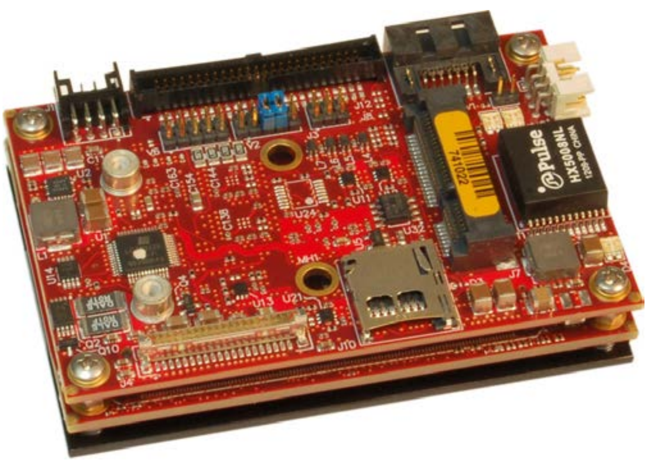

Reference Manual

REV. March 2020

Hawk

(VL-EPU-3310)

Intel® Atom™ E38xx-based Embedded Processing Unit with SATA, Ethernet, USB, Serial, Video, HD Audio, Mini PCIe Socket, and microSD.

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Notice:

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VersaLogic reserves the right to revise this product and associated documentation at any time without obligation to notify anyone of such changes.

† Other names and brands may be claimed as the property of others.

Product Revision Notes

Revision 1.06	Updated the Ground note on page 5
Revision 1.05	Updated broken links
Revision 1.04	Updated Tables 6, 12 and 14. Updated Console Redirection and CMOS sections
Revision 1.03	Updated Thermal Considerations chapter
Revision 1.02	Corrected power requirements data in Technical Specifications section
Revision 1.01	Added Thermal Considerations chapter
Revision 1.00	First release

Support Page

The Hawk Support Page contains additional information and resources for this product including:

- Operating system information and software drivers
- Data sheets and manufacturers' links for chips used in this product
- BIOS information and upgrades

VersaTech KnowledgeBase

The VersaTech KnowledgeBase contains useful technical information about VersaLogic products, along with product advisories.

Customer Support

If you are unable to solve a problem after reading this manual, visiting the product support page, or searching the KnowledgeBase, contact VersaLogic Technical Support at (503) 747-2261. VersaLogic support engineers are also available via e-mail at Support@VersaLogic.com.

Repair Service

If your product requires service, you must obtain a Returned Material Authorization (RMA) number by calling 503-747-2261. Be ready to provide the following information:

- Your name, the name of your company, your phone number, and e-mail address
- The name of a technician or engineer that can be contacted if any questions arise
- The quantity of items being returned
- The model and serial number (barcode) of each item
- A detailed description of the problem
- Steps you have taken to resolve or recreate the problem
- The return shipping address

Warranty Repair All parts and labor charges are covered, including return shipping charges for UPS Ground delivery to United States addresses.

Non-warranty Repair All approved non-warranty repairs are subject to diagnosis and labor charges, parts charges and return shipping fees. Specify the shipping method you prefer and provide a purchase order number for invoicing the repair.

Mark the RMA number clearly on the outside of the box before returning.

KNOWN ISSUES

Hardware

- A microSD card will not function if the Hawk is using Microsoft† Windows† 7
- The eMMC Flash device will not function if the Hawk is using Microsoft Windows 7

Contents

Tables

Figures

Introduction 1

Description

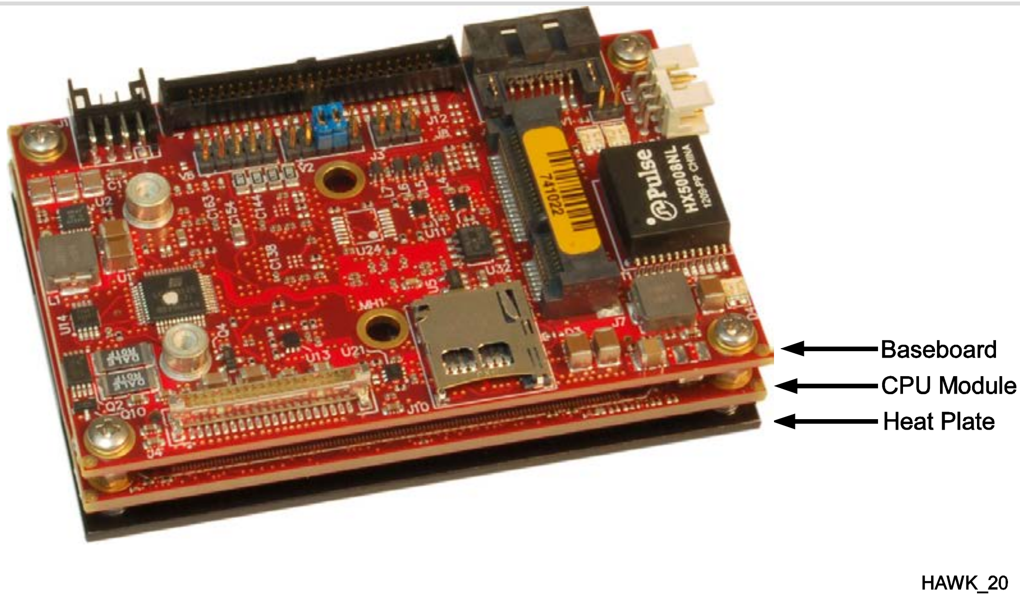


Figure 1. The Hawk (VL-EPU-3310)

Features and Construction

The Hawk (VL-EPU-3310) is a feature-packed Embedded Processing Unit (EPU) engineered and tested to meet the embedded industry's evolving requirements to develop smaller, lighter, and lower power embedded systems while adhering to stringent regulatory standards.

Roughly the size of a credit card and less than one inch thick, the Hawk is the embedded industry's smallest, lightest, ultra-rugged, embedded x86 computer. This embedded computer, equipped with an Intel† Atom† 38xx processor, is designed to withstand extreme temperature, impact, and vibration. Its features include:

- Intel Atom E3845 (1.91 GHz, Quad Core), E3827 (1.75 GHz, Dual Core), or E3815 (1.46 GHz, Single Core) processor
- 4 GB or 2GB soldered-on DDR3L-1333 RAM
- A 10BaseT/100BaseTX/1000BaseT Ethernet interface with a ruggedized 8-pin latching connector
- Integrated Intel Gen 7 graphics core
- Full ACPI support
- Four USB 2.0 ports
- Two RS-232/422 COM ports
- One microSD socket
- One LVDS interface
- One Mini PCIe/ mSATA socket
- One SATA II port, 3.0 Gbits/s
- Intel High Definition Audio (HDA) interface
- Watchdog Timer, prescaler of approximately 1 µs to 10 minutes.
- Speaker out
- Standard heat plate with optional thermal solutions
- Optional mounting plate
- Field upgradeable AMI UEFI BIOS with enhancements
- RoHS compliant
- Extended temperature operation
- Customization available

The Hawk is compatible with popular operating systems including Microsoft† Windows† 7/WES7, and Linux (see the VersaLogic OS Compatibility Chart).

Hawk EPUs are subjected to 100% functional testing and are backed by a limited five-year warranty. Careful parts sourcing and US-based technical support ensure the highest possible quality, reliability, service, and product longevity for this exceptional EPU.

Technical Specifications

Specifications are typical at +25 °C with a +12 V supply unless otherwise noted.

Board Size:
55 x 84 x 22 mm (2.17 x 3.31 x 0.87 inches)

Storage Temperature:
-40° to +85°C

Operating Temperature:
-40° to +85°C. Derate -1.1°C per 305m (1,000 ft.) above 2,300m (7,500 ft.).

Airflow Requirements:
Zero airflow to 85°C based on customer supplied heat removal system. User must keep the heat plate below 90°C, measured topside center point of heat plate.

Power Requirements: *(at +25°C and +12V supply running Windows 7 with LVDS display, SATA, GbE, COM, and USB keyboard/mouse. Typical power computed as the mean value of Idle and Maximum power specifications. Maximum power measured with 95% CPU utilization.)*
VL-EPU-3310-EAP:
5.2W Idle, 6.1W Typical, 7.0W Max, 0.9W S3
VL-EPU-3310-EBP:
5.5W Idle, 6.8W Typical, 8.2W Max, 0.9W S3
VL-EPU-3310-EDP:
5.9W Idle, 7.4W Typical, 8.8W Max, 0.9W S3

DRAM:
Soldered-on DDR3L SDRAM, 1333 MT/s
VL-EPU-3310-EAP: 2 GB
VL-EPU-3310-EBP: 2 GB
VL-EPU-3310-EDP: 4 GB

System Reset:
Push-button power reset via paddleboard
Watchdog timeout (warm/cold reset)

Video Interface
LVDS – 3.3V compatible, 18/24-bit, up to 1280 x 768 resolution (60 Hz)

SATA Interface:
One SATA II port, 3 Gbits/s

Flash Storage:
One microSD socket, up to 32 GB
Mini PCIe/mSATA socket
On-board eMMC Flash -
VL-EPU-3310-EAP: none
VL-EPU-3310-EBP: 4 GB
VL-EPU-3310-EDP: 8 GB

Ethernet Interface:
One IEEE802.3 compliant Gigabit Ethernet MAC, 10BaseT/100BaseTX/1000BaseT

COM Interface:
COM1/COM2 – RS-232/422 to DB-9 connectors on paddleboard

USB:
Four USB 2.0 host ports to Type-A connectors on paddleboard

Audio:
Intel High-Definition Audio CODEC
Stereo HD audio line in/out

BIOS:
AMI Aptio UEFI BIOS with OEM enhancements, field programmable

Weight:
3.6 oz (102 grams)

Specifications are subject to change without notification.

Block Diagram

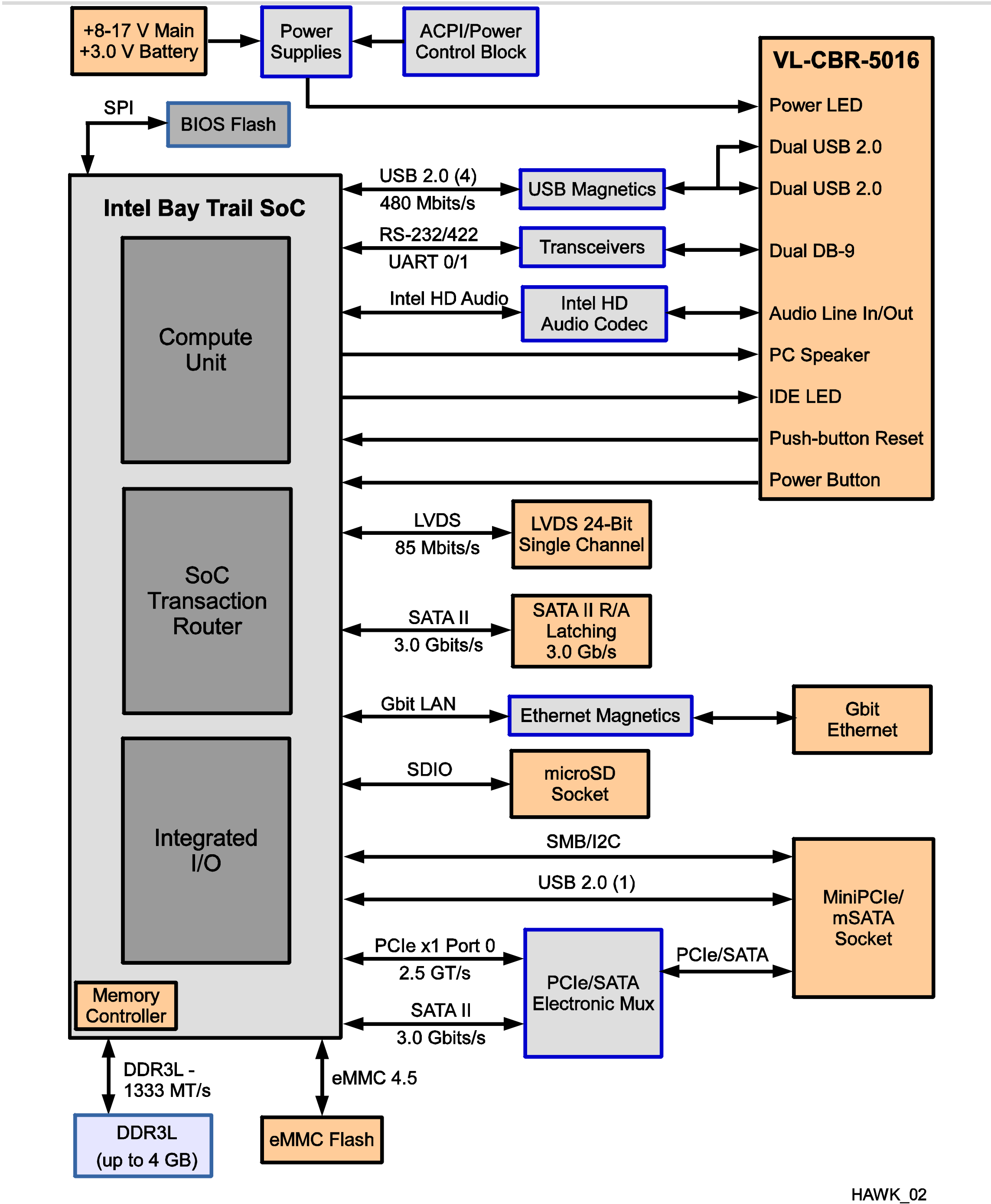


Figure 2. Hawk (VL-EPU-3310) Block Diagram

Cautions

Electrostatic Discharge

CAUTION:

Electrostatic discharge (ESD) can damage circuit boards, disk drives, and other components. The circuit board must only be handled at an ESD workstation. If an approved station is not available, some measure of protection can be provided by wearing a grounded antistatic wrist strap. Keep all plastic away from the board, and do not slide the board over any surface.

After removing the board from its protective wrapper, place the board on a grounded, static-free surface, component side up. Use an antistatic foam pad if available.

The board should also be protected inside a closed metallic antistatic envelope during shipment or storage.

Note:

The exterior coating on some metallic antistatic bags is sufficiently conductive to cause excessive battery drain if the bag comes in contact with the bottom side of the Hawk.

Handling Care

CAUTION:

Avoid touching the exposed circuitry with your fingers when handling the board. Though it will not damage the circuitry, it is possible that small amounts of oil or perspiration on the skin could have enough conductivity to cause the contents of CMOS RAM to become corrupted through careless handling, resulting in CMOS resetting to factory defaults.

Grounding

CAUTION:

All mounting standoffs are signal ground. For example, if metal standoffs are used to mount to an earth-grounded chassis, it is highly recommended to isolate the standoffs from the chassis.

Thermal Considerations

CPU Die Temperature

The CPU die temperature is affected by numerous conditions, such as CPU utilization, CPU speed, ambient air temperature, air flow, thermal effects of adjacent circuit boards, external heat sources, and many others.

