



ITSS IT-643/645 Series Specification

102014-R2

Includes 3 Year Technical Support

Built and Configured for IT Data and IP Video Applications

Specification

Lifetime Warranty

| | ITSS IT- 643 | | | | ITSS IT-645 | | | |
|--|--------------|----------------|-------------------|-------------------|--|--|--|--|
| | 24643 | 24P643 | 48643 | 48P643 | 24645 | 24P645 | 48645 | 48P645 |
| 10/100/1000 Mbps RJ-45 ports | 24 | 24 | 48 | 48 | 24 | 24 | 48 | 48 |
| 1GbE SFP ports (uplink/stacking) | 4 | 4 | 4 | 4 | | | | |
| 1/10 GbE SFP/SFP+ ports (uplink/stacking) | | | | | 4 (optional 2 port license) | 4 (optional 2 port license) | 4 (optional 2 port license) | 4 (optional 2 port license) |
| Stacking bandwidth (data rate, full duplex) | 4 Gbps | 4 Gbps | 4 Gbps | 4 Gbps | 40 Gbps | 40 Gbps | 40 Gbps | 40 Gbps |
| Units per Stack | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 |
| Internal AC power supply rating | 36 W | 525 W | 65 W | 525 W | 65 W | 525 W | 100 W | 880 W |
| External power supply (redundant power and PoE power) | | Optional 525 W | Optional 525 W | Optional 525 W | Optional 525 W | Optional 525 W | Optional 525 W | Optional 525 W × 2 |
| PoE/PoE+ power budget (internal power supply) | | 390 W | | 390 W | | 390 W | | 780 W |
| PoE Class 3 ports (internal power supply) | | 24 | | 24 | | 24 | | 48 |
| PoE+ ports (internal power supply) | | 12 | | 12 | | 12 | | 24 |
| Max PoE Class 3 ports (with internal and external power supplies) | | 24 | | 48 | | 24 | | 48 |
| Max PoE+ ports (with internal and external power supplies) | | 24 | | 24 | | 24 | | 48 |
| Layer 2 base software | Yes | Yes | Yes | Yes | Yes (includes IPv4 static routes) Optional | Yes (includes IPv4 static routes) Optional | Yes (includes IPv4 static routes) Optional | Yes (includes IPv4 static routes) Optional |
| Layer 3 routing (RIP, OSPF) | | | | | | | | |
| Switching capacity (data rate, full duplex) | 56 Gbps | 56 Gbps | 104 Gbps | 104 Gbps | 128 Gbps | 128 Gbps | 176 Gbps | 176 Gbps |
| Forwarding capacity (data rate, full duplex) | 42 Mpps | 42 Mpps | 77 Mpps | 77 Mpps | 96 Mpps | 96 Mpps | 132 Mpps | 132 Mpps |



System Architecture

Connector options 10/100/1000 Mbps ports: RJ-45

ITSS/Brocade IT-643: 1 Gbps SFP ports for uplink/stacking: SX, LX, TX, LHA, LHB, direct-attached copper cable (Twinax) for stacking

ITSS/Brocade IT-645: 1/10 Gbps SFP+ ports for uplink/stacking: USR, SR, LR, ER, LRM, direct attached copper cable (Twinax) for stacking

Out-of-band Ethernet management: 10/100/1000 Mbps RJ-45

Console management: RJ-45 serial

External power connector: Redundant system power supply and extended PoE power supply

Maximum MAC addresses ITSS/Brocade IT-643: IT-645: 16,000

Maximum VLANs 4096

Maximum STP (spanning Tree) IT-643: 32 IT-645: 253

Maximum routes (in hardware) IT-643: 12,000 (IPv4) IT-645: 1070 (IPv6)

