



VPX3-687

Versatile 1, 10, and 40 Gigabit Ethernet Switch. Variants available Developed in Alignment with the SOSA™ Technical Standard

The VPX3-687 is a versatile, fully managed multi-layer Ethernet switch designed for backplane Ethernet within 3U VPX systems. Supporting 1G, 10G, and 40G interfaces, the VPX3-687 is configurable for most OpenVPX backplane slot profiles, including a variant developed in alignment with Sensor Open Systems Architecture[™] (SOSA) Technical Standard.

Offering performance without compromise, the VPX3-687 provides switching and routing throughput of up to 320 Gbps, supporting full line-rate packet forwarding with up to 32x 10GbE ports, 8x 40GbE ports, or any combination of 1G, 10G, and 40G ports. Its non-blocking architecture is suitable for both low-latency Control Plane and highthroughput Data Plane applications. Port allocations are configurable through the management interface, with some standard port profile examples shown in Figure 1. Optional fiber optic I/O is supported on air-cooled variants through a front panel SFP+ transceiver cage.

Integrated multi-layer switching services software provides a range of networking features for filtering and forwarding traffic. Its single-switch architecture can allow traffic between Control and Data Plane ports when required, or, using policy features such as VLANs and ACLs, traffic between Control and Data Planes can be filtered or fully isolated.

The VPX3-687 supports an extensive range of Layer 2 switching and Layer 3 routing services. Network services include efficient L2 or L3 multicast, flexible quality of service (QoS), IPv4 and IPv6 routing, and a range of security features. On-board management software provides options for inband and out-of-band configuration and monitoring through a powerful command-line interface (CLI), SNMP, or via a web browser interface.

Validated for deployment in the harshest environments, the VPX3-687 is available in a range of air-cooled and conduction-cooled options. It includes extensive built-in test (BIT) features to assure correct operation.







Key features

- Ethernet connectivity for OpenVPX and CMOSS/SOSA-Aligned systems
- Fully-managed multi-layer L2 switching and L3 routing services, including multicast, QoS, IPv4 and IPv6, and security features
- Configurable for multiple OpenVPX switch module profiles, including 2F24U, 8F, 6F8U, 4F16U and a SOSA-aligned 6F1U7U variant
- Low-latency, high-throughput line-rate forwarding up to 320 Gbps
- Support for Gigabit, 10 Gbps and 40 Gbps backplane Ethernet standards
 - + Up to 32x 10 GbE or 8x 40GbE interfaces in a single VPX 3U slot
- IEEE-1588 PTP transparent clock for high-precision system-level time synchronization

Applications

- High-performance connectivity for HPEC, sensor, video, and other embedded processing systems
- High reliability embedded and airborne applications
- Industrial Ethernet switching/routing in harsh environments

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Figure 1: VPX3-687 Block Diagram

Features

10G/40G Ethernet for Modern Embedded Systems

Developed to connect modules within 3U VPX systems, the VPX3-687 delivers high-performance switching and routing with the latest managed networking features combined with the security and reliability required for today's rugged embedded applications.

Built around the Broadcom® BCM56842 Trident+ switch device, the VPX3-687 is configured to provide up to 32 ports of mixed 1G/10G/40G Ethernet to the backplane to enable rugged processing systems with flexible high-speed Ethernet interfaces.

IEEE 802.3 Backplane Ethernet

To connect between VPX modules within a chassis, the VPX3-687 features standards-based IEEE 802.3 backplane Ethernet. Up to 32 lanes of SerDes Ethernet are supported, with flexible port configurations to fit into any system. When configured as 10GBASE-KR, the ports provide link training and auto-negotiation, and are compatible with 1000BASE-KX gigabit link partners. Groups of four lanes can be combined into a single 40GBASE-KR4 interface, offering high-speed 40G Ethernet interfaces for fast network traffic. These 40G ports can also be used as uplink or backbone/trunk ports for switch-to-switch connectivity.