The thermal management for the Intel Atom E38xx series of processors consists of a sensor located in the core processor area. The processor contains multiple techniques to help better manage thermal attributes of the processor. It implements thermal-based clock throttling and thermal-based speed step transitions. There is one thermal sensor on the processor that triggers Intel's thermal monitor (the temperature at which the thermal sensor triggers the thermal monitor is set during the fabrication of the processor). Triggering of this sensor is visible to software by means of the thermal interrupt LVT entry in the local APIC. (See the Intel Atom Processor E3800 Series Datasheet for complete information.)

Thermal Options

The following thermal options are available for the Hawk:

- VL-HDW-405 – Secondary 75 mm x 84 mm mounting plate. Attaches to heat plate on standard product. Refer to page 11 for more information.
- VL-HDW-406 – Passive heat sink to mount on product heat plate
- VL-HDW-408 – Heat pipe connector plate. Mounts to standard product
- VL-HDW-411 – Cooling fan for HDW-406 passive heatsink. Operates at 12 V and includes an ATX-style connection

Configuration and Setup 2

Initial Configuration

The following components are recommended for a typical development system with the Hawk EPU:

- ATX power supply
- VL-CBR-5016 paddleboard and cable. Refer to the chapter titled “VL-CBR-5016 Paddleboard”, beginning on page 37 for details on the VL-CBR-5016 paddleboard.
- USB keyboard and mouse
- SATA hard drive
- USB CD-ROM drive
- LVDS monitor
- A thermal solution (using either VersaLogic accessories or a customer-designed solution)

You will also need an operating system (OS) installation CD-ROM.

Basic Setup

The following steps outline the procedure for setting up a typical development system. The Hawk should be handled at an ESD workstation or while wearing a grounded antistatic wrist strap.

Before you begin, unpack the Hawk and accessories. Verify that you received all the items you ordered. Inspect the system visually for any damage that may have occurred in shipping. Contact Support@VersaLogic.com immediately if any items are damaged or missing.

Gather all the peripheral devices you plan to attach to the Hawk as well as their interface and power cables.

It is recommended that you attach standoffs to the board (see Hardware Assembly on page 12) to stabilize the board and make it easier to work with.

Figure 3 shows a typical setup for the Hawk in the development environment.

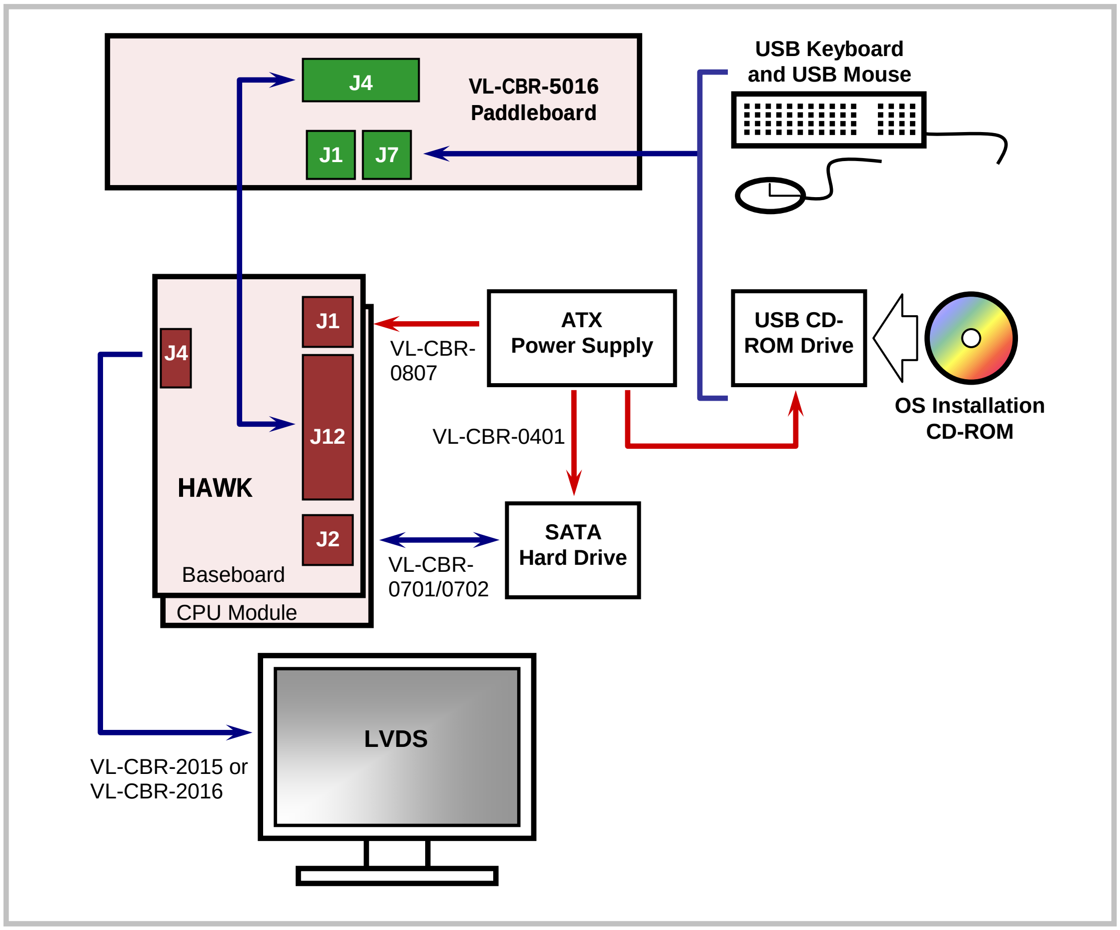


Figure 3. Typical Development Configuration

1. Attach Cables and Peripherals

- Attach an LVDS monitor to connector J4 of the baseboard using the VL-CBR-2015 or VL-CBR-2016 cable.
- Attach SATA hard disk to connector J2 of the baseboard using the VL-CBR-0701 or VL-CBR-0702 cable.
- Attach the user I/O paddleboard, VL-CBR-5016, to connector J12 of the baseboard.
- Connect a USB keyboard and USB mouse to one of the USB Type-A connectors (J1 or J7) on the paddleboard.
- Attach a USB CD-ROM drive to one of the USB Type-A connectors (J1 or J7) on the paddleboard.

2. Connect Power Source

- Plug the power adapter cable VL-CBR-0807 into socket J1 of the baseboard. Attach the motherboard connector of the ATX power supply to the adapter.
- Attach an ATX power cable to any 3.5-inch drive not already attached to the power supply (hard drive or CD-ROM drive).

3. Review Configuration

- Before you power up the system, double-check all the connections. Make sure all cables are oriented correctly, that adequate power will be supplied to the Hawk, and all attached peripheral devices.

4. Power On

- Turn on the ATX power supply and the video monitor. If the system is correctly configured, a video signal should be present.

5. Install Operating System

- Install the operating system according to the instructions provided by the operating system manufacturer.

Operating System Installation

The standard PC architecture used on the Hawk makes the installation and use of most of the standard x86-based operating systems very simple. The operating systems listed on the VersaLogic Software Support page use the standard installation procedures provided by the maker of the operating system. Special optimized hardware drivers for a particular operating system, or a link to the drivers, are available on the Hawk Support Page.

BIOS Setup

Refer to the VersaLogic System Utility Reference Manual for information on how to configure the Hawk BIOS.

Physical Details 3

Dimensions and Mounting

Hawk Dimensions

The Hawk complies with the COM Express mini form factor standard. Figure 4 provides the board's dimensions to assist with pre-production planning and layout.

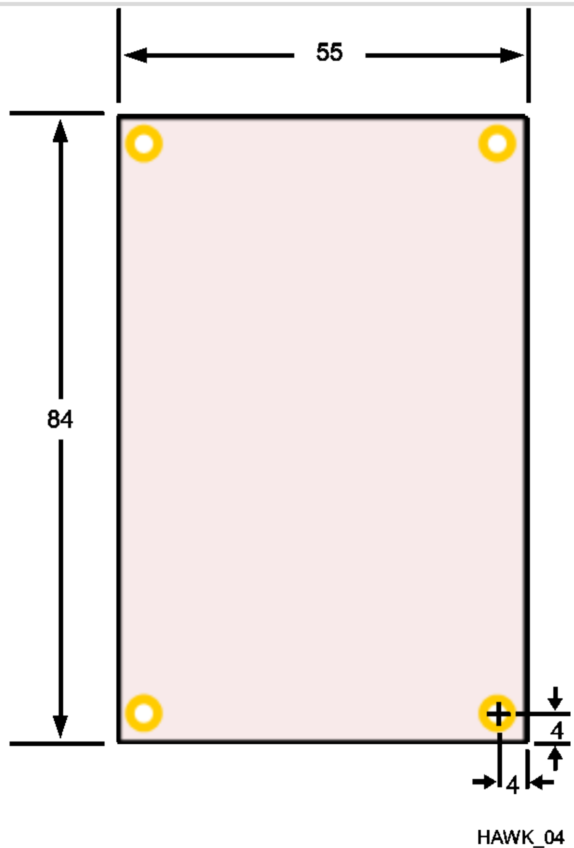


Figure 4. Hawk Dimensions and Mounting Holes

(Not to scale. All dimensions in millimeters.)

VL-HDW-405 Mounting Plate Dimensions

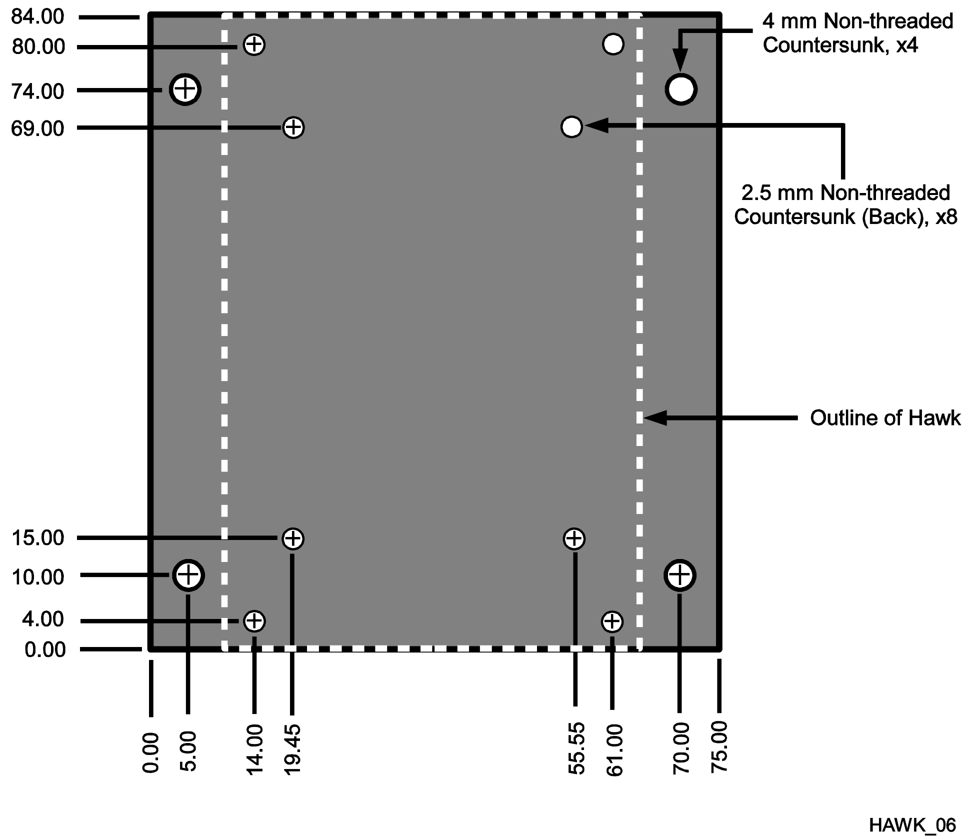


Figure 5. Mounting Plate Dimensions

(Not to scale. All dimensions in millimeters.)

Hardware Assembly

There are two basic assembly methods:

- Heat plate down (in relation to the enclosure)
- Heat plate up

These assembly methods are shown in Figure 6 and Figure 7, respectively. An optional mounting plate, VL-HDW-405, can be used with either method. See Appendix A – Mounting Options beginning on page 53 for mounting configuration details.

Heat Plate Down

Figure 6 shows the assembly including the mounting plate. Use this assembly method if you are attaching the Hawk to a larger thermal solution such as a metal chassis/enclosure.

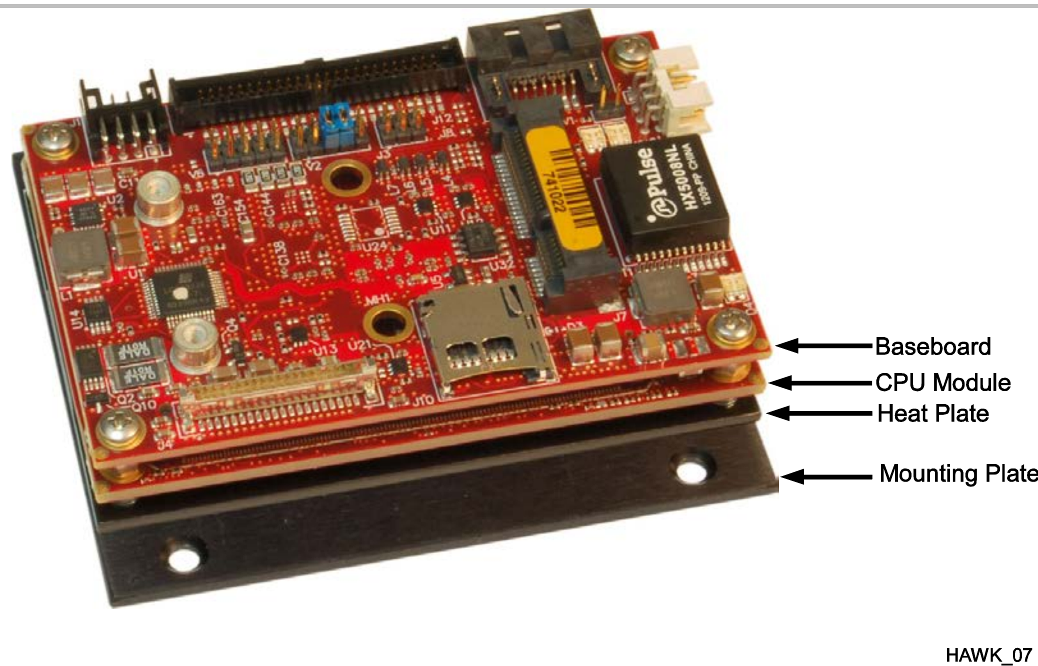


Figure 6. Hardware Assembly with Heat Plate Down

The recommended method is to attach the Hawk heat plate to the mounting plate (VL-HDW-405), and attach the mounting plate to the enclosure.

A thermal interface compound must be applied to the heat plate to thermally bond it to the mounting plate or other surface to which the Hawk is mounted. Spread the compound thinly and evenly across the entire heat plate surface before mounting. The compound is supplied in the VL-CKR-HAWK cable kit or sold separately as part number VL-HDW-401.

Heat Plate Up

Use this assembly method if you are adding a heatsink to the standard Hawk heat plate. Figure 7 shows the assembly including the optional HDW-405 mounting plate and optional HDW-406 heatsink.