Trunking IT-643 Maximum ports per trunk: 8 Maximum trunk groups: 29

IT-645 Maximum ports per trunk: 8 Maximum trunk groups: 124

Priority queues IT-643: 4 IT-645: 8

Maximum jumbo frame size 9216 bytes

Layer 2 switching

802.1s Multiple Spanning Tree 802.1x Authentication

- Auto MDI/MDIX
- BPDU Guard, Root Guard
- Dual-Mode VLANs
- MAC-based VLANs, Dynamic MAC-based VLAN activation
- Dynamic VLAN Assignment
- Dynamic Voice VLAN Assignment
- Fast Port Span
- GARP VLAN Registration Protocol
- IGMP Snooping (v1/v2/v3)
- IGMP Proxy for Static Groups
- IGMP v2/v3 Fast Leave
- IGMP Tracking
- Inter-Packet Gap (IPG) adjustment
- Link Fault Signaling (LFS)
- MAC Address Locking, MAC Port Security
- MAC-Layer Filtering, Filtering on source and destination MAC address
- MAC Learning Disable
- MLD Snooping (v1/v2)
- Multi-device Authentication
- Per-VLAN Spanning Tree (PVST/PVST+/PVRST)
- Mirroring: Port-based, ACL-based, MAC Filter based, and VLAN-based
- Port Loop Detection
- Private VLAN
- Protected Link Groups
- Protocol VLAN (802.1v), Subnet VLAN
- Remote Fault Notification (RFN)
- Single-instance Spanning Tree
- Single-link LACP
- Trunk Groups
- Uni-Directional Link Detection (UDLD) IPv6 support • Host functionality management
- Hardware support for IPv6
- IPv6 static routing (ITSS/Brocade IT- 6450 only) Base



Layer 3 routing

(IT-645)

- IPv4 and IPv6 Static Routes
- Port-based Access Control Lists
- Host Routes
- Virtual Interfaces, up to 255 virtual interfaces
- Routed Interfaces
- Route-only Support
- IP helper
- Routing Between Directly Connected Subnets
- ECMP
- Layer 3/Layer 4 ACLs

Premium Layer 3 routing

(IT-645)

- OSPF v2
- RIP v1/v2
- Virtual Route Redundancy Protocol (VRRP)
- VRRP-E Metro features • Metro-Ring Protocol MRP (v1, v2)
- Virtual Switch Redundancy Protocol (VSRP)
- VLAN Stacking (Q-in-Q)
- VRRP
- Topology Groups Quality of Service (QoS)
- ACL Mapping and Marking of ToS/DSCP
- ACL Mapping and Marking of 802.1p
- ACL Mapping to Priority Queue
- ACL Mapping to ToS/DSCP
- Classifying and Limiting Flows Based on TCP Flags
- DHCP Relay
- DiffServ Support
- Honoring DSCP and 802.1p
- MAC Address Mapping to Priority Queue
- Priority Queue Management using Weighted Round Robin (WRR),
- Strict Priority (SP)

IEEE standards compliance

- 802.1AB LLDP/LLDP-MED
- 802.1D-2004 MAC Bridging
- 802.1p Mapping to Priority Queue
- 802.1Q with Tagging
- 802.1s Multiple Spanning Tree
- 802.1w Rapid Spanning Tree (RSTP)
- 802.1x Port-based Network Access Control
- 802.3 10BASE-T
- 802.3ab 1000BASE-T
- 802.3ad Link Aggregation (Dynamic and Static)
- 802.3ae 10 Gigabit Ethernet
- 802.3af Power over Ethernet
- 802.3at Power over Ethernet Plus
- 802.3u 100BASE-TX



- 802.3x Flow Control
- 802.3z 1000BASE-SX/LX
- 802.3 MAU MIB (RFC 2239)
- 802.1AE- MACsec (HW-capable): IT-645 only
- 802.3az-2010 - EEE (HW-capable) Traffic management • ACL-based inbound rate limiting and traffic policies
- Broadcast, multicast, and unknown unicast rate limiting
- Inbound rate limiting per port
- Outbound rate limiting per port and per queue High availability
- Redundant external power supply
- Layer 3 VRRP protocol redundancy
- Real-time state synchronization across the stack
- Hitless failover from master to standby stack controller
- Protected link groups
- Hot insertion and removal of stacked units

