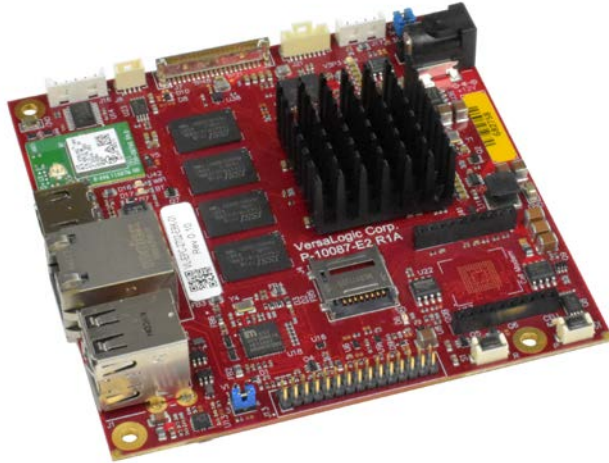




# Hardware Reference Manual

REV. January 2020

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## Swordtail (VL-EPC-2702)

Arm\* i.MX6 Single Board Computer  
with Gigabit Ethernet, Video, USB,  
Bluetooth, Wi-Fi, Cellular, Digital  
I/O, CAN Bus and I<sup>2</sup>C





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## Product Release Notes

- Rev 1.00** Initial draft
- Rev 1.01** Updated cable information for J13 in table 2
- Rev 1.02** Updated pin 27 and 28 information in table 15  
Updated Table 2 with the following:
- Removed the dash from Transition Cable column for the following Connectors: J1 (added "USB", J6 (added "HDMI")
  - Changed the Transition Cable dash to "N/A" for J4 and J20 For J6, added to Mating Connector "Standard HDMI Plug" and added "Standard HDMI Cable" to the Cable Description column
  - For J13, changed the Mating Connector gender to "Female," moved the cable part number over to the Transition Cable column, and added "Serial Interface Ribbon Cable" and "User Input/Output Interface Ribbon Cable" to the Cable Description column respectively
  - For J15, changed the Mating Connector info from "Jack" to "Plug", moved the appropriate "VL-PS-WALL\*" cable part number to the Transition Cable column, and added in the Cable Description "AC/DC \*(12 or 5)V Power Adapter"
- Rev 1.5**
- For J16, added to Mating Connector column, "Housing = Molex 51065-0500 and Pin Crimps = Molex 050212-8000," moved the "VL-CBR-0504" over to the Transition Cable column, and added "DB9 COM Port Interface Cable" to the Cable Description column
  - For J17, added to Mating Connector column: Housing = Molex 51065-0400 and Pin Crimps = Molex 050212-8000
  - For J20 in the Device Description, added "When selecting an add-on board, reference the pinout information to determine compatibility."
  - Added Wi-Fi and Bluetooth content in the Network Interfaces section
  - Added Wi-Fi and Bluetooth information to the "Initial Configuration" and "Basic Setup" sections
  - Added Wi-Fi/BT U.FL connector information to Figure 3 and Table 2
  - Added References for Wi-Fi and Bluetooth parts
- Rev 1.6** Added a note to table 10 regarding backdrive power

## Support Page

The [Swordtail 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
- U-Boot information and upgrades

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- 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

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

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## Description

### Features and Construction

The Swordtail single-board computer is a complete Wi-Fi and Bluetooth\* enabled, Arm\*-based embedded computer. Models are available with power-efficient, dual-core or quad-core i.MX6 CPUs. These boards are designed for applications that demand rugged, power-efficient solutions such as industrial machine automation, transportation, medical, kiosk, and industrial IoT applications. Swordtail boards have been designed to enable transactions and transmission of maintenance or diagnostic information without the presence of a wired data connection. Both Wi-Fi and Bluetooth radios are included on board, and a NimbleLink Skywire\* socket supports a wide range of optional cellular and other wireless plug-ins.

Swordtail is a complete board-level computer. Additional carrier boards, connector boards, or I/O expansion boards are not required for operation. Swordtail boards are delivered with on-board soldered-down RAM, ready to plug-in and run. To simplify mounting and future upgrades, the Swordtail leverages the COM-Express standard for its footprint and mounting points.

- Arm\* i.MX6 dual or quad-core processors
- 95 x 95 mm size
- Low power draw
- Fanless operation
- Up to 4 GB soldered-on RAM
- Gigabit Ethernet
- HDMI video
- LVDS video
- CAN Bus
- Cellular support
- Bluetooth
- Wi-Fi
- USB 2.0 ports
- MicroSD card socket
- RS-232
- I<sup>2</sup>C with interrupt input support
- Optional eMMC Flash. Up to 32 GB
- Linux support

VL-EPC-2702 boards receive complete 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 single-board computer (SBC).

## Technical Specifications

See the [Swordtail Data Sheet](#) for complete specifications.

## Thermal Considerations

The operating temperature for the Swordtail is -40°C to +85°C, de-rated -1.1°C per 305m (1,000 ft.) above 2,300m (7,500 ft.).

**Table 1. Environmental Specifications**

| Characteristic              | Value                                                                                                                              |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Operating Temperature       | Ext Temp (-40°C to +85°C)                                                                                                          |
| Storage Temperature         | -40°C to +85°C                                                                                                                     |
| Cooling                     | Fanless. Heatsink for SoC                                                                                                          |
| Airflow Requirements        | 100 Linear Feet per Minute                                                                                                         |
| Thermal Shock               | 5°C/min. over operating temperature                                                                                                |
| Humidity                    | Less than 95%, noncondensing                                                                                                       |
| Vibration, Sinusoidal Sweep | MIL-STD-202H<br>Sinusoidal sweep: Method 204, Modified Condition A, 2g constant acceleration from 5 to 500 Hz, 20 minutes per axis |
| Vibration, Random           | Random vibration: Method 214A, Condition A, 5.35g rms, 5 minutes per axis                                                          |
| Mechanical Shock            | Shock: Method 213B, Condition G, 20g half-sine, 11 msec duration per axis                                                          |

**Note:** Cellular modules may become unseated during vibrations and mechanical shock. Evaluate for each usage case.

## 9

## Cautions

### Electrostatic Discharge

**CAUTION:**

Electrostatic discharge (ESD) can damage circuit boards, disk drives, and other components. Handle circuit board at an ESD workstation. If an approved station is not available, wearing a grounded antistatic wrist strap provides some measure of protection. 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.

Ship and store the board inside a closed metallic antistatic envelope for protection.