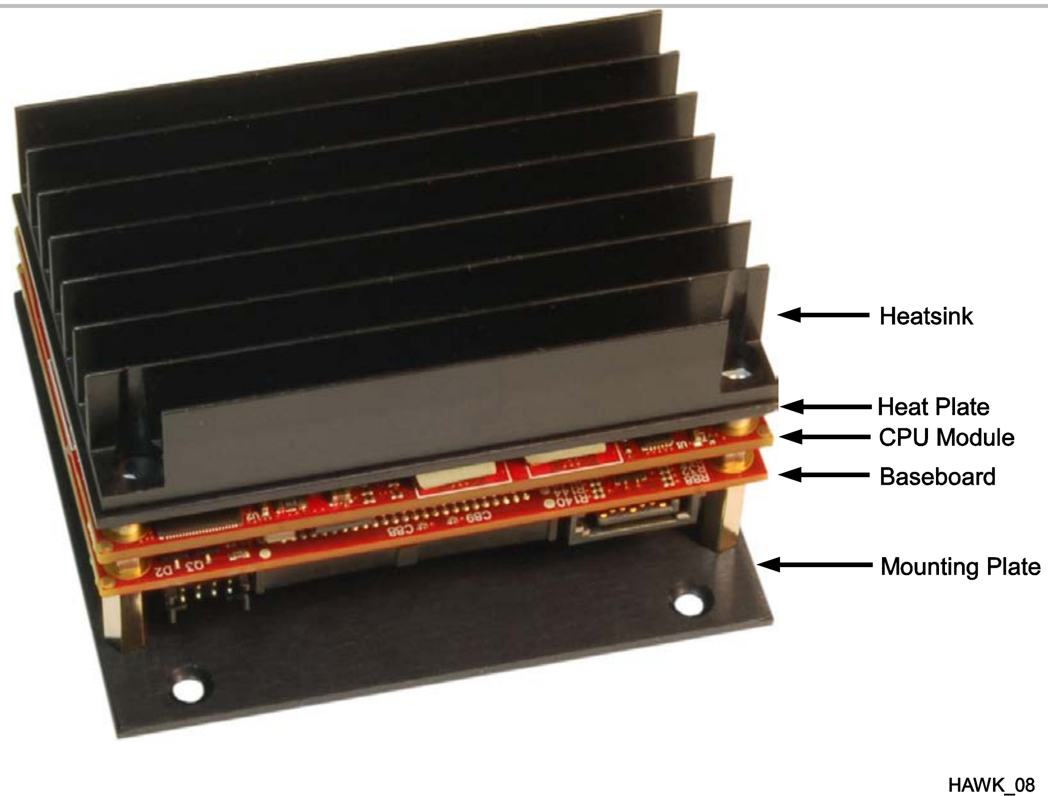


Figure 7. Hardware Assembly with Heat Plate Up

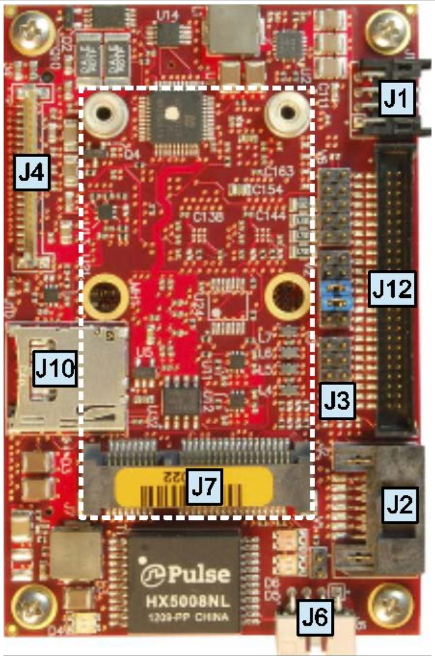
The recommended assembly method for this configuration is as follows:

1. Attach the heatsink to the Hawk heat plate.
2. Attach the baseboard to the mounting plate (VL-HDW-405) with standoffs.
3. Attach the mounting plate to the enclosure.

Additional thermal options are available for the Hawk. Refer to page 6 for more information.

External Connectors

Baseboard Connector Locations



Reference Designator	Description
J1	Power
J12	User I/O
J3	Reserved – not used
J2	SATA
J6	Ethernet
J7	Mini PCIe/mSATA
J10	microSD
J4	LVDS

Figure 8. Baseboard Connector Locations

Hawk Connector Functions and Interface Cables

Table 1 provides information about the function, mating connectors, and transition cables for Hawk connectors. Page numbers indicate where a detailed pinout or additional information is available.

Table 1: Connector Functions and Interface Cables

Connector (Note)	Function	Mating Connector	Transition Cable	Cable Description	Refer to page…
J1	Input power	Hirose DF11-8DS-2C (housing), Hirose DF11-22SC x8 (crimp socket)	VL-CBR-0807	12" 8-pin ATX power cable adapter	18
J2	SATA II port	Latching SATA	VL-CBR-0702	19.75" latching SATA cable	28
J3	Reserved/ Not used	—	—	—	—
J4	LVDS	Hirose DF19G-20S-1C (housing), Hirose DF19-2830SCFA x19 (crimp socket)	VL-CBR-2015 --or— VL-CBR-2016	20" 18- or 24-bit LVDS cable (attaches to optional VL-CBR-2014, LVDS to VGA adapter)	33
J6	Ethernet	FCI 10073599-008LF (housing), 2mm Minitek, AWG 22-24 x8 (crimp terminal)	VL-CBR-0804	Latching Ethernet cable	24
J7	Mini PCIe / mSATA socket	Mini PCIe card or VL-MPEs-F1E Series mSATA Flash Drive	—	—	28
J10	microSD	VL-F41-xxxx microSD Flash Drive	—	—	31
J12	User I/O	Oupiin 1204-50G00B2A	VL-CBR-5016	12" 1.27 mm IDC 50-pin to 50-pin	23

Note: Connectors not listed are either not installed, for factory use only, or used for CPU module/baseboard interconnect.

Jumper Blocks

Jumper As-Shipped Configuration

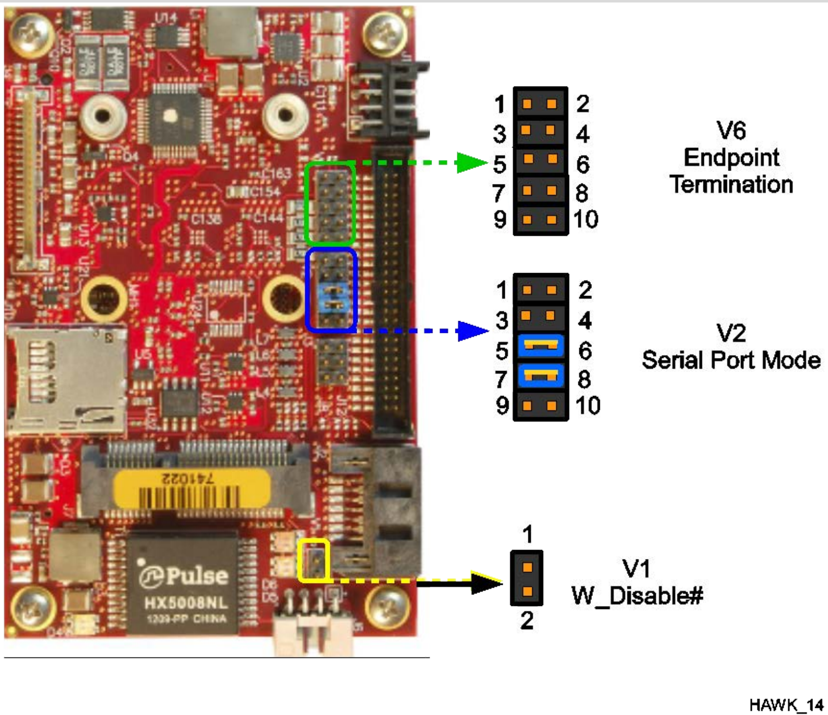


Figure 9. Jumpers As-Shipped Configuration

Jumper Configuration Summary

Table 2: Jumper Block V6 – Endpoint Termination

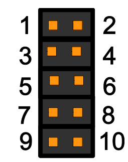
Pins	Function	Description	Configuration, as shipped
1-2	Reserved	Not used	
3-4	Reserved	Not used	
5-6	Reserved	Not used	
7-8	COM1 termination	▪ In: Endpoint termination ▪ Out: Not terminated	
9-10	COM2 termination	▪ In: Endpoint termination ▪ Out: Not terminated	

Table 3: Jumper Block V2 - Serial Port Mode

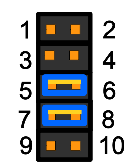
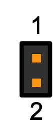
Pins	Function	Description	Configuration, as shipped
1-2	Reserved	Not used	
3-4	Reserved	Not used	
5-6	COM1 mode	▪ In: RS-232 ▪ Out: RS-422	
7-8	COM2 mode	▪ In: RS-232 ▪ Out: RS-422	
9-10	Reserved	Not used	

Table 4: Jumper Block V1 - Wireless Radio Disable Configuration

Pins	Function	Description	Configuration, as shipped
1-2	Wireless Disable	▪ In: Wireless radio operation disabled on Mini PCIe card ▪ Out: Wireless radio operation enabled	

Power Delivery

Main input power is applied to the Hawk through the 8-pin power connector, J1.

Power Requirements

The Hawk requires a single +8-17 VDC supply of 2 A (24 W) or better. The input DC supply creates both the standby and payload voltages provided to the CPU module.

The exact power requirements for the Hawk depend on several factors, including CPU configuration (the number of cores, CPU clock rate), memory configuration, peripheral connections, and attached devices, and others. For example, driving long RS-232 lines at high speed can increase power demand.

The VersaLogic VL-PS-ATX12-300A is a 1U size ATX power supply designed for use with the Hawk. Use the VL-CBR-0807 adapter cable to attach the power supply to the J1 connector.

Table 5: J1 Main Power Connector Pinout

Pin	Signal	Description	Pin	Signal	Description
1	V12P0_IN	+12 VDC power input	2	V12P0_IN	+12 VDC power input
3	V12P0_IN	+12 VDC power input	4	GND	Ground
5	GND	Ground	6	GND	Ground
7	V3P3_RTC	+2.75V to +3.3V Battery	8	SLP_R#	Sleep#

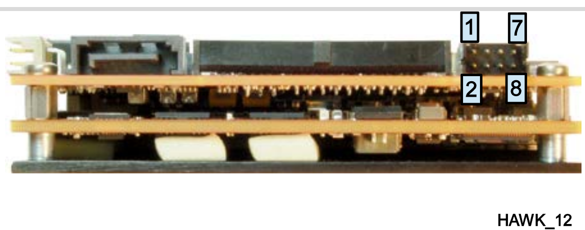


Figure 10. J1 Main Power Connector Pin Orientation

Power Delivery Considerations

Using the VersaLogic approved power supply (VL-PS-ATX12-300A) and power cable (VL-CBR-0807) will ensure high quality power delivery to the board. Customers who design their own power delivery methods should take into consideration the guidelines below to ensure good power connections.

Also, the specifications for typical operating current do not include any off-board power usage that may be fed through the Hawk power connector. Expansion boards and USB devices plugged into the board will source additional power through the Hawk power connector.

- Do not use wire smaller than 22 AWG. Use high quality UL 1007 compliant stranded wire.
- The length of the wire should not exceed 18 inches.
- Avoid using any additional connectors in the power delivery system.
- The power and ground leads should be twisted together, or as close together as possible to reduce lead inductance.
- A separate conductor must be used for each of the power pins.
- All power input pins and all ground pins must be independently connected between the power source and the power connector.
- Use a high quality power supply that can supply a stable voltage while reacting to widely varying current draws.

CPU

The Intel Atom E38xx SoC features integrated 3D graphics, video encode and decode, and memory and display controllers in one package.

System RAM

The Hawk has soldered-on SDRAM with the following characteristics:

- Memory Type: DDR3L
- Data Rate: 1333 MT/s
- Storage Capacity: 2 GB or 4 GB
  - VL-EPU-3310-EAP: 2 GB
  - VL-EPU-3310-EBP: 2 GB
  - VL-EPU-3310-EDP: 4 GB

Flash Storage

The Hawk has the following Flash storage capabilities:

- One microSD socket that supports microSD cards up to 32 GB
- One Mini PCIe/mSATA socket
- On-board eMMC Flash
  - VL-EPU-3310-EAP: none
  - VL-EPU-3310-EBP: 4 GB
  - VL-EPU-3310-EDP: 8 GB

Real-Time Clock (RTC)

The Hawk features a real-time clock/calendar (RTC) circuit. The Hawk supplies RTC voltage in S5, S3, and S0 states, but requires an external +2.75 V to +3.3 V battery connection to pin 7 of the J1 power connector to maintain RTC functionality and RTC CMOS RAM when the Hawk is not powered. The RTC can be set using the BIOS Setup program.

Watchdog Timer

The Hawk has a watchdog timer that contains a selectable prescaler approximately 1 µs to 10 minutes. See the Intel Atom Processor E3800 Series Datasheet for configuration information.

Default BIOS Settings

The Hawk permits you to store user-defined BIOS settings. This enables you to retrieve those settings from cleared or corrupted CMOS RAM, or battery failure. All BIOS defaults can be changed, except the time and date. BIOS defaults can be updated with the BIOS Update Utility.

⚠ **CAUTION:** If BIOS default settings make the system unbootable and prevent the user from entering the BIOS Setup program, the Hawk must be serviced by the factory.

Default BIOS Setup Values

After CMOS RAM is cleared, the system loads default BIOS parameters the next time the board is powered on. The default CMOS RAM setup values will be used in order to boot the system whenever the main CMOS RAM values are blank, or when the system battery is dead or has been removed from the board.

Resetting CMOS to Factory Settings

1. Power on the unit and press the Del key several times (3-4x) then wait 5-10 seconds.
2. Press F9 to Restore the BIOS defaults and press enter.
3. Press F10 for the settings and enter to Autosave, the unit should power down and restart with the default settings.

Console Redirection

The Hawk can be configured for remote access by redirecting the console to a serial communications port. BIOS Setup and some operating systems such as DOS can use this console for user interaction.

Console redirection settings are configured in the BIOS Setup. Console redirection is enabled in BIOS Setup in Advanced -> Serial Port Console Redirection. The serial port must be enabled before the serial console can be assigned to the port. On the Hawk, the only serial port that supports console redirection is in Advanced -> Module Serial Ports -> Serial Port 0.

To enter BIOS Setup, press Esc on the remote console. To simulate a function key, press Esc followed by a number key. For example, simulate an "F10 - Save & Exit" keystroke using Esc, 0.Console redirection can be disabled or redirected to a different COM port. The default settings for the redirected console are 115.2 Kbps, 8 data bits, 1 stop bit, no parity, and no flow control. Figure 11 shows the wiring for a DB9-to-DB9 adapter for console redirection of an RS-232 serial port.

