

VPX3-1260, E-OSA

3U VPX™ 8th Gen Intel® Xeon® E-2176M
Single Board Computer

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Key Features

- E-OSA Compliant General Purpose Processor (GPP)
- Intel 8th Gen Xeon “Coffee Lake” processor
- 6-Core (12-thread) Xeon E-2176M at 2.7 GHz with Turbo up to 4.4 GHz
- 32 GB DDR4 at 2,400 MT/s with ECC
- 80 GB high-performance NVMe onboard storage
- 1G-BaseT and 1/10G SerDes Ethernet connectivity
- Supports one XMC expansion mezzanine
- Conduction-cooled L300 with 2LM covers
- Supports Linux® (CentOS and Red Hat)

Applications

- E-OSA compliant computing with integrated graphics
- General computing and mission processing
- High-Performance Embedded Computing (HPEC) systems

Overview

The [VPX3-1260](#) from Curtiss-Wright Defense Solutions is a rugged, high-performance 3U OpenVPX™ single board computer (SBC) featuring the latest 8th Gen Intel Xeon processor with integrated graphics. Compliant to meet the Enterprise Open System Architecture (E-OSA) Tier 2 requirements as a General Purpose Processor (GPP), the VPX3-1260 offers a huge leap in performance over previous generations of GPP modules.

The Xeon E-2176M processor offers 6-core (12-thread) performance at 2.7 GHz. With 32 GB of dual-channel, high-speed ECC, protected DDR4 memory, the VPX3-1260 provides up to 38.4 GB/s memory throughput, maximizing the capabilities of the processor. The processor also features Intel’s AVX2 SIMD extensions, accelerating math-intensive algorithms with 518 GFLOPs of floating-point performance.

The Xeon processor includes an integrated Intel Graphics P630 graphics engine, offering discrete GPU performance with OpenGL® for graphics-intensive applications. It also serves as a GPGPU with performance up to 403 GFLOPS and OpenCL™ support for data processing-intensive applications.

Non-volatile storage of 80 GB capacity using high-speed on-board NVMe Flash storage makes the VPX3-1260 an ideal SBC for handling applications with demanding storage, data logging and sensor processing requirements.

External connectivity is provided with three Ethernet ports supporting one 1000Base-T and two 1/10G SerDes connections.

The VPX3-1260 also features high-speed PCI Express® (PCIe) Gen3 connectivity. The VPX backplane supports eight lanes of configurable PCIe fabric, offering flexible NTB assignment and supporting 8-lane, 4-lane, and 2-lane port widths. A local XMC mezzanine site supports an independent 8-lane PCIe Gen3 bus directly to the processor. These features make the VPX3-1260 an ideal building block when architecting systems requiring processor expansion or when connecting multiple processor boards together to create a High-Performance embedded system for ISR processing.

The VPX3-1260 is shipped with CentOS Linux pre-loaded from the factory, and supports Red Hat Enterprise Linux.

Features and Specifications

Form factor

- 3U OpenVPX, supporting an E-OSA Tier 2 compliant GPP profile

Processor

- Intel Xeon 'Coffee Lake' 8th Gen processor
 - + 6-Core (12 thread) Xeon E-2176M @ 2.7 GHz with Turbo up to 4.4 GHz
 - + 256 KB cache per core, 12 MB Intel Smart Cache
 - + Intel Streaming SIMD Extensions (SSE 4.1/4.2)
 - + Intel Advanced Vector Extensions (AVX, AVX2) floating-point
 - + Intel Trusted Execution Technology (TxT)
 - + Intel Virtualization Technology (VT-x, VT-d)
 - + Intel HD Graphics P630

Platform

- CM246 Chipset Platform Controller Hub (PCH)

SDRAM memory

- 32 GB DDR4 at 2,400 MT/s supporting 38.4 GB/s
- Dual-channel memory configuration with ECC

Non-volatile memory

- 80 GB NVMe SSD
- 16 MB SPI flash for BIOS functions

Backplane fabrics

- High-speed PCIe Gen3 connectivity
 - + 8-lane PCIe fabric supporting 1 x 8-lane, 2 x 4-lane or 4 x 2-lane configurations with support for one assignable NTB port
 - + Support for PCIe Gen1 (2.5 GT/s), Gen2 (5.0 GT/s) and Gen3 (8.0 GT/s)

One XMC mezzanine site

- 8-lane PCIe Gen2 to a VITA 42 compatible XMC, configurable for Gen3 with VITA 61 connectors
- Backplane Pn6 I/O mapping of P1w9-X12d per VITA 46.9
- Support for up to 30 watts DC power. Thermal qualification with 15 watt mezzanines. [Contact Curtiss-Wright](#) for higher power mezzanine qualification details.



