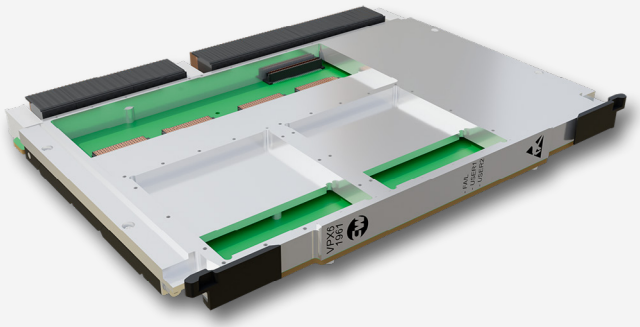
CURTISS-WRIGHT



VPX6-1961

6U VPX™ Intel® Xeon® W-11000E Series Single Board Computer

The VPX6-1961 from Curtiss-Wright Defense Solutions is a rugged, high-performance 6U OpenVPX™ single board computer (SBC) that combines Intel's powerful 11th Gen Intel Xeon W-11865MRE (formerly "Tiger Lake-H") processor with the power and flexibility of the VPX platform's high speed fabric interconnects.

Utilizing the advanced 8-core 11th Gen Intel Xeon processor and Curtiss-Wright's proven ruggedization technology, the VPX6-1961 excels in harsh environments, making it ideal for architecting high-performance computing and processing systems utilizing DSP, GPU, and FPGA modules, and/or multiple SBC processors.

With a high-speed, dual-channel DDR4 memory subsystem supporting up to 64 GB SDRAM, the VPX6-1961 is able to maximize the performance of the multiple processing cores, the internal GPU cores and the AVX512 floating-point processing units of the processor. Up to 480 GB of high-speed NVMe SSD memory make the VPX6-1961 an ideal SBC for handling applications with demanding storage, data logging and sensor processing requirements.

The VPX6-1961 includes dual XMC mezzanine sites to support a wide variety of expansion mezzanine daughter cards, including high-performance FPGA, GPU, and storage modules. Four Ethernet ports are provided for Control Plane connectivity, supporting Gigabit 1000BASE-T and 10 Gigabit 10GBASE-KR interfaces.

The VPX6-1961 supports 32 lanes of PCI Express® (PCIe), with 16 lanes to the Data Plane and 16 additional lanes to the Expansion Plane, providing high-bandwidth connectivity to GPU, FPGA, storage, I/O or other processor modules. Data can also flow from the VPX backplane directly to the XMC sites to support demanding high bandwidth applications such as sensor and data processing or video/graphics mezzanines. The VPX6-1961 supports a host of standard I/O including multiple RS-232, RS-422, SATA and USB ports, discrete DIO, and dual-head DisplayPort or DVI interfaces supporting up to 4K resolution.

A wide range of popular operating systems are supported, including Linux (Alma and RHEL), VxWorks, Microsoft Windows, GHS Integrity, LynxOS and others.

Key Features

- 11th Gen Intel Xeon W processor
- 8-Core (16-thread) processor
- Up to 64 GB DDR4 with ECC
- Up to 480 GB local NVMe SSD
- Supports two XMC expansion mezzanines
- Available in air-cooled and conduction-cooled versions
- Supports Linux® (Alma and Red Hat® Enterprise Linux [RHEL]) VxWorks®, Windows®, INTEGRITY and LynxOS®

Applications

- High-Performance Embedded Computing (HPEC) systems
- General computing and mission processing
- Multi-SBC systems for advanced processing and ISR applications