**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 Swordtail.

### 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.

### Earth Ground Requirement

**CAUTION:**

All mounting standoffs for EPC boards should be connected to earth ground (chassis ground). This provides proper grounding for EMI purposes.

# Configuration and Setup

## 2

## Initial Configuration

Use the following components for a typical development system:

- Swordtail (VL-EPC-2702) computer
- VL-PS-WALL12-24 wall mount 12V 24W power supply
- VL-F41-8SBN-LINUX3 – 8GB MicroSD card with bootable Linux, standard temp
- VL-CBR-0205 cable and VL-CBR-ANT04 antenna – shared for Wi-Fi and Bluetooth
- USB keyboard and mouse
- HDMI monitor and cable

**Note:** VL-CKR-Swordtail includes VL-F41-8SBN-LINUX3, CBR-0205, CBR-ANT04, CBR-0504, CBR-3004 and PS-WALL12-24.

## Basic Setup

### 1. Attach Cables and Peripherals

- Attach the VL-PS-WALL12-24 to a wall outlet but DO NOT connect it to the computer yet
- Attach a HDMI display to the HDMI connector at J6
- Plug in a USB keyboard, and a USB mouse into the USB connectors at J1
  - Note:** If using the top USB port, you must install the jumper on V1 pins 3-4 for the OTG USB port to be placed in Host mode. Alternatively, you can use an external USB Hub to provide separate mouse and keyboard connections for the bottom USB port. Make sure the upstream USB Hub port (connecting to the EPC-2702 host port) does not provide VBUS power, but the downstream USB Hub port(s) can be externally powered to ease the loading on the EPC-2702 power supply.
- Attach the CBR-ANT04 to the CBR-0205 cable, and then attach the U.FL end to the Wi-Fi / Bluetooth module U42's U.FL connector. This cable and antenna combination provides the approved wireless communications interface for both Wi-Fi and Bluetooth simultaneously at 2.4 GHz
- Insert a VL-F41-8SBN-LINUX3 MicroSD card into the MicroSD slot located at J4
  - Note:** The top of the MicroSD socket slides down and then the lid rotates open. Use caution when opening.

### 2. Review Configuration

- Before you power up the system, double-check all the connections. Make sure all cables are oriented correctly and that there is adequate power to the VL-EPC-2702 and peripheral devices.

### 3. Power On

- Turn on the video monitor, and then plug the power adapter cable VL-PS-WALL12-24 into the computer power jack J15. The presence of a video signal indicates proper configuration of the system.

**Note:** Booting and operating the Yocto Linux operating system is covered in the VersaLogic Yocto Linux User Guide.

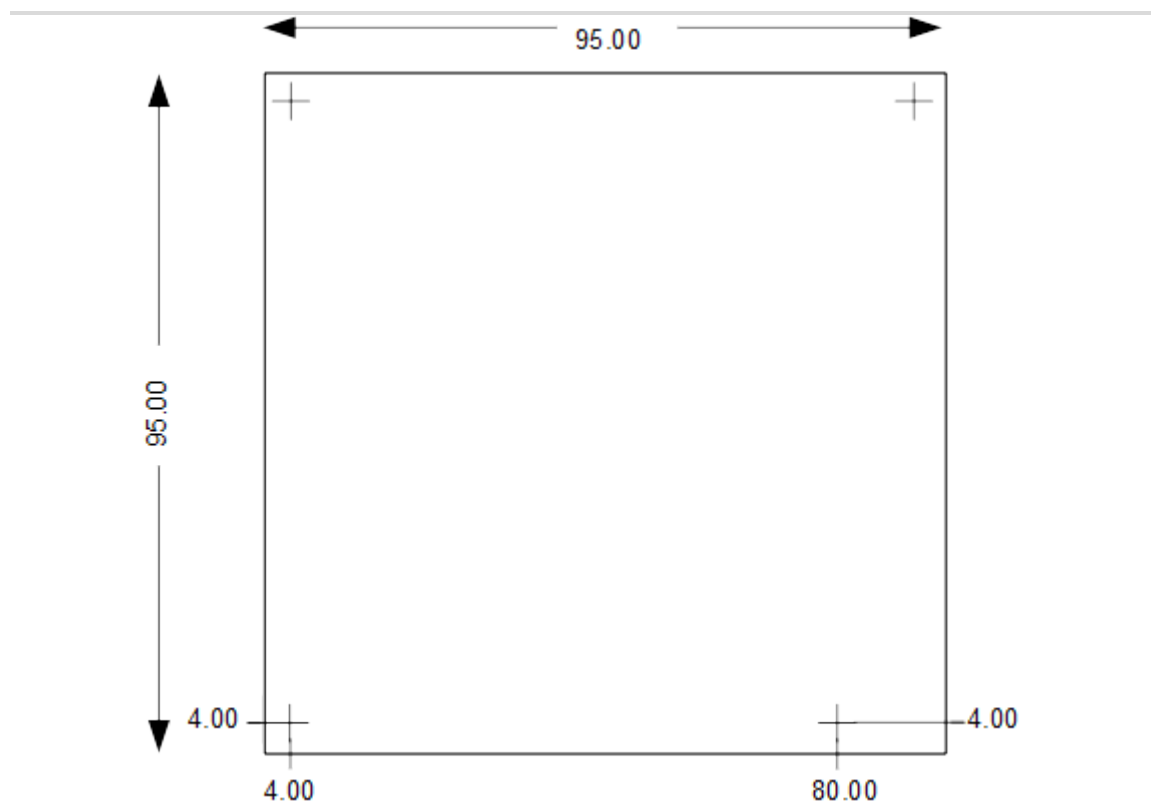
## Physical Layout

### Swordtail Dimensions

The figure below shows board dimensions to help with pre-production planning and layout.

