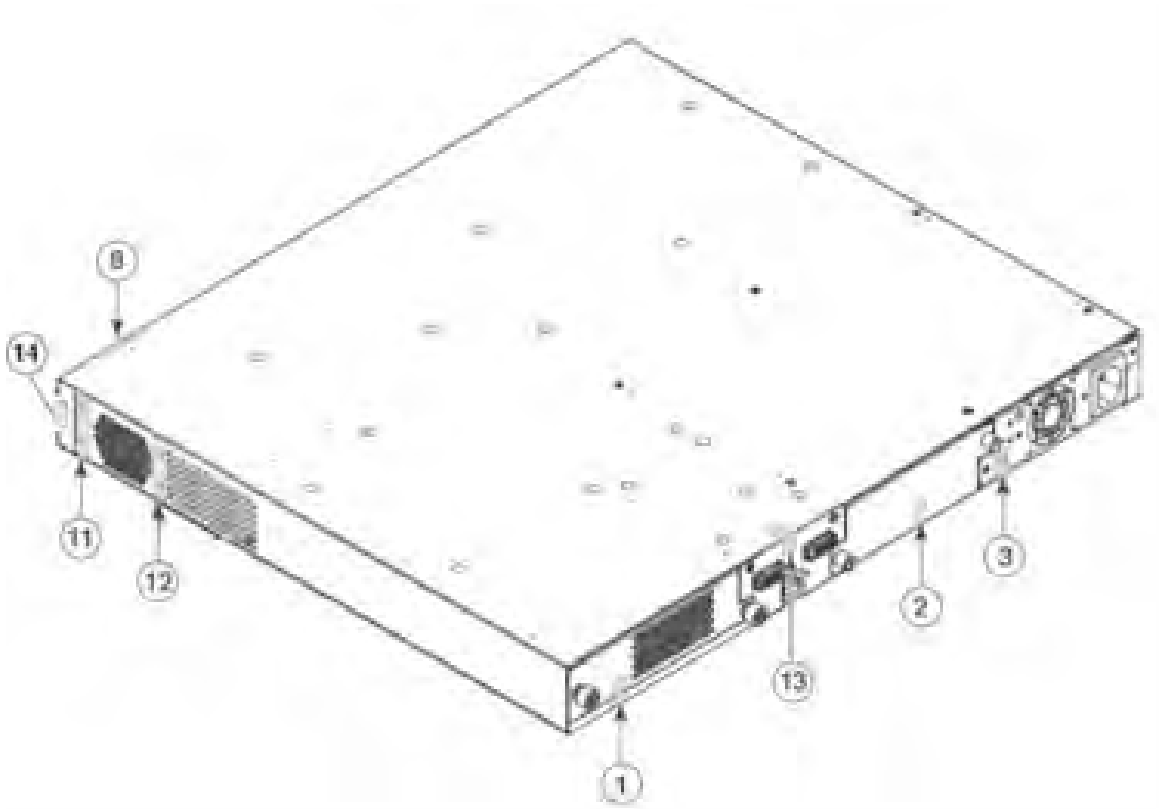


Figure 27 Rear, bottom, and left side views of a Brocade FCX624S-F-ADV, FCX 624S and FCX 624S-HPOE-ADV device with security seals



FCX 648S, FCX 648S-HPOE and FCX 648S-HPOE-ADV devices

Use the figures in this section as a guide for security seal placement on the following Brocade FastIron devices:

- Brocade FCX 648S
- Brocade FCX 648S-HPOE
- Brocade FCX 648S-HPOE-ADV

Figure 28 and Figure 29 display a Brocade FCX 648S with seals as a model for the seal placement on the Brocade FCX 648S, FCX 648S-HPOE and FCX 648S-HPOE-ADV. Each of these devices requires the placement of fourteen (14) seals:

- **Top:** Affix 4 total seals to the top panel of the device. Affix two seals so that they cover the left and right front most screws on the top panel of the device. Affix two seals so that they cover the two screws adjacent to the front most screws on the top panel. See Figure 28 for correct seal orientation and positioning.
- **Right and left sides:** Affix 4 total seals to the left and right sides of the device--two seals on the right side and two seals on the left side. Each seal should cover two holes on either side of the first vent section. See Figure 28 for correct seal orientation and positioning on the right side of the device. The orientation and placement of seals on the left side mirrors the orientation and placement of seals on the right side of the device (visible in Figure 28).
- **Front:** Affix one seal horizontally aligned with half affixed to the front panel and half affixed to the bottom panel. You must bend this seal to place it correctly. See Figure 28 for correct seal orientation

and positioning.

- **Rear:** Affix 4 total seals to the rear panel of the device. Affix one seal from the rear panel to the bottom panel and three seals from the rear panel to the top panel. You must bend these seals to place them correctly. See Figure 29 for correct seal orientation and positioning.

Figure 28 Front, top and right side views of a Brocade FCX 648S, FCX 648S-HPOE and FCX 648S-HPOE-ADV device with security seals

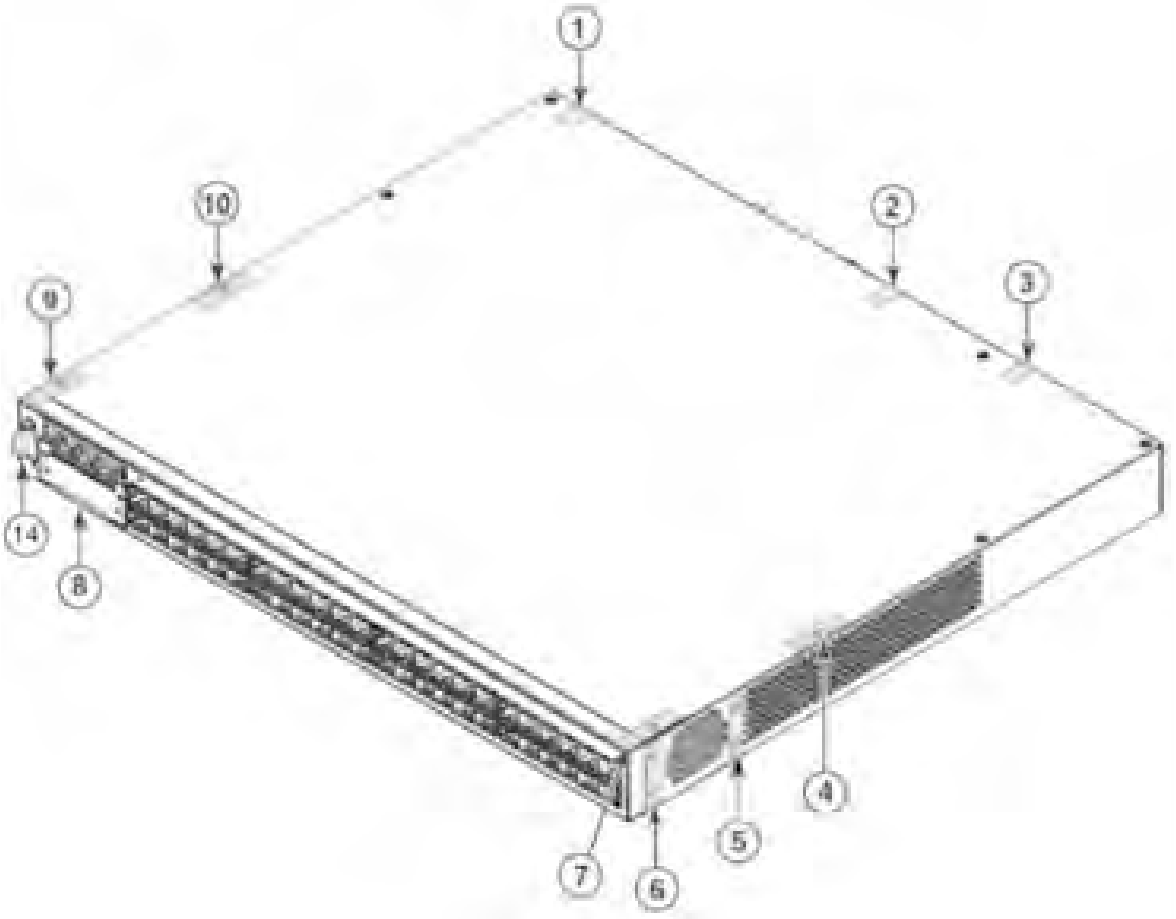
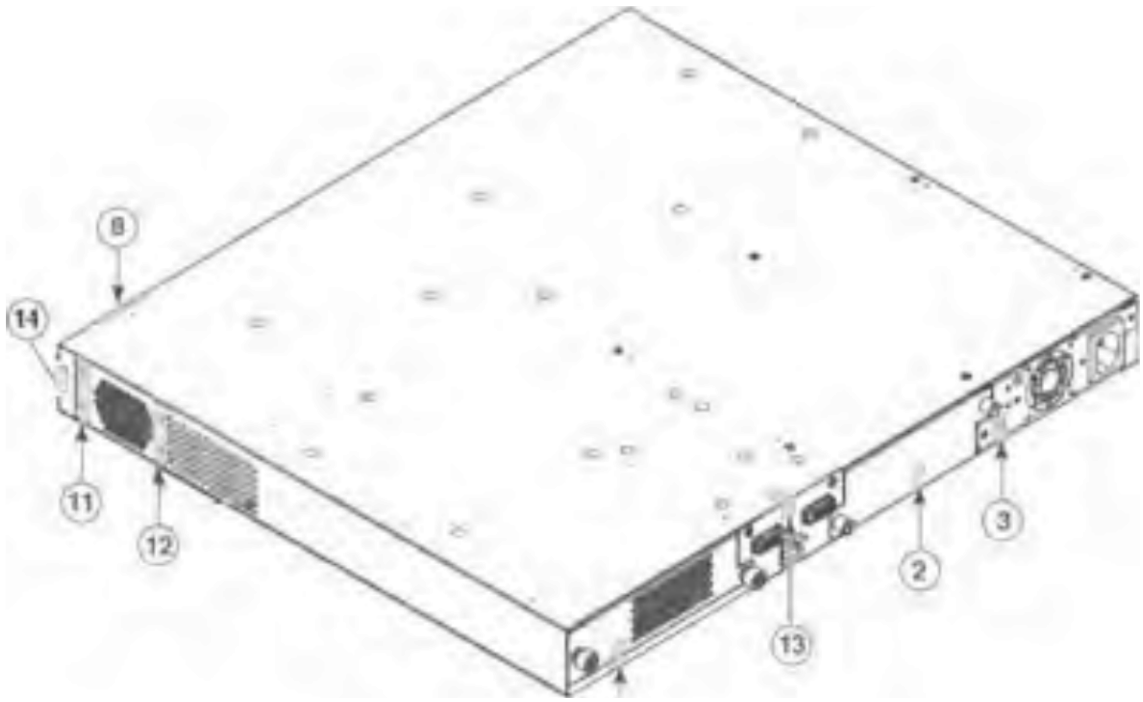


