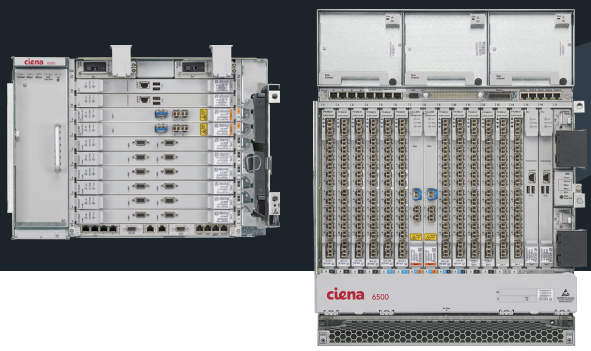
DATA SHEET

6500 PTS

Packet Transport System



Ciena's 6500 Packet Transport System (PTS) addresses the growing need to maintain profitable delivery of TDM services while future-proofing investments toward network modernization.

To this day, network providers continue to add to their Time Division Multiplexing (TDM) infrastructure—an investment that is getting more expensive to run and operate. Clearly doing more of the same only increases OPEX due to expensive spares and higher maintenance, hard-to-find legacy skill sets, and manual operations.

Today's operators have transitioned toward IP/MPLS architectures as the means to access and scale connectivity to legacy services. This is becoming critical to maintaining productivity while reducing costs.

As service providers approach the end-of-life of their legacy equipment, one clear objective is to maintain the profitable delivery of TDM services.

The 6500 PTS is purpose-built to save significant central office footprint and power and maintain substantial customer mission-critical private line services. It enables new IP and Carrier Ethernet services and allows simple customer TDM-to-Ethernet service migration as needed, without having to replace the platform or the transport network.

Ciena's 6500 PTS enables network providers to consolidate Digital Access Cross-connect System (DACS), Multi-Service Provisioning Platforms (MSPPs), routing, switching and transport functions, all in the same platform.

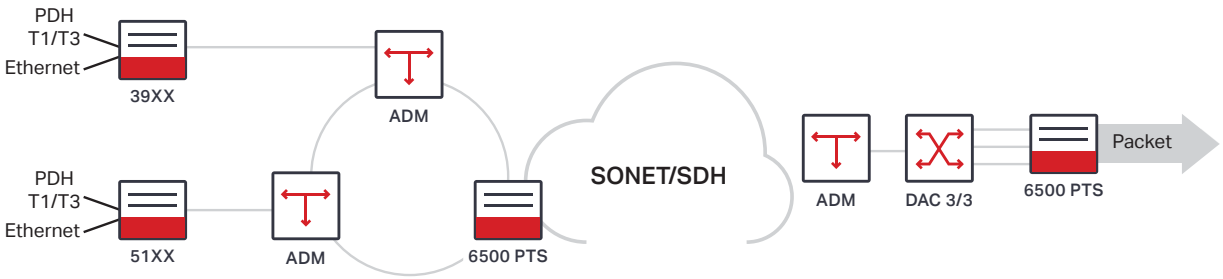
Enabling Ethernet, IP and TDM over the same network

Migration of TDM services can be complex and difficult, as not all TDM services can be replaced or shut down. In some cases, regulatory restrictions may exist for critical services, and in other cases, end-customers are reluctant to migrate even in the face of rising costs. Maintaining contractual and regulatory commitments while meeting new IP/MPLS demand using two different networks is inefficient and adds cost.

With massive and unpredictable bandwidth demands, network operators need to manage, consolidate, and modernize TDM assets (Figure 1).

Features and benefits

- Exceptional DS1, DS3, E1, E3, OC-3/12/48/192, STM-1/4/16/64, and 10/100/1GbE/10GbE, 40GbE/100GbE density to address space constraints
- Preserves TDM service, no change to customer end or revenue, customer experience, and tariffs
- Launches new IP/MPLS and CE services, including MEF CE 3.0-certified for E-Tree, E-Line, E-LAN, E-Access, and E-Transit
- Features hardware-assisted OAM capabilities for guaranteed SLA differentiation
- Offers Zero-Touch Provisioning (ZTP) for rapid, secure, and error-free turn-up of services
- Includes advanced synchronization
- Integrates line-rate Service Activation Testing capabilities
- Includes Ciena's MCP multi-layer provisioning support for end-to-end network management control and planning
- Offers flexible low-power configuration options with redundant power supply (DC) and fan modules



Traditional SONET/SDH Network Architecture

Figure 1. 6500 PTS TDM and multi-service packet delivery

Ciena's 6500 PTS effortlessly supports replacement of massive legacy 3/1 DACS, enabling DS1 and VT1.5 level switching through an Ethernet/OTN fabric. The same fabric also allows operators to replace and consolidate MSPP SONET/SDH platforms, with the ability to transport circuit-switched Ethernet services using a variety of encapsulation protocols.