**Figure 2. Swordtail Board Dimensions and Mounting Holes**

*(Not to scale. All dimensions in millimeters.)*

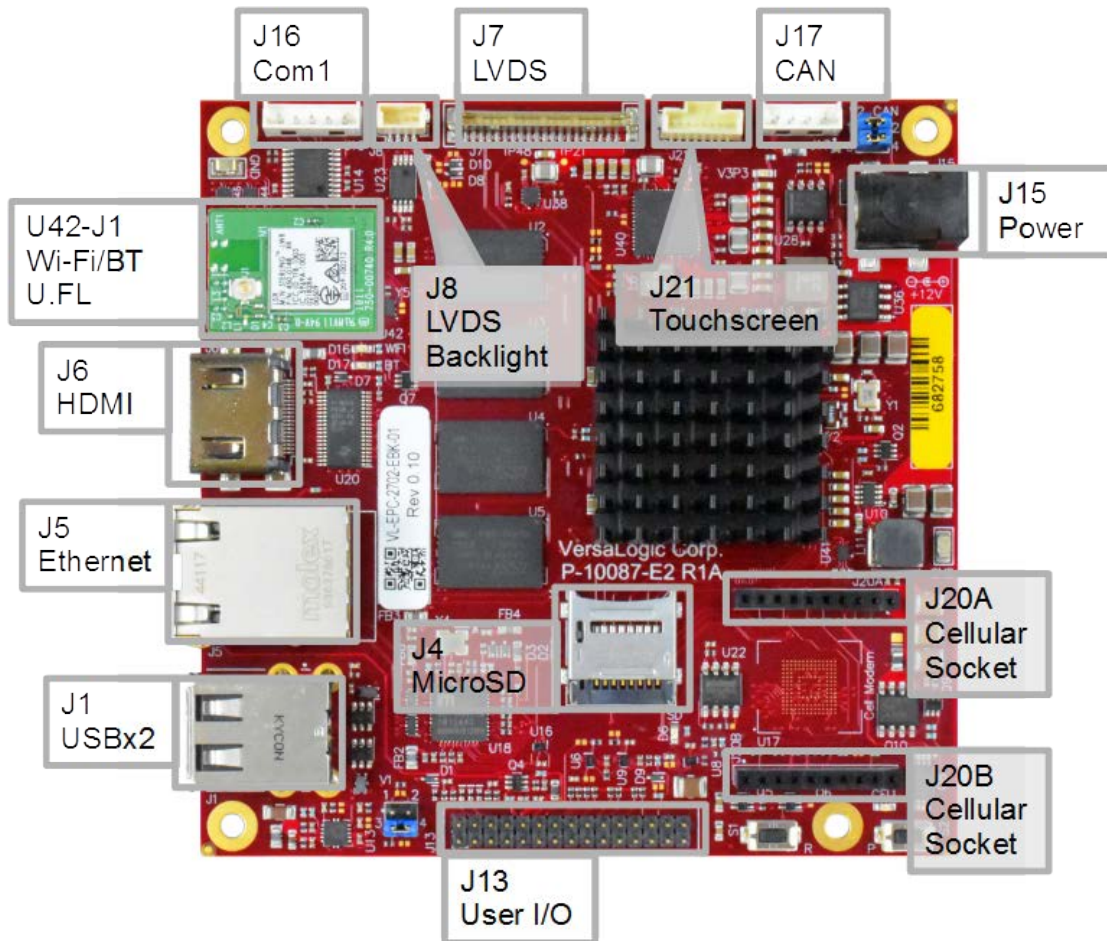


### Hardware Assembly

The entire assembly can fit on a tabletop. When bolting the unit down, make sure to secure all standoffs to the mounting surface to prevent circuit board flexing. Standoffs secure the top circuit board using four pan head screws.

## External Connectors

Figure 3. Connector Locations



### Swordtail Connector Functions and Interface Cables

The table below provides information about the function, mating connectors, and transition cables for Swordtail connectors.

**Table 2. Connector Functions and Interface Cables**

| Connector | Function           | Mating Connector/Device                                                                          | Transition Cable                          | Cable/Device Description                                                                                                                                                        |
|-----------|--------------------|--------------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| U42-J1    | U.FL Antenna       | U.FL                                                                                             | VL-CBR-0205<br>(Laird 080-0001)           | U.FL to RP-SMA connects to VL-CBR-ANT04 (Wi-Fi/BT Antenna – Laird 001-0001)                                                                                                     |
| J1        | USB (dual stacked) | Standard USB Type A                                                                              | USB                                       | Male Type A USB 2.0 to Male Type B for downstream devices, Male Type A USB 2.0 to Male Type A USB 2.0 for top port only when OTG port is set as Device mode (V1 jumper off).    |
| J4        | MicroSD            | 8GB microSD card with bootable Linux<br>2GB microSD card<br>4GB microSD card<br>8GB microSD card | N/A                                       | VL-F41-8SBN-LINUX3 (MLC, Standard Temperature)<br>VL-F41-2EBN (SLC, Extended Temperature)<br>VL-F41-4EBN (SLC, Extended Temperature)<br>VL-F41-8EBN (SLC, Extended Temperature) |
| J5        | Ethernet           | RJ45 Crimp-on Plug                                                                               | Cat5e                                     | Cat5e Ethernet Patch Cable                                                                                                                                                      |
| J6        | HDMI               | Standard HDMI Plug                                                                               | HDMI                                      | Standard HDMI Cable                                                                                                                                                             |
| J7        | LVDS Panel         | Housing = Hirose DF19G-20S-1C<br>Pin Crimps = Hirose DF19-2830SCFA                               | VL-CBR-2015<br>VL-CBR-2016<br>VL-CBR-2017 | 20-pin Hirose 1mm to Hirose 1mm 24-bit cable<br>20-pin Hirose 1mm to JAE 1.25mm 18-bit cable<br>20-pin Hirose 1mm to 20-pin Hirose 1.25mm 24-bit cable                          |
| J8        | Backlight          | Housing = Molex 501330-0400<br>Pin Crimps = Molex 501193-2000                                    | VL-CBR-0404                               | 20" 12V LED Backlight Control Cable                                                                                                                                             |
| J13       | User I/O           | 0.5m 30-pin 2mm IDC to Ribbon Cable                                                              | VL-CBR-3004                               | User Input/Output Interface Ribbon Cable                                                                                                                                        |
| J15       | Power              | DC Power Plug for 0mm positive center pin                                                        | VL-PS-WALL12-24                           | AC/DC 12V Power Adapter                                                                                                                                                         |
| J16       | COM1               | Housing = Molex 51065-0500<br>Pin Crimps = Molex 050212-8000                                     | VL-CBR-0504                               | DB9 COM Port Interface Cable                                                                                                                                                    |
| J17       | CAN1               | Housing = Molex 51065-0400<br>Pin Crimps = Molex 050212-8000                                     | VL-CBR-0405<br>VL-CBR-0406                | (Micro-Latch to Micro-Latch)<br>(Micro-Latch to DB9 )                                                                                                                           |
| J20A/J20B | Cellular Socket    | 20-pin NimbleLink Skywire socket                                                                 | N/A                                       | When selecting an add-on board, reference the pinout information to determine compatibility.                                                                                    |
| J21       | Touchscreen        | Housing = Molex 501330-0800<br>Pin Crimps = Molex 501193-3000                                    | VL-CBR-0811                               | Touchscreen Support (20" 8-pin Pico-Clasp / 8-pin Pico-Clasp)                                                                                                                   |

