Eagle and Eaglet Baseboard for Toradex Apalis ARM Modules

PRELIMINARY

This manual may contain errors or omissions. Please contact Sales or Support for updates or additional information.

Revision	Date	Comment
1.3b	Dec. 2016	Initial release

FOR TECHNICAL SUPPORT PLEASE CONTACT:

support@diamondsystems.com

CONTENTS

1 Important Safe Handling Information

WARNING!

ESD-Sensitive Electronic Equipment

Observe ESD-safe handling procedures when working with this product. Always use this product in a properly grounded work area and wear appropriate ESD-preventive clothing and/or accessories.
Always store this product in ESD-protective packaging when not in use.

Safe Handling Precautions

The Eagle baseboard contains a high number of I/O connectors with connection to sensitive electronic components. This creates many opportunities for accidental damage during handling, installation and connection to other equipment. The list here describes common causes of failure found on boards returned to Diamond Systems for repair. This information is provided as a source of advice to help you prevent damaging your Diamond (or any vendor's) embedded computer boards.

ESD damage – This type of damage is usually almost impossible to detect, because there is no visual sign of failure or damage. The symptom is that the board eventually simply stops working, because some component becomes defective. Usually the failure can be identified and the chip can be replaced.
To prevent ESD damage, always follow proper ESD-prevention practices when handling computer boards.

Damage during handling or storage – On some boards we have noticed physical damage from mishandling. A common observation is that a screwdriver slipped while installing the board, causing a gouge in the PCB surface and cutting signal traces or damaging components.
Another common observation is damaged board corners, indicating the board was dropped. This may or may not cause damage to the circuitry, depending on what is near the corner. Most of our boards are designed with at least 25 mils clearance between the board edge and any component pad, and ground / power planes are at least 20 mils from the edge to avoid possible shorting from this type of damage. However these design rules are not sufficient to prevent damage in all situations.
A third cause of failure is when a metal screwdriver tip slips, or a screw drops onto the board while it is powered on, causing a short between a power pin and a signal pin on a component. This can cause overvoltage / power supply problems described below. To avoid this type of failure, only perform assembly operations when the system is powered off.
Sometimes boards are stored in racks with slots that grip the edge of the board. This is a common practice for board manufacturers. However our boards are generally very dense, and if the board has components very close to the board edge, they can be damaged or even knocked off the board when the board tilts back in the rack. Diamond recommends that all our boards be stored only in individual ESD-safe packaging. If multiple boards are stored together, they should be contained in bins with dividers between boards. Do not pile boards on top of each other or cram too many boards into a small location. This can cause damage to connector pins or fragile components.

Power supply wired backwards – Our power supplies and boards are not designed to withstand a reverse power supply connection. This will destroy each IC that is connected to the power supply (i.e. almost all ICs). In this case the board will most likely will be unrepairable and must be replaced. A chip destroyed by reverse power or by excessive power will often have a visible hole on the top or show some deformation on the top surface due to vaporization inside the package. **Check twice before applying power!**

Bent connector pins – This type of problem is often only a cosmetic issue and is easily fixed by bending the pins back to their proper shape one at a time with needle-nose pliers. The most common cause of bent connector pins is when a PC/104 board is pulled off the stack by rocking it back and forth left to right, from one end of the connector to the other. As the board is rocked back and forth it pulls out suddenly, and the pins at the end get bent significantly. The same situation can occur when pulling a ribbon cable off of a pin header. If the pins are bent too severely, bending them back can cause them to weaken unacceptably or even break, and the connector must be replaced.

2 Introduction

Eagle is a 3.5 inch form factor baseboard compatible with the Toradex Apalis family of ARM COMs, including Freescale i.MX6, Nvidia Tegra T30, and Nvidia K1 processors.
Eaglet is a low cost version of Eagle, with 4”x4” form factor. Eaglet features basic interfaces supported by the Apalis module.

2.1 Available Models

Model	***Eaglet***	***Eagle***
PCB size	4”x4”	5.75”x4" (3.5” SBC)
Serial ports	2x Multiprotocol(1) 2x RS232 Only	8x Multiprotocol(1)
USB2.0(3)	2	4
USB3.0(4)	2	2
Input voltage	5V	9-36V
Gigabit Ethernet Port	1	2
GPIO	8	16
Opto GPIO	-	4 in + 4 out
Type specific connector	-	1
CSI	-	1
Micromodule expansion (CAN, I2C, SPI)	Yes	Yes

(1) RS232/RS422/RS485.
(2) T30 module supports 1x USB2.0 for Eaglet and 3xUSB2.0 for Eagle
(3) USB3.0 is supported for TK1 module only.