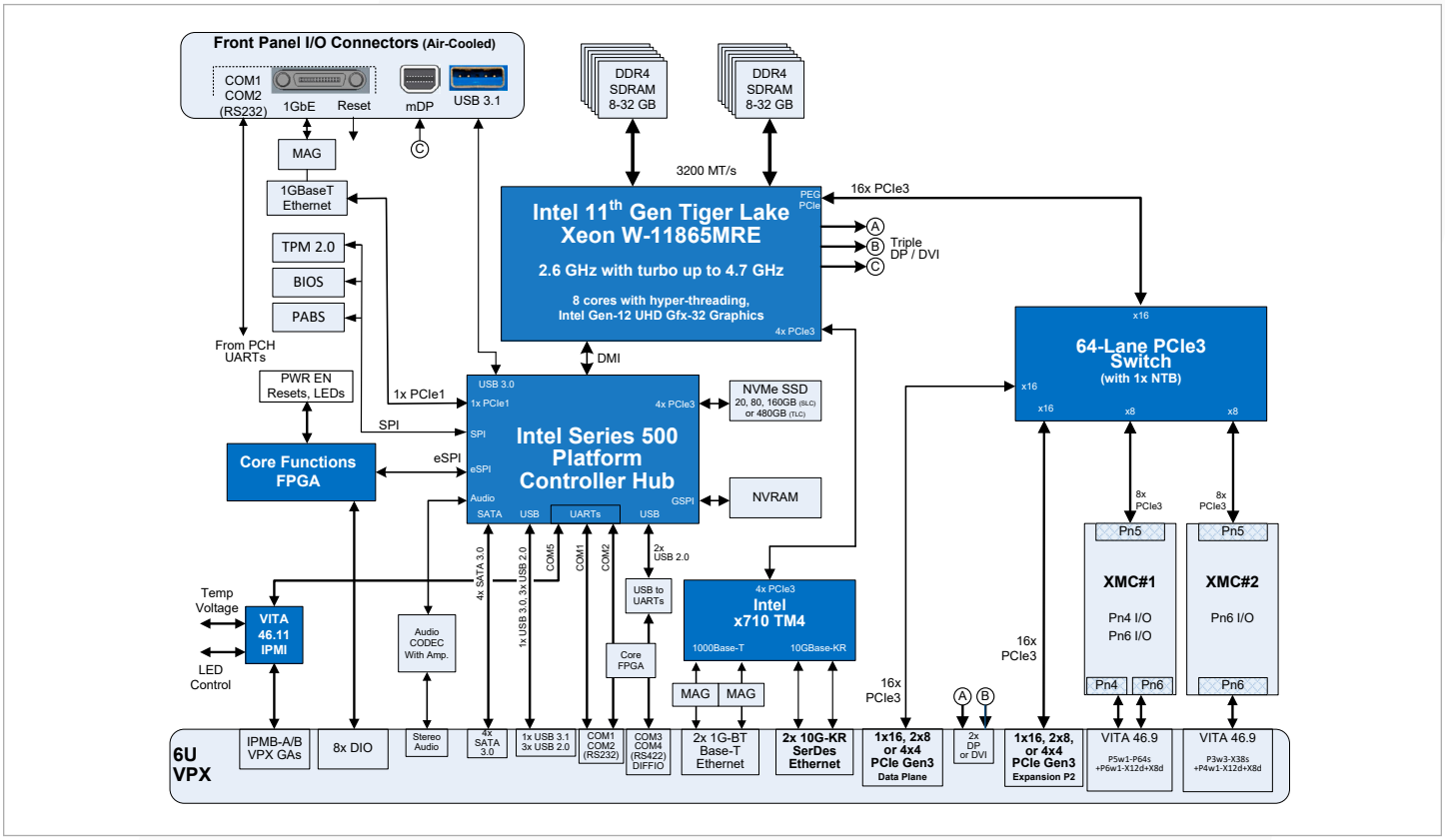


Figure 1: Product block diagram

VPX6-1961 Features

Powerful 11th Gen Intel Xeon W (formerly "Tiger Lake-H") CPU

The 11th Gen Intel Xeon W-11865MRE processor is based on Intel's industry-leading silicon technology and the latest micro-architecture enhancements to deliver unmatched performance at the manageable power levels required to support today's size, weight, and power (SWaP) sensitive designs to deliver unmatched performance at the manageable power levels required to support today's size, weight, and power (SWaP) sensitive designs.