Management and control

- Auto Configuration
- ITSS/Brocade HyperEdge technology (HW-capable)
- Configuration Logging
- Digital Optical Monitoring (DOM)
- Display Log Messages on Multiple Terminals
- Embedded Web Management
- Embedded DHCP Server
- Industry-standard Command Line Interface (CLI)
- Key-based activation of optional software features
- Integration with HP OpenView for Sun Solaris, HP-UX, IBM AIX, and Windows
- ITSS/Brocade Network Advisor support
- MIB Support for MRP, Port Security, MAC Authentication, MAC-based VLANs
- Out-of-band Ethernet Management
- RFC 783 TFTP
- RFC 854 TELNET Client and Server
- RFC 951 Bootp
- RFC 1157 SNMPv1/v2c
- RFC 1213 MIB-II
- RFC 1493 Bridge MIB
- RFC 1516 Repeater MIB
- RFC 1573 SNMP MIB II
- RFC 1643 Ethernet Interface MIB
- RFC 1643 Ethernet MIB
- RFC 1724 RIP v1/v2 MIB
- RFC 1757 RMON MIB
- RFC 2068 Embedded HTTP
- RFC 2131 DHCP Server and DHCP Relay
- RFC 2570 SNMPv3 Intro to Framework
- RFC 2571 Architecture for Describing SNMP Framework
- RFC 2572 SNMP Message Processing and Dispatching
- RFC 2573 SNMPv3 Applications
- RFC 2574 SNMPv3 User-based Security Model
- RFC 2575 SNMP View-based Access Control Model SNMP
- RFC 2818 Embedded HTTPS
- RFC 3176 sFlow (ITSS/Brocade IT- 6450 only)



- SNTP Simple Network Time Protocol
- Multiple Syslog Servers

Embedded security

- 802.1X Accounting
- MAC authentication
- DHCP snooping
- Dynamic ARP inspection
- Bi-level Access Mode (Standard and EXEC Level)
- EAP pass-through support
- Packet filtering on TCP Flags
- IEEE 802.1X username export in sFlow
- Protection against Denial of Service (DoS) attacks
- Secure management Authentication, Authorization, and Accounting (AAA)
- Advanced Encryption Standard (AES) with SSHv2
- Bi-level Access Mode (Standard and EXEC Level)
- RADIUS/TACACS/TACACS+
- Secure Copy (SCP)
- Secure Shell (SSHv2)
- Username/password
- Web authentication

Physical Specifications

Dimensions • All 24-port models:

1.7 in. (H) × 17.44 in. (W) × 9.45 in. (D)

4.34 cm (H) × 44.3 cm (W) × 24 cm (D)

- All 48-port models:

1.7 in. (H) × 17.44 in. (W) × 14.57 in. (D)

4.34 cm (H) × 44.3 cm (W) × 37 cm (D)

- IT-64-1500:

1.7 in. (H) × 17.44 in. (W) × 14.57 in. (D)

4.34 cm (H) × 44.3 cm (W) × 37 cm (D)

Weight

- IT-24643: 7.58 lb (3.44 kg)
- IT-24P643: 10.08 lb (4.57 kg)
- IT-48643: 11.09 lb (5.03 kg)
- IT-48P643: 13.8 lb (6.26 kg)
- IT-24645: 7.39 lb (3.35 kg)
- IT-24P645: 10.03 lb (4.55 kg)
- IT-48645: 11.07 lb (5.02 kg)
- IT-48P645: 14.11 lb (6.4 kg)
- IT-64-1500: 14.85 lb (6.75 kg)

Environment Ranges

Temperature Operating temperature: 0°C to 45°C / 32°F to 113°F
Storage temperature: -40°C to 70°C / -40°F to 158°F

Humidity Relative humidity: 5% to 95%, non-condensing

Storage altitude 10,000 ft (3000 m) maximum

Acoustic (25°C)

- IT-24643: 37.9 dBA Fanless (ambient)
- IT-24P643: 39.2 dBA



- IT-48643: 37.2 dBA
- IT-48P643: 39.3 dBA
- IT-24645: 37.9 dBA
- IT-24P645: 39.2 dBA
- IT-48645: 37.2 dBA
- IT-48P645: 55.5 dBA
- IT-64-1500: 60.9 dBA

Vibration

- IEC 68-2-36, IEC 68-2-6

Shock and drop

- IEC 68-2-27
- IEC 68-2-32

MTBF (25°C, CL: 60%)