2.2 Features

2.2.1 Eagle Features

- 5-6x USB 2.0, 2x USB 3.0 port (TK1 model only); 1 port supports OTG
- 2x Ethernet (10/100/1000 Mbps)
- 1x SD/MMC 4-Bit
- 1x mSATA socket
- Mini PCIe socket
- Analog VGA interface
- Dual channel LVDS interface (up to 24 bit color)
- HDMI port
- Analog audio I/O
- 8x RS-232/422/485 serial ports
- 4x PWM (3 customer-accessible + 1 LCD Backlight control)
- 4x 12-bit Analog inputs
- 2x CAN 2.0B ports (up to 1Mbit/s) using optional daughterboard
- Real-time clock with battery backup
- 16x GPIO (3.3V)
- 4x Opto-isolated Digital Inputs and 4x Opto-isolated Digital Outputs
- Resistive touch screen connector 4/5-wire
- 3x I2C
- 2x SPI

- 1x S/PDIF In/Out
- CSI Camera Interface
- Type Specific Board Connector

2.2.2 Eaglet Features

- 2x USB 2.0, 2x USB 3.0 port (one OTG supported port)
- 1x RJ45 Ethernet (10/100/1000 Mbit)
- 1x SD/MMC 4 Bit
- 1x mSATA socket
- Mini PCIe socket
- Analog VGA interface
- Dual channel LVDS interface (up to 24 bit color)
- HDMI port
- Analog audio I/O
- 1x S/PDIF In/Out
- 4x RS-232/422/485 Serial Interfaces
- 4x PWM(3 customer-accessible + 1 LCD Backlight control)
- 4x Analog inputs
- 2x CAN 2.0B Interface (up to 1Mbit/s) using optional daughterboard
- Real-time clock with battery backup
- 8xDigital GPIOs (3.3V)
- Resistive touch screen connector 4/5-wire
- 3x I2C
- 2x SPI

2.3 Operating System Support

- Linux

2.4 Mechanical, Electrical, Environmental

- Form factor: Eagle: 3.5” form factor, 146 x 102mm / 5.7” x 4.0
  Eaglet: 4.0” x 4.0” / 102 x 102mm
- Cooling : Apalis heat sink must be installed for wide temperature operation
- Power input: Eagle: +9VDC to +36VDC standard, +5VDC optional
  Eaglet: +5VDC +/-5% standard, 9-36VDC optional
- Operating Temp: -40°C to +85°C ambient (depending on the model of COM installed)

2.5 Customization Options

The following customization options are available for the Eagle Baseboard. Minimum order quantities may apply for customization. Contact Diamond Systems sales for further information.

2.5.1 Eagle Customization

- Opto isolation for Serial ports 5-8
- Replace configuration jumpers with 0 ohm resistors
- Lower Cost RS-232 only serial protocol
- Low cost non opto I2C expander GPIOs
- Low cost 5VDC input

2.5.2 Eaglet Customization

- 4 Multi-protocol serial ports
- SIM Card holder for 3G/4G module
- Support for +9V to +36V wide input