Multiple Add-Drop Multiplexer (ADM) rings are also supported on the 6500 PTS, saving even more space and power.

As an MPLS switch, network operators can modernize their TDM network, enabling migration of TDM services to an MPLS protected core network. In addition, the 6500 PTS operates as a standard MPLS switch for transport and switching of Ethernet services and a pathway to future IP services.

Scalable, dense capacity

Native TDM networks are becoming obsolete, operationally expensive, difficult to maintain, power- and space-inefficient, and unable to handle traffic efficiently.

Using 6500 PTS provides a high-density TDM and native Ethernet on-ramp to a next-generation packet optical network. As services transition from TDM-to-Packet, the same 6500 PTS can be used to support Ethernet and IP/MPLS services and seamlessly transport the legacy TDM services.

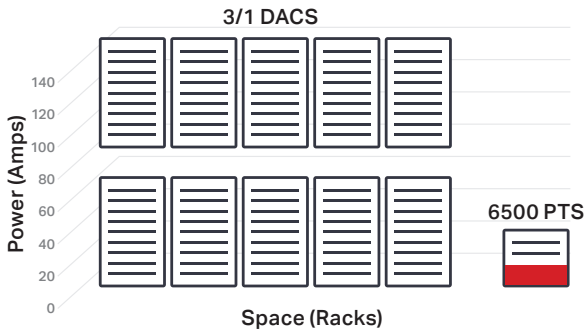


Figure 2. Power and space usage in DACS versus 6500 PTS

Addressing TDM migration by expanding the use of legacy equipment is not a sustainable business model. As shown in Figure 2, traditional legacy 3/1 DACS equipment can take up to ten times the space and five times the power as the 6500 PTS.

Using advanced routing and switching technology and Ethernet/OTN switching fabric, the 6500 PTS delivers unprecedented scale and density.

Differentiation through service velocity

Service velocity has become a critical competitive advantage for network operators. In many cases, service velocity is the determining factor in winning new service sales. The 6500 PTS implements Ciena's unique and secure Zero-Touch Provisioning (ZTP) capabilities, allowing network operators to rapidly deploy IP/MPLS services in a completely automated manner. With no human intervention required, manual provisioning errors are eliminated. Most importantly, ZTP improves service deployment velocity and offers significant competitive advantages.

Rich OAM capabilities

As network operators and their customers increasingly rely on new IP/MPLS networks, providers must maintain the reliability and deterministic behavior of the legacy TDM services. Networks must support a broad array of Operations, Administration, and Maintenance (OAM) capabilities to ensure network operators can proactively and reactively maintain and report on the ongoing health of their metro Ethernet networks and services. The 6500 PTS supports a comprehensive set of hardware-assisted OAM capabilities—including per-service Ethernet fault (IEEE 802.1ag) and performance monitoring (ITU-T Y.1731), and embedded line-rate Service Activation Test (RFC2544 and Y.1564 KPI's)—to help guarantee and manage strict, market-differentiating SLAs.

Link Aggregation Group (LAG), Distributed-LAG (D-LAG), MPLS-TP, or MPLS alternate path capabilities provide redundancy and resilience by addressing single-point-of failure concerns and maintaining high levels of customer satisfaction.

Simplified multilayer management and control

Ciena's Manage, Control and Plan (MCP) domain controller software offers a unique and comprehensive solution for the administration of mission-critical networks that span access, metro, and core domains, and provides unprecedented multilayer visibility from the photonic to the network layer. With this innovative management approach, MCP returns control of the metro network and services directly to the network operator. By providing a unified view of the network from the photonic layer to the network layer, MCP ensures network operations are simple, secure, and highly cost-effective.