**Table 3. Jumper Information**

| EPC-2702 Reference Designator | EPC-2702 Signal Name                                                 | Control/Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V1                            | Pins 1-2 - BOOT_MODE0<br>Pin 3-4 - USB_OTG_ID                        | <p>Default: One jumper stored on pin 4</p> <p>With jumper installed on pins 1-2, BOOT_MODE0 = 1, to allow use of USB OTG Device communications using the NXP i.MX6 Serial Downloader method. When this jumper is installed V1 pins 3-4 should not have a jumper installed.</p> <p>With the jumper installed on pins 3-4, the USB OTG port behaves as a Host Port and will enable the power switch to the Type A connector (top socket of J1), ensure that the cable connection goes to a Device and not another Host.</p> |
| V2                            | Pins 1-2 - CAN1_SPLIT / CAN1_R_P<br>Pins 3-4 - CAN1_SPLIT / CAN1_R_N | <p>Default: One jumper on pins 1-2 and one jumper on pins 3-4 sets 120 Ohm termination for end node and split termination capacitor connections between CAN1_P/N.</p> <p>Remove both jumpers to disconnect all termination.</p> <p>Place one jumper across pins 2-4 to bypass capacitor to have 120 Ohms resistor termination only.</p>                                                                                                                                                                                   |

# System Features

# 3

## Power Supply

### Power Connectors

Main power may be applied to the Swordtail through a DC Power Jack (J15) or through alternate power input pins on the User I/O Interface connector (J13). For pin details on using the alternate power input method, please see the User I/O section later in this document. Use only one power input method.

The VersaLogic VL-PS-WALL12-24 plugs into an AC outlet and provides a 12V DC input for the Swordtail via a 2.1 mm center positive DC plug. See the table below for the connector interface.



#### CAUTION:

To prevent severe and possibly irreparable damage to the system, it is critical that the power connectors are wired correctly. The power connector is not fuse or diode protected. Proper polarity must be followed otherwise damage will occur.

Table 4. DC Power Jack Interface

| Signal | Description        |
|--------|--------------------|
| V_MAIN | Center Pin Voltage |
| Ground | Ground Sleeve      |

Table 5. Power Requirements

| Model              | Idle  | Typical | Max.  |
|--------------------|-------|---------|-------|
| VL-EPC-2702-EBK-01 | 1.74W | 2.25W   | 2.75W |
| VL-EPC-2702-EDK-02 | 2.03W | 2.97W   | 3.9W  |

**Note:** The power measurements reflect the Ethernet (eth0) down and Wi-Fi (wlan0) producing the connected values while running a benchmark test in Linux called Himeno with 4 threads. The test was run at room temperature.

## CPU

The Swordtail uses a low power Arm i.MX 6 DualLite or Quad-core processor.

- NXP i.MX 6Dual/**6Quad** Arm processors - [Specification](#)
- NXP i.MX 6Solo/**6DualLite** Arm processors – [Specification](#)

## System RAM

The Swordtail ships with 1 GB with the DualLite or 2 GB with the Quad of soldered-on DDR3L RAM. Both processors allow for customization of memory device capacities providing 1 GB, 2 GB, or 4 GB.

## RTC Battery

There are two pins dedicated for an RTC Battery input on the User I/O connector J13 (See Table 15 - User I/O Pinouts). This 3.0V battery (or power supply) connection allows the real time clock in the i.MX 6 to remain powered and running while the board input power is turned off. In order to size the battery appropriately for your application, please use the following information:

At 25°C ambient operation, each year of RTC battery power requires  $8760 \text{ hrs} \times 73.4\mu\text{A} = 643\text{mAh}$ .

**Note:** The PMIC will power the i.MX 6 RTC circuits from the board power whenever it is available, so the battery would only need to cover the expected percentage of time that the board input power is not on and it switches over to the battery power source.

# Interfaces and Connectors

# 4

## Headers and Jumpers

### V1 – BOOT\_MODE0/USB\_OTG\_ID Jumper

The EPC-2702 uses a 4-pin jumper to provide access to two required boot modes as well as providing a control setting for the USB OTG block to function as either an OTG port set to device mode or set to host mode.

The jumper ships in a storage position, with the boot mode defaulting to boot from the eFuses and the USB OTG port set to Device mode (top USB port on J1). Putting the jumper on pins 1-2 allows the board to run in Serial Download mode waiting to boot from a USB Host connection (local USB set to device mode by default). Putting the jumper on pins 3-4 sets the USB OTG port to Host mode, allowing the user to connect a downstream device. Never use more than one jumper on this header as there is no case where that would be useful.

**Note:** For custom product designs, there are placeholders to bypass and hard strap the jumper settings.

**Table 6. V1 Pinout**

| Pin | Signal Name   |
|-----|---------------|
| 1   | PU_BOOT_MODE0 |
| 2   | BOOT_MODE0    |
| 3   | USB_OTG_ID    |
| 4   | GND           |

### V2 - CAN1 Termination Jumper

The EPC-2702 uses two jumpers to provide two 60 Ohm bus termination resistors. There is a split termination capacitor to GND between them for the CAN1 bus termination solution when a jumper is installed each on pins 1-2 and pins 3-4. The split termination capacitor can be removed from the path by removing these two jumpers and placing one of them on pins 2-4 to provide only the 120 Ohm bus termination.

If no termination enabled is preferred (when the bus is mid-point on a CAN bus network), both jumpers can be removed to open the termination path for the bus signals.

**Note:** For custom product designs, there are placeholders to bypass the jumper and still provide any combination of terminations.

**Table 7. V2 Pinout**

| Pin | Signal Name                |
|-----|----------------------------|
| 1   | CAN1_SPLIT (tied to pin 3) |
| 2   | CAN1_R_P (CAN1_P)          |
| 3   | CAN1_SPLIT (tied to pin 1) |
| 4   | CAN1_R_N (CAN1_N)          |

## Storage Interfaces

Up to 32GB of eMMC Flash storage is available with customization.

### MicroSD Interface (J4)

The table below lists the pinout of the 8-pin MicroSD connector.