Figure 29 Rear, bottom, and left side views of a Brocade FCX 648S, FCX 648S-HPOE and FCX 648S-HPOE-ADV device with security seals

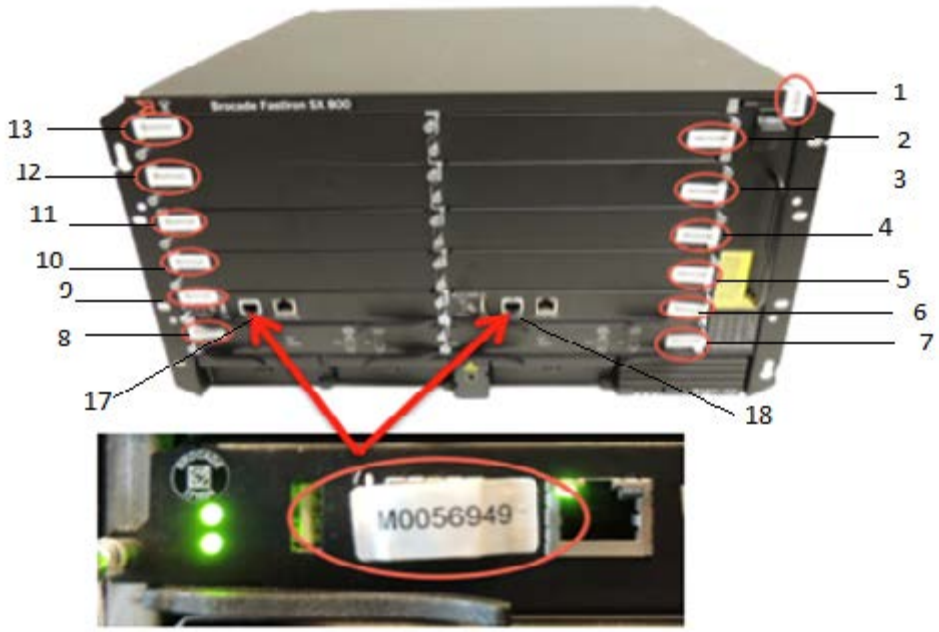


SX 800 devices

Use the figures in this section as a guide for security seal placement on a Brocade FastIron SX 800 device. The connectors on the faceplates of a particular module might vary from the connectors shown on the figures,
but the placement of the seals will be the same. There is no seal placement required on the side panels or solely on the top and bottom panels of Brocade FastIron SX 800 devices. Each Brocade FastIron SX 800 device requires the placement of eighteen (18) seals:

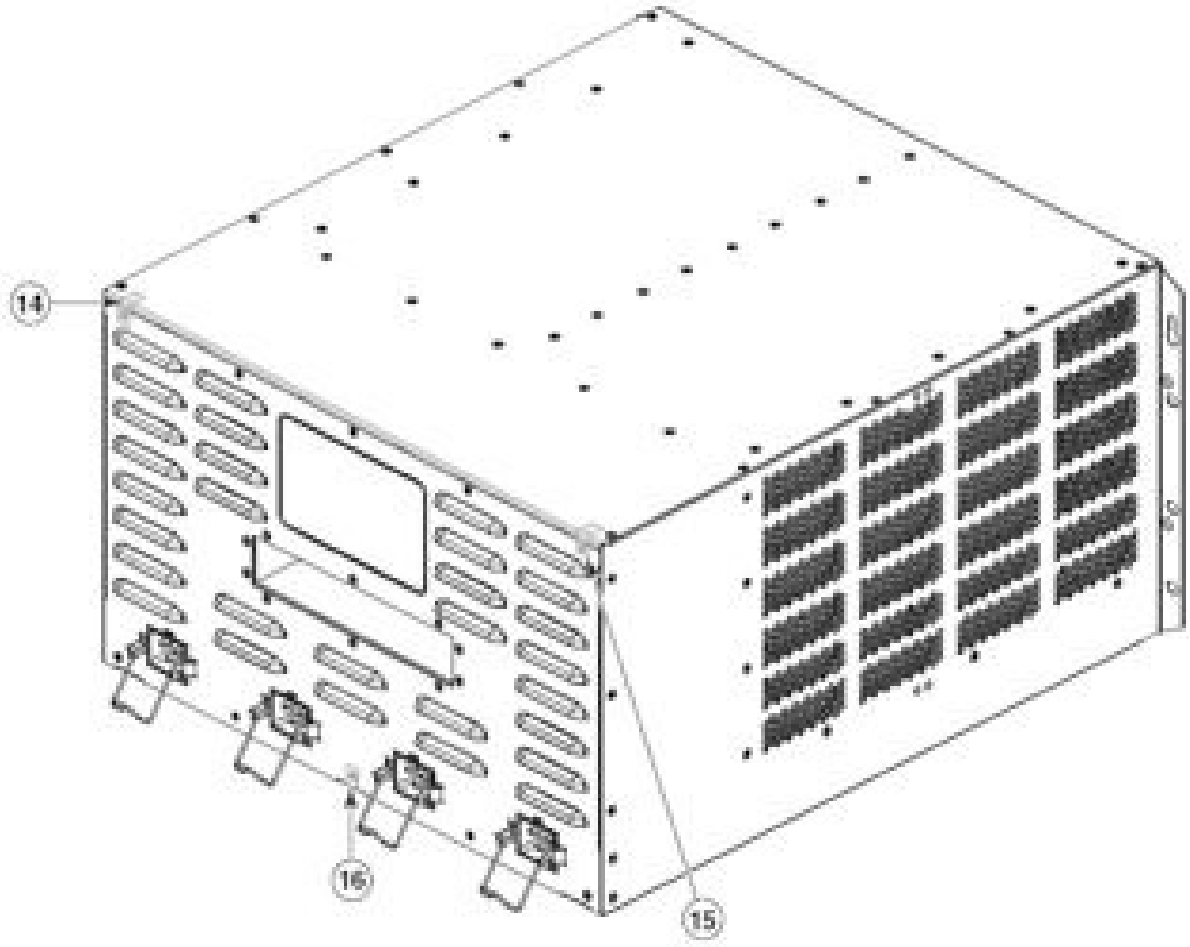
- **Front**: Affix 15 total seals to the front panel of the device. Affix one vertically oriented seal to the left ear of each module installed in the left side of the chassis. As much as possible of the seal should be affixed to the module directly above the left screw for the left side modules. Affix one vertically oriented seal to each of the modules installed in the right side of the chassis by affixing the seals directly under the screw to the right ear of each module and to the chassis. Affix one seal from the upper right corner of the fan tray to the chassis. Affix two seals horizontally over the console ports. All 15 of these seals should lie flat against the front of the device. See Figure 30 for correct seal orientation and positioning.