- IT-24643: 1,229,732 hours
- IT-24P643: 505,469 hours
- IT-48643: 748,262 hours
- IT-48P643: 384,288 hours
- IT-24645: 906,243 hours
- IT-24P645: 485,749 hours
- IT-48645: 756,081 hours
- IT-48P645: 397,590 hours
- IT-64-1500: 789,923 hours

Power

Power supplies • Integrated AC power supply for system and PoE power

- External 1500 W AC power supply for redundant system power and extended PoE power Power inlet (Max current rating at 100 V input)
- ITSS/Brocade IT- 12643: 1.8 Amp
- ITSS/Brocade IT- 24643: 0.9 Amp
- ITSS/Brocade IT- 24P643: 6 Amp
- ITSS/Brocade IT- 48643: 1.5 Amp
- ITSS/Brocade IT- 48P643: 6 Amp
- ITSS/Brocade IT- 12645-PD: 1.8 Amp
- ITSS/Brocade IT- 24645: 1.5 Amp
- ITSS/Brocade IT- 24P645: 6 Amp
- ITSS/Brocade IT- 48645: 2 Amp
- ITSS/Brocade IT- 48P645: 10 Amp
- ITSS/Brocade IT- 64-1500: 16 Amp Input voltage • Universal 100 to 240 VAC AC power cord current rating
- ITSS/Brocade IT- 12643/12645-PD: 10 Amp, 100 to 240 V
- ITSS/Brocade IT- 643 and 645 switches: 13 Amp, 100 to 240 V
- ITSS/Brocade IT- 64-1500: 20 Amp, 100 to 240 VDC power cord current rating
- ITSS/Brocade IT- 64-1500: 5.6 Amp at 12 V rail; 6.85 Amp at 54 V rail
- ITSS/Brocade IT- 64-1500: 3 DC cables included; cable length: 3 feet Input line frequency • 50 to 60 Hz Heat dissipation (no PoE load)
- ITSS/Brocade IT- 12643: 62 BTU/hr
- ITSS/Brocade IT- 24643: 67 BTU/hr
- ITSS/Brocade IT- 24P643: 104 BTU/hr
- ITSS/Brocade IT- 48643: 128 BTU/hr
- ITSS/Brocade IT- 48P643: 132 BTU/hr



- ITSS/Brocade IT- 12645-PD: 68.3 BTU/hr
- ITSS/Brocade IT- 24645: 124 BTU/hr
- ITSS/Brocade IT- 24P645: 129 BTU/hr
- ITSS/Brocade IT- 48645: 186 BTU/hr
- ITSS/Brocade IT- 48P645: 192 BTU/hr

Regulatory Compliance and Safety Approvals

Electromagnetic compatibility

- FCC Part 15, Subpart B, Class A
- ICES-003: 2004
- VCCI—Technical Requirement (V-3/2011.04)/Class A
- EN 55022: 2006+A1: 2007 Class A
- EN 61000-3-2: 2006+A1:2009+A2:2009 Class A
- EN 61000-3-3: 2008
- EN 61000-6-1: 2007
- EN 61000-6-3: 2007
- EN 55024: 1998+A1:2001+A2:2003
- EN 300 386 (V1.4.1): 2008
- IEC 61000-4-2: 2008 ED. 2.0
- IEC 61000-4-3: 2006+A1:2007+A2:2010 ED. 3.2
- IEC 61000-4-4: 2004+A1:2010 ED. 2.0
- IEC 61000-4-5: 2005 ED. 2.0
- IEC 61000-4-6: 2008 ED. 3.0
- IEC 61000-4-8: 2009 ED. 2.0
- IEC 61000-4-11: 2004 ED. 2.0

Safety • CAN/CSA-C22.2 NO. 60950-1-07; UL 60950-1 2nd Edition; IEC 60950-1 2nd Edition; EN 60950-1:2006 Safety of Information Technology Equipment; EN 60825-1 Safety of Laser Products—Part 1: Equipment Classification, Requirements and User's Guide; EN 60825-2 Safety of Laser Products—Part 2: Safety of Optical Fibre Communication Systems Environmental regulatory compliance

- RoHS-compliant (6 of 6); WEEE-compliant

Brocade NET Health

Brocade NET Health is an easy-to-use network discovery, audit, and health checking application for Brocade network switches. It is available at no cost to all Brocade customers and partners.