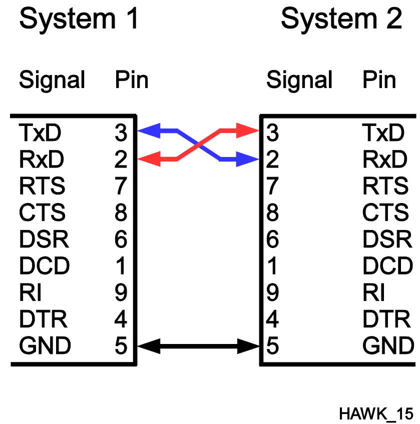


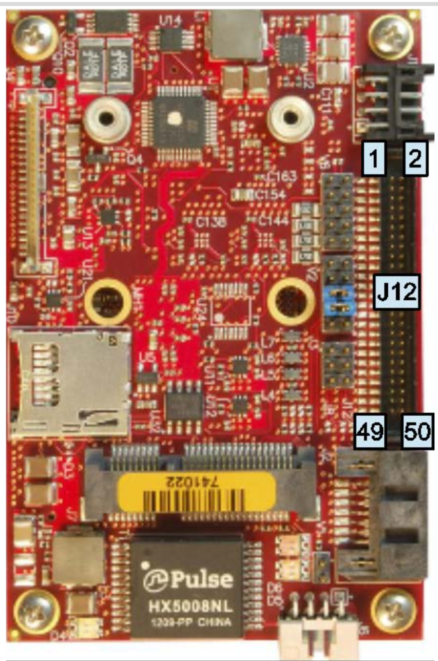
Figure 11. Wiring for a DB9 to DB9 RS-232 Adapter for Console Redirection

Interfaces and Connectors

I/O Connector

The 50-pin user I/O connector (J12) incorporates the two COM ports, four USB ports, programmable LED, power LED, push-button reset, power button, audio line in/out, and speaker interfaces. The following figure and tables describe the J12 connector:

- Figure 12 shows the pin orientation of the J12 connector.
- Table 6 lists the function of each pin on the J12 connector.
- Table 14 on page 38 shows how the pins of the J12 connector map to the connectors on the VL-CBR-5016 paddleboard.



HAWK_21

Figure 12. Pin Orientation of J12 User I/O Connector

Table 6 lists the function of each pin on the J12 connector.

Table 6: J12 User I/O Connector Pinout

Pin	Signal	Pin	Signal
1	Ground	2	Not used
3	Not used	4	Ground
5	Not used	6	Not used
7	Ground	8	Not used
9	Not used	10	Ground
11	TxD [for RS-232] TxD- [for RS-422]	12	Not Used
13	Ground	14	RxD [for RS-232] RxD- [for RS-422]
15	RxD+ [for RS-422]	16	Ground
17	TxD [for RS-232] TxD- [for RS-422]	18	TxD+ [for RS-422]
19	Ground	20	RxD [for RS-232] RxD- [for RS-422]
21	RxD+ [for RS-422]	22	Ground
23	TxD [for RS-232] TxD- [for RS-422]	24	TxD+ [for RS-422]
25	USB0 +5.0V	26	USB0 Data +
27	USB0 Data -	28	USB1 +5.0V
29	USB1 Data +	30	USB1 Data -
31	USB2 +5.0V	32	USB2 Data +
33	USB2 Data -	34	USB3 +5.0V
35	USB3 Data +	36	USB3 Data +
37	+5.0 V (Protected)	38	Programmable LED output (D1 mSATA activity)
39	Speaker output	40	Push-button Reset
41	Power button	42	Ground
43	Left channel line in	44	High-Definition Audio ground
45	Right channel line in	46	High-Definition Audio ground
47	Left channel line out	48	High-Definition Audio ground
49	Right channel line out	50	High-Definition Audio ground

Ethernet Interface

The Hawk features an Intel I210 Gigabit Ethernet controller. The controller provides a standard IEEE 802.3 Ethernet interface for 1000Base-T, 100Base-TX, and 10Base-T applications. Drivers are readily available to support a variety of operating systems.

Ethernet Connector

An 8-pin, right angle, latching Ethernet connector (J6) is provided to make connection with a Category 5 or 6 Ethernet cable. The Ethernet controller auto-negotiates connection speed. The interface uses IEC 61000-4-2-rated TVS components to help protect against ESD damage.

Table 7: J6 Ethernet Connector Pinout

Pin	Signal	Function	Pin	Signal	Function
1	MDI3_N	Bi-directional pair D–	2	MDI3_P	Bi-directional pair D+
3	MDI1_N	Bi-directional pair B–	4	MDI1_P	Bi-directional pair B+
5	MDI2_N	Bi-directional pair C–	6	MDI2_P	Bi-directional pair C+
7	MDI0_N	Bi-directional pair A–	8	MDI0_P	Bi-directional pair A+

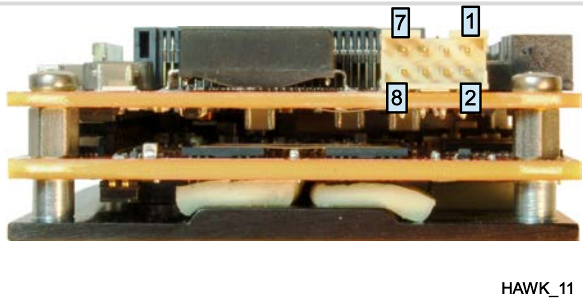


Figure 13. J6 Ethernet Connector Pin Orientation

Correctly Installing the VL-CBR-0804 Latching Ethernet Cable

When attaching the VL-CBR-0804 Latching Ethernet Cable, be sure to align the cable correctly to the connector. Figure 14 shows the correct alignment of the cable, as seen from the top and bottom sides of the board.

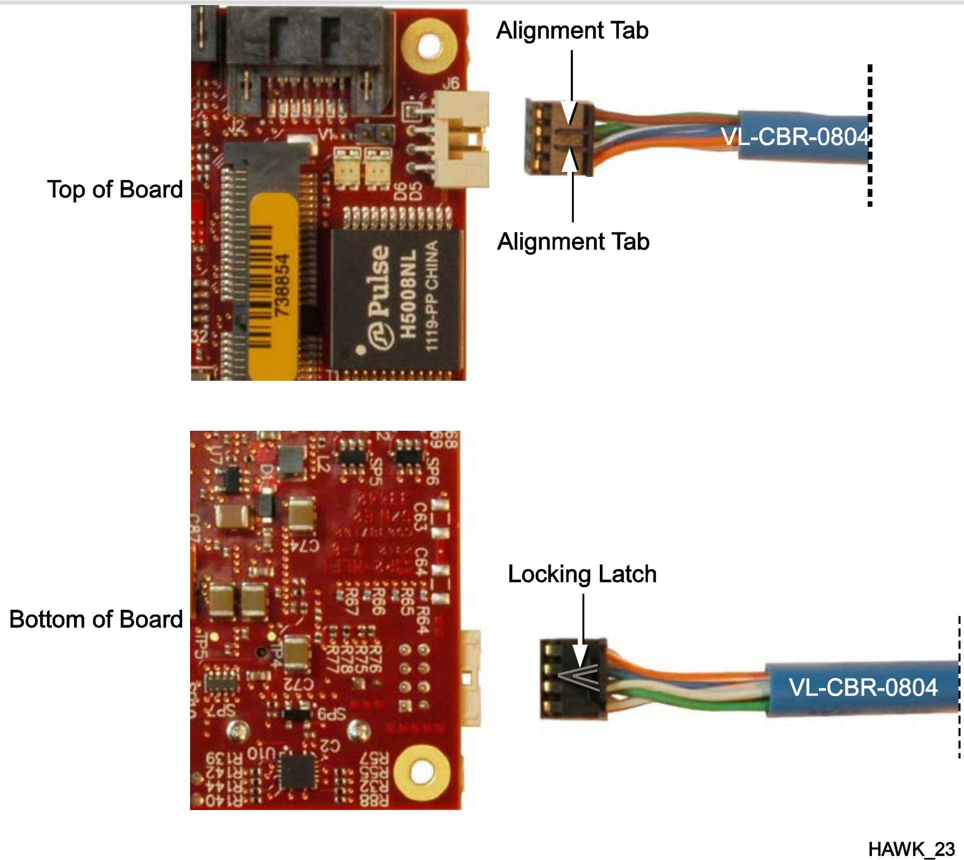


Figure 14. Correct Alignment of VL-CBR-0804 Cable to J6 Ethernet Connector

Figure 15 shows the cable correctly installed, as seen from the top and bottom sides of the board.

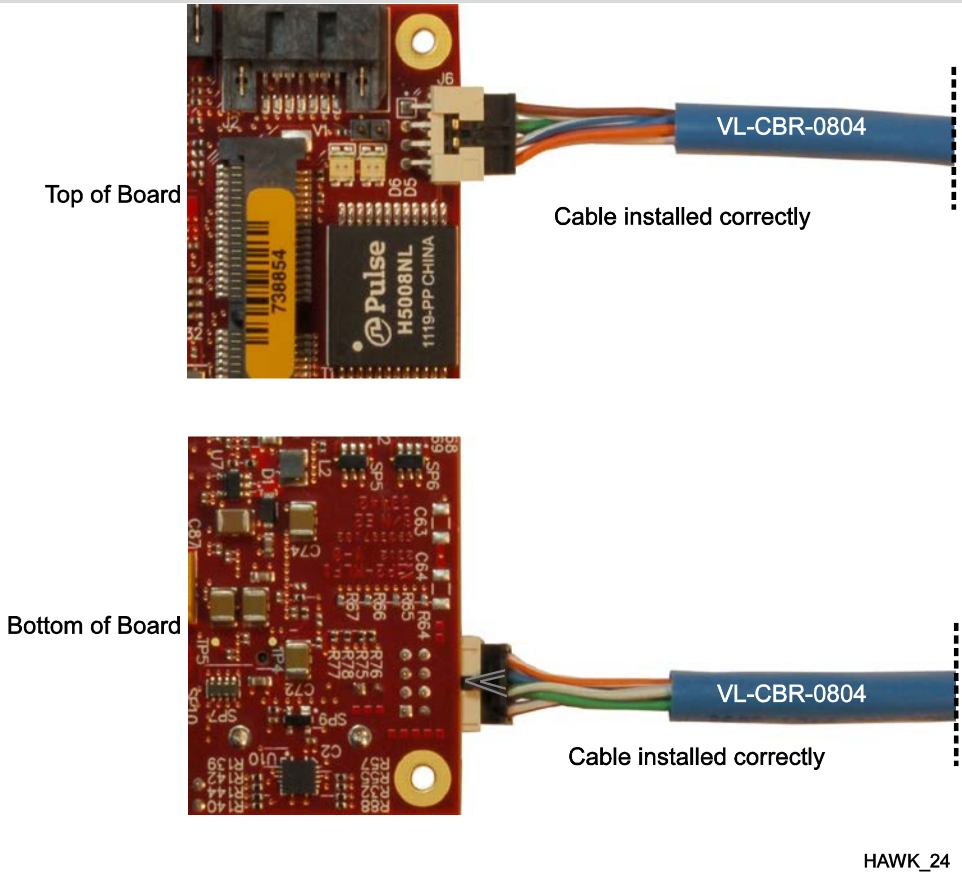


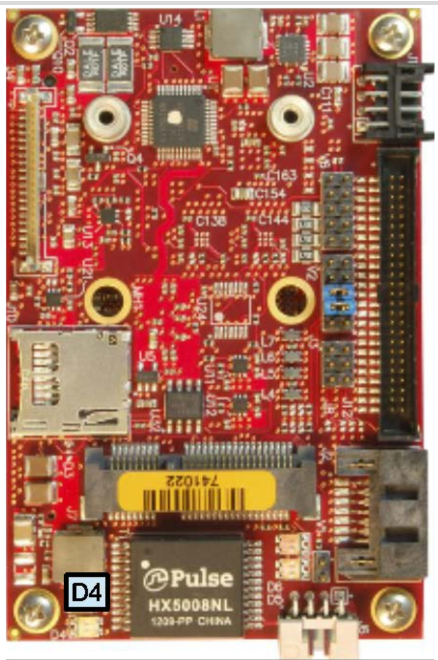
Figure 15. Correct Installation of VL-CBR-0804 Cable

Ethernet Status LEDs

A dual green/yellow status LED is provided at location D4. This LED provides an indication of the Ethernet status as shown in Table 8. Figure 16 shows the location of the Ethernet status LED.

Table 8: On-board Ethernet Status LEDs (D4)

LED	State	Description
	Yellow	Activity
Green/Yellow (Link/Activity)	Green	Link
	Off	No Link



HAWK_16

Figure 16. Onboard Ethernet Status LED

SATA Interface

The Hawk provides one serial ATA (SATA) port that communicates at a rate of up to 3.0 Gbits/s (SATA II). The SATA connector at baseboard location J2 is a SATA II-compatible right-angle connector with latching capability. Power to SATA drive is supplied by the ATX power supply. Note that the standard SATA drive power connector is different from the common 4-pin Molex connector used on IDE drives. Most current ATX power supplies provide SATA connectors, and many SATA drives provide both types of power connectors. If the power supply you are using does not provide SATA connectors, adapters are available.

Table 9: J2 SATA Port Pinout

J2 (baseboard)	Signal Name	Function
1	GND	Ground
2	TX+	Transmit +
3	TX-	Transmit -
4	GND	Ground
5	RX-	Receive -
6	RX+	Receive +
7	GND	Ground

Mini PCIe / mSATA Socket

The socket at location J7 accepts a full- or half-height Mini PCI Express (PCIe) card or an mSATA module.

The Mini PCIe interface includes one PCIe x1 lane, one USB 2.0 channel, and the SMBus interface. The socket is compatible with plug-in Wi-Fi modems, GPS receivers, MIL-STD-1553, flash data storage, and other cards for added flexibility. An Intel Wi-Fi Link 5300 Mini PCIe card (VL-WD10-CBN) is available from VersaLogic. A Wi-Fi antenna (VL-CBR-ANT01) and a 12" Wi-Fi card to bulkhead RP-SMA transition cable (VL-CBR-0201) are also available. For more information, contact Sales@VersaLogic.com.

The VL-MPEs-F1E series of mSATA modules provide flash storage of 4 GB, 16 GB, or 32 GB.

To secure a Mini PCIe card or mSATA module to the on-board standoffs, use two M2.5 x 6 mm pan head Philips nylon screws. These screws are available in quantities of 10 in the VL-HDW-108 hardware kit from VersaLogic.