Figure 30 Front view of a Brocade FastIron SX 800 device with security seals



- **Rear**: Affix 3 total seals to the rear panel of the device. Affix two vertically-aligned seals at the upper right and left sides of the rear panel so that one half of the seal is affixed to the top panel of the device and the other half is affixed to the rear panel and covering the rightmost and leftmost screws. You must bend these seals to place them correctly. Affix one seal vertically aligned at the lower center of the rear panel so that one-half of the seal is affixed to the bottom panel of the device and the other half of the seal is affixed to the rear panel of the device, covering the middle screw. See Figure 31 for seal orientation and positioning.

Figure 31 Rear, top and left side panel views of a Brocade FastIron SX 800 device with security seals



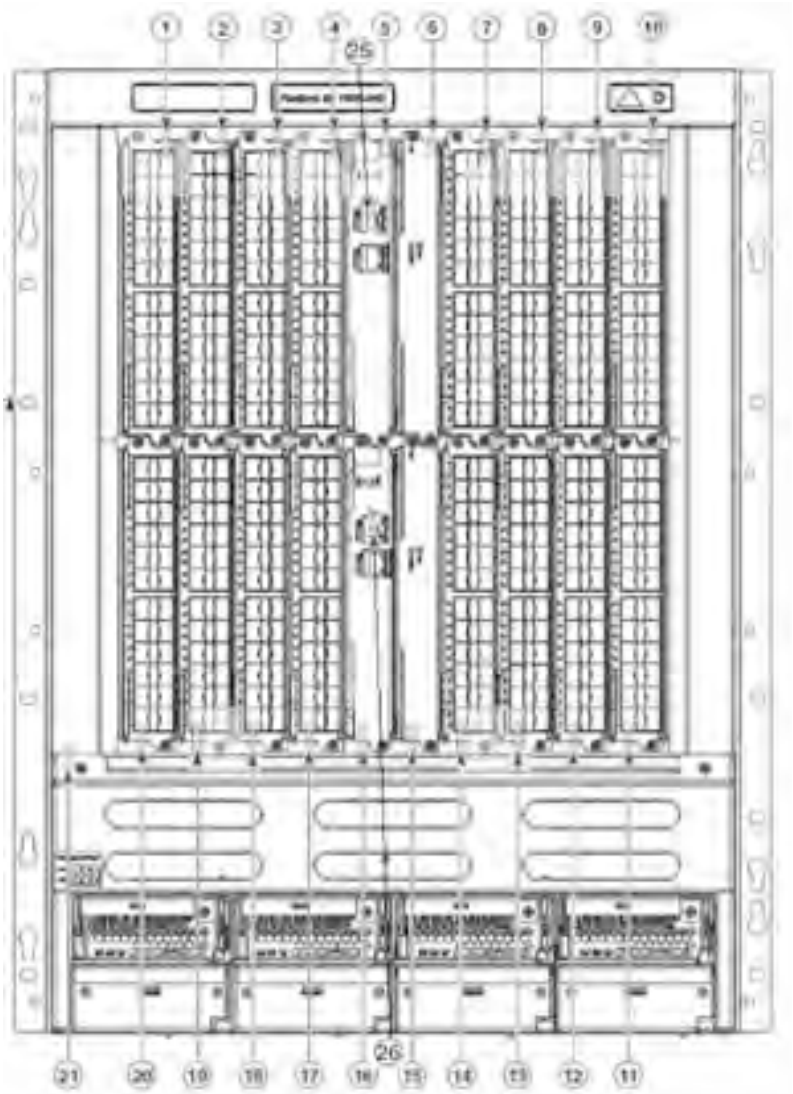
SX 1600 devices

Use the figures in this section as a guide for security seal placement on a Brocade FastIron SX 1600 device.

The connectors on the faceplates of a particular module might vary from the connectors shown on the figures, but the placement of the seals will be the same. There is no seal placement required on the top panel, bottom panel, or side panels of Brocade FastIron SX 1600 devices. Each Brocade FastIron SX 1600 device requires the placement of twenty-six (26) seals:

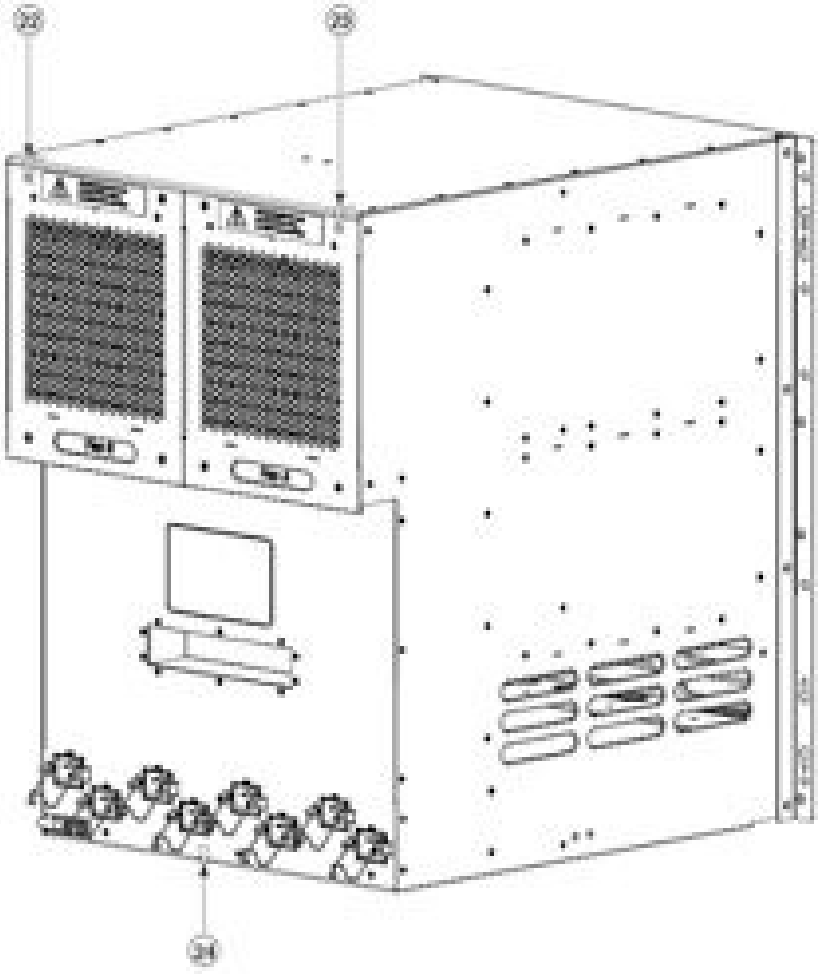
- **Front**: Affix 23 total seals to the front panel of the device. Affix one horizontally oriented seal to the upper ear of each module installed in the top row of the chassis as shown in Figure 32. As much as possible of the seal should be affixed to the module to the right of the screw that secures each module to the chassis. Affix one horizontally oriented seal to the lower ear of each module installed in the bottom row of the chassis as shown in Figure 32. As much as possible of the seal should be affixed to the module to the left of the screw that secures each module to the chassis. Affix one seal from the upper left corner of the fan tray to the chassis, as shown in Figure 32. Affix one seal over both console ports (2 seals total) as shown in Figure 32. All 23 of the seals should lie flat against the front panel of the device.

Figure 32 Front view of a Brocade FastIron SX 1600 device with security seals



- **Rear:** Affix 3 total seals to the rear panel of the device. Affix two vertically aligned seals to the right and left top edges of the chassis so that half of the seal is affixed to the top panel and half to the rear panel or, in the case of an ANR, to the bracket that attaches the ANR bracket to the rear panel of the chassis. Affix one seal vertically to the center bottom edge of the rear panel so that one-half of the seal is affixed to the rear panel of the device and one-half of the seal is affixed to the bottom panel. You must bend this seal to place it correctly. See Figure 33 for correct seal orientation and positioning.

Figure 33 Rear view of the FastIron SX 1600 device with security seals



ICX 6450-24 Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 6450-24 device. Each device requires the placement of seven (7) seals:

- **Top:** Affix 3 seals between the top of the front panel and the top removable metal cover of the device.Apply each seal flat over the seam between the top cover and front panel so that part of the seal is on the metal cover and the other part is affixed over the top of the front panel. See Figure 34 for correct seal orientation and positioning.
- **Rear:** Affix 3 seals to the rear of the device between bottom of the chassis and the rear removable cover. Place the seals in a 90 degree bend, so that part of the seal is affixed to the chassis bottom and the other part is affixed to the rear cover as shown. Refer to Figure 35 for correct seal orientation and positioning.
- **Console Port:** Affix 1 seal over the console port, as shown in Figure 42.