Advanced timing and synchronization options

The heartbeat of any circuit-based network is timing. The 6500 PTS supports a flexible arrangement of timing modes of operation including an internal clock, BITS, Line, Synchronous Ethernet, and 1588v2-Grand Master, boundary, and ordinary clock support.

Flexible service delivery configurations

The 6500 PTS supports a flexible menu of service offerings ranging from MEF-compliant E-Line/E-LAN/E-Tree/E-Access/E-Transit, to L3 services over a carrier-class, connection-oriented infrastructure using MPLS, MPLS-TE, and MPLS-TP.

Advanced QoS support

The 6500 PTS supports fine-grained SLA monitoring and enforcement techniques to help operators deliver successfully on tight SLA guarantees. Hierarchical QoS permits delivery of a wide range of traffic types including management, timing/synchronization, multiple customer-prioritized, and best-effort service traffic, without interference or degradation. These capabilities enable greater revenue generation by utilizing available network resources more efficiently.

Sophisticated VLAN tag manipulation and control allow innovative customer traffic separation approaches and a rich set of classification of service flows through the switch. Hierarchical ingress metering can be configured for sub-port services, offering the ultimate in flexible flow control based on L2, L3, and L4 classification. In addition, egress bandwidth shaping on a per-EVC basis is built to allow fine-tuning delay and buffering efficiency within the device.

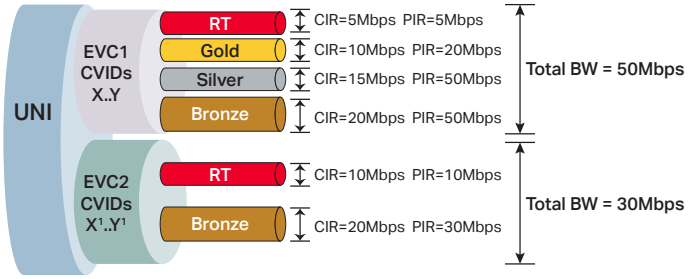


Figure 3. Hierarchical QoS supports multiple services

Multiservice-capable circuit emulation

In addition to its industry-leading Ethernet capabilities, the 6500 PTS supports multiservice transport over Ethernet networks, allowing traditional TDM, ATM, and native Ethernet traffic to be carried over metro backhaul and core data networks.

- Structured Agnostic TDM access (T1/E1 – SAToP)
- Structured Aware TDM access (nxDS0/E0- CESoPSN)
- Full support of IETF Pseudowire Emulation Edge-to-Edge (PWE3) over Ethernet and MPLS networks

The 6500 PTS takes circuit emulation to the next level, allowing the service to be carried as a co-routed, route-diverse protected service adhering to strict deterministic and restoration needs.

Advanced multi-layer protocol support

Making liberal use of a Ethernet/OTN fabric to support TDM circuit emulation Ethernet, IP, and MPLS technologies, the 6500 PTS can support any number of new network architectures.

The 6500 PTS supports a flexible selection of service offerings, including L2 and L3 services over a carrier-class, connection-oriented infrastructure using MPLS and Segment Routing (SR). Using SR policy, different source-routed domains and their services, including L2VPN, TDM-PW, and L3VPNs, can be selected for a path to upstream routers. Ciena's 6500 PTS supports coexistence of SR and other signaling protocols, including Resource Reservation Protocol-Traffic Engineering (RSVP-TE), enabling seamless MPLS connectivity and scalability of intra domain SR paths.

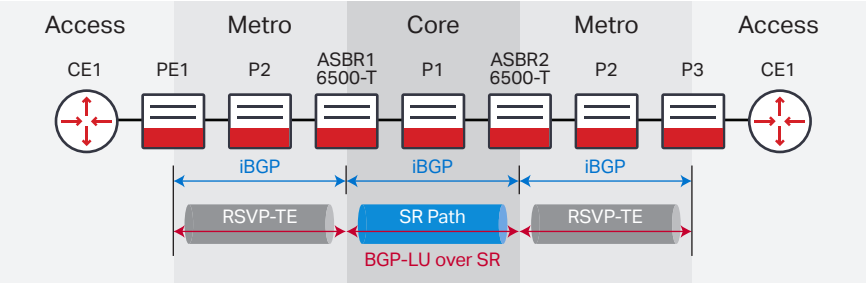


Figure 4. BGP-LU over Segment Routing

6500 PTS supports Border Gateway Protocol (BGP); Exterior Gateway Protocol (ERP); BGP-Labeled Unicast (BGP-LU) multiprotocol extensions; BGP Route Reflectors (BGP RR) to learn available routes without creating loops; and BGP Prefix Independent Convergence (BPG PIC) performance enhancements to decrease PE path convergence time should an Interior Gateway Protocol (IGP) or edge PE router fail and switch to a different PE router.