Ethernet ports

- 1 x 1000Base-T and 2 x 10GBase-KR/1000Base-KX/BX

Additional I/O

- 1 x configurable RS-232 / RS-422 / RS-485 serial channel
 - + the RS-422 port can be configured as differential I/O
- 2 x Discrete I/O, configurable as 1 x I2C port
- 2 x USB 2.0 ports
- 2 x SATA 3.0 ports
- 1 x 4-lane DisplayPort graphics port

Health management

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

Security features

- Trusted Platform Module (TPM) 2.0 hardware device, compliant to FIPS-240-2 and Common Criteria
- Intel Boot Guard, supporting measured and secure/trusted boot
- UEFI Secure Boot
- Intel Software Guard Extensions (SGX)

Software support

- Fedora Linux
- CentOS and Red Hat Enterprise Linux

Built-in Test

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

Power

- Primary Power: Vs1 (+12V)

Power consumption will vary based on operational loading. Values below are guidelines for operation with six cores @ 2.7 GHz at room temperature (25°C) – contact Curtiss-Wright for more details on power consumption.

- Idle power consumption = 16 watts
- Typical power consumption = 40 watts
- Maximum power consumption = 74 watts

Note: power consumption is exclusive of optional mezzanine power

Environmental

- Conduction-cooled Level 300

Weight

- Conduction-cooled Level 300: 545g

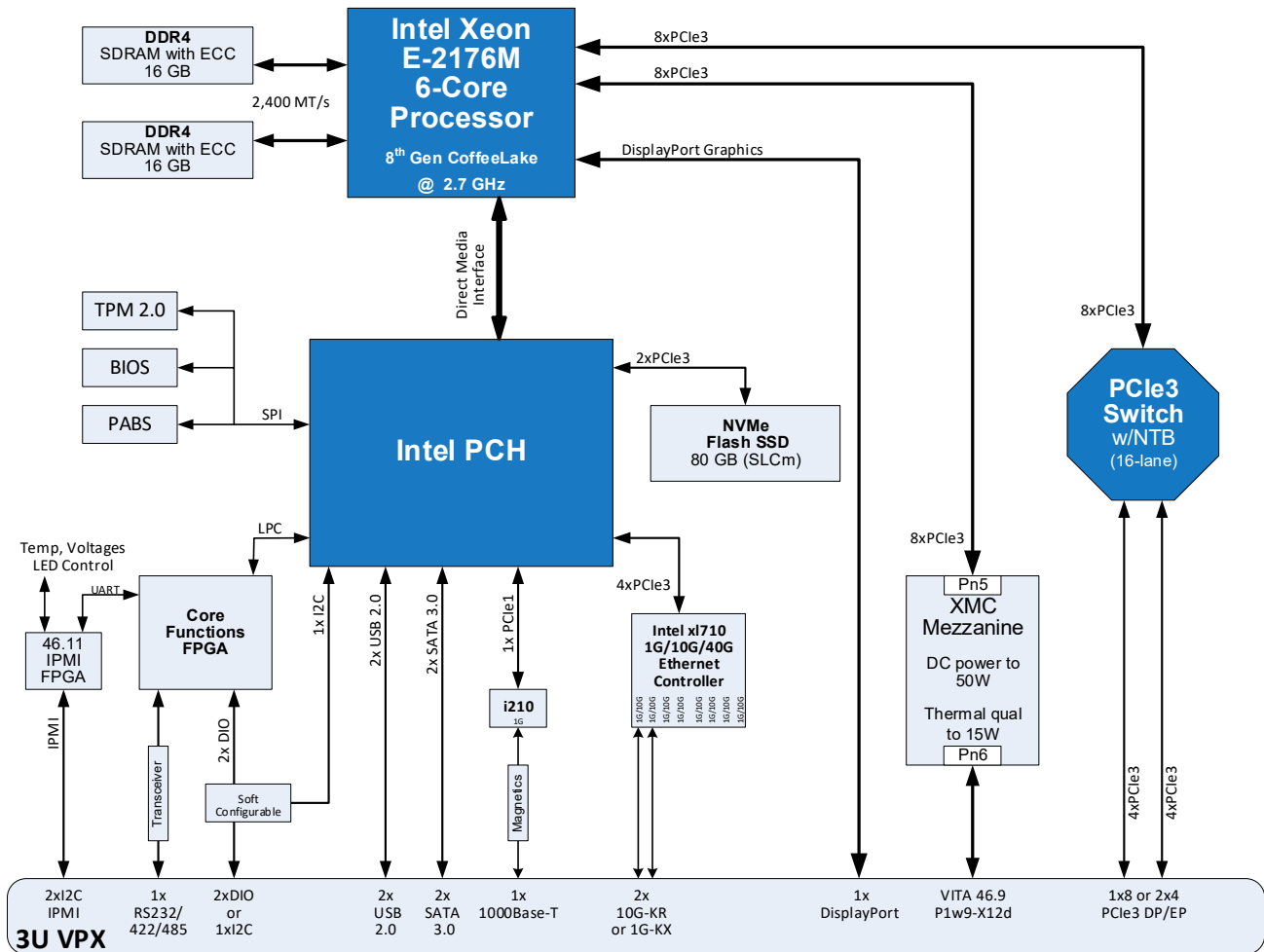


Figure 1: VPX3-1260, E-OSA variant block diagram

VPX3-1260 Features

Powerful 8th Gen Intel Xeon E-2176M CPU

The Intel Xeon E-2176M processor is based on Intel’s industry-leading silicon technology and the latest micro-architecture enhancements. This 8th Generation Xeon processor marks the next step in Intel’s continual cadence for delivering the highest performance processors to the aerospace and defense industry, delivering a 50% increase in core count over previous Xeon E3 generations while still meeting the manageable power levels required to support today’s size, weight and power (SWaP) sensitive designs.