Figure 34 Top view of a Brocade ICX 6450-24 device with security seals

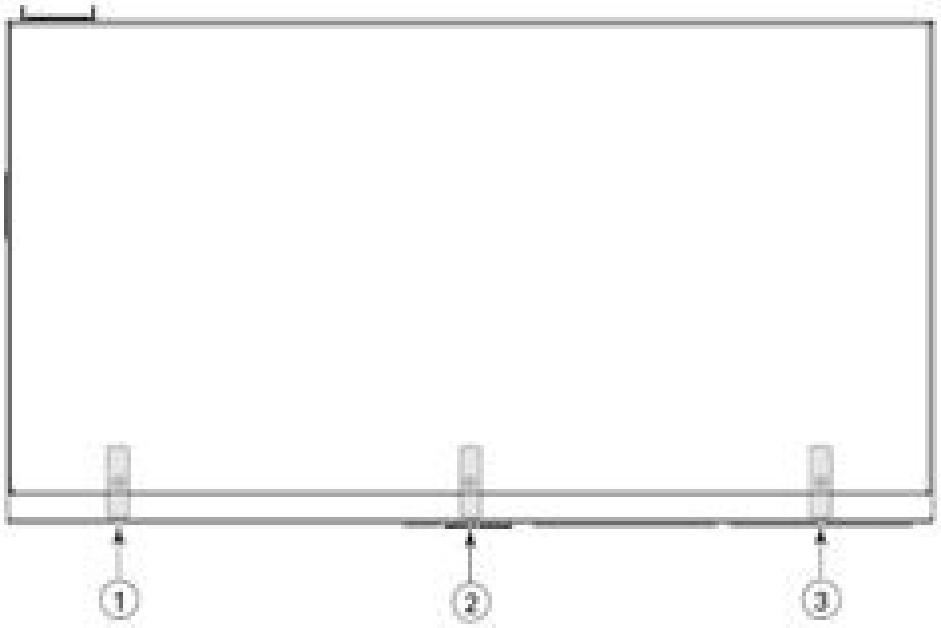
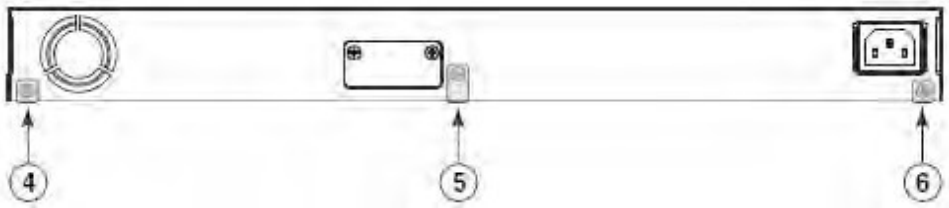


Figure 35 Rear view of a Brocade ICX 6450-24 device with security seals



ICX 6450-24P Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 6450 - 24P device. Each device requires the placement of seven (7) seals:

- **Top**: Affix 3 seals between the top of the front panel and the top removable metal cover of the device. Apply each seal flat over the seam between the top cover and front panel so that part of the seal is on the metal cover and the other part is affixed over the top of the front panel as shown. See Figure 36 for correct seal orientation and portioning.
- **Rear:** Affix 3 seals to the back side of the device between bottom of the chassis and the rear removable cover. Place the seals in a 90 degree bend, so that part of the seal is affixed to the chassis bottom and other part is affixed to the rear cover as shown. Refer to Figure 37 for correct seal orientation and positioning.
- **Console Port:** Affix 1 seal over the console port, as shown in Figure 42.

Figure 36 Top view of a Brocade ICX 6450-24P device with security seals

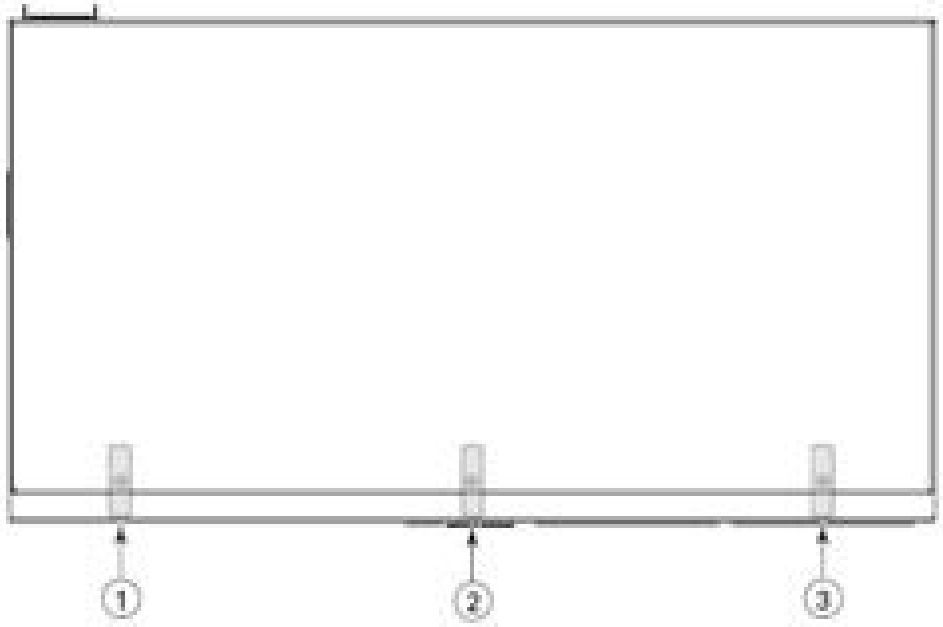
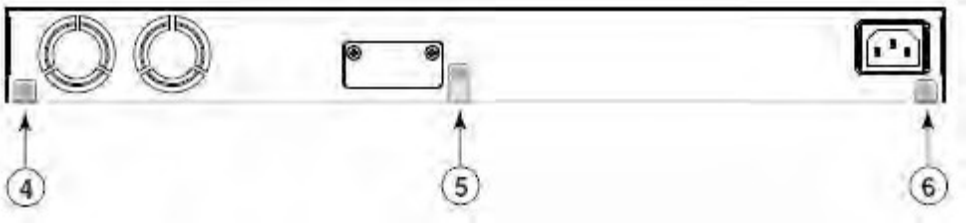


Figure 37 Rear view of a Brocade ICX 6450-24P device with security seals



ICX 6450-48 Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 6450 - 48 device. Each device requires the placement of seven (7) seals:

- **Top:** Affix 3 seals between the top of the front panel and the top removable metal cover of the device. Apply each seal flat over the seam between the top cover and front panel so that part of the seal is on the metal cover and the other part is affixed over the top of the front panel. See Figure 38 for correct seal orientation and positioning.
- **Rear:** Affix 3 seals to the rear of the device between bottom of the chassis and the rear removable cover. Place the seals in a 90 degree bend, so that part of the seal is affixed to the chassis bottom and the other part is affixed to the rear cover as shown. Refer to Figure 39 for correct seal orientation and positioning.
- **Console Port**: Affix 1 seal over the console port, as shown in Figure 43 and Figure 44. Place the seal so that part of the seal entirely covers the console port while the remainder of the seal wraps around the side of the chassis as shown.

Figure 38 Top view of a Brocade ICX 6450-48 device with security seals

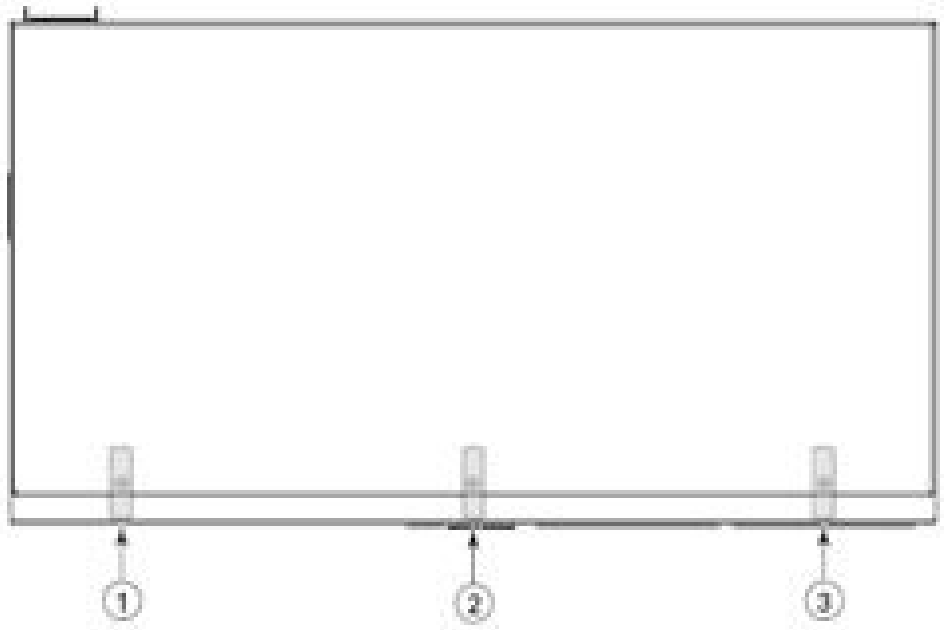
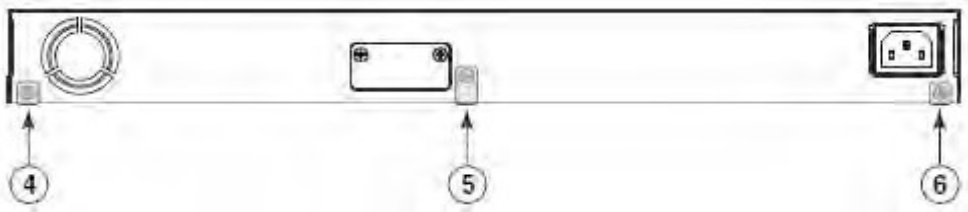