Dedicated, Virtual Routing Forwarding (VRF) instances per L3VPN or IPVPN can be provided on the 6500 PTS over MPLS transport (RSVP-TE or SR) to take advantage of MPLS resiliency such as FRR/TI-LFA, etc.

Technical Information

Description	6500-S8	6500-S14
H x W x D (mm)	7U 310 x 440.5 x 281	13U 577.1 x 440.5 x 280
H x W x D (inches)	7U 12.2 x 17.3 x 11.1	13U 22.7 x 17.3 x 11.0
Chassis Per Rack	6	3
Weight (Max)	33Kg	56Kg
DC Input	1x 50A	2x 50A
Power Consumption (Watts@ 25° C/ -48vDC, no optics)	1333W (Typical)	1960w (Typical)
Operating Temp.	Normal: 41° F to 104° F (5° C to 40° C)	
Storage Temp.	-40° F to 158° F (-40° C to 70° C)	
Relative Humidity	5% to 85% RH (normal operating humidity)	
Air Flow	Front to back, front to front, and right to left	Front to front, and front to back

Control Timing & Fabric Switch Modules

Shelf processor

SP2: local craft access, security, event history, alarms, and controls

Fabric switch

X-CONN 800G PTS: 1x QSFP28/QSFP+, 2x SFP+

Ethernet

Hierarchical Quality of Service (HQoS) including Ingress Metering/Egress shaping

IEEE 802.1ad Provider Bridging (Q-in-Q) VLAN full S-VLAN range

IEEE 802.1 D MAC Bridges

IEEE 802.1p Class of Service (CoS) prioritization IEEE 802.1Q VLANs

IEEE 802.1Q VLANs

IEEE 802.3 Ethernet

IEEE 802.3ab 1000Base-T via Copper SFP

IEEE 802.3ad Link Aggregation Control Protocol (LACP)

IEEE 802.3ba-2010 40Gbe & 100GbE

IEEE 802.3u Fast Ethernet

IEEE 802.3z Gigabit Ethernet

Jumbo Frames to 9,600 bytes

Layer 2 Control Frame Tunneling

Link Aggregation (LAG): Active/Active; Active/ Standby

MEF 10.2 Egress Bandwidth Shaping per EVC per COS

Per-VLAN MAC Learning Control

Private Forwarding Groups

VLAN tunneling (Q-in-Q) for Transparent LAN Services (TLS)

Tributary Service Interfaces

PDH Modules:
PTS PDH I/F 2xDIM: 168xDS1/E1 ports or 48xDS3/E3/EC1 CEM

PTS PDH I/F 10X DIM 1:N PROTECTION: up to 1:5 PDH protection

84xDS1/E1 DIM

24xDS3/E3/EC1 DIM unprotected, 1:1 protection or 1:5 protection

MRO Module:
- PTS MRO I/F 2xSFP+/14xSFP: 16x SFP

(16xOC-3/12/STM-1/4, 8xOC-48/STM16, 2x OC192/STM-64, or 16x100FX/GbE

(10/100/1000BaseT), or 2x10GbE ports

Ethernet Module:
PTS ETH I/F 40G 16 PORT (4X SFP+/16X CSFP) CIRCUIT PACK
- 4xSFP+ (4x10GE)
- 16xSFP (16x 10/100BaseT/ 100FX/ GE)
- 16xCSFP (32 GE ports)

PTS ETH I/F 100G 12 Port (2x QSFP28/10xSFP+) Circuit Pack
- 1xQSFP+ (1x40GE, 4x10GE)
- 1xQSFP+/QSFP28 (1x100GE, 1x40GE, 4x10GE)
- 10xSFP+ (10x10GE)

DWDM Module:
OTR WL3n Enh: 1xQSFP28

Any module; any slot

Technical Information continued

MEF CE 3.0 Compliant

E-Transit: Transit E-LINE, Transit E-LAN

E-Access: Access EPL, Access EVPL

E-LAN: EP-LAN, EVP-LAN

E-LINE: EPL, EVPL

E-Tree: EP-Tree, EVP-Tree

Carrier Ethernet OAM

EVC Ping (IPv4)