The VPX6-1961 processor incorporates the following features:

- 8-core (16 thread) @ 2.6 GHz with Turbo up to 4.7 GHz
- Integrated two-channel memory controller with ECC
- 24 MB Intel Smart Cache
- Intel Streaming SIMD Extensions (SSE 4.1/4.2)
- Intel Advanced Vector Extensions (AVX, AVX2, AVX512) floating-point with up to 1,331 GFLOPS of accelerated floating point vector math capability
- Intel Virtualization Technology (VT-x, VT-d)
- Intel AI Acceleration with Deep Learning Boost (VNNI)
- Intel integrated UHD Gfx-32 Graphics

Power consumption and CPU tuning

The VPX6-1961 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 VPX6-1961 performance can be tailored to meet a wide range of processing and power requirements.

Intel Platform Controller Hub

The VPX6-1961 employs the Intel Series 500 PCH Chipset. This highly integrated PCH handles much of the flow of information between the board's I/O interfaces and the Intel Processor.

Dual Data Rate (DDR4) SDRAM

The VPX6-1961 has two independent DDR4 memory controllers supporting independent banks of 72-bit DDR4 SDRAM (64-bit plus ECC) operating at 3,200 MT/s. The VPX6-1961 can be factory fitted with 16, 32, or 64 GB of DDR4 SDRAM.

NVMe SSD

The VPX6-1961 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.

The SSD is factory orderable supporting SLC or TLC modes of operation, which provide a tradeoff of capacity vs. longevity and reliability (see table 1). The 20/80/160 GB SLC drives offers 30,000 P/E cycle endurance while the 480 GB TLC drive offers 3,000 P/E cycle endurance. The SSD storage system provides read performance up to 1.4 GB/s and write performance up to 0.7 GB/s.

Expansion and Data Plane ports

The VPX6-1961 provides 16 lanes of PCIe to the VPX Expansion Plane, used primarily to connect at the highest possible speeds to an adjacent VPX module. Supporting a flexible configuration of 1x 16-lane, 2x 8-lane, or 4x 4-lane ports, the PCIe ports operate at Gen1 (2.5 GT/s), Gen2 (5 GT/s), or Gen3 (8 GT/s) for fast data transfers. An additional 16 PCIe Gen3 lanes are available on the Data Plane, also configurable as a 1x16-lane, 2x8-lane, or 4x4-lane ports.

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

Interconnecting the processor, backplane and XMC sites is a Gen3 PCIe switch. A single Non-Transparent Bridge (NTB) can be configured on any port.

Dual mezzanine sites

The VPX6-1961 is equipped with two mezzanine sites capable of supporting VITA 42 XMC modules. Each XMC site supports 8 lanes of PCIe Gen1 through Gen3 rates directly to the on-board PCIe switch. Contact Curtiss-Wright for VITA 61 ordering options.

One XMC site provides full Pn6 I/O with VPX backplane signal mapping per VITA 46.9 as X38s+X12d+X8d. The second XMC site provides both Pn4 and Pn6 I/O with VPX backplane signal mapping as P64s+X12d+X8d.

Each mezzanine site can support DC power up to 50 watts, and has been qualified with mezzanines up to 20 watts. Contact Curtiss-Wright for higher power or specific mezzanine thermal configurations.

On the conduction-cooled card configuration, 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 VPX6-1961 thermal frame incorporates both the primary and secondary thermal interfaces as defined by VITA 20-2001.

Four Ethernet interfaces

The VPX6-1961 provides four Control Plane Ethernet ports. Two ports support Gigabit speed BASE-T connectivity supporting 1000BASE-T, 100BASE-TX, and 10BASE-T connections with auto-negotiation. The other two ports support 10G SerDes interfaces of 10GBASE-KR and 1000BASE-KX/BX for board-to-board backplane connections or to directly drive optical transceivers.