Power consumption and CPU tuning

The VPX3-1260 provides extremely flexible and dynamic methods of controlling power consumption. From statically parking cores in the BIOS to dynamically adjusting CPU clocks at run time, the VPX3-1260 performance can be tailored to meet a wide range of processing and power requirements. Processor (alone) power consumption can range from 5 watts to 45 watts.

Intel 8th Generation Platform Controller Hub

The VPX3-1260 employs the Intel CM246 PCH Chipset. This highly integrated PCH handles much of the flow of information between the board’s I/O interfaces and the Intel Xeon Processor.

Dual Data Rate (DDR4) SDRAM

The VPX3-1260 has two independent DDR4 memory banks of 72-bit DDR4 SDRAM (64-bit plus ECC). The VPX3-1260 is fitted with 32 GB of DDR4 SDRAM. The DDR4 interface operates at 2,400 MT/s, yielding a memory throughput performance of 38.4 GB/s.

To preserve data integrity, the SDRAM is provided with ECC circuitry that detects and corrects all single-bit data errors, detects all double-bit errors, and detects all 3-bit and 4-bit errors within the same nibble. The SDRAM is accessible from the processor, as well as from the Ethernet and PCIe interfaces.

NVMe SSD



The VPX3-1260 is configured with high-performance Non-Volatile Memory Express (NVMe) local storage connected directly to a PCIe interface, eliminating traditional performance bottlenecks associated with SATA connected storage. It is also configured with a single 80 GB SSD operating in SLC mode.

Fabric ports

The VPX3-1260 provides eight lanes of PCIe to the VPX Expansion and Data Planes, used primarily to connect at the highest possible speeds to adjacent VPX modules. Supporting a flexible configuration of 1x 8-lane, 2x 4-lane, or 4x 2-lane ports, the PCIe ports operate at Gen1 (2.5 GT/s), Gen2 (5.0 GT/s), or Gen3 (8.0 GT/s) speeds, for a throughput of up to 7.9 GB/s for extremely fast data transfers.