Figure 2 shows a VPX3-687 module partnered with a Curtiss-Wright VPX3-655 Ethernet switch module via an 80Gbps inter-switch trunk. In this example, the VPX3-687 provides 24 lanes of 10G and/or 40G backplane Ethernet to boards within a chassis. The VPX3-655 provides 12 lanes of 10GBASE-T twisted pair Ethernet, which is ideal for longer distance out-ofthe-box connectivity to external devices requiring 10G, 1G, or 100M copper Ethernet. Two 40G ports are combined using Link Aggregation to form an 80Gbps switch-to-switch trunk.

For compatibility with fixed-speed Ethernet links, such as FPGA devices, links can also be configured to support the PICMG 1000BASE-BX standard without auto-negotiation.







Figure 2: Dual Switch Example with External Base-T Ports

Flexible Management Interfaces

The VPX3-687 is a complete networking solution with integrated software that provides a range of multi-layer services. Management interfaces for switch configuration and monitoring include a flexible command-line interface (CLI), SNMP, and a web-based interface.

The VPX3-687's command line interface is available on a dedicated serial console port and also available in-band via SSH on any of the switch's Ethernet interfaces. It features a range of usability features, including command completion, enables configuration auditing, and facilitates the deployment of standard configurations.

For switch management and operations using SNMP, the VPX3-687 implements a wide range of standards-based MIBs.

For enhanced security, in-band ports can be restricted from management capabilities, allowing only specific ports, or no in-band ports at all, to access management functions.

High-performance Packet Switching

The VPX3-687 features a 320 Gbps switching core that provides line-rate, non-blocking forwarding for all packet sizes in all configurations. It performs extensive packet processing in hardware to provide an array of features at full rate without performance degradation Traditional embedded and enterprise switches are based on a store-and-forward model which waits for a full packet to be received and processed before it is forwarded to the destination. To meet the requirements of the latest real-time processing and high-performance embedded computing systems, the VPX3-687 also provides a cut-through switching mode that enables submicrosecond forwarding latency.

Powerful Packet Switching Services

In today's embedded systems, a switch must provide more than connectivity – it must also participate in converged network architectures that utilize the power of network services and secure and reliable packet forwarding.

Managed networking software integrated on the VPX3-687 provides a rich set of enterprise-class multi-layer switching features. Policy features such as virtual LANs (VLAN) and Access Control Lists (ACLs) allow traffic to be filtered, segregated and/ or restricted. Support for IGMP snooping allows multicast traffic to be efficiently forwarded to multiple destinations at hardware speeds. Flexible quality of service (QoS) mechanisms can classify traffic to provide priority forwarding to delay-sensitive, real-time applications. Port security and 802.1x authentication restrict access to the network to trusted devices.

Ethernet switching on the VPX3-687 is based on the IEEE 802.1d standards for bridging. Support for the Spanning Tree Protocols (STP) provides automated topology discovery for loop-free forwarding at a line rate between any devices on the LAN. It includes support for RSTP and MSTP to provide faster recovery when links fail or topology changes.

QoS and Real-Time Networking

For applications where many devices share the network, a variety of QoS mechanisms are available to manage congestion and prioritize time-sensitive flows. Hardware parsing allows the classification of packets based on L2-L4 headers filtering and differential service policies. Multiple output queues per port and configurable queue service schemes enable low-latency treatment for high-priority traffic. Rate limiting can be used to police best-effort traffic to enforce partitioning of overall network bandwidth.

Layer 3 Routing

In addition to all the Layer-2+ switching features, the VPX3-687 can be ordered with Layer 3 IP routing features. Supporting both static and dynamic IPv4 and IPv6 routing protocols, the VPX3-687 can participate in larger platform-wide or off-platform routed networks, efficiently routing traffic between network segments.