A Powerful but Easy-to-Use Tool

Brocade NET Health is a powerful, free-of-charge tool that helps you automate the process of optimizing your Brocade networks rather than having to manually track all the devices. Designed to run efficiently and provide easy-to-understand reports, this tool enables you to:

- Capture a point-in-time snapshot of your network environment with minimal effort
- Audit your network to easily track changes
- Check health parameters of your Brocade switches
- Make more proactive decisions to optimize your network



How Brocade NET Health Works

To run Brocade NET Health, you need a workstation with IP access and user credentials for the devices you want to audit. The tool's interaction with the devices is non-intrusive, and data collection takes approximately two to five minutes per device. (Brocade NET Health version 1.0 uses http, telnet, and ssh ports.)

For greater efficiency, you can schedule audits to run in the background. All audits are cumulative, in that multiple collection agents at different sites can be aggregated into a single file/report.

Download the Tool

[Download](#) the latest version of Brocade NET Health.

Upload your .NETHealth File

The result of running the Brocade NET Health tool is a generated .NETHealth audit file.

To get the full diagnostics for the audit, you can e-mail the .NETHealth file as an attachment to NETHealthFileUpload@brocade.com.

Or you can submit the file via the [upload page](#).

After Brocade processes your file, you will receive an e-mail with instructions to download the final report from your secure MyBrocade or Brocade Partner Network account. If you do not have a [MyBrocade](#) or [Partner Network](#) account, Brocade NET Health will automatically register you for access. *Please allow five business days to get your report.*

Provide Feedback and Request New Features

Brocade NET Health provides a framework for discovery and reporting that is designed for continual enhancement. If you have any feedback or requests for enhancements, send them to NetHealthAdmin@brocade.com.

3 –Year Support

Brocade ICX 6430 and 6450 Switches are supported by next-business-day advance replacement where available, as well as software defect repairs and maintenance updates. In an effort to further improve service levels and operational efficiency, Brocade includes three years of technical support for Brocade IT-643 and It-645 Switches, providing direct access to the Brocade Technical Assistance Center during normal 8x5 business hours.

Warranty

| | | | | | | |
|--|---|--|---|--|--|-------------------------------------|
| Brocade Assurance Limited Lifetime Warranty³ | FC, FSX800/1600, IT-661, IT-643, IT-645 | Life of product ¹ Initial registered end user only | Advanced Hardware Replacement (Next Business Day where available) | Life of product ¹ Initial registered end user only | Software defect repairs and software maintenance updates through the product end of support date. Knowledge portal | Removable optics, LEDs ² |
|--|---|--|---|--|--|-------------------------------------|



FWS & TI-24X

access.

Software defect
repairs for firmware
release current at
time of purchase
only. Knowledge
portal access.

For informational purposes only.

Terms and conditions apply. Brocade branded products only.

1 Covered through product end of support date

2 Subject to Brocade's Standard Limited Warranty

3 Applies only to Brocade branded FC, IT-661, IT-643, IT-645, FW and TI products purchased on or after October 1, 2009 or FI-SX800/1600 chassis and SX-FI modules purchased on or after July 1, 2010. Brocade branded FC, FW and TI products purchased prior to October 1, 2009 or FI-SX800/1600 chassis and SX-FI modules purchased prior to July 1, 2010 are covered under Brocade's Standard Limited Warranty.

8/2014

IT-64-1500
Specification

Brocade Enterprise Redundant power Supply

The following devices are supported by the ITSS/Brocade IT-64-1500:

IT-643-24P
IT-643-48
IT-643-48P
IT-645-24
IT-645-24P
IT-645-48
IT-648-48P

- Supports up to **three** connections to IT-643 and IT-645 devices stacked or in same rack
- Fixed internal power supply.
- Total power rating is 1500 W.
- Status LEDs located on the front panel.
- Universal (100-240 V) AC line cord draws power from power outlet.
- DC line cord provides power to the attached device.
- Thermal overload protection prevents the IT-64-1500 from overheating if a thermal overload occurs.
- Over-voltage protection shuts down an output channel if the voltage exceeds a preset threshold.
- Over-current protection shuts down the IT-64-1500 if the output load exceeds a preset threshold.
- Short-circuit protection prevents damage to the IT-64-1500 due to a short circuit on any output channel.
- If an IT-643 or IT-645 device is not connected to an EPS port, the power will not come up.
- Power supplies are hot swappable. The device can be running while the IT-643 or IT-645 units are connected to the IT-



64-1500.