Table 10: Mini PCIe / mSATA Pinout

J7 Pin	Mini PCIe Signal Name	Mini PCIe Function	mSATA Signal Name	mSATA Function
1	WAKE#	Wake	Reserved	Not connected
2	3.3VAUX	3.3 V auxiliary source	+3.3V	3.3 V source
3	NC	Not connected	Reserved	Not connected
4	GND	Ground	GND	Ground
5	NC	Not connected	Reserved	Not connected
6	1.5V	1.5 V power	+1.5V	1.5 V power
7	CLKREQ#	Reference clock request	Reserved	Not connected
8	NC	Not connected	Reserved	Not connected
9	GND	Ground	GND	Ground
10	NC	Not connected	Reserved	Not connected
11	REFCLK-	Reference clock input –	Reserved	Not connected
12	NC	Not connected	Reserved	Not connected
13	REFCLK+	Reference clock input +	Reserved	Not connected
14	NC	Not connected	Reserved	Not connected
15	GND	Ground	GND	Ground
16	NC	Not connected	Reserved	Not connected
17	NC	Not connected	Reserved	Not connected
18	GND	Ground	GND	Ground
19	NC	Not connected	Reserved	Not connected
20	W_DISABLE#	Wireless disable	Reserved	Not connected
21	GND	Ground	GND	Ground
22	PERST#	Card reset	Reserved	Not connected
23	PERn0	PCIe receive –	+B	Host receiver diff. pair +
24	3.3VAUX	3.3 V auxiliary source	+3.3V	3.3 V source
25	PERp0	PCIe receive +	-B	Host receiver diff. pair –
26	GND	Ground	GND	Ground
27	GND	Ground	GND	Ground
28	1.5V	1.5 V power	+1.5V	1.5 V power
29	GND	Ground	GND	Ground
30	SMB_CLK	SMBus clock	Two Wire I/F	Two wire I/F clock
31	PETn0	PCIe transmit –	-A	Host transmitter diff. pair –
32	SMB_DATA	SMBus data	Two Wire I/F	Two wire I/F data
33	PETp0	PCIe transmit +	+A	Host transmitter diff. pair +
34	GND	Ground	GND	Ground
35	GND	Ground	GND	Ground
36	USB_D-	USB data –	Reserved	Not connected
37	GND	Ground	GND	Ground
38	USB_D+	USB data +	Reserved	Not connected
39	3.3VAUX	3.3V auxiliary source	+3.3V	3.3 V source
40	GND	Ground	GND	Ground

J7 Pin	Mini PCIe Signal Name	Mini PCIe Function	mSATA Signal Name	mSATA Function
41	3.3VAUX	3.3 V auxiliary source	+3.3V	3.3 V source
42	LED_WWAN#	Wireless WAN LED	Reserved	Not connected
43	GND	mSATA Detect [1]	GND/NC	Ground/Not connected [2]
44	LED_WLAN#	Wireless LAN LED	Reserved	Not connected
45	NC	Not connected	Vendor	Not connected
46	LED_WPAN#	Wireless PAN LED	Reserved	Not connected
47	NC	Not connected	Vendor	Not connected
48	1.5V	1.5 V power	+1.5V	1.5 V power
49	Reserved	Reserved	DA/DSS	Device activity [3]
50	GND	Ground	GND	Ground
51	Reserved	Reserved	GND	Ground [4]
52	3.3VAUX	3.3 V auxiliary source	+3.3V	3.3 V source

Notes:

1. This pin is not grounded on the Hawk since it can be used to detect the presence of an mSATA module versus a Mini PCIe card.
2. This pin is not grounded on the Hawk to make it available for mSATA module detection.
3. This signal drives the top LED (D1) on the VL-CBR-5016 paddleboard. This LED lights with mSATA disk activity (if supported by the mSATA module).
4. Some Mini PCIe cards use this signal as a second Mini PCIe card wireless disable input. On the Hawk, this signal is available for use for mSATA versus Mini PCIe card detection. There is an option on the VersaLogic Features BIOS setup screen for setting the mSATA detection method.

W_Disable# Signal

The W_DISABLE# is for use with optional wireless Ethernet Mini PCIe cards. The signal enables you to disable a wireless card’s radio operation in order to meet public safety regulations or when otherwise desired. The W_DISABLE# signal is an active low signal that when driven low (shorted to ground) disables radio operation on the Mini PCIe card wireless device. When the W_DISABLE# is not asserted, or in a high impedance state, the radio may transmit if not disabled by other means such as software.

Mini PCIe Card Wireless Status LEDs

Three wireless status LEDs are provided on the Hawk at locations D5 and D6. D6 is a dual-colored (green and yellow) LED. These LEDs light when the associated device is installed and capable of transmitting. Table 11 lists the states of the D5 and D6 LEDs. Figure 17 shows their location on the Hawk.

Table 11: Mini PCIe Card Wireless Status LEDs (D5/D6)

LED	State	Description
D5	Yellow	Wireless WAN activity
D6	Green	Wireless LAN activity
	Yellow	Wireless PAN activity

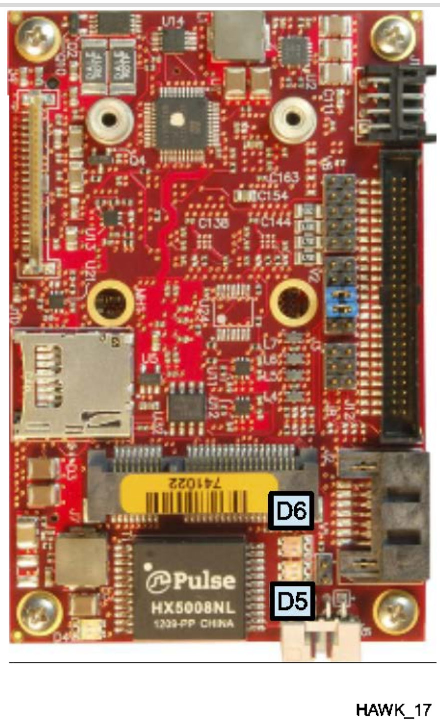


Figure 17. Mini PCIe Wireless Status LEDs

USB Interface

The Hawk provides four USB 2.0 ports.

The USB interface on the Hawk is UHCI (Universal Host Controller Interface) and EHCI (Enhanced Host Controller Interface) compatible, which provides a common industry software/hardware interface. The Hawk provides dual Type-A USB host connectors at locations J1 and J7 on the VL-CBR-5016 paddleboard. One additional USB channel is available through the Mini PCIe card connector at J7.

microSD Socket

The Hawk provides a microSD socket on the baseboard (J10). The VL-F41 series of microSD cards provide solid-state storage of 2 GB, 4 GB, or 8 GB. The microSD socket accommodates cards with up to 32 GB of storage capacity.

Serial Ports

The Hawk provides two serial ports. Both ports can be operated in RS-232 or RS-422 mode. IRQ lines are chosen in CMOS Setup. The UARTs for the two ports are implemented differently. The following two subsections describe the unique characteristics of each UART.

UART0

UART0 provides a 16550-based serial port driven by a 48 MHz clock. The operating system should configure the clock rate in the UART Driver and UART Clock in the Packet Hub Driver for proper functionality.

UART1

UART1 is a PCI memory-mapped I/O port. For information on how to implement this UART, refer to the Intel Atom Processor E3800 Product Family Design-in Guide.

COM Port Configuration

Jumper block V2 configures the serial ports for RS-232 or RS-422 operation. See the section titled "Jumper Blocks" on page 16 for details. The termination resistor should be enabled for RS-422 endpoint stations. Termination is not used for RS-232 intermediate stations.

Serial Port Connectors

Table 12 lists the pinouts of the DB9M serial port connectors on the VL-CBR-5016 paddleboard. These connectors use IEC 61000-4-2-rated TVS components to help protect against ESD damage.

Table 12: COM1 and COM2 Pinouts – VL-CBR-5016 Connector J2

DB9 Pin	RS-232	RS-422
1	—	—
2	RXD	RxD-
3	TXD	TxD-
4	—	—
5	Ground	Ground
6	—	—
7	—	TxD+
8	—	RxD+
9	—	—

Video

The Intel Atom E38xx processor series contains an integrated graphics engine with advanced 2D/3D graphics, video decode and encode capabilities, and a display controller. The Hawk supports one LVDS display.

LVDS Flat Panel Display Connector

The integrated LVDS flat panel display in the Hawk is an ANSI/TIA/EIA-644-1995 specification-compliant interface. It can support 18 or 24 bits of RGB pixel data plus 3 bits of timing control (HSYNC/VSYNC/DE) on the 4 differential data output pairs. The LVDS interface supports a maximum resolution of 1280 x 768 (60 Hz).

The Hawk has one LVDS connector at location J4.

The BIOS Setup program provides several options for standard LVDS flat panel types. If these options do not match the requirements of the panel you are using, contact Support@VersaLogic.com for a custom video BIOS.

Table 13: J4 LVDS Flat Panel Display Connector Pinout

Pin	Signal Name	Function
1	GND	Ground
2	NC	Not Connected
3	LVDSA3	Differential Data 3 (+)
4	LVDSA3#	Differential Data 3 (-)
5	GND	Ground
6	LVDSCLK0	Differential Clock (+)
7	LVDSCLK0#	Differential Clock (-)
8	GND	Ground
9	LVDSA2	Differential Data 2 (+)
10	LVDSA2#	Differential Data 2 (-)
11	GND	Ground
12	LVDSA1	Differential Data 1 (+)
13	LVDSA1#	Differential Data 1 (-)
14	GND	Ground
15	LVDSA0	Differential Data 0 (+)
16	LVDSA0#	Differential Data 0 (-)
17	GND	Ground
18	GND	Ground
19	+3.3V	+3.3 V (Protected)
20	+3.3V	+3.3 V (Protected)

The +3.3V power provided to pins 19 and 20 of J4 is protected by a software-controllable power switch (1 Amp max.). This switch is controlled by the LVDD_EN signal from the LVDS interface controller in the CPU.

VGA Output

A VGA monitor can be attached to the J4 connector using the VL-CBR-2014 LVDS to VGA adapter card. Follow the procedure below to do this.

1. Plug the "Host End" of the LVDS cable VL-CBR-2015 into connector J4 of the Hawk.
2. Plug the LVDS cable into connector J1 of the VL-CBR-2014 adapter card (see Figure 18).
3. Attach the VGA monitor data cable to connector CN1 of the VL-CBR-2014 adapter cable.

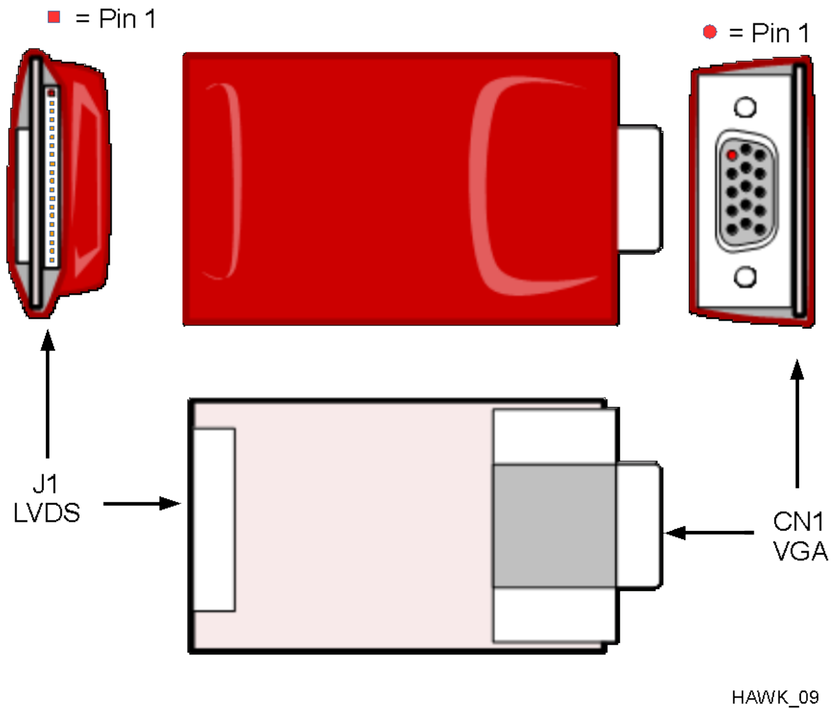


Figure 18. VL-CBR-2014 LVDS to VGA Adapter Card

External Speaker

Connector J12 includes a speaker output signal at pin 39. The VL-CBR-5016 paddleboard provides a piezoelectric speaker. Figure 19 on page 37 shows the location of the piezoelectric speaker on the VL-CBR-5016 paddleboard.

Audio

The audio interface on the Hawk is implemented using an Integrated Device Technology, Inc. audio codec. This interface is Intel High Definition Audio (HDA) compatible. Drivers are available for most Windows-based and Linux operating systems. To obtain the most current versions, consult the Hawk Product Support Page**.**

The J12 main I/O connector provides the line-level stereo input and line-level stereo output connection points. The outputs will drive most amplified PC speaker sets. Audio line-in and line-out connectors are provided on the VL-CBR-5016 paddleboard. Figure 19 on page 37 shows the locations of the audio line-in and line-out connectors.

Integrator's Note:

In Windows, the rear line-in audio input is configured by default as a microphone input. To configure it for audio input, disable the microphone boost to eliminate audio distortion.

Push-button Reset

Connector J12 includes an input for a push-button reset switch. Shorting J12 pin 40 to ground causes the Hawk to reboot. This must be a mechanical switch or an open-collector or open-drain active switch with less than a 0.5V low-level input when the current is 1 mA. There must be no pull-up resistor on this signal. This connector uses IEC 61000-4-2-rated TVS components to help protect against ESD damage.

A reset button is provided on the VL-CBR-5016 paddleboard. Refer to Chapter 6, VL-CBR-5016 Paddleboard, beginning on page 37 for more information.

Power Button

Connector J12 includes an input for a power button. A momentary short to ground or assertion of J12 pin 41 will cause a power button ACPI event. The button event can be configured in Windows to enter an S3 power state (Sleep, Standby, or Suspend-to-RAM), an S4 power state (Hibernate or Suspend-to-Disk), or an S5 power state (Shutdown or Soft-Off). A short or assertion with a duration of more than 4 seconds will cause an abrupt hardware power down to S5. This connector uses IEC 61000-4-2-rated TVS components to help protect against ESD damage.

A power button is provided on the VL-CBR-5016 paddleboard. Refer to Chapter 6, VL-CBR-5016 Paddleboard, beginning on page 37 for more information.

Supported Power States

The Hawk supports the following power states:

- S0 (G0): Working.
- S1 (G1-S1): All processor caches are flushed and the CPU stops executing instructions. Power to the CPU and RAM is maintained. Devices that do not indicate they must remain on may be powered down.

- S3 (G1-S3): Commonly referred to as Standby, Sleep, or Suspend-to-RAM. RAM remains powered.
- S4 (G1-S4): Hibernation or Suspend-to-Disk. All content of main memory is saved to non-volatile memory, such as a hard drive, and is powered down.
- S5 (G2): Soft Off. Almost the same as G3 Mechanical Off, except that the power supply still provides power, at a minimum, to the power button to allow return to S0. A full reboot is required. No previous content is retained. Other components may remain powered so the computer can "wake" on input from the keyboard, clock, modem, or LAN.
- G3: Mechanical off (ATX supply switch turned off).

LEDs

mSATA Activity LED

Connector J12 includes an output signal for an mSATA activity LED that corresponds to the top LED at position D1 on the VL-CBR-5016 paddleboard. Refer to the section titled “Indicators/LEDs” on page 39 for more information.

Power LED

The power LED (the bottom LED at position D1) on the VL-CBR-5016 indicates that the paddleboard is being powered by the +5V supply (though it does not indicate that all S0 power supplies are good). The LED is lit only when the board is in the S0 power state. If the board enters a Sleep or Hibernate mode, the LED will not light. Refer to the section titled “Indicators/LEDs” on page 39 for more information.

6 VL-CBR-5016 Paddleboard

This chapter provides information on the VL-CBR-5016 paddleboard.