For air-cooled modules, an additional independent 1000BASE-T Ethernet port is provided on the front panel.

TABLE 1	NVMe SSD CAPABILITIES	
DRIVE CAPACITY	OPERATIONAL MODE	ENDURANCE (P/E CYCLES)
20, 80, 160 GB	SLC	30,000
480 GB	TLC	3,000

Serial ports

The VPX6-1961 provides two RS-232 and two RS-422 serial channels to the VPX backplane, as well as providing access to the two RS-232 serial channels on the front panel for air- cooled modules. The serial ports support asynchronous communications with baud rates independently configurable from 300 to 115,200 Kbaud. The RS-422 ports can also support 1Mbaud operation.

Discrete Digital I/O (DIO)

The VPX6-1961 provides 8 independent discrete digital I/O signals supported from the Core Functions FPGA. All DIOs are individually programmable as inputs or outputs.

Each DIO is capable of triggering an interrupt upon a change of state, programmable to detect either rising or falling edge. All DIOs are 5V-tolerant.

USB ports

The VPX6-1961 provides four USB 2.0 ports with one backplane port capable of operating as a USB 3.1 port. An additional USB 3.1 port is provided on the front panel on air-cooled modules. All ports include +5V VBUS power.

Four SATA ports

The VPX6-1961 provides four SATA 3.0 interfaces operating at up to 6 Gbps on the rear VPX backplane.

Display interfaces

The module's processor supports an integrated Intel Gen 12 UHD Gfx-32 graphics engine, which operates with a clock up to 1.35 GHz for high-performance display operations.

The VPX6-1961 provides two DVI/DisplayPort ports to the backplane, which can support up to 4K display resolutions. Each port can be independently configured to operate in DVI-D mode with up to 1920x1200 resolution, or to support DisplayPort modes at HBR or HBR2 data rates with resolutions up to 4Kp60 (see Table 2). In DisplayPort mode, embedded audio is also supported.

An additional DisplayPort++ interface is provided on the front panel of air-cooled modules. Depending on the operating system, up to three independent displays can operate simultaneously.

The graphics engine can also provide GPU computational functionality, offering an additional 134 GFLOPS of performance (with up to 518 GFLOPS in turbo mode) which is usable by applications using an OpenCL programming interface.

Audio interfaces

The VPX6-1961 provides Intel HD Audio, offering 24-bit input and stereo output with a built-in headphone amplifier. One microphone input supporting up to 30 dB pre-amp boost is also provided.

Temperature sensors

The VPX6-1961 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. The card edge sensors can be read by software in order to monitor for over-temperature conditions.

Timers

The VPX6-1961 includes 8 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.

The watchdog timer can be used in two ways. As a standard watchdog timer, a single time period is programmed which defines a maximum interval between writes to the watchdog register. For increased system integrity, the watchdog can optionally be configured to operate in "Avionics" mode whereby a minimum interval between writes to the watchdog register is also enforced. In other words, writing to the watchdog register too soon or too late causes an exception event.

TABLE 2	DISPLAY CONFIGURATIONS, SPEEDS AND RESOLUTIONS		
DISPLAY CONFIGURATION	SIGNAL RATE (PER LANE)	EFFECTIVE DATA RATE (4-LANE)	MAX RESOLUTION
DVI-D	1.65 Gbps	3.96 Gbps	1920 x 1200 @ 60Hz
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 @ 60Hz

Security Features

The VPX6-1961 has been designed to support a powerful and flexible set of Trusted COTS (TCOTS) features. Security features include hardware and software capabilities designed to protect critical resources from unauthorized access or modification.

Trusted Platform Module (TPM)

The VPX6-1961 includes a Trusted Platform Module (TPM) 2.0 hardware security device. The TPM can be used to create a secure computing environment, ensuring only trusted and authenticated BIOS and software can execute on the board.

The TPM device is certified to FIPS-140-2 and Common Criteria security standards.