Common uses of the VPX Expansion Plane are to connect the SBC to sensor or signal acquisition modules, to augment the SBC processor with additional graphics modules, or to connect to dedicated GPGPU or FPGA modules to offer additional computational power.

When connecting multiple SBCs directly together using PCIe, a Non-Transparent Bridge (NTB) can be configured on any port. Curtiss-Wright's Dolphin eXpressWare PCIe Fabric Software provides high-speed, low-latency peer-to-peer communications using direct PCIe connections to send high-speed messages and bulk data between computing nodes. Applications can be developed using high-level, common communications API interfaces, such as Berkeley Sockets (TCP/IP), SuperSockets (socket interface without the TCP/IP stack overhead), and message passing via MPI. For the highest performance and maximum control, an optimized shared memory API called Software Infrastructure Shared-Memory Cluster Interconnect (SISCI) is also supported.

XMC site

The module is equipped with one mezzanine site capable of supporting VITA 42 XMC modules. The XMC site supports eight lanes of PCIe Gen1, Gen2, or Gen3 rates directly from

the processor. Support for Gen1 and Gen2 rates is with the standard VITA 42 connectors, and support for Gen3 is with optional VITA 61 connectors. [Contact Curtiss-Wright](#) for VITA 61 ordering options.

Pn6 I/O to the backplane is provided per VITA 46.9 as P1w9-X12d providing 12 pairs of high-speed differential I/O from the mezzanine site to the VPX backplane connector.

The mezzanine sites adhere to the VITA 20-2001 (R2005) conduction-cooled PCI Mezzanine Card standard specifications. To optimize the thermal transfer from XMC modules to the base card, the VPX3-1260 thermal frame incorporates both the primary and secondary thermal interfaces as defined by VITA 20-2001.

Serial ports

The VPX3-1260 provides one serial port configurable as RS-232, RS-422, or RS-485. The serial port support asynchronous communications with baud rates configurable from 300 to 115,200 baud, and with selectable RS-422/485 terminations.

The RS-422 port can also be configured as a differential I/O port operating at RS-422 signal levels. Software drivers are provided to support reading of the differential I/O input and setting of its output.

Ethernet interfaces

The VPX3-1260 provides one 1000Base-T port, plus dual SerDes ports supporting 10GBase-KR (10 GbE) and 1000Base-KX/BX (1 GbE) operation.

Discrete Digital I/O (DIO)

The VPX3-1260 provides two independent discrete digital I/O signals. Each DIO is individually programmable as an input or an output. Each DIO is capable of triggering an interrupt upon a change of state, and are programmable to detect either rising or falling edge. All DIOs are 5V-tolerant. The DIOs can be configured as one I2C port operating at 100 kbps or 400 kbps data rates.

USB ports

The VPX3-1260 provides two USB 2.0 ports.

SATA ports

The VPX3-1260 provides two SATA 3.0 interfaces on the rear VPX backplane operating at up to 6 Gbps.

Display interfaces

The module's E-2176M processor supports an integrated Intel P630 graphics engine, which operates with a base clock of 350 MHz, increasing up to 1.2 GHz for high-performance operations.

The VPX3-1260 provides one 4-lane DisplayPort interface to the backplane and supports DisplayPort modes at HBR or HBR2 data rates with resolutions up to 3840x2160. Embedded audio is also supported.

TABLE 1		Max Graphics Resolution	
DISPLAY CONFIG	Signal Rate (per lane)	Effective Data Rate (4-lane)	Max Resolution
DP 1.1 (HBR)	2.7 Gbps	8.64 Gbps	2560 x 1440 @ 75Hz 3840 x 2160 @ 30Hz
DP 1.2 (HBR2)	5.4 Gbps	17.28 Gbps	3840 x 2160 @ 75Hz

The graphics engine can also provide GPGPU functionality, offering up to 403 GFLOPS of performance and usable by applications using an OpenCL programming interface.

Integrated hardware codec

The Xeon E-2176M processor incorporates a hardware video codec, accelerating video compression and decompression algorithms and reducing CPU processing requirements. The codec supports MPEG, H.264 (AVC), H.265 (HEVC) and VP9 formats and features both 8-bit and 10-bit (HDR) image processing.