3 Functional Block Diagram

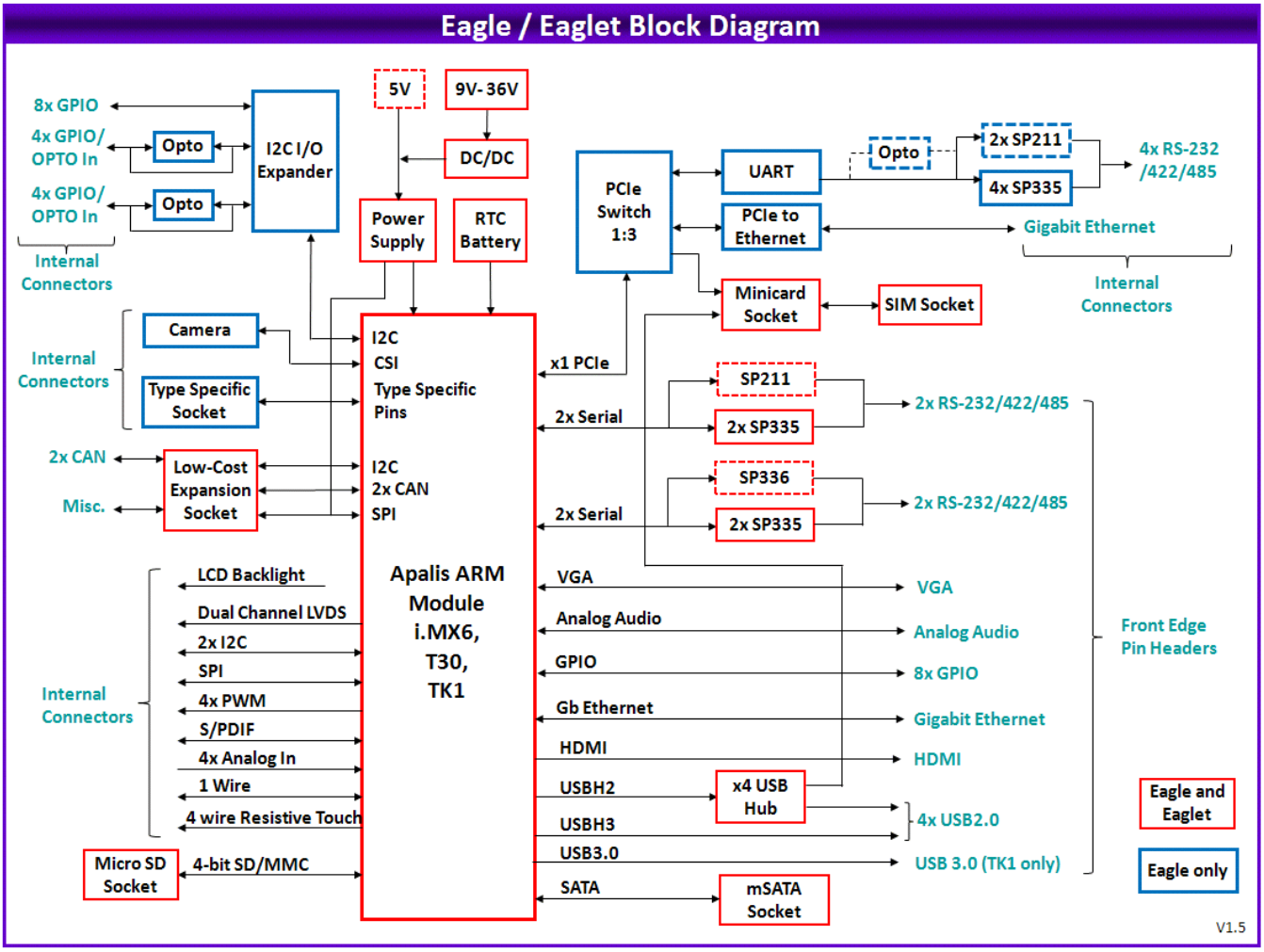


Figure 1 Functional Block Diagram of Eagle / Eaglet

3.1 Feature Descriptions

This section describes the key subsystems of both Eagle and Eaglet baseboard

3.1.1 Processor Features

Eagle baseboard supports 3 types of Toradex Apalis family of ARM COMs, including both Freescale i.MX6, Nvidia Tegra T30, and Nvidia K1 processors. Following Table provides the brief features of the ARM processor modules.

Feature	T30	i.MX6	TK1
COM	NVidia Tegra 3, quad ARM A9, up to 1.4GHz	Freescale i.MX6, dual/quad ARM A9, up to 1.0GHz	NVIDIA Tegra K1 quad-core Cortex-A15, up to 2.2GHz
Memory	1GB/2GB DDR3L built into module	512MB/1GB/2GB DDR3 built into module	2GB DDR3L built into module
Flash	4GB/8GB eMMC built into module	4GB eMMC built into module	16GB eMMC built into module

For detailed information about Apalis ARM product family visit Toradex website

3.1.2 Ethernet

The Eagle provides two Ethernet ports. One is a 10/100/1000 Ethernet port directly from the Apalis module. Ethernet connection is via a pin header, with necessary magnetics on the board. Ethernet is connected to RJ45 connector with Magnetics on a Panel IO board. On board LEDs are provided for Link and Activity indication near the Ethernet header (**J13**).

The second is a 10/100/1000Mbps Ethernet port realized using an Intel I210IT PCIe Gigabit Ethernet Controller (MAC + PHY). Ethernet connection is via a pin header (**J23**) with necessary magnetics on the board.
The connector (**J23**) provides access to LED signals

Primary Ethernet port is available on both Eagle and Eaglet baseboard. Secondary Ethernet is available only in Eagle full feature baseboard.