Secure Management Interfaces

As embedded computers transition from stand-alone appliances to connected systems, the importance of network security grows. The VPX3-687 is designed with cybersecurity in mind and uses a number of approaches to limit and mitigate potential vulnerabilities.

To support both system development and stable deployment, VPX3-687 offers multiple management interfaces for configuring and monitoring its networking features. These administrative interfaces can be individually disabled to limit access, protected with passwords, or secured with standards-based encryption. Hardware write-protection features can be used to prevent unauthorized or unintentional modification of the switch configuration. Logging of configuration changes and administrative actions facilitates security audits. Other network services exposed on the switch interfaces can be disabled to limit potential network threats further.

Time and Synchronization

Maintaining accurate time is essential for many applications, including those that combine data from multiple sensors or connected systems. To enable high-precision synchronization of real-time clocks over the Ethernet network, the VPX3-687 supports the IEEE 1588-2008 Precision Time Protocol. Acting as a transparent clock, the switch uses hardware timestamps in the switch to account for the transit time through the network, allowing connected endpoints to synchronize with sub-microsecond precision.

Built-in Test (BIT) for Reliability and Serviceability

The VPX3-687 features a comprehensive power-on built-in test (PBIT) suite to detect hardware faults that affect module performance. Additional tests can be initiated (IBIT) upon demand while the card is operational. To support diagnostics and monitoring at the system level, interface status and statistics are available via the management CLI as Continuous BIT (CBIT).

These vital signs can also be monitored using an array of SNMP MIBs.

- PBIT for power-up self-test
- IBIT for user-initiated self-test
- CBIT for continuous self-test and monitoring

Designed for Harsh Environments

Curtiss-Wright modules are designed and manufactured to meet the challenging requirements of military, aerospace, and industrial environments and benefit from decades of experience and investment focused on achieving the highest levels of quality and durability. The VPX3-687 is available in the Curtiss-Wright standard L0, L100, and L200 ruggedization levels.

Conduction-cooled modules are also offered with VITA 48 two-level maintenance covers to create a truly field-serviceable Line Replaceable Module (LRM), ruggedization level L300.

Full details of Curtiss-Wright's standard Ruggedization Guidelines can be found on the <u>Curtiss-Wright website</u>.

Software Maintenance

To keep pace with emerging requirements and security threats, Curtiss-Wright continues to maintain network switch embedded software over the full life-cycle of a product. Customers with an active support contract receive access to periodic updates that address emerging and potential vulnerabilities and maintain compliance with published specifications.

Accessories for Development

To facilitate system development in a lab environment, Curtiss-Wright provides a Rear Transition Module (RTM) that plugs into the backside of the VPX3-687's backplane slot. The RTM-687-0008 shown in Figure 3 provides access to interfaces on industry-standard connectors, using an oversized board for sufficient area to support many connectivity ports.



Figure 3: RTM-687-0008 Rear Transition Module



RTM Connectivity:

- RS-232 serial port for management console and RJ-45 Ethernet port for maintenance operations
 - 8 x QSFP+ slots map to the 32 backplane SerDes Ethernet interfaces
 - Supports passive (unpowered) QSFP+ and SFP+ directattach cables up to 3 m in length
- 10.3125 and 1.25 GBaud SerDes modes only

For SOSA variants, a separate RTM (RTM3-SWH-0001) shown in Figure 4 is offered and provides access to serial ports for configuration and updates. No Ethernet ports are available on this RTM.

An optional cable (CBL-663-0000) is available to access the Ethernet maintenance port for SOSA variants.



Figure 4: RTM3-SWH-0001 Rear Transition Module for SOSA Variant

VPX Slot Profiles

Two main hardware variants are available - one for classic OpenVPX switch slot applications and one for SOSA-aligned switch applications.

Classic OpenVPX profiles draw primary power from the VPX Vs3 (+5V) power rail. They also allow 'User Defined' I/O signals on some P1 and all P2 single-ended signals, through which the VPX3-687 implements a 100BASE-TX maintenance port, and an RS-232 maintenance port.