Temperature sensors

The VPX3-1260 provides temperature sensors to measure board and processor temperatures. There is a sensor at each edge of the card and sensors built into the CPU. All temperature sensors can be read by software.

Timers

The VPX3-1260 includes eight general purpose, high-resolution timers as well as a hardware watchdog timer.

Software can select whether a watchdog exception event causes a software interrupt, a processor reset, a card reset or a system reset.

Security Features

Due to the nature of trusted computing, not all security features are described here. Please [contact Curtiss-Wright](#) for additional security information.

Trusted Platform Module (TPM) support

The VPX3-1260 includes a Trusted Platform Module (TPM) 2.0 hardware security device which is compliant to FIPS-140-2 and is Common Criteria certified. The TPM can be used to create a secure computing environment, ensuring

only trusted and signed BIOS and software can execute on the board.

The TPM supports secure key storage and other enhanced features.

Intel Boot Guard (BtG)

The VPX3-1260 supports Intel Boot Guard (BtG), which provides both a measured and an authenticated boot. With Boot Guard enabled, only signed and authenticated boot modules can be executed, creating a secure Root-of-Trust (RoT) on the module.

UEFI Secure Boot

In addition to Intel-specific Boot Guard security features, the VPX3-1260 includes support for UEFI Secure Boot. Secure Boot extends the secure boot process to validate the operating system boot loader, and then extends security into the operating system.

Software Support

The VPX3-1260 is supported by a suite of firmware, operating systems, and RTOS board support packages (BSP), as well as communication and signal processing libraries. Systems developers will be able to kick-start application development using a common set of features and software interfaces across many products from Curtiss-Wright.

Built-in Test (BIT)

Built-in Test (BIT) is a library of diagnostic routines to support Power-On BIT (PBIT), Initiated BIT (IBIT), and Continuous BIT (CBIT) for health management of the module. BIT operations are supported through BIOS and software APIs, and can be accessed in customer developed applications.

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

Operating system software

The VPX3-1260 is shipped with Fedora 27 Linux pre-loaded from the factory, and includes drivers with full source code. A separate BSP can be purchased to support Red Hat Enterprise Linux (RHEL) or CentOS 7.6 and also includes driver source code.

Dolphin PCIe fabric communications software

For the highest performance SBC-to-SBC communications, the VPX3-1260 is supported by our Dolphin eXpressWare Fabric Communications Library. This middleware supports

high-speed, low-latency peer-to-peer communications using PCIe connections. The software library hides the complexities and technical details of programming directly to PCIe devices, and presents an easy to use software API to applications developers wishing to send high-speed messages and bulk data between computing nodes.

Applications can be developed using common communications API interfaces, which are supported by the software, including standard TCP/IP interfaces (ie: standard Berkeley Sockets), SuperSockets (socket interface without the TCP/IP stack overhead), and message passing via MPI. For the highest performance and maximum control, an optimized shared memory API called Software Infrastructure Shared-Memory Cluster Interconnect (SISCI) is also supported.

Effective Utilization of Multicore Resources

The VPX3-1260's six-core 8th Gen Intel Xeon processor offers an ideal architecture to support [multicore software](#), such as the field-proven operating systems from Green Hills Software, including its DO-178 safety-certifiable [INTEGRITY-178 tuMP](#) real-time operating system (RTOS). Supporting a variety of multi-processing architectures is crucial to enabling system integrators and designers to fully utilize all available computing power from the processor's cores. The INTEGRITY-178 tuMP RTOS permits any mix of Asymmetric Multi-Processing (AMP), Bound Multi-Processing (BMP), and Symmetric Multi-Processing (SMP) running on the VPX3-1260 to provide deterministic, user-defined core and scheduling assignments that can ensure the performance potential of the multicore hardware is fully achieved. As well, Green Hills Software operating systems support guest OS virtualization, enabling software applications requiring legacy or non-critical OSs to run on same processor. This brings the SWaP benefit of eliminating the need for a separate processor to support a guest OS. Together, the flexible options for software multi-processing architectures and hosting guest OS applications are critical components to achieve [optimal multicore processing for safety-critical](#) and non-critical applications.