Intel Boot Guard (BtG)

The VPX6-1961 is instrumented to support Intel Boot Guard (BtG), which provides both measured and a verified/ authenticated boot capabilities. With Boot Guard, only signed and authenticated boot modules can be executed. Contact Curtiss-Wright for BootGuard options.

UEFI Secure Boot

In addition to Intel-specific BootGuard security features, the VPX6-1961 includes support for UEFI Secure Boot. UEFI Secure Boot extends the secure boot process to authenticate the OS boot loader, and then extends security into the operating system.

Due to the nature of Trusted Computing, not all security features are described here. Please contact Curtiss-Wright for additional security information.

Software Support

The VPX6-1961 is supported by a suite of firmware, Operating Systems (OS), RTOS board support packages (BSP), as well as communication 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.

Continuum Built-in Test (BIT)

Continuum Built-in Test (BIT) is a library of diagnostic routines to support Power-up 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 VPX6-1961 is supported with an extensive array of software items, which cover all facets of developing and running application code for the board. The following 64-bit operating systems are currently supported for the VPX6-1961:

- Alma 8 (pre-installed from the factory)
- Red Hat Enterprise Linux (RHEL) 8
- Wind River VxWorks 7 (BSP available from Wind River - included with VxWorks 7 development license)
- Microsoft Windows 10
- Green Hills INTEGRITY (contact factory for availability)
- LynxOS 7 (contact factory for availability)

For information regarding additional operating systems support, please contact Curtiss-Wright.

Applications software

Software drivers and middleware is available to accelerate applications development and provides support for most popular operating systems.

- OpenGL® and Vulcan® graphics drivers supporting high-performance 2D and 3D imaging applications are available for many operating systems.
- OpenCL™ for computational GPU performance
- Hardware accelerated video codec functions supporting MPEG, H.264, H.265/HEVC and others are available from Intel for Linux and Windows

Front Panel I/O

To simplify the use of front-panel I/O in a development or lab environment, Curtiss-Wright offers a front panel breakout cable, model CBL-1961-0003. This cable breaks out the front panel's RS-232 and 1000BASE-T Ethernet, ports to industry standard connectors. A board reset pushbutton is also provided.

Rear Transition Module

For building systems in the lab environment, Curtiss-Wright provides a Rear Transition Module (RTM), part number RTM-1961-0000, that plugs into the backside of the VPX6-1961's backplane and provides access to most of the board connections on industry standard connectors.

Ruggedization Levels

To cost-effectively address a diverse range of applications, the VPX6-1961 is available in a range of ruggedization levels and mechanical formats. Air-cooled cards available at Level 0 (0 to 50°C) and Level 100 (-40 to +71°C) and conduction-cooled cards are available at Level 200 (-40 to +85°C).

The VPX6-1961 can also be made available in an Air Flow-Through design (contact factory for details). Full details of Curtiss-Wright's standard Ruggedization Guidelines can be found on the Curtiss-Wright website.

Conduction-cooled modules are also offered with VITA 48 2-level maintenance covers to create a truly field-serviceable LRM.