Figure 39 Rear view of a Brocade ICX 6450-48 device with security seals



ICX 6450-48P Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 6450 - 48P device. Each device requires the placement of seven (7) seals:

- **Top:** Affix 3 seals between the top of the front panel and the top removable metal cover of the device. Apply each seal flat over the seam between the top cover and front panel so that part of the seal is on the metal cover and the other part is affixed over the top of the front panel as shown. See Figure 40 for correct seal orientation and portioning.
- **Rear:** Affix 3 seals to the back side of the device between bottom of the chassis and the rear removable cover. Place the seals in a 90 degree bend, so that part of the seal is affixed to the chassis bottom and the other part is affixed to the rear cover as shown. Refer to Figure 41 for correct seal orientation and positioning.
- **Console Port:** Affix 1 seal over the console port, as shown in Figure 43 and Figure 44. Place the seal so that part of the seal entirely covers the console port while the remainder of the seal wraps around the side of the chassis as shown.

Figure 40 Top view of a Brocade ICX 6450-48P device with security seals

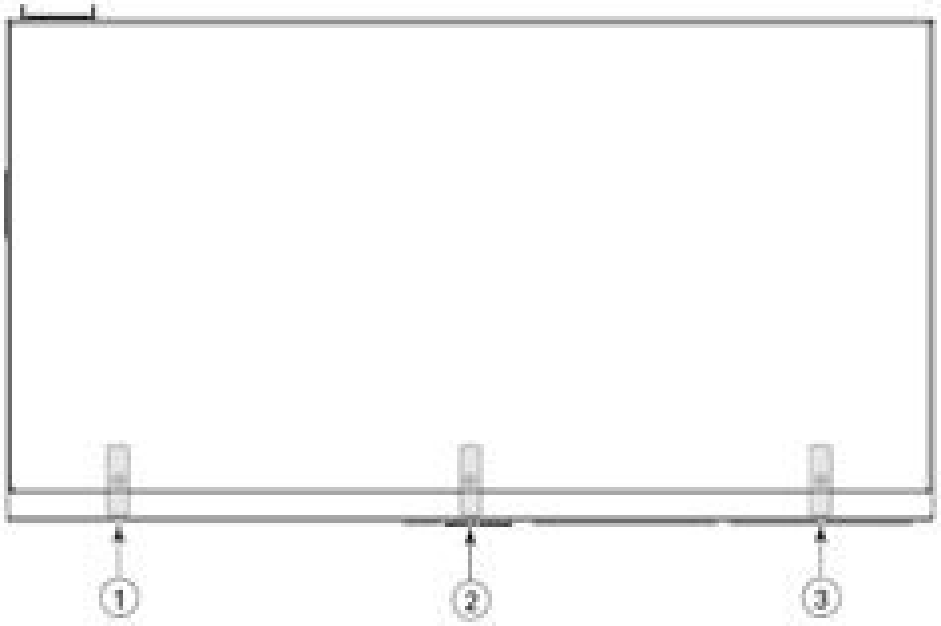


Figure 41 Rear view of a Brocade ICX 6450-48P device with security seals

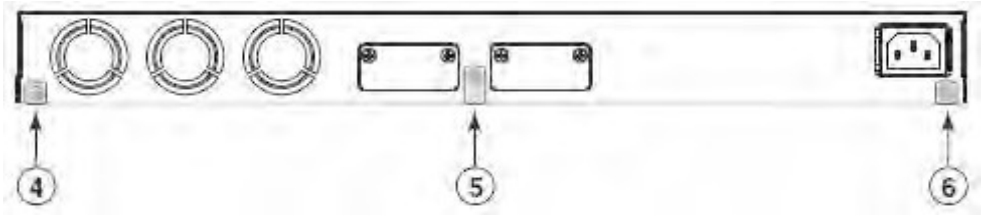


Figure 42 Security Seal over the console port on the Brocade ICX 6450-24 and ICX 6450-24P devices

Figure 43 Security Seal over the console port on the Brocade ICX 6450-48 and ICX 6450-48P devices

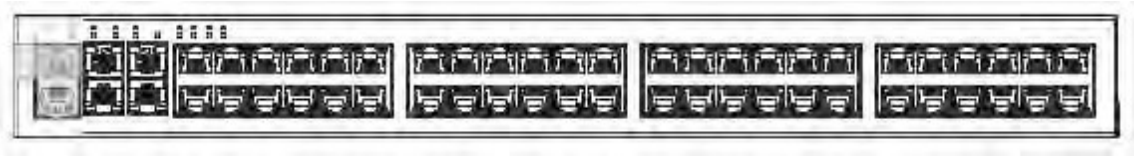
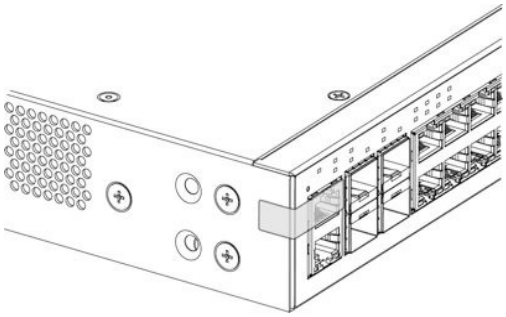


Figure 44 Side View of Security Seal over the console port on the Brocade ICX 6450-48 and ICX 6450-48P devices



ICX 6450-C12-PD Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 6450 - CP12-PD device. Each device requires the placement of sixteen (16) seals:

- **Front:** Affix a seal, at seal locations 1 and 2, which wraps from the front panel to the side panel on the left and right side, respectively. Each seal must bridge the seam between the front panel and the side panel. See Figure 45 and Figure 46 for the correct seal orientation and portioning. Affix one seal over the console port. Three (3) seals are required to complete this step of the procedure.
- **Right:** Affix a seal at locations 10, 11, and 12 on the right side of the module, as seen in Figure 46. Three (3) seals are required to complete this step of the procedure.
- **Left:** Affix a seal at locations 14, 15, and 16 on the left side of the module, as seen in Figure 48. Three (3) seals are required to complete this step of the procedure.
- **Back:** Affix a seal at location 13, as seen in Figure 48. Three (3) seals are required to complete this step of the procedure.
- **Bottom:** Affix a seal, at seal locations 3 through 8, which covers the screws that attach the bottom panel to the chassis to chassis cover. Each seal must bridge the seam between the bottom panel and the chassis cover. See Figure 47 for the correct seal orientation and portioning. Six (6) seals are required to complete this step
  of the procedure.

Figure 45 Front view of a Brocade ICX 6450-CP12-PD device with security seals

Figure 46 Front right side view of a Brocade ICX 6450-CP12-PD device with security seals

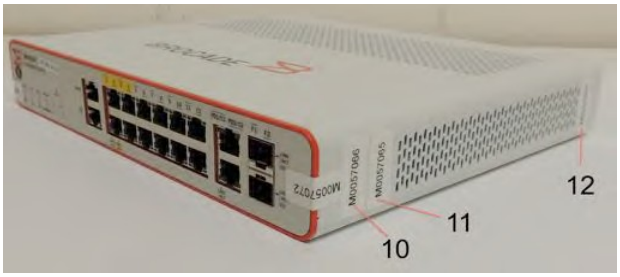


Figure 47 Bottom side view of a Brocade ICX 6450-CP12-PD device with security seals

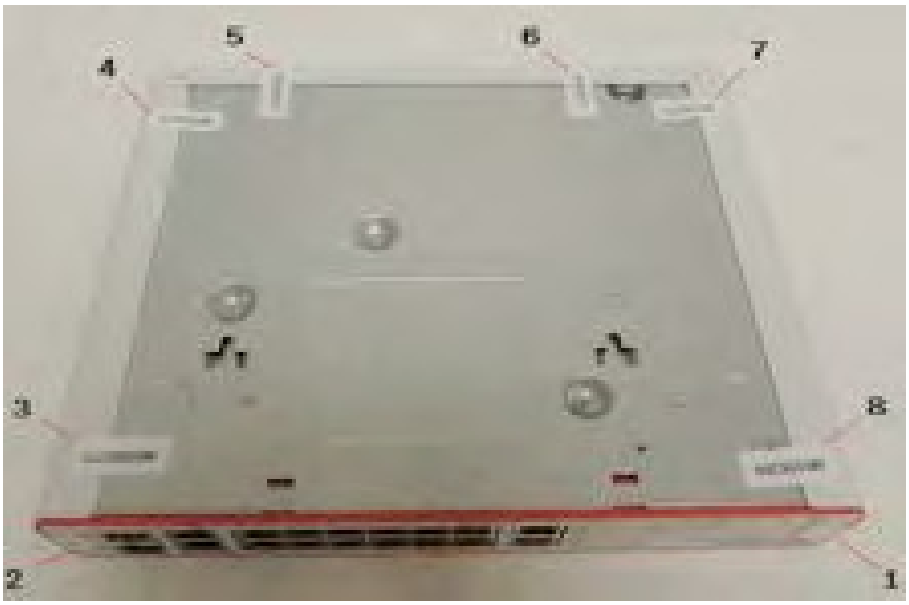


Figure 48 Back left side view of a Brocade ICX 6450-CP12-PD device with security seals

ICX 7750 Devices

Use the figures in this section as a guide for security seal placement on a FIPS-compliant Brocade ICX 7750 devices. The seal placement for ICX 7750-48C, ICX 7750-48F and ICX 7750-26Q are equivalent. Each device requires the placement of fourteen (14) seals.