Supported VersaLogic SLC extended temperature cards:

- VL-F41-2EBN (2 GB)
- VL-F41-4EBN (4 GB)
- VL-F41-8EBN (8 GB)

**Note:** MicroSD card number VL-F41-8SBN-LINUX3 is an 8 GB MLC MicroSD card with bootable Linux, standard temperature

**Table 8. J4 MicroSD Pinout**

| Pin | Signal      |
|-----|-------------|
| 1   | DAT2        |
| 2   | CD/DAT3     |
| 3   | CMD         |
| 4   | VDD (+3.3V) |
| 5   | CLK         |
| 6   | VSS (GND)   |
| 7   | DAT0        |
| 8   | DAT1        |

## Network Interfaces

### Wi-Fi and Bluetooth

Wi-Fi and Bluetooth support is provided via the Laird Connectivity Sterling-LWB module. The Sterling-LWB is a 2.4 GHz Wi-Fi and Bluetooth Smart Ready Multi-Standard Module that is soldered on the VL-EPC-2702 as component U42. There is a U.FL antenna connector on the module (U42-J1) that supports both the Wi-Fi and Bluetooth communications simultaneously. The module is pre-certified with the use of Laird's 080-0001 U.FL to RP-SMA cable adapter and Laird's 001-0001 2.4 GHz Dipole Antenna.

There are other antennas that have been certified with the Sterling-LWB module. Refer to the Application Guide (referenced in Appendix A - References - section 7.2). There is more certification information in the Sterling LWB/LWB5 Certification Guide (<https://connectivity-staging.s3.us-east-2.amazonaws.com/2019-03/LWBCert.pdf>).

To certify different antennas and/or U.FL cables for Wi-Fi / Bluetooth:

[https://connectivity-staging.s3.us-east-2.amazonaws.com/s3fs-public/2019-01/Application%20Note%20-%20Guidelines%20for%20Replacing%20Antennas%20v1\\_0.pdf](https://connectivity-staging.s3.us-east-2.amazonaws.com/s3fs-public/2019-01/Application%20Note%20-%20Guidelines%20for%20Replacing%20Antennas%20v1_0.pdf)

**Note:** End products containing the VL-EPC-2702 will require testing per this notification from Laird Connectivity:

<http://go.pardot.com/webmail/647203/74547931/a66d3e0af3a350e4637b86a2e965b9556b44b5782f2b1880ccda219aca42d7b8>

## Ethernet Interface (J5)

The table below lists the pinout of the Ethernet connector.

**Table 9. J5 Ethernet RJ45 Pinout**

| J5 RJ45 Pin # | Wire-Color (CAT5E) | 10/100 Signals                         | 10/100/1000 Signals |
|---------------|--------------------|----------------------------------------|---------------------|
| 1             | White/Orange       | + Auto Switch (can be either Tx or Rx) | BI_DA+              |
| 2             | Orange             | - Auto Switch (can be either Tx or Rx) | BI_DA-              |
| 3             | White/Green        | + Auto Switch (can be either Tx or Rx) | BI_DB+              |
| 4             | Blue               | + Auto Switch (can be either Tx or Rx) | BI_DC+              |
| 5             | White/Blue         | - Auto Switch (can be either Tx or Rx) | BI_DC-              |
| 6             | Green              | - Auto Switch (can be either Tx or Rx) | BI_DB-              |
| 7             | White/Brown        | + Auto Switch (can be either Tx or Rx) | BI_DD+              |
| 8             | Brown              | - Auto Switch (can be either Tx or Rx) | BI_DD-              |

## Video Interfaces

### HDMI (J6)

**Table 10. HDMI Connector Pinout**

| Pin | Signal      | Direction | Description                     |
|-----|-------------|-----------|---------------------------------|
| 1   | HDMI_D2_P   | Out       | HDMI Data 2 Differential Pair + |
| 2   | DATA2SHIELD | --        | Ground                          |
| 3   | HDMI_D2_N   | Out       | HDMI Data 2 Differential Pair - |
| 4   | HDMI_D1_P   | Out       | HDMI Data 1 Differential Pair + |
| 5   | DATA1SHIELD | --        | Ground                          |

| Pin | Signal         | Direction | Description                         |
|-----|----------------|-----------|-------------------------------------|
| 6   | HDMI_D1_N      | Out       | HDMI Data 1 Differential Pair -     |
| 7   | HDMI_D0_P      | Out       | HDMI Data 0 Differential Pair +     |
| 8   | DATA0SHIELD    | --        | Ground                              |
| 9   | HDMI_D0_N      | Out       | HDMI Data 0 Differential Pair -     |
| 10  | CLK_HDMI_P     | Out       | HDMI Clock Differential Pair +      |
| 11  | CLKSHIELD      | --        | Ground                              |
| 12  | CLK_HDMI_N     | Out       | HDMI Clock Differential Pair -      |
| 13  | HDMI_CEC_CON   | I/O       | HDMI CEC Line                       |
| 14  | HDMI_NC_CON    | N/A       | No Connect - Resistor to GND option |
| 15  | HDMI_SCL_CON_R | Out       | DDC Serial Clock Line (5V signal)   |
| 16  | HDMI_SDA_CON_R | I/O       | DDC Serial Data Line (5V signal)    |
| 17  | HDMI_CEC_GND   | I/O       | CEC_GND - 0 Ohm Resistor to GND     |
| 18  | V5_HDMI_CON    | Out       | 5V HDMI Cable Power                 |
| 19  | HDMI_HPD_CON   | In        | HDMI Hot Plug Detection Signal      |

**Note:** Some back-drive occurs when an HDMI panel has power and is connected to an unpowered board.

## LVDS (J7)

**Table 11. LVDS Connector Pinout**

| Pin | Signal          | Description              |
|-----|-----------------|--------------------------|
| 1   | GND             | Signal Ground            |
| 2   | GND             | Signal Ground            |
| 3   | LVDS_TX3_P      | LVDS Data 3 (positive)   |
| 4   | LVDS_TX3_N      | LVDS Data 3 (negative)   |
| 5   | GND             | Signal Ground            |
| 6   | CLK_LVDS_P      | LVDS Clock (positive)    |
| 7   | CLK_LVDS_N      | LVDS Clock (negative)    |
| 8   | GND             | Signal Ground            |
| 9   | LVDS_TX2_P      | LVDS Data 2 (positive)   |
| 10  | LVDS_TX2_N      | LVDS Data 2 (negative)   |
| 11  | GND             | Signal Ground            |
| 12  | LVDS_TX1_P      | LVDS Data 1 (positive)   |
| 13  | LVDS_TX1_N      | LVDS Data 1 (negative)   |
| 14  | GND             | Signal Ground            |
| 15  | LVDS_TX0_P      | LVDS Data 0 (positive)   |
| 16  | LVDS_TX0_N      | LVDS Data 0 (negative)   |
| 17  | GND             | Power Ground             |
| 18  | GND             | Power Ground             |
| 19  | V3P3_LVDS_PANEL | LVDS Panel Power (+3.3V) |

| Pin | Signal          | Description              |
|-----|-----------------|--------------------------|
| 20  | V3P3_LVDS_PANEL | LVDS Panel Power (+3.3V) |