As an example of a classic OpenVPX profile, Figure 4 shows a switch slot profile with 6 Fat Pipes for the Data Plane supporting 40GBase-KR4 ports, and 8 Ultra-Thin Pipes for the Control Plane supporting 10GBase-KR. Other profiles with different mixes of Fat Pipe vs. Ultra-Thin Pipes for both planes are allowed under OpenVPX and can be implemented by reconfiguration of the switch through the management interface.



Figure 5: OpenVPX Example SLT3-SWH-6F8U-14.4.9

SOSA-aligned profiles require boards to draw primary power from the VPX Vs1 (+12V) power rail only. Switch profile SLT3-SWH-6F1U7U-14.4.14, shown in Figure 5, defines all VPX I/O pins, some of which are reserved. P2 wafer 9 is grounded between the Data Plane and Control Plane sections, so one fewer Control Plane lanes is available. A single UART Maintenance Port is available using LVCMOS signaling levels. The 100BASE-TX management port is not available in the SOSA-aligned variant.



Figure 6: SOSA-Aligned Profile SLT3-SWH-6F1U7U-14.4.14





Specifications and standards

Form factor

- 3U OpenVPX, in two orderable versions:
 - Classic OpenVPX switch profile variants supports all 32 lanes and multiple profiles, including
 - SLT3-SWH-6F8U-14.4.9
 - SLT3-SWH-8F-14.4.2
 - SLT3-SWH-2F24U-14.4.3
 - SOSA variant supports 31 lanes, developed in alignment with the SOSA Technical Standard profile
 - SLT3-SWH-6F1U7U-14.4.14
 - All variants provide configurable port assignments with groups of four 10G ports configurable as one 40G
 - Air-cooled versions optionally add one 10GBASE-SR front panel interface via SFP+ plug-in
- Conduction-cooled and air-cooled versions available

Ethernet interfaces

- 32 (or 31 for SOSA variant) SerDes backplane Ethernet lanes, supports 10GBASE-KR link training and autonegotiation, compatible with 1000BASE-KX
- 4 lanes can be combined for 1 x 40GBASE-KR4
- Auto-negotiation can be disabled for fixed-speed link partners

Forwarding performance

- Non-blocking at full line rate, all interfaces, all packet sizes
- Jumbo frames (up to 9 Kbytes)
- 2 MB packet buffer

Management Interfaces

- Serial Console (EIA RS-232 or LVCMOS (SOSA variant))
- In-band Web UI via HTTP/HTTPS
- In-band Console via SSH (IPv4, IPv6)
 - Multiple SSH ciphers via OpenSSL library
- SNMP v2c, SNMP v3

Health Management

• IPMC per VITA 46.11 for all Tier 1 and Tier 2 requirements

Built-in Test

- Power-up BIT (PBIT)
- User-Initiated BIT (IBIT)
- Continuous BIT (CBIT)

Power

- All variants require 3.3V_AUX power
- Primary Power
 - Standard OpenVPX variants: Vs3 (5V)
 - SOSA variants: Vs1 power (12V)
- Optional VBAT power to maintain local real-time clock when 3.3V_AUX is removed
- Power consumption: 49 W typical, 60
 W max

Environmental

- Air-cooled:
 - Level 0 (0°C to +50°C)
 - Level 100 (-40°C to +71°C)
 - VPX slot pitch: 1.0"
- Conduction-cooled:
 - Level 200 (-40°C to +85°C), VPX slot pitch: 0.8"
 - Level 300 (-40°C to +85°C) with
 2-level maintenance covers per VITA
 48.2, Type 1, VPX slot pitch: 1.0"
- Contact factory for VITA 48.8 Air Flow-Through cooling options

Weight (nominal)