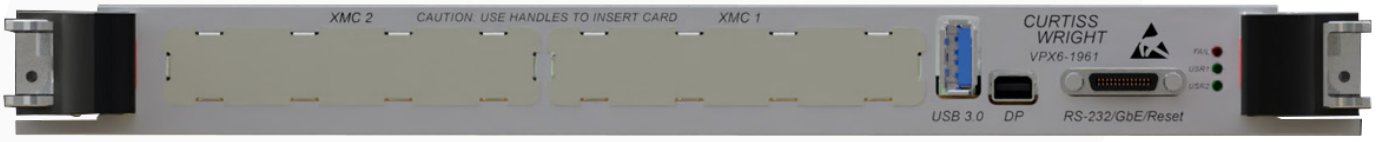


Figure 2: VPX6-1961 Air-Cooled Front Panel

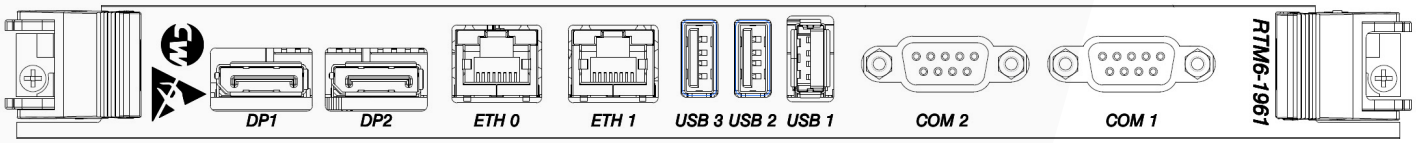


Figure 3: RTM6-1961 Rear Transition Module

Specifications

Form factor

- 6U OpenVPX, supporting module profile MOD6-PAY- 4F1Q2U2T

Processor

11th Gen Intel Xeon W-11865MRE (formerly “Tiger Lake-H”) processor

- 8-core (16-thread) processor at 2.6 GHz base clock, turbo to 4.7 GHz
- Intel Advanced Vector Extensions (AVX, AVX2, AVX512) floating-point
- Intel Virtualization Technology (VT-x, VT-d)
- Intel AI Acceleration with Deep Learning Boost (VNNI)
- Intel UHD Gfx-32 Graphics

Platform

- Series 500 Chipset Platform Controller Hub (PCH)

SDRAM memory

- 16, 32 or 64 GB DDR4 at 3,200 MT/s
- Dual-channel memory configuration with ECC

Non-volatile memory

- 20 GB to 480 GB NVMe SSD storage
  - 20, 80, 160GB capacities in SLCm mode
  - 480 GB capacity in TLC mode
- 32 MB SPI flash for BIOS functions

Backplane fabrics

- 16 lane PCIe Gen3 Expansion Plane P2 supporting 1x16, 2x8, and 4x4 configurations. Other PCIe configurations also available.
- 16 additional lanes PCIe Gen3 on Data Plane P1 offering 1x16, 2x8, or 4x4 port configurations

Dual mezzanine sites

- 8-lane PCIe to each XMC site
  - VITA 42 connectors standard, VITA 61 connectors also available
  - XMC Mezzanine Site # 1 supports Jn4 and Jn6 I/O per VITA 46.9 mapping P5w1-P64s+P6w1-X12d+X8d
  - XMC Mezzanine Site # 2 supports Jn6 I/O per VITA 46.9 mapping P3w3-X38s+P4w1-X12d+X8d
- Support for up to 50 watts DC power available to each site
- Thermal qualification with 20 watt mezzanines. Contact Curtiss-Wright for higher power mezzanine qualification details.

Control Plane Ethernet ports

- 2 x BASE-T Ethernet ports supporting 1000BASE-T, 100BASE-TX, and 10BASE-T
- 2 x SerDes Ethernet ports supporting 10GBASE-KR and 1000BASE-KX/BX

Front I/O (air-cooled only)

- 2 x RS-232 serial channels
- 1 x USB 3.1 port
- 1 x 1 Gigabit Ethernet port (1000BASE-T)
- 1 x DisplayPort++ graphics port
- Board local reset

Rear I/O

- 2 x RS-232 serial channels
- 2 x RS-422 serial channels
- 8 x Discrete I/O
- 3 x USB 2.0 ports, 1 x USB 3.1 port
- 4 x SATA 3.0 ports
- 4 x Ethernet ports – 2x 1000BASE-T and 2x SerDes 10GBASE-KR
- 2 x Configurable DisplayPort / DVI graphics ports
- Intel HD audio input and stereo output

Security features

- Trusted Platform Module (TPM) 2.0 hardware device
  - FIPS and Common Criteria certified
- Intel Boot Guard, supporting measured and secure/trusted boot (contact factory)
- UEFI Secure Boot
- SSD encryption

Software support

- Linux: Alma and RHEL
- Wind River® VxWorks
- Microsoft® Windows 10
- Green Hills Software INTEGRITY (contact factory for availability)
- Lynx Software Technologies LynxOS (contact factory for availability)

Built-in Test

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

Power

Power consumption will vary based on operational loading. Values below are guidelines for operation with 8 cores @ 2.6 GHz at room temperature (25°C) – contact Curtiss-Wright for more details on power consumption.