### LVDS Backlight (J8)

Table 12. LVDS Backlight Connector Pinout

| Pin | Signal         | Description                            |
|-----|----------------|----------------------------------------|
| 1   | LVDS_BKLT_EN   | Backlight Enable for LVDS panel        |
| 2   | GND            | Ground                                 |
| 3   | LVDS_BKLT_CTRL | Backlight Control for LVDS panel (PWM) |
| 4   | V_LVDS_BKLGTT  | Voltage for LVDS Backlight control     |

### Touchscreen (J21)

Table 13. Touchscreen Pinout

| Pin | Signal       | Description                                          |
|-----|--------------|------------------------------------------------------|
| 1   | CLK_I2C2_SCL | I <sup>2</sup> C Bus Clock                           |
| 2   | GND          | Ground (black wire)                                  |
| 3   | I2C2_SDA     | I <sup>2</sup> C Bus Data                            |
| 4   | GND          | Ground (black wire)                                  |
| 5   | GP_IRQ#      | General Purpose Interrupt Request Input (active low) |
| 6   | GND          | Ground (black wire)                                  |
| 7   | SYSTEM_RST#  | System Reset output (active low)                     |
| 8   | V3P3_LVDS    | +3.3V Power                                          |

## I/O Interfaces

### USB Interfaces (J1)

Table 14. USBx2 2.0 Connector Pinout

| Pin | Signal      | Description                             |
|-----|-------------|-----------------------------------------|
| T1  | V5_USB0_OTG | Top Connector Switched USB +5V Power    |
| T2  | USB0_OTG_N  | USB OTG DN diff pair -                  |
| T3  | USB0_OTG_P  | USB OTG DP diff pair +                  |
| T4  | GND         | Top Connector Ground                    |
| TM1 | V5_USB1_H1  | Bottom Connector Switched USB +5V Power |
| TM2 | USB1_H1_N   | USB Host1 DN diff pair -                |
| TM3 | USB1_H1_P   | USB Host1 DP diff pair +                |
| TM4 | GND         | Bottom Connector Ground                 |

### User I/O (J13)

Table 15. User I/O Pinouts<sup>1</sup>

| Pin | Signal       | Description                                                                                                                                                       | Pin | Signal          | Description                                                                                                                                                       |
|-----|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | GPIO9        | 3.3V General Purpose I/O                                                                                                                                          | 2   | GND             | Ground                                                                                                                                                            |
| 3   | PB_CTL_PWR#  | Open-Drain Push Button Control Power Input                                                                                                                        | 4   | GND             | Ground (for PB_CTL_PWR#)                                                                                                                                          |
| 5   | PB_CTL_RST#  | Open-Drain Push Button Control Reset Input                                                                                                                        | 6   | GND             | Ground (for PB_CTL_RST#)                                                                                                                                          |
| 7   | PLED#        | Open-Drain 3.3V max Programmable LED driver                                                                                                                       | 8   | V3P3            | 3.3V power for Programmable LED                                                                                                                                   |
| 9   | LED_ETH_GRN# | Open-Drain 3.3V max Ethernet LED driver                                                                                                                           | 10  | V3P3            | 3.3V power for Ethernet LED                                                                                                                                       |
| 11  | WDOG1#       | Watch dog 1 Output                                                                                                                                                | 12  | GND             | Ground                                                                                                                                                            |
| 13  | GPIO1        | 3.3V General Purpose I/O                                                                                                                                          | 14  | GPIO2           | 3.3V General Purpose I/O                                                                                                                                          |
| 15  | GND          | Ground                                                                                                                                                            | 16  | GPIO3           | 3.3V General Purpose I/O                                                                                                                                          |
| 17  | GPIO4        | 3.3V General Purpose I/O                                                                                                                                          | 18  | GND             | Ground                                                                                                                                                            |
| 19  | GPIO5        | 3.3V General Purpose I/O                                                                                                                                          | 20  | GPIO6           | 3.3V General Purpose I/O                                                                                                                                          |
| 21  | GND          | Ground                                                                                                                                                            | 22  | GPIO7           | 3.3V General Purpose I/O                                                                                                                                          |
| 23  | GPIO8        | 3.3V General Purpose I/O                                                                                                                                          | 24  | GND             | Ground                                                                                                                                                            |
| 25  | V_BATT       | Battery Input (3.0V Coin Cell)                                                                                                                                    | 26  | RETURN_BATT/GND | Tied to GND on CPU board and direct to the battery minus terminal on a paddleboard or external battery connector.                                                 |
| 27  | GND          | Ground (for V_MAIN) <sup>2</sup>                                                                                                                                  | 28  | GND             | Ground (for V_MAIN) <sup>2</sup>                                                                                                                                  |
| 29  | V_MAIN       | V_MAIN power. Can be supplied by this connector or provided to add-in cards through this connector. (bypassed to ground). Voltage can be 8V to 17V (default 12V). | 30  | V_MAIN          | V_MAIN power. Can be supplied by this connector or provided to add-in cards through this connector. (bypassed to ground). Voltage can be 8V to 17V (default 12V). |

**Notes**

<sup>1</sup> GPIO1, GPIO3, and GPIO7 can alternatively be setup as PWM outputs (Contact VersaLogic for details)

<sup>2</sup> : Keep current safely below 2A total

## CAN Interface (J17)

Table 16. CAN Pinouts

| Pin | J17 Signal | Description                  |
|-----|------------|------------------------------|
| 1   | CAN1_P     | CANH signal for CAN bus      |
| 2   | CAN1_N     | CANL signal for CAN bus      |
| 3   | GND        | Ground                       |
| 4   | V5         | 5V power (for off-board use) |

**Note:** Keep 5V signal under 0.5A.

## COM1 Interface (J16)

Table 17. COM1 Pinout

| Pin | Signal    | Description                            |
|-----|-----------|----------------------------------------|
| 1   | COM1_RTS  | COM1 RS-232 Request to Send            |
| 2   | COM1_TXD# | COM1 RS-232 Transmit Data (active low) |
| 3   | COM1_CTS  | COM1 RS-232 Clear to Send              |
| 4   | COM1_RXD# | COM1 RS-232 Receive Data (active low)  |
| 5   | GND       | Ground                                 |

## Cellular Socket (J20A and J20B together form 20-pin socket)

The design of the cellular socket fully supports Skywire modems. With minimal board customizations, the socket can also support some Digi XBee or XBee3 modems or RF Modules.