Connectors and Controls

Connector and Control Locations

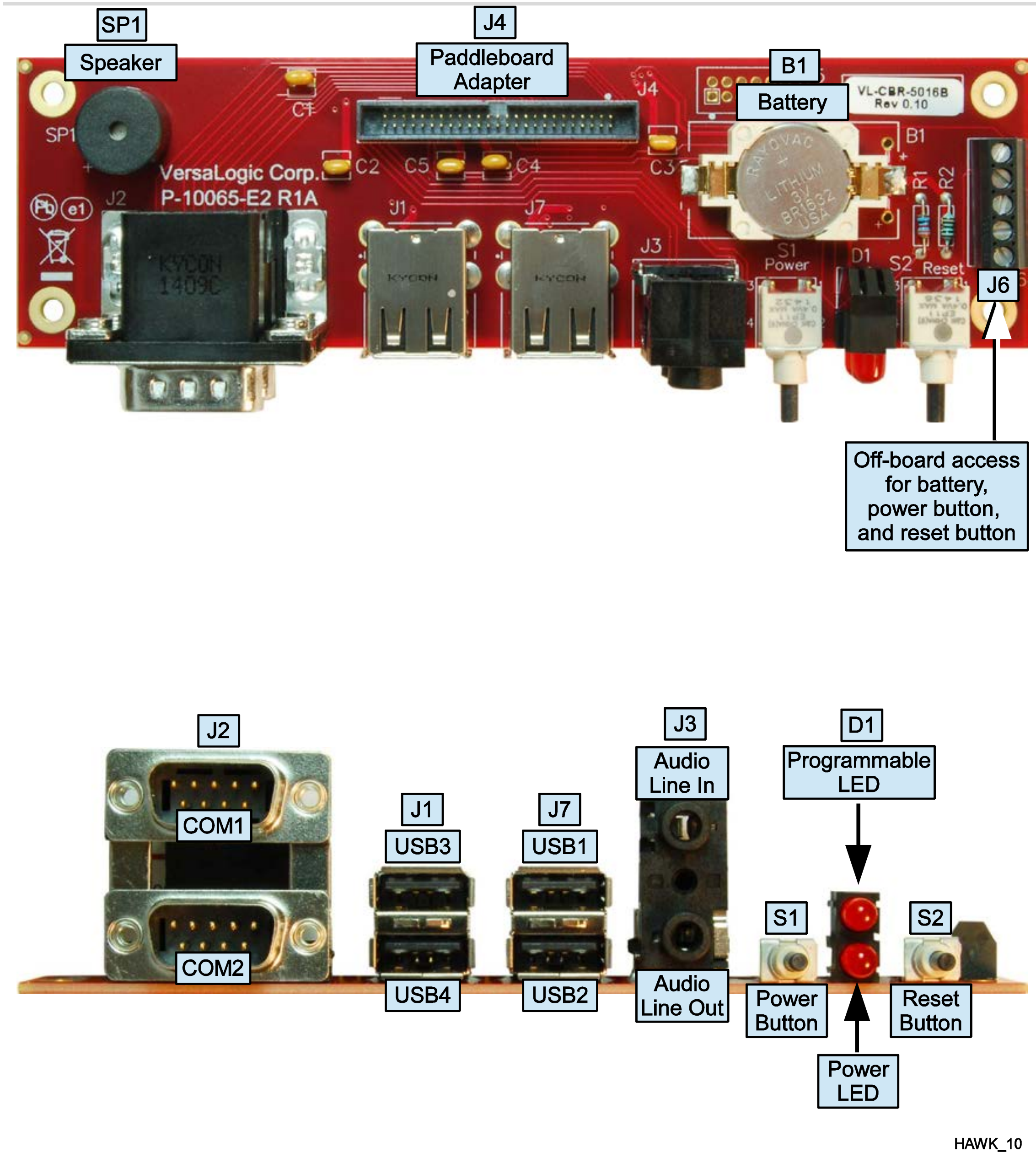


Figure 19. VL-CBR-5016 Connectors and Controls

Table 14 shows how the pins of the baseboard's J12 connector map to the connectors on the VL-CBR-5016 paddleboard.

Table 14: User I/O Connector Pinout Mapped to VL-CBR-5016 Paddleboard

J12 Pin	Paddleboard Connector	Signal	
		RS-232	**RS-422**
1	Not used	Ground	Ground
2			-
3		—	
4		Ground	Ground
5			
6		—	
7	Not used	Ground	Ground
8			
9			
10		Ground	Ground
11			
12			
13	**J2 COM1** (Top DB9)	Ground	Ground
14		RxD	RxD-
15		—	RxD+
16		Ground	Ground
17		TxD	TxD-
18		—	TxD+
19	**J2 COM2** (Bottom DB9)	Ground	Ground
20		RxD	RxD-
21		—	RxD+
22		Ground	Ground
23		TxD	TxD-
24		—	TxD+

J12 Pin	Paddleboard Connector	Signal
25	**USB0**	USB0 +5.0V
26		Data +
27		Data -
28	**USB1**	USB1 +5.0V
29		Data +
30		Data -
31	**USB2**	USB2 +5.0V
32		Data +
33		Data -
34	**USB3**	USB3 +5.0V
35		Data +
36		Data -
37		+5.0V (Protected)
38	**D1**	mSATA activity
39	**SP1**	Speaker
40	**S2**	Push-button Reset
41	**S1**	Power Button
42		Ground
43	**Audio In** (J3 Top)	Audio In - Left
44		HDA ground (isolated)
45		Audio In - Right
46		HDA ground (isolated)
47	**Audio Out** (J3 Bottom)	Audio Out - Left
48		HDA ground (isolated)
49		Audio Out - Right
50		HDA ground (isolated)

J6 Terminal Block

The five-pin terminal block at location J6 provides off-board access to the power button, the reset button, and an external battery input. Table 15 lists the pinout of the J6 terminal block. Figure 20 shows the location and the pin configuration of the J6 terminal block.

Table 15: J6 Terminal Block Pinout (on VL-CBR-5016 Paddleboard)

Pin	Signal Name	Function
1	V_BATT_AUX	Auxiliary battery connection
2	GND	Ground
3	PWR_BTN#	Power button input
4	GND	Ground
5	RST_BTN#	Reset button input

Figure 20. Pin Configuration of J6 Terminal Block on the VL-CBR-5016 Paddleboard

Indicators/LEDs

mSATA Activity LED

Connector J12 on the baseboard includes an output signal for an mSATA activity LED that corresponds to the top LED at position D1 on the VL-CBR-5016 paddleboard.

Power LED

The power LED (the bottom LED at position D1) on the VL-CBR-5016 indicates that the paddleboard is being powered by the +5V supply (though it does not indicate that all S0 power supplies are good). The LED is lit only when the board is in the S0 power state. If the board enters a Sleep or Hibernate mode, the LED will not light.

Dimensions

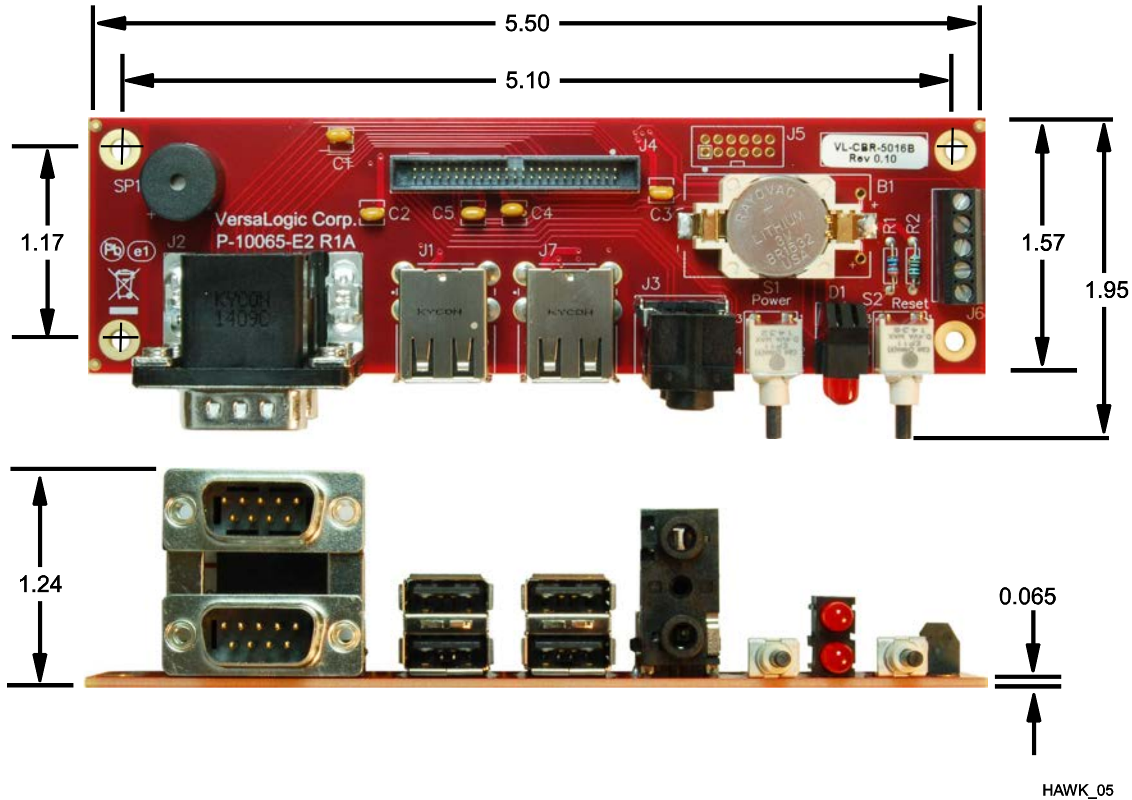


Figure 21. VL-CBR-5016 Dimensions

(Not to scale. All dimensions in inches.)

Thermal Considerations 7

This chapter discusses the following topics related to thermal issues:

- Selecting the correct thermal solution for your application
- EPU-3310 thermal characterization
- Installing the passive (HDW-406 heat sink), the active (HDW-411 fan), and the heat pipe block (HDW-408) thermal solutions available from VersaLogic

Selecting the Correct Thermal Solution for Your Application

This section provides guidelines for the overall system thermal engineering effort.

Heat Plate

The heat plate supplied with the Hawk is the basis of the thermal solution. The heat plate draws heat away from the CPU chip as well as other critical components. Some components rely on the ambient air temperature being maintained at or below the maximum specified 85 ºC temperature.

The heat plate is designed with the assumption that the user's thermal solution will maintain the top surface of the heat plate at 90 ºC or less. If that temperature threshold is maintained, the CPU will remain safely within its operating temperature limits.

CAUTION:

By itself, the heat plate is not a complete thermal solution. Integrators should either implement a thermal solution using the accessories available from VersaLogic or develop their own thermal solution that attaches to the heat plate, suitable for environments in which the EPU-3310 will be used. As stated above, the thermal solution must be capable of keeping the top surface of the heat place at or below 90 ºC and the air surrounding the components in the assembly at or below 85 ºC.

The heat plate is permanently affixed to the Hawk and must not be removed. Removal of the heat plate voids the product warranty. Attempting to operate the Hawk without the heat plate voids the product warranty and can damage the CPU.

System-level Considerations

The Hawk is often mounted directly to another thermally controlled surface via its heat plate (that is, the inside surface of an enclosure). In this case, the user needs to maintain the heat plate at or below 90 ºC by controlling the mounting surface temperature. The EPU-3310 thermal solutions available from VersaLogic – the HDW-406 heat sink with or without the HDW-411 fan, or the HDW-408 heat pipe block – can be used in the user's final system or only used during product development as a temporary bench-top solution.

The ambient air surrounding the EPU-3310 needs to be maintained at 85 ºC or below. This may prove to be challenging depending on how and where the EPU-3310 is mounted in the end user system.

The decision as to which thermal solution to use can be based on several factors including:

- Number of CPU cores in the SoC (single, dual, or quad)
- CPU and video processing utilization by the user application
- Temperature range within which the EPU-3310 will be operated
- Air movement (or lack of air movement)

Most of these factors involve the demands of the user application on the EPU-3310 and cannot be isolated from the overall thermal performance. Due to the interaction of the user application, the Hawk thermal solution, and the overall environment of the end system, thermal performance cannot be rigidly defined.

The ambient air surrounding the EPU-3310 needs to be maintained at 85 ºC or below. This would include the space between the two main boards as well as the space beneath an installed miniPCIe expansion board. This may prove to be challenging depending on how and where the EPU-3310 is mounted in the end-user system. Standard methods for addressing this requirement include the following:

- Provide a typical airflow of 100 linear feet per minute (LFM) / 0.5 linear meters per second (as described in the section titled EPU-3310 Thermal Characterization, beginning on page 45) within the enclosure
- Position the EPU-3310 board to allow for convective airflow
- Lower the system level temperature requirement as needed

CPU Thermal Trip Points

The CPU cores in the Hawk have their own thermal sensors. Coupled with these sensors are specific reactions to three thermal trip points. Table 16 describes the three thermal trip points. Note that these are internal temperatures that are about 10 ºC above the heat plate temperature.

Table 16: CPU Thermal Trip Points

Trip Point	Description
Passive (Note 1)	At this temperature, the CPU cores throttle back to a lower speed. This reduces the power draw and heat dissipation, but lowers the processing speed.
Critical (Note 2)	At this temperature, the operating system typically puts the board into a sleep or other low-power state.
Maximum core temperature	The CPU turns itself off when this temperature is reached. This is a fixed trip point and cannot be adjusted.

Notes:

1. The default value in the BIOS Setup program for this trip point is 90 ºC.
2. The default value in the BIOS Setup program for this trip point is 100 ºC.

These trip points allow maximum CPU operational performance while maintaining the lowest CPU temperature possible. The long-term reliability of any electronic component is degraded when it is continually run near its maximum thermal limit. Ideally, the CPU core temperatures will be kept well below 100 ºC with only brief excursions above.

CPU temperature monitoring programs are available to run under both Windows and Linux. Table 17 lists some of these hardware monitoring programs.

Table 17: Temperature Monitoring Programs

Operating System	Program Type	Description
Windows	Core Temperature	http://www.alcpu.com/CoreTemp/
	Hardware Monitor	http://www.cpuid.com/softwares/hwmonitor.html
	Open Hardware Monitor	http://openhardwaremonitor.org/
Linux	lm-sensors	http://en.wikipedia.org/wiki/Lm_sensors

Thermal Specifications, Restrictions, and Conditions

Graphical test data is in the section titled EPU-3310 Thermal Characterization, beginning on page 45. Refer to that section for the details behind these specifications. These specifications are the thermal limits for using the EPU-3310 with one of the defined thermal solutions.

Due to the unknown nature of the entire thermal system, or the performance requirement of the application, VersaLogic cannot recommend a particular thermal solution. This information is intended to provide guidance in the design of an overall thermal system solution.

Table 18: Absolute Minimum and Maximum Air Temperatures

Board	With Heat Plate	With Heat Sink (HDW-406)	With Heat Sink + Fan (HDW-406 + HDW-411)
VL-EPU-3310-EAP	-40 ° to +85 °C	-40 ° to +85 °C	-40 ° to +85 °C
VL-EPU-3310-EBP	-40 ° to +85 °C	-40 ° to +85 °C	-40 ° to +85 °C
VL-EPU-3310-EDP	-40 ° to +85 °C	-40 ° to +85 °C	-40 ° to +85 °C

Overall Restrictions and Conditions:

- Ranges shown assume less than 90% CPU utilization.
- Keep the maximum CPU core temperature below 100ºC.
- The ambient air surrounding the EPU-3310 needs to be maintained at 85 ºC or below. This includes the space between the two main boards as well as the space beneath an installed miniPCIe expansion board. A recommended overall air flow of 100 linear feet per minute (LFM) / 0.5 linear meters per second (LMS) addresses this requirement. If this air flow is not provided, other means must be implemented to keep the adjacent air at 85 ºC or below.