- Idle power consumption: <TBD> watts
- Typical power consumption: <TBD> watts
- Maximum power consumption: <TBD> watts

Note: power consumption is exclusive of optional mezzanine power

Environmental

- Air-cooled: available in Level 0 and Level 100
- Conduction-cooled: available in Level 200 and Level 300
- Air Flow-Through also available (contact factory)

Pitch

- Air-cooled = 1.0” pitch
- Conduction-Cooled L200 = 0.8” pitch without mezzanine, 1.0” pitch with mezzanine
- Conduction-cooled L300 = 1.0” pitch

Weight

- Air-cooled Level 0: 815g
- Air-cooled Level 100: TBD
- Conduction-cooled Level 200: TBD
- Conduction-cooled Level 300: TBD

VPX6-1961

VPX-1961 ordering information

The VPX6-1961 is ordered with the following part number convention. Not all possible configurations are offered – see Ordering Configurations below or contact Curtiss-Wright for additional configurations

Part Number	Description
VPX6-1961-A04dsyz	Air-cooled Level 0, 0 to +50°C, 1.0” pitch front panel and metalwork
VPX6-1961-A14dsyz	Air-cooled Level 100, -40 to +71°C, 1.0” pitch front panel and metalwork
VPX6-1961-C21dsyz	Conduction-cooled Level 200, -40 to +85°C card edge
VPX6-1961-C25dsyz	Conduction-cooled Level 300, -40 to +85°C card edge with 2LM covers
d	3U DRAM Memory • 1 = 16 GB DRAM in dual channels • 2 = 32 GB DRAM in dual channels • 3 = 64 GB DRAM in dual channels
s	SSD Configuration • 0 = no SSD installed • 1 = 20 GB NVMe SSD (SLC) • 2 = 80 GB NVMe SSD (SLC) • 3 = 160 GB NVMe SSD (SLC) • 4 = 480 GB NVMe SSD (TLC)
yz	Configuration • 00 = no Data Plane RT2 connectors • P2 = PCIe Data Plane RT2 connectors • P3 = PCIe Data Plane RT3 connectors • 8x = non-standard variant • 9x = customer specific variant

Part Number	Standard Product Variants					
	Ruggedization			DRAM / SSD		
	AC-L0	AC-L100	CC-L200	16GB / 20GB	32GB / 80GB	64GB / 80GB
VPX6-1961-A0411P2	X			X		
VPX6-1961-A0422P2	X				X	
VPX6-1961-A0432P2	X					X
VPX6-1961-A1411P2		X		X		
VPX6-1961-A1422P2		X			X	
VPX6-1961-A1432P2		X				X
VPX6-1961-C2111P2			X	X		
VPX6-1961-C2122P2			X		X	
VPX6-1961-C2132P2			X			X

Part Number	Software and Accessories
RTM6-1961-0000	Rear Transition Module (RTM) for the VPX6-1961 Single Board Computer. • Provides breakout connectors and cables for most 1961 board I/O • Supports Curtiss-Wright RIM mezzanine modules RTMs are air-cooled and designed for lab use only. Not suitable for deployment.
CBL-1961-0003	Front panel breakout cable for air-cooled variants
DSW-1961-6860-RHL6	Red Hat Enterprise Linux (RHEL) 8.6 Board Support Package (BSP) for VPX6-1961 • Includes driver source code.
MNT-1961-RHL	Annual Software Upgrade / Maintenance Program (SUP) for VPX6-1961 RHEL BSP
DPK-1961-SI-000	Signal Integrity package for high-speed backplane signals