**Note:** XBee and XBee3 are available via customization. For more information, please contact VersaLogic.

The end product manufacturer is responsible for compliance with FCC requirements.

Table 18. Cellular Socket Pinout

| J20(A)<br>Pin | Skywire<br>Cellular<br>Modems<br>Socket<br>Signal | XBee/XBee3 Cellular<br>Modems (or Other<br>RF)<br>Socket Signal<br>Custom Option | Skywire Description<br>for Socket Default | XBee/XBee3 RF Modules<br>Description<br>for Customization Option       |
|---------------|---------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------|
| 1             | VCC                                               | VCC                                                                              | Main Power Supply for Modem (4.0V)        | Main Power Supply for Modem (stuff option to change to 3.3V)           |
| 2             | DOUT                                              | DOUT (DIO13)                                                                     | Cellular Modem UART data out              | Same (GPIO on XBee3 RF)                                                |
| 3             | DIN                                               | DIN (CONFIG#/DIO14)                                                              | Cellular Modem UART data in               | Same (GPIO on XBee3 RF)                                                |
| 4             | GND                                               | DIO12/SPI_MISO                                                                   | Ground for socket on Skywire              | GPIO/SPI data output line Defaults to disabled, so hard GND signal OK. |

| J20(A)<br>Pin | Skywire<br>Cellular<br>Modems<br>Socket<br>Signal | XBee/XBee3 Cellular<br>Modems (or Other<br>RF)<br>Socket Signal<br>Custom Option | Skywire Description<br>for Socket Default                                                                                                                                                                                                                                                                                 | XBee/XBee3 RF Modules<br>Description<br>for Customization Option                                                                                                                                                                                  |
|---------------|---------------------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5             | RESET#                                            | RESET#                                                                           | Modem active-low reset input, must be driven low for 20 msec minimum (on some modems) and then released to activate. Internally (on modem) pulled up to VCC or an I/O voltage rail. Must be driven with an open collector output without a pull resistor. After power-on, only use in emergency (not a "graceful" reset). | Same                                                                                                                                                                                                                                              |
| 6             | VUSB                                              | PWM0/RSSI/DIO10 or USB_VBUS                                                      | USB Power Detection Pin (4.5V to 5.5V). Used to turn on the USB interface. Disabled by default, but can be electronically switched on along with the differential pair on pins 7 and 8 to provide the USB interface to the Skywire.                                                                                       | PWM Output 0 / RX Signal Strength Indicator / Digital I/O 10, defaults to output on all Digi modems. Can be configured on LTE-M modem for the USB interface use, but suggested use is 3.3V instead of 5V. Stuff option to connect switch to 3.3V. |
| 7             | USB_D+                                            | USB_D+ (PWM1/DIO11)                                                              | USB differential Data + signal                                                                                                                                                                                                                                                                                            | Same on some. (PWM Output 1 / Digital I/O 11, defaults to disabled)                                                                                                                                                                               |
| 8             | USB_D-                                            | USB_D- or RSVD                                                                   | USB differential Data - signal                                                                                                                                                                                                                                                                                            | Same on some. (Reserved on XBee/XBee3, defaults to disabled)                                                                                                                                                                                      |
| 9             | WAKE or DTR#                                      | DTR# (SLEEP_RQ/DIO8)                                                             | Wakes up the modem from low power modes. Default configuration for wakeup is a low to high transition on this line. Data Terminal Ready (active low) on some modems. Pulled-down on board by default.                                                                                                                     | Data Terminal Ready (Sleep Control Line / Digital I/O 8)                                                                                                                                                                                          |
| 10            | GND                                               | GND                                                                              | Power/Signal Ground for socket                                                                                                                                                                                                                                                                                            | Same                                                                                                                                                                                                                                              |
| 11            | GND                                               | DIO4/SPI_MOSI                                                                    | Ground for socket on Skywire                                                                                                                                                                                                                                                                                              | GPIO/SPI data input line Defaults to disabled, so hard GND signal OK.                                                                                                                                                                             |
| 12            | CTS#                                              | CTS# (DIO7)                                                                      | Cellular Modem UART Clear to Send hardware flow control out                                                                                                                                                                                                                                                               | Same (Digital I/O 7)                                                                                                                                                                                                                              |
| 13            | ON_STATUS                                         | ON/SLEEP# (DIO9)                                                                 | Modem status indicating it is on and ready for commands when high (it can be idle, blink with activity, or off in sleep mode). NC if not used.                                                                                                                                                                            | Module status indicator (Digital I/O 9)                                                                                                                                                                                                           |
| 14            | VREF                                              | Reserved/VREF                                                                    | Voltage reference for I/O signals (set to 3.3V), drives input voltage side of modem buffers converting external I/O voltage from VREF to the I/O voltage used to drive the onboard modem module for Skywire.                                                                                                              | Not supported on XBee or XBee3 Modems, but used on other XBee devices for analog voltage reference. Could be switched off for customs.                                                                                                            |