In the event of an AC power loss or internal power supply device failure, the Brocade IT-64-1500 external power supply can be used as a backup power source to a device when any of the three ports are connected to an IT-643 or IT-645 device. Proprietary DC cables are used to connect any of the three EPS ports of the IT-64-1500 to the rear EPS port of an IT-643 or IT-645 device. For more information about connecting an IT-643 or IT-645 device to the IT-64-1500, refer to, [“Connecting devices to the external power supply”](#).

Each EPS port provides an external 12 V as redundant system power source (up to 65 W), and an external 54 V additional PoE power source (up to 370 W). When the IT-64-1500 is connected to an IT-643 or IT-645 non-PoE device, it operates as an external redundant power supply to the devices. In this case, only the 12 V of the EPS port is utilized by the device. The 54 V PoE power source is not used by the device.

NOTE: The internal power supply of the IT-643 or IT-645 device is not a field-replaceable unit (FRU). The devices must be shut down by administrators for replacement.

ITSS and Brocade recommends that you pay attention to the PoE or PoE+ port configuration of the device when connecting to an IT-64-1500. The internal power supply of each IT-643 or IT-645 PoE or PoE+ device has a maximum number of PoE or PoE+ ports that are supported. When the IT-64-1500 is connected to an IT-643 or IT-645 PoE device to be used as a redundant backup power source, Brocade recommends that the maximum number of PoE or PoE+ ports of the external power supply must not exceed the maximum number of PoE or PoE+ ports of the internal power supply capability of each IT-643 or IT-645 device. For more information about the maximum number of PoE or PoE+ ports supported with the internal power supply of a device, refer to [Table 6](#). For example, an IT-645-48P device with two EPS connectors must be connected to the IT-64-1500. If you increase the maximum number of PoE or PoE+ ports that can be supported in each IT-643 or IT-645 device, the IT-64-1500 cannot guarantee the devices are protected by the backup power source if the internal power supply fails. The IT-64-1500 will not have enough power to sustain the failed internal power supply. In this case, the device can go down even with the IT-64-1500 connected.

The IT-64-1500 has three DC output ports: EPS OUT 1, EPS OUT 2, and EPS OUT 3. Each port supplies 65 W of +12 VDC of DC power, and 370 W of 54 VDC of PoE power. The IT-64-1500 is powered on when it is connected to an active AC power source.

NOTE: The IT-64-1500 DC cable is hot-pluggable. You must pay attention to the PoE power usage to ensure that the devices are protected before removing the EPS connectors or AC power cords.

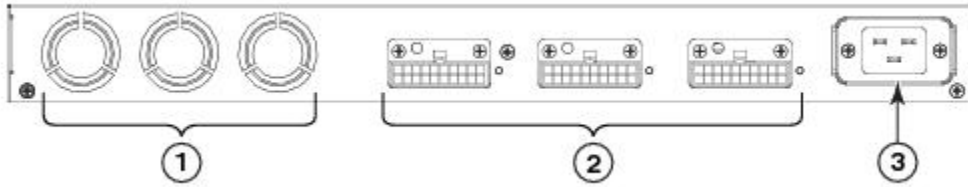
Three power indicators and three fan indicators are located on the front panel. Refer to [Figure 30](#). The AC supply and the three EPS DC backup receptacles are located on the rear panel. Refer to [Figure 31](#).

FIGURE 30 IT-64-1500 front panel



1. System status indicators

FIGURE 31 IT-64-1500 rear panel



- 1 Fans
- 2 External power sockets 1-3
- 3 AC power socket

System Status LEDs on the IT-64-1500

PS 1 Green The power supply is operating normally. The port is providing power to the connected device at 12 V and 54 V of power.

Red The port is not delivering power to the device. Power failure at 12 V and 54 V of power.

EPS 2 Green The power supply is operating normally. The port is providing power to the connected device at 12 V and 54 V of power.