IEEE 802.1ab Link Layer Discovery Protocol (LLDP)

IEEE 802.1ag Connectivity Fault Management (CFM)

IEEE 802.3ah EFM Link-fault OAM

ITU-T Y.1564 Ethernet Service Activation Test Methodology

ITU-T Y.1731 Performance Monitoring (SLM; DM)

RFC 2544 Benchmarking Methodology for Network Interconnect Devices

RFC 5618 TWAMP Responder and Receiver TWAMP Sender

Synchronization

GR-1244

ITU-T G.781

ITU-T G.813

ITU-T G.823/G.824

ITU-T G.8262 Synchronous Ethernet

ITU-T G.8262/G.8264 EEC option1 and option2

ITU-T G.8261

Stratum 3

Line Timing Interfaces:
- 1GbE/10GbE/40GbE/100GbE In and Out
- OC-n/STM-n In and Out

External Timing Interfaces:
- BITS in or out (T1: 1.544Mb/s, E1: 2.048MHz and 2.048Mb/s, 64kHz CC (SDH-J)

Networking Protocols

Automatic Pseudowire Reversion

Layer 2 Control Frame Tunneling over MPLS Virtual Circuits

BGP Prefix Independent Convergence

MPLS Label Switch Path (LSP) Tunnel Groups

MPLS Label Switch Path (LSP) Tunnel Redundancy

MPLS Virtual Private Wire Service (VPWS)

Plane RFC 2205 RSVP

RFC 2439 BGP Route Flap Damping

RFC 2474 Definition of the Differentiated Services

Field (DS Field) in the IPv4 and IPv6 Headers

RFC 2918 Route Refresh Capability for BGP-4

RFC 3031 MPLS architecture

RFC 3107 Support BGP carry Label for MPLS

RFC 3209 RSVP-TE: Extensions to RSVP for LSP

RFC 3392 Capabilities Advertisement with BGP-4

RFC 3784 ISIS TE support

RFC 3942 Reclassifying Dynamic Host Configuration Protocol version 4 (DHCPv4) Options

RFC 3985 Pseudo Wire Emulation Edge-to-Edge (PWE3) Architecture

RFC 4090 Fast Reroute Extensions to

RSVP-TE for LSP tunnels

RFC 4124 Protocol Extensions for Support of Diffserv-aware MPLS Traffic Engineering

RFC 4271 A Border Gateway Protocol 4 (BGP-4)

RFC 4272 A Border Gateway Protocol 4 (BGP-4)

RFC 4360 BGP Extended Communities Attribute

RFC 4364 BGP/MPLS IP Virtual Private Networks (VPNs)

RFC 4385 Pseudowire Emulation Edge-to-Edge (PWE3) Control Word for Use over an MPLS PSN

RFC 4447 Pseudowire Setup & Maintenance using Label Distribution Protocol (LDP)

RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks (PW over MPLS)

RFC 4456 BGP Route Reflections: An Alternative to Full Mesh Internal BGP (IBGP)

RFC 4664 Framework of L2VPN (VPLS/VPWS)

RFC 4665 Service Requirement of L2 VPN

RFC 4724 Graceful Restart Mechanism for BGP

RFC 4760 Multiprotocol Extensions for BGP-4

RFC 4762 VPLS (Virtual Private LAN Service) and Hierarchical VPLS (H-VPLS)

RFC 5085 Pseudowire Virtual Circuit Connectivity Verification (VCCV): A Control Channel for Pseudowires

RFC 5287 Control Protocol Extensions for the Setup of Time-Division Multiplexing (TDM) Pseudowires in MPLS Networks

RFC 5291 Outbound Route Filtering Capability for BGP-4

RFC 5292 Address-Prefix-Based Outbound Route Filter for BGP-4

RFC 5301 Dynamic Hostname Exchange Mechanism for IS-IS

RFC 5303 Three-Way Handshake for IS-IS Point-to-Point Adjacencies

RFC 5493 BGP capabilities advertisement

RFC 5654 MPLS-Transport Profile (TP)
- LSP Static provisioning
- LSP Dynamic provisioning
- 1:1 Tunnel protection