| J20(A)<br>Pin | Skywire<br>Cellular<br>Modems<br>Socket<br>Signal | XBee/XBee3 Cellular<br>Modems (or Other<br>RF)<br>Socket Signal<br>Custom Option | Skywire Description<br>for Socket Default                                                                                                                                                                                                                 | XBee/XBee3 RF Modules<br>Description<br>for Customization Option                                                                                                                                           |
|---------------|---------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15            | GND                                               | Associate/DIO5                                                                   | Ground for socket on Skywire                                                                                                                                                                                                                              | Defaults to Associated Indicator Output (Digital I/O 5)<br>Since this pin must be grounded per Skywire, it has a 0 Ohm resistor to GND. Customs could remove the resistor and use the pad as a test point. |
| 16            | RTS#                                              | RTS#<br>(DIO6)                                                                   | Cellular Modem UART Request to Send hardware flow control in.<br>Pulled-down on board by default.                                                                                                                                                         | Same (Digital I/O 6)                                                                                                                                                                                       |
| 17            | Reserved, I <sup>2</sup> C,<br>or GPIO            | AD3/DIO3/SPI_SS#                                                                 | Most Skywire modems have this as a 1.8V GPIO, but the SVZM20 has it reserved and the QBG96 has is as an I <sup>2</sup> C data signal.<br>NOT CONNECTED                                                                                                    | Analog Input 3 / Digital I/O 3 / SPI low enabled select line (defaults to disabled)<br>NOT CONNECTED                                                                                                       |
| 18            | Reserved, I <sup>2</sup> C,<br>or GPIO            | AD2/DIO2/SPI_CLK                                                                 | Most Skywire modems have this as a 1.8V GPIO, but the SVZM20 has it reserved and the QBG96 has is as an I <sup>2</sup> C clock signal.<br>NOT CONNECTED                                                                                                   | Analog Input 2 / Digital I/O 2 / SPI clock line (defaults to disabled)<br>NOT CONNECTED                                                                                                                    |
| 19            | RING or ADC1                                      | AD1/DIO1/SPI_ATTN#                                                               | RING signal wakes up a host processor when there is incoming traffic on the network. ADC1 is an analog input (0 to 1.2V). NC if not used. Default is to pull-down (1k) this pin, but have stuff option to connect it to an i.MX6 GPIO for customs.        | Analog Input 1 / Digital I/O 1 / SPI Attention low enabled line output (defaults to disabled)                                                                                                              |
| 20            | ON_OFF or<br>PWR_ON                               | AD0/DIO0                                                                         | ON_OFF = Modem PWR_ON is active low internally pulled up to internal I/O rail with resistor. Do not use external pull ups. Note: If you want modem to turn on automatically when power is applied, permanently tie this signal to GND using stuff option. | Analog Input 0 / Digital I/O 0 (defaults to input)                                                                                                                                                         |

## Push Buttons

**Table 19. Push Buttons and Designators**

| Reference Designator | Signal Name | Description                                |
|----------------------|-------------|--------------------------------------------|
| S1                   | PB_CTL_RST# | Push Button Control for Power-On Reset     |
| S2                   | PB_CTL_PWR# | Push Button Control for PMIC Power Outputs |

**Notes:**

- 1) A momentary push of S1 or a low pulse (~100ms or more) using an open-drain driver from the User I/O connector pin (J13 – pin 5) will force a reset of the board.
- 2) Holding the S2 power pushbutton in or driving the signal low (using open-drain driver) from the User I/O connector pin (J13 - pin 3) is the only way to turn off the power to the processor and I/O when the board input power is still being applied.

# References

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# 5

- [Yocto Linux User Guide for the VL-EPC-2702](#)
- [i.MX6Dual/6Quad Applications Processors for Industrial Products Datasheet](#)
- [i.MX6Solo/6DualLite Applications Processors for Industrial Products Datasheet](#)
- [Hardware Development Guide for i.MX6 Families of Application Processors](#)
- NXP Website Documentation for the Quad: [https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/i.mx-applications-processors/i.mx-6-processors/i.mx-6quad-processors-high-performance-3d-graphics-hd-video-arm-cortex-a9-core:i.MX6Q?tab=Documentation\\_Tab](https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/i.mx-applications-processors/i.mx-6-processors/i.mx-6quad-processors-high-performance-3d-graphics-hd-video-arm-cortex-a9-core:i.MX6Q?tab=Documentation_Tab)
- NXP Website Documentation for the DualLite: [https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/i.mx-applications-processors/i.mx-6-processors/i.mx-6duallite-processors-dual-core-3d-graphics-hd-video-arm-cortex-a9-core:i.MX6DL?tab=Documentation\\_Tab](https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/i.mx-applications-processors/i.mx-6-processors/i.mx-6duallite-processors-dual-core-3d-graphics-hd-video-arm-cortex-a9-core:i.MX6DL?tab=Documentation_Tab)
- NimbeLink NL-SW-LTE-SVZM20: <https://nimbelink.com/products/4g-lte-m-verizon-sequans/>
- NimbeLink NL-SW-LTE-GELS3: <https://nimbelink.com/products/4g-lte-cat-1-verizon-gemalto/>
- Wi-Fi / Bluetooth Sterling-LWB Module Documentation: <https://www.lairdconnect.com/wireless-modules/wi-fi-bt-modules/sterling-lwb>
- Wi-Fi / Bluetooth Sterling-LWB Module Application Guide: <https://connectivity-staging.s3.us-east-2.amazonaws.com/2019-03/330-0192.pdf>
- FCC guidance for equipment authorization of transmitter module devices: <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=44637>
- CAN transceiver device datasheet: <http://www.ti.com/lit/ds/symlink/sn65hvd230.pdf>

## KNOWN ISSUES

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- The i.MX 6 SW controlled power-off is unsupported. In order to turn off the PMIC power output while the power input to the board is still supplied, you must either hold the S2 power pushbutton in or drive the PB\_CTL\_PWR# signal on the User IO connector (J13) low (with an open-drain driver) since the input is level sensitive by default.
- At high temperatures, the thermal sensor can sometimes not be read, resulting in the loss of thermal protection. The following command was found to allow completion of our verification testing.

```
echo enabled > /sys/class/thermal/thermal_zone0/mode
```

- The Ethernet controller and UFD intermittently do not show up during power cycle test. This event is caused by systemd being used for initialization instead of the sysvinit method used in the previous Yocto versions. The released Yocto SD card image has systemd disabled. In order to disable systemd for a newly built image, edit a file in the NXP BSP (sources/meta-fsl-bsp-release/imx/meta-sdk/conf/distro/include/fsl-imxpreferred-env.inc) and comment out the following:

```
#VIRTUAL-RUNTIME_init_manager = "systemd"  
#PREFERRED_PROVIDER_udev = "systemd"  
#PREFERRED_PROVIDER_udev-utils = "systemd"  
#DISTRO_FEATURES_BACKFILL_CONSIDERED = "sysvinit"  
#IMX_DEFAULT_DISTRO_FEATURES += " systemd"
```

- Ethernet system limitation per i.MX6 chip errata ERR004512 (for Solo/DualLite and Quad):

The theoretical maximum performance of 1 Gbps ENET is limited to 470 Mbps (total for Tx and Rx). The actual measured performance in an optimized environment is up to 400 Mbps.