- **Top Front**: Affix a seal, at seal locations 1, 2, 3, and 4, which covers the screw that attaches the top cover to the front panel and bridges the seam between the top of the front panel and the removable metal cover of the device. Affix a seal, at seal location 5, which covers the console port of the module. See Figure 49 for correct seal orientation and positioning. Five (5) tamper evident seals are required to complete this step of the procedure.
- **Top right side:** Affix a seal at location 13, which attaches the top cover to the right side panel and wraps around the 90 degree angle formed by the side panel and the removable metal cover of the device. See Figure 50 for correct seal orientation and positioning. One (1) tamper evident seal is required to complete this step of the procedure.
- **Top left side:** Affix a seal at location 6, which attaches the top cover to the left side panel and wraps around the 90 degree angle formed by the side panel and the removable metal cover of the device. See Figure 50 for correct seal orientation and positioning. One (1) tamper evident seal is required to complete this step of the procedure.
- **Rear:** Affix a seal, at seal locations 7, 8, 9, 10, 11, 12 and 14, which attaches the top cover to the rear panel and wraps around the 90 degree angle formed by the rear panel and the removable metal cover of the device. See Figure 51 for correct seal orientation and positioning. Seven (7) tamper evident seals are required to complete this step of the procedure.

Figure 49 Front top view of Brocade ICX 7750 device with security seals

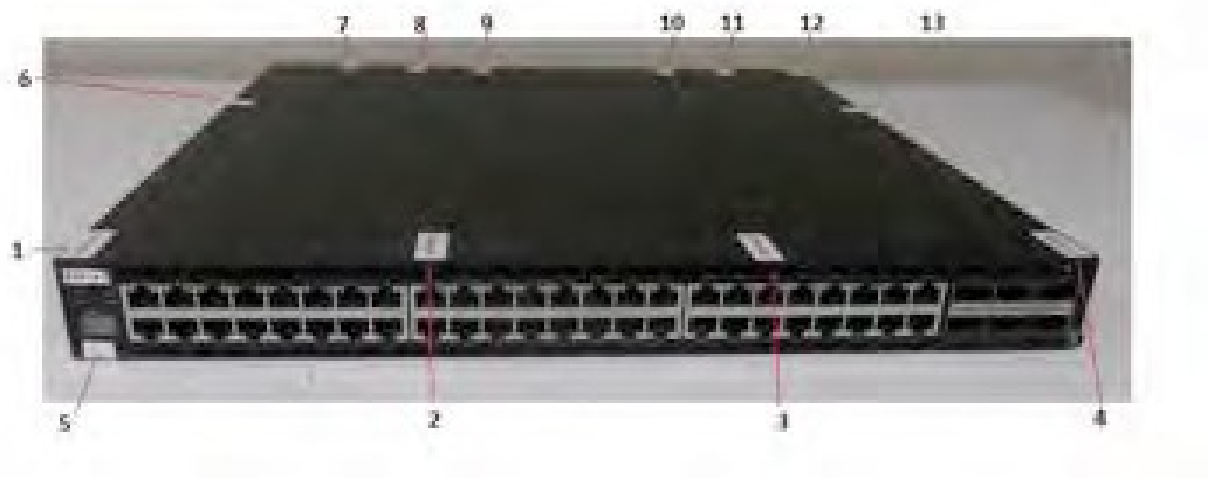


Figure 50 Right and left side view of Brocade ICX 7750 device with security seals

Right side view of the ICX 7750

Left side view of the ICX 7750

Figure 51 Rear top view of Brocade ICX 7750 device with security seals

ICX 7450 Devices

Figures 52–57 display the TEL placement on the Brocade® ICX 7450 (Total TEL Count: 14). Note: All SKUs have the same total quantity of tamper labels, and are located in the same positions. Figure 52 and Figure 56 demonstrate the front side of a module with 24 ports, and a module with 48 ports.

Figure 52. Front side of the Brocade® ICX 7450 with 24 ports. (QTY.2) TEL are placed to cover the console port (label 14), and to secure the removable component to the module (label 10).

Figure 53. Front side of the Brocade® ICX 7450 with 48 ports. (QTY.2) TEL are placed to cover the console port (label 14), and to secure the removable component to the module (label 10).

Figure 54. Top side of the Brocade® ICX 7450. (Qty. 11) TEL are placed on the top side of the module. Labels 1, 12, 11, and 9 cover screws near the front side of the module. Labels 3, 4, 5, 6, and 7 secure the fans, removable components, and filler panel located on the rear side of the module to the top side of the module. Label 2 and label 8 secure the top cover to the left and right sides, respectively, of the module.

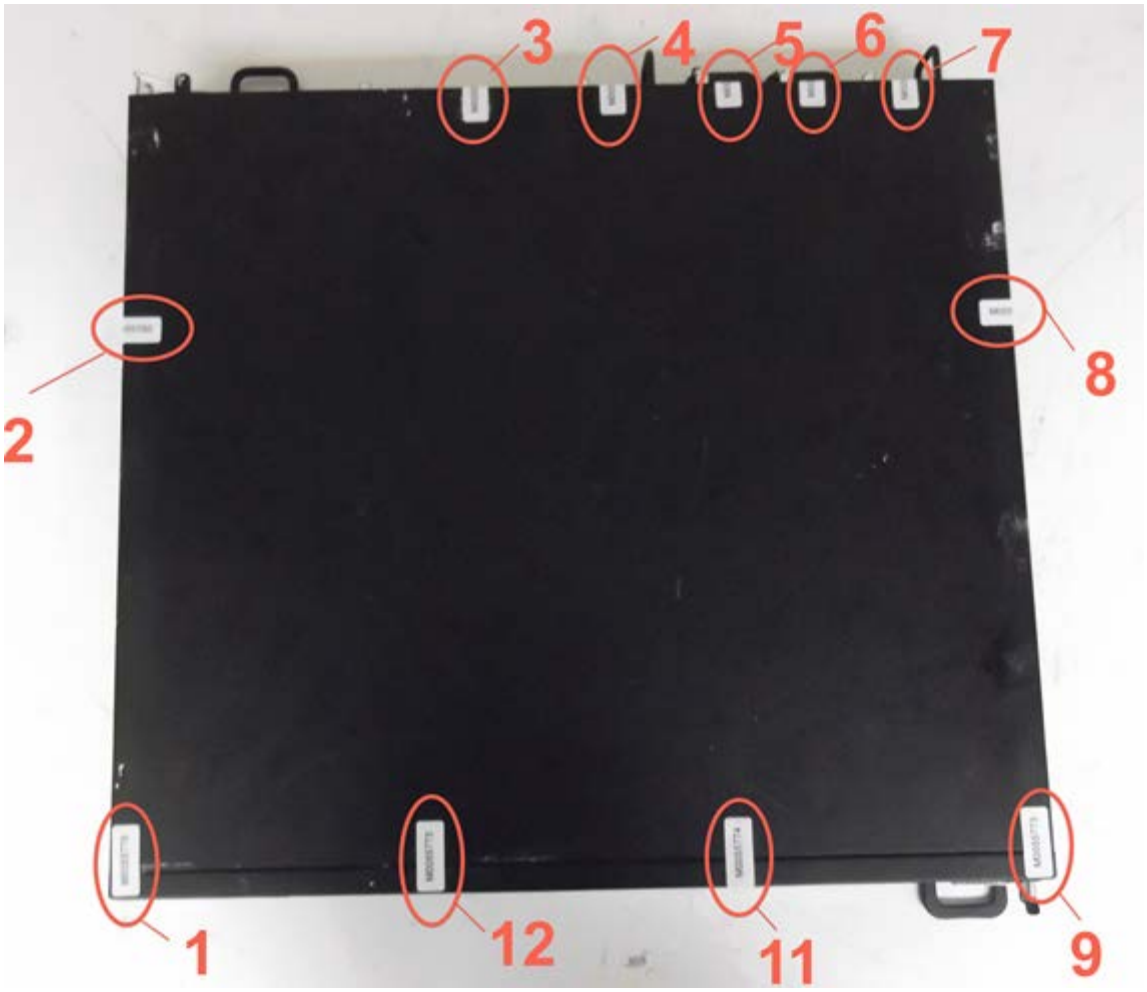


Figure 55. Rear side of the Brocade® ICX 7450. In addition to labels 3, 4, 5, 6, and 7 that were described in Figure 57, (Qty. 1) TEL is utilized to secure the power supply to the bottom of the module (label 13).