RFC 5884 LSP Bidirectional Forwarding Detection (BFD) via GAL/G-Ach channels

RFC 5905 NTP v4

RFC 6192 Protecting the Router Control Plane"

RFC 6215 MPLS Transport Profile User-to Network and Network-to-Network Interfaces

RFC 6426 MPLS On-demand Connectivity Verification and Route Tracing

RFC 7310 Bidirectional Forwarding Detection (BFD) on Link Aggregation Group (LAG) Interfaces

RFC 7311 The Accumulated IGP Metric Attribute for BGP

RFC 7490 Remote Loop-Free Alternate (LFA) Fast Reroute (FRR)

RFC 8102 Remote-LFA Node Protection and Manageability

RFC 8333 Micro-Loop Prevention by introducing a Local Convergence Delay

RFC 8402 Segment Routing Architecture

RFC 8660 Segment Routing with MPLS Data Plane

RFC 8667 IS-IS Extensions for Segment Routing

Segment Routing Policy Architecture draftietf-spring-segment-routing-policy-08

RFC 6428 LSP and PW Connectivity Verification and Trace Route

Static ARP and MAC Destination Address Resolution

VCCV (Virtual Circuit Continuity Check) Ping and Trace Route

Circuit Emulation:
RFC 4553 Structure Agnostic TDM over Packet
RFC 4842 SONET/SDH Circuit Emulation over Packet
RFC 5086 Circuit Emulation Service over Packet Switched Network

Network Management

Alarm Management & Monitoring Configuration

Comprehensive Management via OneControl Enhanced CLI

Integrated Firewall

IPv4 & IPv6 Management Support Local Console Port

Per-VLAN Statistics Port State Mirroring

RADIUS Client and RADIUS Authentication

Remote Auto configuration via TFTP, SFTP

Remote Link Loss Forwarding (RLLF)

RFC 959 File Transfer Protocol (FTP)

RFC 1035 DNS Client

RFC 1213 SNMP MIB II

RFC 1493 Bridge MIB

RFC 1573 MIB II interfaces

RFC 1643 Ethernet-like Interface MIB

RFC 2131 DHCP Client

RFC 3877 Alarm MIB

RFC 4291 – IPv6 addressing (for Management Plane)

RFC 4443 – ICMPv6

RFC 4862 – Stateless address auto-configuration

RFC 5905 NTP Client

Technical Information

Network Management continued

Secure File Transfer Protocol (SFTP)

Secure Shell (SSHv2)

SNMP v1/v2c/v3

SR-MPLS TI-LFA Topology Independent Fast Reroute using Segment Routing draftietfrtgwg-segment-routing-ti-lfa-03

SNMP v3 Authentication and Message Encryption

Software upgrade via FTP, SFTP

Syslog with Syslog Accounting

TACACS + AAA

Telnet Server

Virtual Link Loss Indication (VLLI)

Zero Touch Provisioning

Service Security

Broadcast Containment Egress Port Restriction

Hardware-based DOS Attack Prevention

Layer 2, 3, 4 Protocol Filtering

User Access Rights

Agency Approvals

- Australia C-Tick (Australia/New Zealand) CE mark (EU)
- EMC Directive (2014/30/EU)
- LVD Directive (2006/95/EC)
- RoHS2 Directive (2011/65/EU)

ETSI 300 019 Class 1.2, 2.2, 3.1E

GR-1089 Issue 6 – NEBS Level 3

GR-63-CORE, Issue 4 – NEBS Level 3, Zone 4 Earthquake

NRTL (NA)

VCCI (Japan)

Standards Compliance

Emissions:

CISPR 22 Class A

CISPR 32 Class A

EN 300 386

EN 55022

EN 55032

FCC Part 15 Class A

GR-1089 Issue 6

Industry Canada ICES-003 Class A

VCCI Class A

Environmental:

RoHS2 Directive (2011/65/EU)

Immunity (EMC):

CISPR 24

EN 300 386

EN 55024

GR-1089 Issue 6

Power:

ETSI EN 300 132-2

ETSI EN 300 132-3

Safety:

ANSI/UL 60950-1 2nd edition 2007

CAN/CSA C22.2 No. 60950-1-07

EN 60950-1

IEC 60825-1 2nd edition (2007)

IEC 60825-2 3rd edition (2004) IEC 60950-1