Heat Plate Only Restrictions and Conditions:

- The heat plate must be kept below 90 °C. This applies to a heat plate mounted directly to another surface as well as when the HDW-408 heat pipe block is used.

Heat Sink Only Considerations:

- At 85°C air temperature and 90% CPU utilization, there will be little if any thermal margin to a CPU core temperature of 100 °C or the passive trip point (see test data). If this is the use case, consider adding a fan or other additional air flow.

Heat Sink with Fan Considerations:

- The heat sink and fan combination cools the CPU when it is running in high temperature environments, or when the application software is heavily utilizing the CPU or video circuitry. The fan assists in cooling the heat sink and provides additional air movement within the system.

Integrator's Note: The ambient air surrounding the EPU-3310 needs to be maintained at 85 °C or below.

EPU-3310 Thermal Characterization

The EPU-3310 board underwent the following thermal characterization tests:

- Test Scenario 1: Single core EPU-3310-EAP + HDW-406 heat sink
- Test Scenario 2: Dual core EPU-3310-EBP + HDW-406 heat sink, with/without HDW-411 fan
- Test Scenario 3: Quad core EPU-3310-EDP + HDW-406 heat sink, with/without HDW-411 fan
- Test Scenario 4: Quad core EPU-3310-EDP + HDW-406 heat sink + HDW-408 heat pipe block, with/without HDW-411 fan

Table 19 describes the thermal testing setup for the board.

Table 19: EPU-3310 Thermal Testing Setup

Hardware configuration	EPU-3310 (Hawk) single/dual/quad core CPU with: ▪ 4 GB of DDR3L DRAM (2 GB for the single- and dual-core board models) ▪ HDW-406 (passive heat sink) ▪ HDW-408 (heat pipe block) ▪ HDW-411 (heat sink fan) ▪ One VGA display device (connected through the LVDS interface) ▪ One SATA hard disk drive ▪ Two RS-232 ports in loopback configuration **(Note)** ▪ One VersaLogic VL-MPEe-E3 Mini PCIe Gigabit Ethernet module ▪ Two active Ethernet ports in loopback configuration ▪ Two USB 2.0 ports in loopback configuration **(Note)** ▪ USB keyboard and mouse **(Note)**
BIOS	▪ ID string: Hawk_3.1.0.334.r1.101 ▪ Passive thermal trip point setting: 105 ºC ▪ Critical thermal trip point setting: 110 ºC
Operating system	Microsoft Windows 7, SP1
Test software	▪ Passmark BurnIn Test v7.1 b1017 - CPU utilization ~90% ▪ Intel Thermal Analysis Tool (TAT) v5.0.1014 - Primarily used to read the CPU core temperature
Test environment	Thermal chamber

Note: This device is connected through a VersaLogic VL-CBR-5016 paddleboard.

The test results reflect the test environment within the temperature chamber used. This particular chamber has an airflow of about 0.5 linear meters per second (~100 linear feet per minute). Thermal performance can be greatly enhanced by increasing the airflow beyond 0.5 linear meters per second.

The system power dissipation is primarily dependent on the application program; that is, its use of computing or I/O resources. The stress levels used in this testing are considered to be at the top of the range of a typical user's needs.

Test Results

Test Scenario 1: Single Core EPU-3310-EAP + HDW-406 Heat Sink

At 90% CPU utilization this single core unit operates within the CPU's core temperature safe operating range all the way up to +85 ºC using only a heat sink.

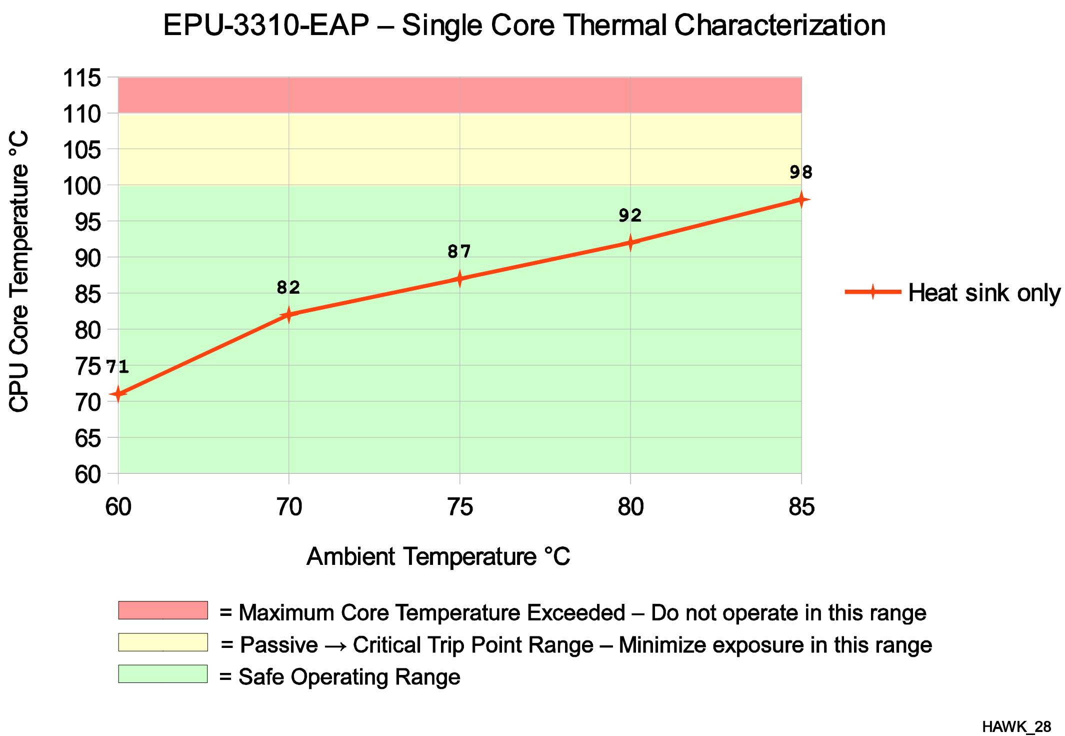


Figure 22. EPU-3310-EAP Single Core Temperature Relative to Ambient Temperature

Test Scenario 2: Dual Core EPU-3310-EBP + HDW-406 Heat Sink, with/without HDW-411 fan

As shown in Figure 23, running the test scenario with just the heat sink, the core temperature is slightly above 100 ºC at maximum ambient temperature. This will be less in most applications that require less than 90% CPU utilization. Adding the fan provides an additional 5-6 ºC of margin. For long-term reliability, ensure the CPU cores are predominately running with their temperatures below 100 ºC.

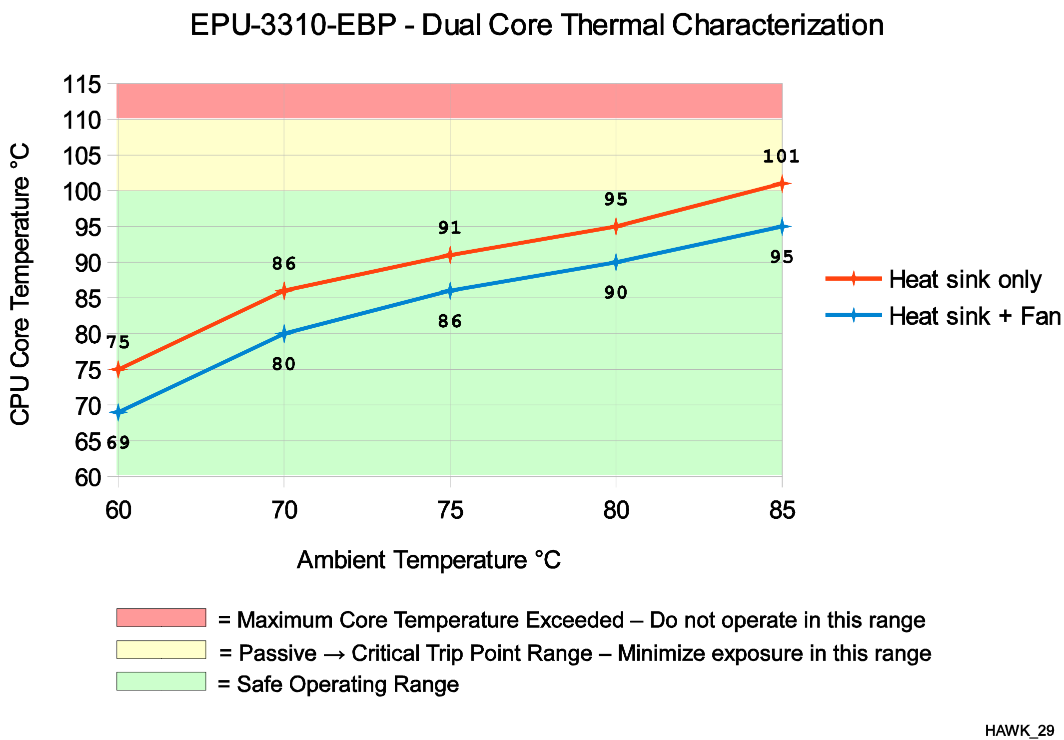


Figure 23. EPU-3310-EBP Dual Core Temperature Relative to Ambient Temperature

Test Scenario 3: Quad Core EPU-3310-EDP + HDW-406 Heat Sink, with/without HDW-411 Fan

As shown below, the quad core version of the Hawk will typically require a heat sink + fan for operation above 80 ºC, at >90% CPU utilization.

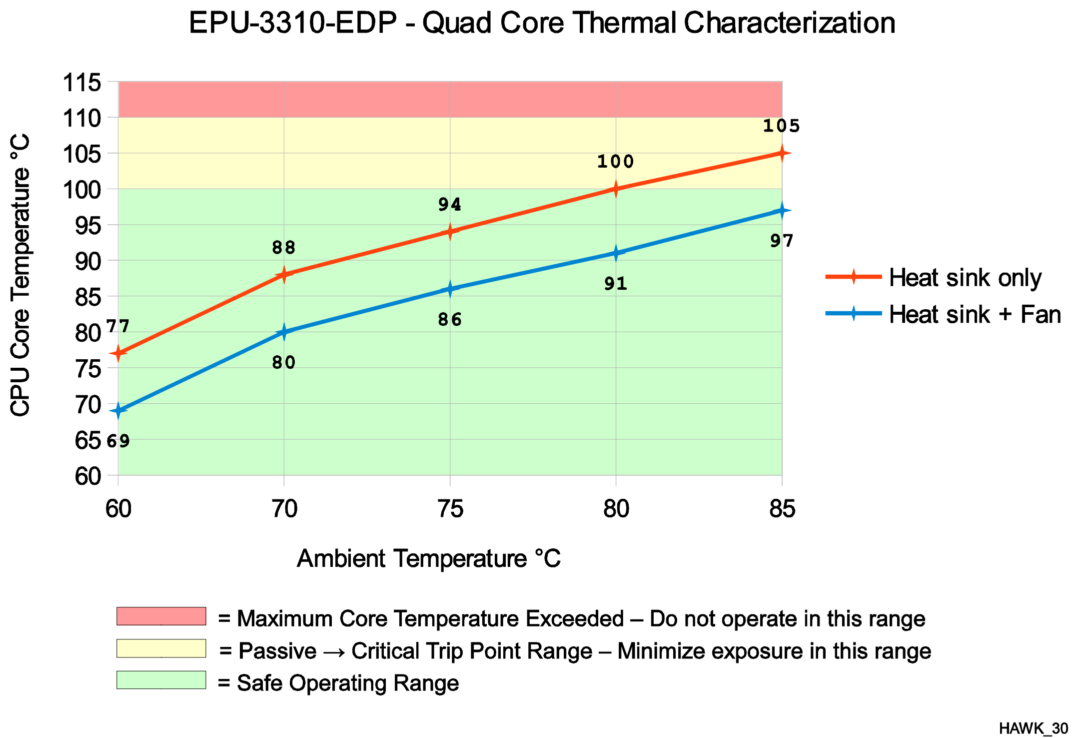


Figure 24. EPU-3310-EDP Quad Core Temperature Relative to Ambient Temperature

Test Scenario 4: Quad Core EPU-3310-EDP + HDW-408 Heat Pipe Block

This data is supplied as a reference point for custom heat pipe solutions.

Table 20: Heat Pipe Additional Configuration Details

Passive Solution Configuration	HDW-408 Heat Pipe Block mounted to the EPU-3310 heat plate with: ▪ Three 4 mm x 225 mm copper / water heat pipes ▪ The EPU-3310 is inside an environmental chamber at the noted temperatures Thermal solution at far end of heat pipes: ▪ HDW-408 heat pipe block attached to a HDW-406 heat sink ▪ The thermal solution is outside of the environmental chamber in free-air at an ambient temperature of 25 ºC
Active Configuration	▪ Same as above with an added HDW-411 fan on the HDW-406 heat sink

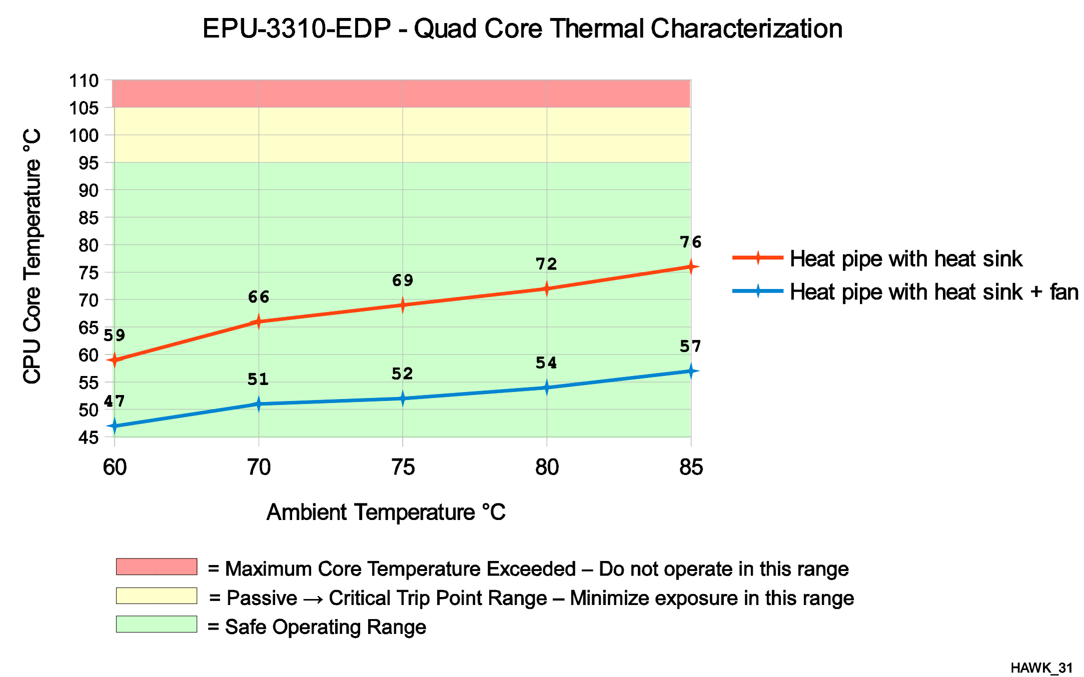


Figure 25. EPU-3310-EDP Quad Core with Heat Pipe - Temperature Relative to Ambient

Installing VersaLogic Thermal Solutions

The following thermal solution accessories are available from VersaLogic:

- VL-HDW-401 Thermal Compound Paste - used to mount the heat sink to the heat plate
- VL-HDW-406 Passive Heat Sink – mounts to standard product.
- VL-HDW-411 Fan Assembly – mounts to HDW-406 Heat Sink.
- VL-HDW-408 Heat Pipe Block – mounts to heat plate

Installing the VL-HDW-406 Passive Heat Sink

1. Apply the Arctic Silver† Thermal Compound

- Apply the thermal compound to the heat plate using the method described on the Arctic Silver website - http://www.arcticsilver.com/

2. Position the passive heat sink

- Using Figure 26 as a guide, align the six mounting holes of the heat sink with the heat plate.