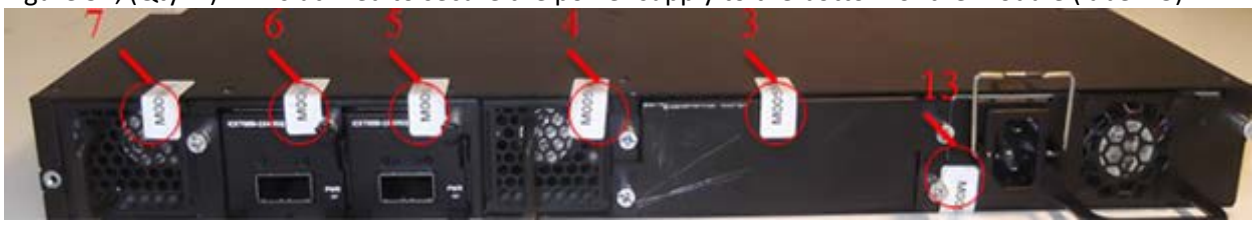
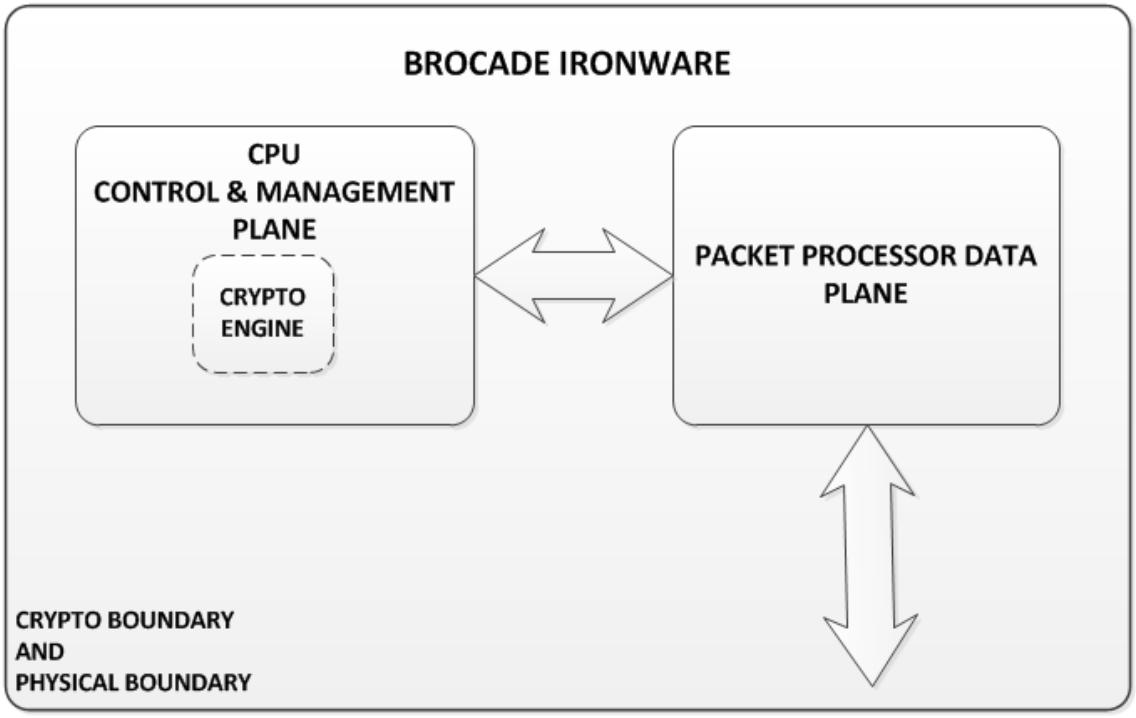


Figure 56. Left side of the Brocade® ICX 7450. (QTY.1) TEL is placed on the left side (label 2), and secures the top covers to the left side of the module.

Figure 57. Right side of the module Brocade® ICX 7450. (QTY. 1) TEL is placed on the right side (label 8), and secures the top cover to the right side of the module.

Appendix B: Block Diagram

Figure 58. Cryptographic Module Block Diagram



Appendix C: Critical Security Parameters

The module supports the following CSPs and public keys:

1) SSHv2 Host RSA Private Key (2048 bit)
- Description: Used to authenticate SSHv2 server to client
- Type: RSA Private Key
- Generation: N/A
- Establishment: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Entry: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Output: N/A
- Storage: Plaintext in RAM and BER encoded (plaintext) in Compact Flash
- Key-to-Entity: Process
- Zeroization: "fips zeroize all" command

2) SSHv2 DH Private Key (2048 bit)
- Description: Used in SCP and SSHv2 to establish a shared secret
- Type: DH Private Key
- Generation: As per SP800-133 Section 6.2, the random value (K) needed
to generate key pairs for the finite field is the output of the SP800-90A
DRBG; allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Establishment: N/A
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: Process
- Zeroization: Session termination and "fips zeroize all" command

3) SSHv2 DH Shared Secret Key (2048 bit)
- Description: Output from the DH Key agreement primitive - (K) and (H). Used in SSHv2 KDF to derive (client and server) session keys.
- Type: DH Shared Secret Key
- Generation: N/A
- Establishment: SSHv2 DH Key Agreement; allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Entry: N/A

- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

4) SSHv2/SCP Session Keys (128 and 256 bit AES CBC)
- Description: AES encryption key used to secure SSHv2/SCP
- Type: AES CBC Key
- Generation: N/A
- Establishment: SSHv2 DH Key Agreement and SSHv2 KDF (SP800-135 Section 5.2); allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
-Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

5) SSHv2/SCP Authentication Key (HMAC-SHA-1)
- Description: Session authentication key used to authenticate and provide integrity of SSHv2 session
- Type: HMAC-SHA-1
- Generation: N/A
- Establishment: SSHv2 DH Key Agreement and SSHv2 KDF (SP800-135 Section 5.2); allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

6) SSHv2 KDF Internal State
- Description: Used to generate Host encryption and authentication key
- Type: KDF
- Generation: N/A
- Establishment: SSHv2 DH Key Agreement and SSHv2 KDF (SP800-135 Section 5.2); allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

7) TLS Host RSA Private Key (RSA 2048 bit)
- Description: RSA key used to establish TLS v1.0/1.1 and v1.2 sessions
- Type: RSA Private Key
- Generation: N/A
- Establishment: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Entry: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Output: N/A
- Storage: Plaintext in RAM and BER encoded (plaintext) in Compact Flash
- Key-to-Entity: Process
- Zeroization: "fips zeroize all" command

8) TLS Pre-Master Secret
- Description: Secret value used to establish the Session and Authentication key
- Type: TLS v1.0/1.1 and v1.2 CSP
- Generation: N/A, established during the TLS v1.0/1.1 and v1.2 handshake using RSA key transport
- Establishment: Key transport: RSA key wrapped over TLS v1.0/1.1 and v1.2 session; allowed as per FIPS 140-2 IG D.9
- Entry: Key transport: RSA key wrapped over TLS v1.0/1.1 and v1.2 session; allowed as per FIPS 140-2 IG D.9
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

9) TLS Master Secret
- Description: 48 bytes secret value used to establish the TLS v1.0/1.1 and v1.2 Session Key and TLS Authentication Key
- Type: TLS v1.0/1.1 and v1.2 CSP
- Generation: N/A

- Establishment: TLS KDF as per SP800-135 Section 4.2.1 & 4.2.2; allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

10) TLS KDF Internal State
- Description: Values of the KDF internal state
- Type: TLS v1.0/1.1 (HMAC-SHA-1/HMAC-MD5); TLS v1.2 (HMAC-SHA-256)
- Generation: Approved TLS KDF
- Establishment: N/A
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

11) TLS Session Key
- Description: 128 or 256 bit AES CBC key used to secure TLS v1.0/1.1 and v1.2 sessions
- Type: AES CBC
- Generation: N/A
- Establishment: TLS KDF as per SP800-135 Section 4.2.1 & 4.2.2; allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