Rear Transition Module

For building systems in the lab environment, Curtiss-Wright provides a Rear Transition Module (RTM), part number RTM 3-1260, that plugs into the backside of the VPX3-1260's backplane and provides access to many of the board I/O interfaces on industry standard connectors.



Figure 1: VPX3-1260 Rear Transition Module

Ruggedization Levels

The VPX3-1260 is available at Curtiss-Wright Level 300 (-40 to +85°C) which includes VITA 48 2LM maintenance covers to create a truly field-serviceable LRM. Full details of Curtiss-Wright's standard Ruggedization Guidelines can be found on the [Curtiss-Wright website](#).

Power Consumption

Power consumption of an Intel SBC can vary greatly, depending on the processor configuration and loading characteristics. Curtiss-Wright has extensive experience in characterizing Intel SBCs and can provide detailed power characteristic data to better understand the power vs. performance tradeoffs when designing systems around the VPX3-1260 module.

Table 2 outlines common operating configurations and power measurements for the VPX3-1260. These power figures are actual measured values taken while executing a test application generating CPU and GPU processing loads and interface data traffic representative of a typical customer application.

Although power consumption increases as operating temperature rises, Intel processors may hit a thermal limit, after which they will throttle the processor performance to limit operational power. The power levels below were measured at 25°C room temperature in an air-cooled environment without throttling.

The VPX3-1260 BIOS provides a rich set of controls to statically or dynamically control CPU core parking, CPU clock speed, and Turbo Mode operation, allowing the module to be tailored to the target application environment.

TABLE 2 Power consumption under various loading conditions

PROCESSOR CONFIGURATION	PROCESSING LOAD		
	MODERATE CPU NO GFX Note 1	MODERATE CPU HIGH GFX Note 2	MAXIMUM CPU NO GFX Note 3
	6 cores @ 2.7 GHz	36	40
4 cores @ 2.7 GHz	33	36	41
4 cores @ 800 MHz	21	23	25

Notes:

1. CPU cores 50%, GFX cores 0%, memory r/w stress test
2. CPU cores 50%, GFX cores 70%, memory r/w stress test
3. CPU cores 100%, GFX cores 0%, memory r/w stress test

Ordering Information

The VPX3-1260 E-OSA Variant is orderable per below.

TABLE 3 VPX3-1260 E-OSA Variant ordering information

PART NUMBER	DESCRIPTION
VPX3-1260-C250E90	Intel 8th Gen Coffee Lake Xeon E-2176M Single Board Computer <ul style="list-style-type: none"> > 32 GB DRAM, 80 GB SSD > E-OSA Compliant GPP Pinout
RTM3-1260-3100	Rear Transition Module for VPX3-1260 E-OSA Variant <ul style="list-style-type: none"> > Provides breakout connectors and cables to many 1260 board I/O interfaces > Supports Curtiss-Wright RIM mezzanine module

TABLE 4 Software

PART NUMBER	DESCRIPTION
DSW-1260-6271-FED6	Fedora 27 BSP for VPX3-1260 E-OSA variant. Includes driver source code.
DSW-1260-6761-RHL6	Red Hat Enterprise Linux (RHEL) 7.6 BSP for VPX3-1260 E-OSA. Also supports CentOS 7.6. Includes driver source code.
MNT-1260-LNX	Annual maintenance and Software Upgrade Program (SUP) for VPX3-1260 Linux
DSW-1260-6001-LSD6	Dolphin eXpressWare PCIe Fabric Software for VPX3-1260, 64-bit Linux operating systems <ul style="list-style-type: none"> > Supports Dolphin SuperSockets, TCP/IP, MPI and SISC I API interfaces > Licensed for applications development on the VPX3-1260 for one project, per site > License includes 4 x run-time licenses (RTL) for development
RTL-1260-6001-LSD6	Run-Time License for Dolphin PCIe Fabric Software for DSW-1260-6001-LSD6 <ul style="list-style-type: none"> > One required for each module running Dolphin eXpressWare
MNT-1260-6001-LSD6	Annual Software Upgrade Program (SUP) for Dolphin PCIe Fabric Software DSW-1260-6001-LSD6