3. Secure the passive heat sink to the heat plate

- Affix the passive heat sink to the heat plate using six M2.5 pan head screws.
- Using a torque screwdriver, tighten the screws to 4.0 inch-pounds.

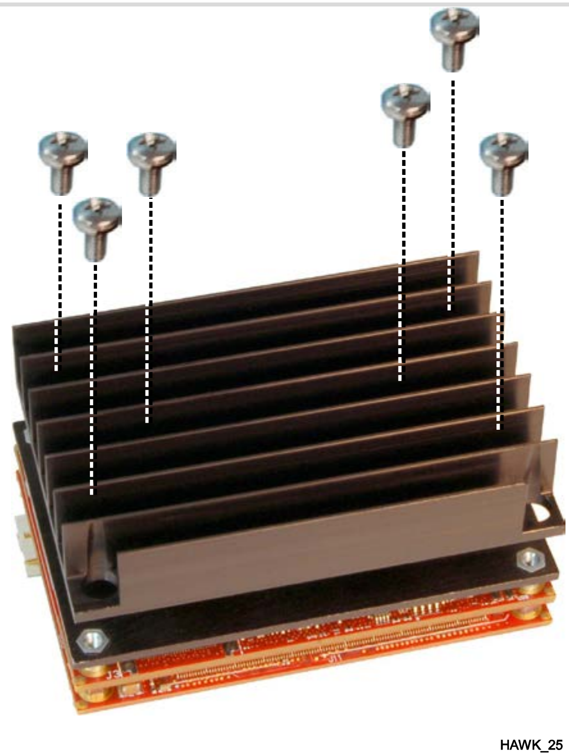


Figure 26. Installing the Passive Heat Sink

Installing the VL-HDW-411 Heat Sink Fan

1. **Position the fan assembly**
   - Using Figure 27 as a guide, align the mounting holes of the heat sink fan with the four holes in the passive heat sink. Position the fan so that its power cable can easily reach its mate – an ATX-style four-pin +12 V power connector (or equivalent).
2. **Secure the fan to the heat sink**
   - Affix the heat sink fan using four M3 pan head screws.
   - Using a torque screwdriver, tighten the screws to 4.0 inch-pounds.
3. **Connect power to the fan**
   - Connect the fan's power cable to a four-pin ATX style +12 V IDE drive power connector.

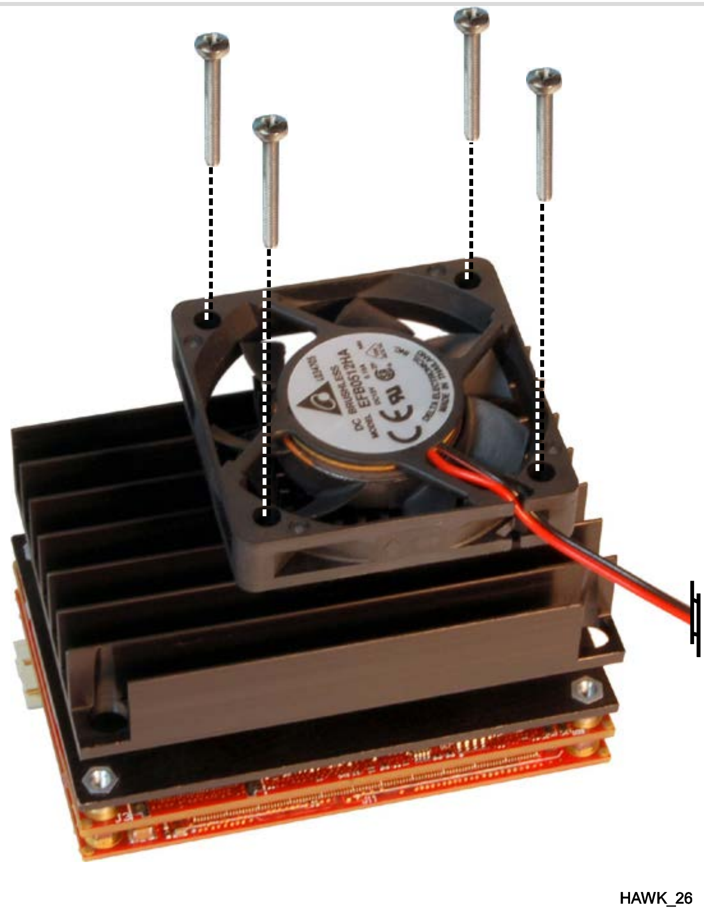


Figure 27. Installing the Heat Sink Fan

Installing the VL-HDW-408 Heat Pipe Block

1. Apply the Arctic Silver Thermal Compound

- Apply the thermal compound to the heat plate using the method described on the Arctic Silver website - http://www.arcticsilver.com/. The 4 mm heat pipes will also typically have the thermal compound applied to where the pipes contact both the heat plate and the block.

2. Position the heat pipe block

- Using Figure 28 as a guide, align the six mounting holes of the heat pipe block with the heat plate. (Figure 28 shows the heat pipe block installed.)

3. Secure the heat pipe block to the heat plate

- Affix the heat pipe block to the heat plate using six M2.5-0.45 x 10mm, Phillips, pan head screws.
- Using a torque screwdriver, tighten the screws to 4.0 inch-pounds.

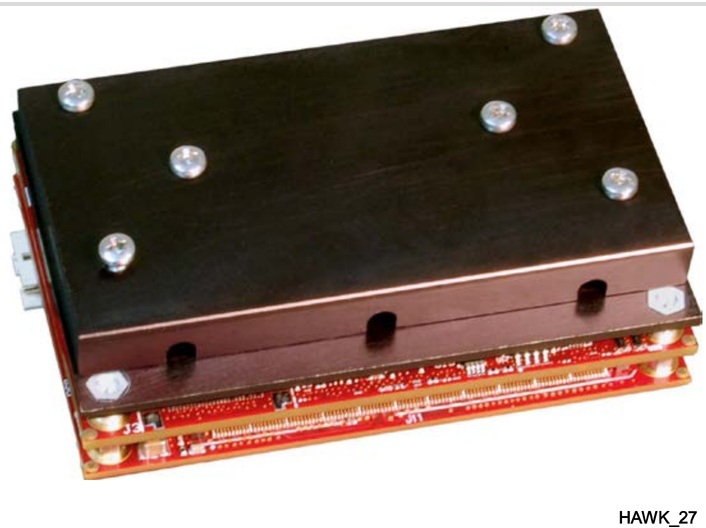


Figure 28. Installing the Heat Pipe Block

Appendix A – Mounting Options

A

Hawk Mounting Configuration

Figure 29 shows the heat plate mounting configuration for the Hawk.

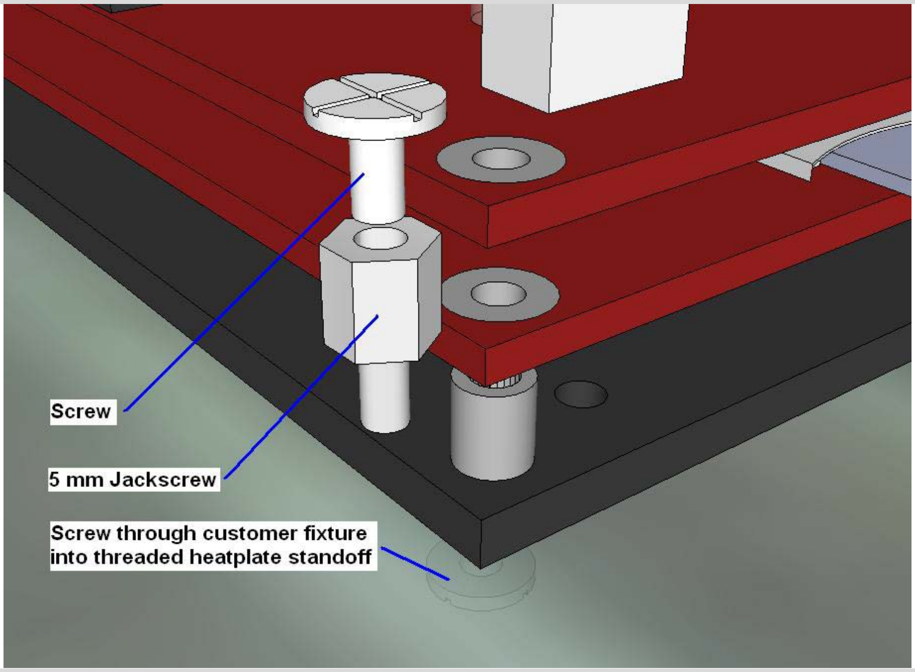


Figure 29. Bolt-through Heat Plate

Mounting Plate Configurations

Figure 30 and Figure 31 show options for installing the Hawk with the VL-HDW-405 mounting plate.

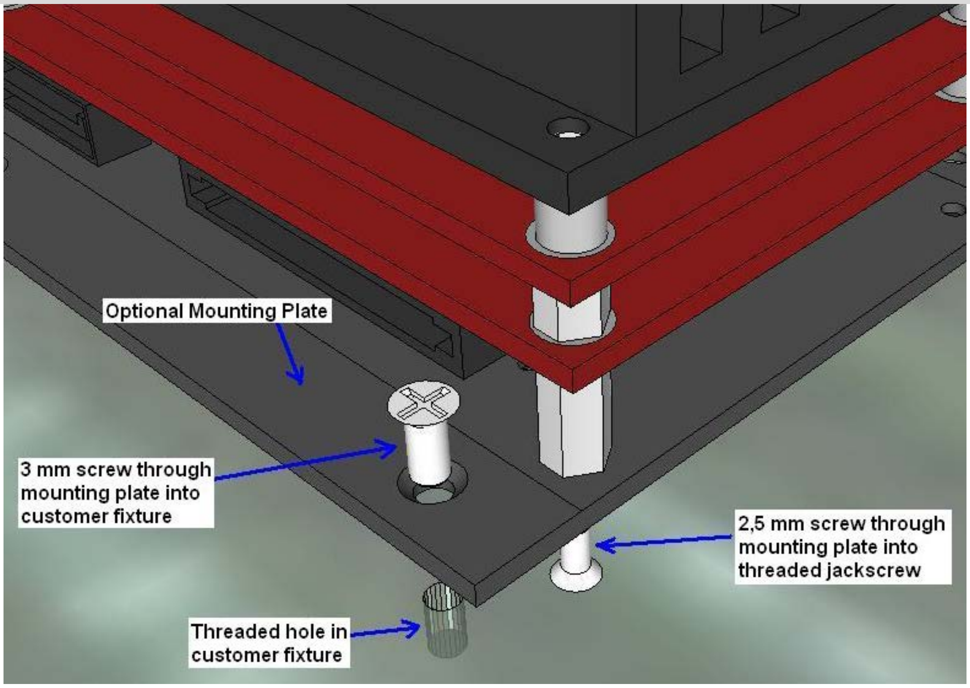


Figure 30. Mounting Plate Option 1

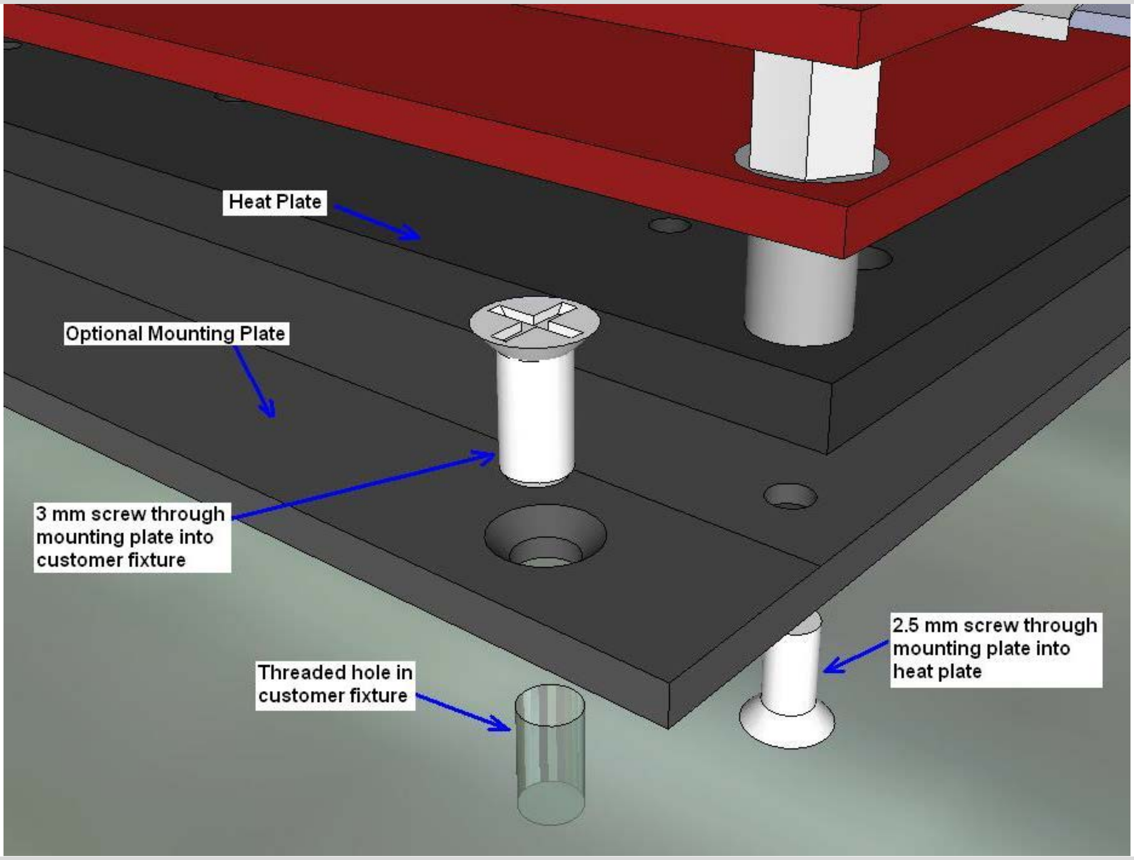


Figure 31. Mounting Plate Option 2