12) TLS Authentication Key
- Description: HMAC-SHA-1/HMAC-MD5 key used to provide data authentication for TLS v1.0/1.1 sessions; HMAC-SHA-256 key used to provide data authentication for TLS v1.2 sessions
- Type: TLS v1.0/1.1 (HMAC-SHA-1/HMAC-MD5); TLS v1.2 (HMAC-SHA-256)
- Generation: N/A
- Establishment: TLS KDF as per SP800-135 Section 4.2.1 & 4.2.2; allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: User
- Zeroization: Session termination and "fips zeroize all" command

13) DRBG Seed
- Description: Seeding material for the SP800-90A CTR_DRBG
- Type: DRBG Seed material
- Generation: internally generated; raw random data from NDRNG
- Establishment: N/A
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: Process
- Zeroization: Session termination and "fips zeroize all" command

14) DRBG Value V
- Description: Internal State of SP800-90A CTR_DRBG
- Type: SP800-90A DRBG
- Generation: SP800-90A DRBG
- Establishment: N/A
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: Process
- Zeroization: "fips zeroize all" command

15) DRBG Key
- Description: Internal State of SP800-90A CTR_DRBG
- Type: SP800-90A DRBG
- Generation: SP800-90A DRBG
- Establishment: N/A

- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: Process
- Zeroization: "fips zeroize all" command

16) DRBG Internal State
- Description: Internal State of SP800-90A CTR_DRBG
- Type: SP800-90A DRBG
- Generation: SP800-90A DRBG
- Establishment: N/A
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: Process
- Zeroization: "fips zeroize all" command

17) User Password
- Description: Password used to authenticate User (8 to 48 characters)
- Type: Authentication data
- Generation: N/A
- Establishment: N/A
- Entry: Configured by the operator, entered encrypted/authenticated over SSHv2 session
- Output: MD5 hashed in configuration, output encrypted/authenticated over SSHv2 session
- Storage: MD5 digest in plaintext in Compact Flash
- Key-to-Entity: User
- Zeroization: "fips zeroize all" command

18) Port Administrator Password
- Description: Password used to authenticate Port Configuration Administrator (8 to 48 characters)
- Type: Authentication data
- Generation: N/A
- Establishment: N/A
- Entry: Configured by the operator, entered encrypted/authenticated over SSHv2 session
- Output: MD5 hashed in configuration, output encrypted/authenticated over SSHv2 session
- Storage: MD5 digest in plaintext in Compact Flash
- Key-to-Entity: User
- Zeroization: "fips zeroize all" command

19) Crypto Officer Password
- Description: Password used to authenticate Crypto Officer (8 to 48 characters)
- Type: Authentication data
- Generation: N/A
- Establishment: N/A
- Entry: Configured by the operator, entered encrypted/authenticated over SSHv2 session
- Output: MD5 hashed in configuration, output encrypted/authenticated over SSHv2 session
- Storage: MD5 digest in plaintext in Compact Flash
- Key-to-Entity: User
- Zeroization: "fips zeroize all" command

20) RADIUS Secret
- Description: Used to authenticate the RADIUS server (8 to 64 characters)
- Type: Authentication data
- Generation: N/A
- Establishment: N/A
- Entry: Configured by the operator, entered encrypted/authenticated over SSHv2 session
- Output: MD5 hashed in configuration, output encrypted/authenticated over SSHv2 session
- Storage: Plaintext in RAM, Brocade proprietary two-way encrypted using base-64 (plaintext) in RAM and Compact Flash
- Key-to-Entity: Process
- Zeroization: "fips zeroize all" command

21) TACACS+ Secret
- Description: Used to authenticate the TACACS+ server (8 to 64 characters)
- Type: Authentication data
- Generation: N/A
- Establishment: N/A
- Entry: Configured by the operator, entered encrypted/authenticated over SSHv2 session
- Output: MD5 hashed in configuration, output encrypted/authenticated over SSHv2 session

- Storage: Plaintext in RAM, Brocade proprietary two-way encrypted using base-64 (plaintext) in RAM and Compact Flash
- Key-to-Entity: Process
- Zeroization: "fips zeroize all" command

22) Firmware Integrity / Firmware Load RSA Public Key
- Description: RSA 2048-bit public key used to verify signature of firmware of the module
- Type: RSA Public Key
- Generation: N/A, Generated outside the module
- Establishment: N/A
- Entry: Through firmware update
- Output: N/A
- Storage: Plaintext in RAM, Plaintext in Compact Flash
- Key-to-Entity: Process

23) SSHv2 Host RSA Public Key
- Description: (2048 bit); Used to establish shared secrets
- Type: RSA Public Key
- Generation: N/A, generated outside the module
- Establishment: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Entry: Configured by the operator; Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Output: Plaintext
- Storage: Plaintext in RAM, Plaintext in Compact Flash
- Key-to-Entity: Process

24) SSHv2 Client RSA Public Key
- Description: (2048 bit); Used to establish shared secrets
- Type: RSA Public Key
- Generation: N/A, generated outside the module
- Establishment: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Entry: Configured by the operator; Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Output: N/A
- Storage: Plaintext in RAM, Plaintext in Compact Flash
- Key-to-Entity: Process

25) SSHv2 DH Public Key
- Description: (2048 bit modulus); Used to establish shared secrets (SSHv2 and DHCHAP)
- Type: DH Public Key
- Generation: As per SP800-133 Section 6.2, the random value (K) needed to generate key pairs for the finite field is the output of the SP800-90A DRBG; allowed method as per FIPS 140-2 IG D.8 Scenario 4
- Establishment: N/A
- Entry: N/A
- Output: Plaintext
- Storage: Plaintext in RAM, Plaintext in Compact Flash
- Key-to-Entity: Process

26) SSHv2 DH Peer Public Key
- Description: (2048 bit modulus); Used to establish shared secrets (SSHv2 and DHCHAP)
- Type: DH Peer Public Key
- Generation: N/A
- Establishment: N/A
- Entry: Plaintext
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: Process

27) TLS Host Public Key (RSA 2048 bit)
- Description: Used by client to encrypt TLS Pre-Master secret
- Type: TLS host Public key
- Generation: N/A, Generated outside the module
- Establishment: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Entry: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Output: Plaintext
- Storage: Plaintext in RAM, Plaintext in Compact Flash

- Key-to-Entity: Process

28) TLS Peer Public Key (RSA 2048 bit)
- Description: Used to authenticate the client
- Type: TLS Peer Public Key
- Generation: N/A
- Establishment: N/A
- Entry: Plaintext during TLS handshake protocol
- Output: N/A
- Storage: Plaintext in RAM, Plaintext in Compact Flash
- Key-to-Entity: Process

The following CSPs are only available in ICX 6610:

29) CAK
- Description: Connectivity association key - main master key; Pre-shared key; 128 bits in length
- Type: KDF Input
- Generation: N/A - generated outside of the module
- Establishment: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Entry: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Output: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Storage: Plaintext in configuration file (Flash); Save configuration
- Key-to-Entity: Process: MKA
- Zeroization: Session termination and "fips zeroize all" command

30) CKN
- Description: Connectivity key name; pre-shared key; 128 bits in length)
- Type: KDF input
- Generation: N/A - generated outside of the module
- Establishment: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Entry: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Output: Key transport: AES Encrypted & HMAC-SHA-1 authenticated over SSHv2 session; Approved as per FIPS 140-2 IG D.9
- Storage: Plaintext in configuration file (Flash); Save configuration
- Key-to-Entity: Process: MKA
- Zeroization: Session termination and "fips zeroize all" command

31) ICK
- Description: Integrity checksum key; 128 bits
- Type: AES CMAC 128
- Generation: Approved as per FIPS 140-2 IG 7.10; derived from SP800-108 KDF
- Establishment: N/A
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: Process: MKA
- Zeroization: Session termination and "fips zeroize all" command

32) KEK
- Description: Key encryption key; 128 bits
- Type: AES Key Wrap
- Generation: Approved as per FIPS 140-2 IG 7.10; derived from SP800-108 KDF
- Establishment: N/A
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity: Process: MKA
- Zeroization: Session termination and "fips zeroize all" command

33) SAK
- Description: Secure association key; 128 bits
- Type: GCM Key
- Generation: Approved as per FIPS 140-2 IG 7.10; derived from SP800-108 KDF
- Establishment: Key transport: AES Encrypted with the KEK; Allowed as per FIPS 140-2 IG D.9
- Entry: Input AES encrypted by the KEK
- Output: Output AES encrypted by the KEK
- Storage: Plaintext in RAM and Plaintext in Marvell chip

- Key-to-Entity: Process: MACsec
- Zeroization: Session termination and "fips zeroize all" command

34) SP800-108 State KDF
- Description: SP800-108 KDF
- Type: SP800-108 (AES 128 CMAC in Counter Mode)
- Generation: SP800-108 KDF
- Establishment: N/A
- Entry: N/A
- Output: N/A
- Storage: Plaintext in RAM
- Key-to-Entity:Process: MKA
- Zeroization: Session termination and "fips zeroize all" command