Red The port is not delivering power to the device. Power failure at 12 V and 54 V of power.

EPS 3 Green The power supply is operating normally. The port is providing power to the connected device at 12 V and 54 V of power.

Red The port is not delivering power to the device. Power failure at 12 V and 54 V of power.

FAN 1 Green The cooling fan is operating normally.

Amber The cooling fan has failed.

FAN 2 Green The cooling fan is operating normally.

Amber The cooling fan has failed.

FAN 3 Green The cooling fan is operating normally.

Amber The cooling fan has failed.

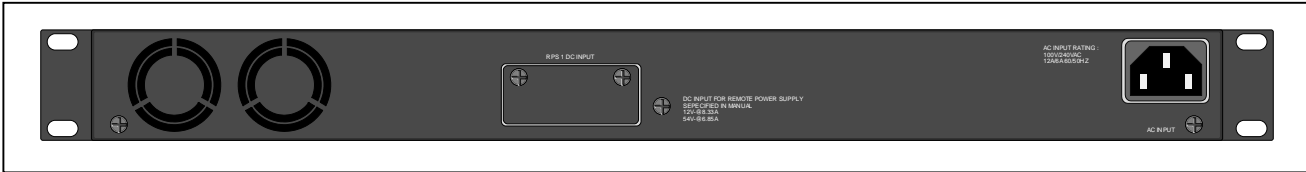


Brocade Switch CAD Drawing 2014

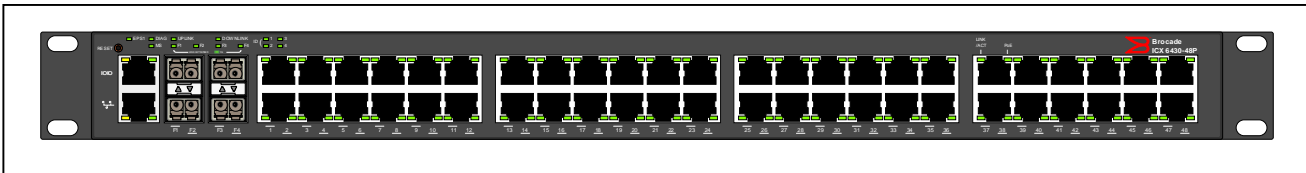
IT-48P643 ICX 6430-48P

IT-24645 ICX 6450-24

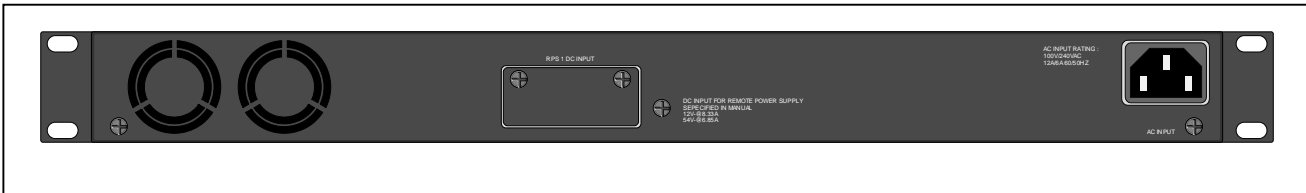
IT-48P643 ICX 6430-48P REAR VIEW



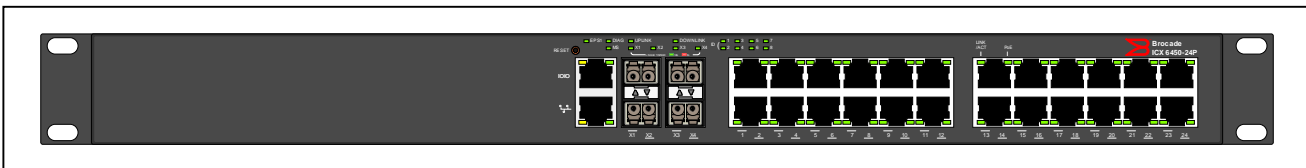
IT-48P643 ICX 6430-48P FRONT VIEW



IT-24645 ICX 6450-24 REAR VIEW



IT-24645 ICX 6450-24 FRONT VIEW



IT-64-1500 ICX 6400-EPS EXTERNAL POWER SUPPLY