- Air-cooled: 500g
- Conduction-cooled without L2 covers: 480g
- Conduction-cooled with L2 covers: 545g



Switching and Routing Features

Configuration Management

- · Configuration save and restore
- File system for storing multiple configurations
- Remote configuration save/restore via TFTP/SFTP

LAN Switching

- 802.1D Transparent Bridging
- Spanning Tree Protocol, RSTP, MSTP
- IEEE 802.1Q VLAN tagging
- Port-based VLANs
- IEEE 802.1v protocol-based VLAN
- 802.1ad QinQ
- GVRP, GMRP
- 9KB Jumbo frames
- Link Aggregation and IEEE 802.3ad LACP

DHCP

- DHCPv4 & DHCPv6 Client
- DHCPv4 & DHCPv6 Relay
- DHCPv4 & DHCPv6 Server
- Port-based DHCP binding
- MAC-based and port-based IP address assignment

Secure Access

- IEEE 802.1x port access control
- RADIUS, TACACS+ authentication

Timing Services

- IEEE 1588-2008 PTPv2 Transparent Clock
- SNTP client for local switch time

Network Services

- 802.1ab LLDP
- Port mirroring
- Storm control
- Syslog
- TCP and UDP statistics

Layer 2+ Routing Services

- Static routing, IPv4 & IPv6
- ARP, NDP monitoring & statistics
- ICMP, ICMPv6

IP Multicast Switching

- IGMP Snooping
- MLD Snooping

Policy & Filtering

 Access Control Lists (ACL) based on L2-L4 headers

Quality of Service

- IP DSCP class mapping, re-marking
- Configurable queue service including strict priority
- Rate limiting

IP Routing (L3 models only)

- OSPFv3
- IGMP
- BGP
- PIM SSM, PIM DM

SNMP MIBs

Contact Curtiss-Wright for details



VPX3-687 ordering information

To order the VPX3-687 product or software services, contact your local Curtiss-Wright sales representative or email ds@curtisswright.com.

Table 1: VPX3-687 Hardware Ordering Information

Part number	Ruggedization	Feature set	Description
VPX3-687-A04126	AC L0	L2	Air-cooled, L0. Switching feature set
VPX3-687-A04326	AC L0	L2 + L3	Air-cooled, L0. Switching & routing feature set
VPX3-687-A14126	AC L100	L2	Air-cooled, L100. Switching feature set
VPX3-687-A14326	AC L100	L2 + L3	Air-cooled, L100. Switching & routing feature set
VPX3-687-C21026	CC L200	L2	Conduction-cooled, L200. Switching feature set
VPX3-687-C21326	CC L200	L2 + L3	Conduction-cooled, L200. Switching & routing feature set
VPX3-687-C23026	CC L300 (2LM covers)	L2	Conduction-cooled, L300. Switching feature set
VPX3-687-C23326	CC L300 (2LM covers)	L2 + L3	Conduction-cooled, L300. Switching & routing feature set
VPX3-687-C25767	CC L300 (2LM covers)	L2 + L3	Conduction-cooled, L300. SOSA 6F1U7U profile
RTM-687-0008	Lab use	N/A	L-Shaped Rear Transition Module (RTM), 8 x QSFP+
RTM3-SWH-0001	Lab use	N/A	Rear Transition Module (RTM) for SOSA variant
CBL-687-FPL-000	Lab use	N/A	Front panel serial port cable for air-cooled VPX3-687
CBL-663-0000	Lab use	N/A	Ethernet management port cable/adapter for VPX3-687-C25767 (P11 on base card)

Software maintenance is highly recommended during the active development phase of customer projects and provides software support and firmware/software updates for one year.

Table 2: VPX3-687 Software Maintenance

Part number	Description		
MNT-687-0020	Annual software maintenance service for VPX3-687 with switching (L2) software		
MNT-687-0030	Annual software maintenance service for VPX3-687 with switching and routing (L3) software		

VPX3-687

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