3.1.3 USB

The Eagle provides 2x USB3.0 ports coming directly from Apalis module and available on the standard UBSB3.0 20 pin header (**J17**).
Eagle has 4x USB 2.0 Host interface via a header. One of these (USBH3) directly comes from Apalis module and available on the 2x5 header (**J12**).
USBH2 port from Apalis module is connected to a 4 port USB hub from SMSC (USB2514). Three of these are available on 2x5 Headers (**J12 and J16**), and fourth port is connected to the mini PCIe socket.
USB 2.0 ports on Header **J12** are available at stacked USB2.0 header on Panel IO Board.

Refer **Figure 2** for USB interface block diagram for Eagle baseboard.

USBO1 on USB3.0 header (**J17**) supports OTG. By using jumper JP2 Pins 1-2-3, it is possible to configure USBO1 port either as Peripheral or as a Host interface.

Caution: While using USBO1 in peripheral mode special attention should be given to ensure if the jumper JP2 is set for peripheral mode (Pins 1-2). USB Type A to Type A cable should not be used as it may cause damage to the circuitry of Eagle or the external device connected.

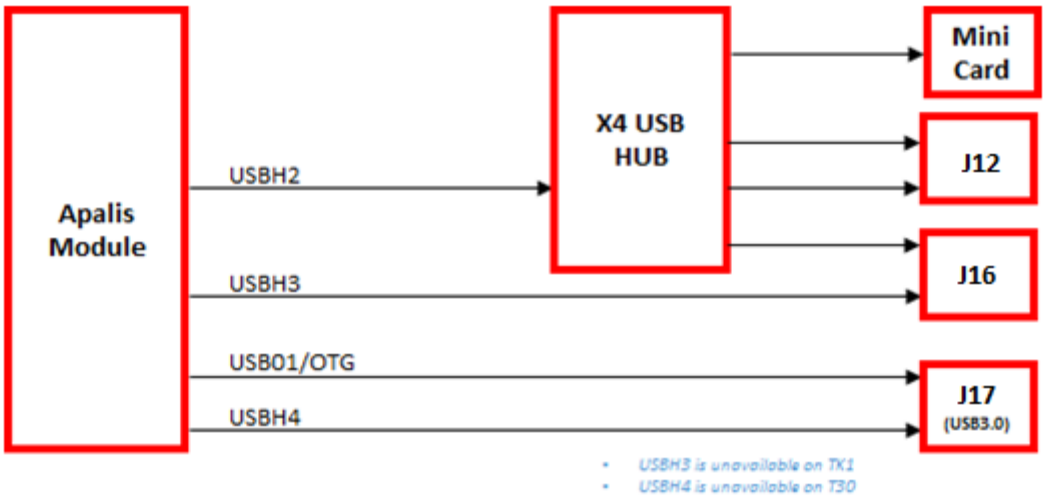


Figure 2 USB Signal connection for Eagle baseboard

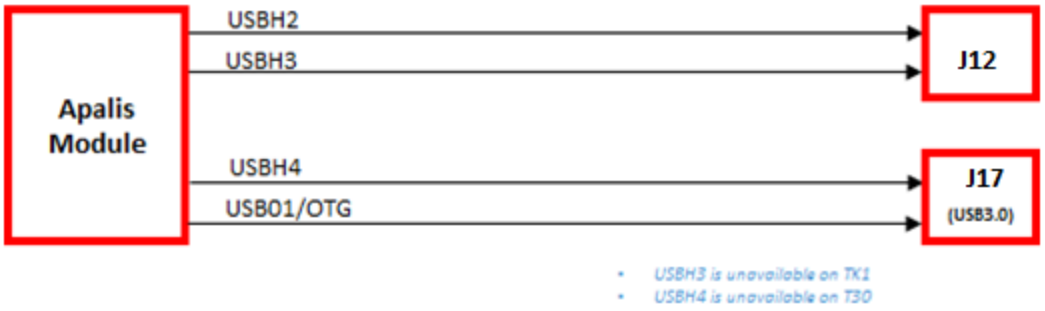


Figure 3 USB Signal connection for Eaglet baseboard

3.1.4 PCIe

Eagle baseboard features 4 port PCI Express Gen2 Switch from PLX. It is used to connect the standard PCIe interface on the Eagle baseboard to PCIe to UART, PCIe to Ethernet and mini PCIe slot (**J29**).
Eagle baseboard supports both half sized and full sized mini PCIe cards.
For low cost Eaglet baseboard, PCIe switch is not available and the PCIe lane from Apalis module is directly available on mini PCIe slot.

Refer to **Figure 4** for PCIe interface realization in Eagle/Eaglet baseboard base board.

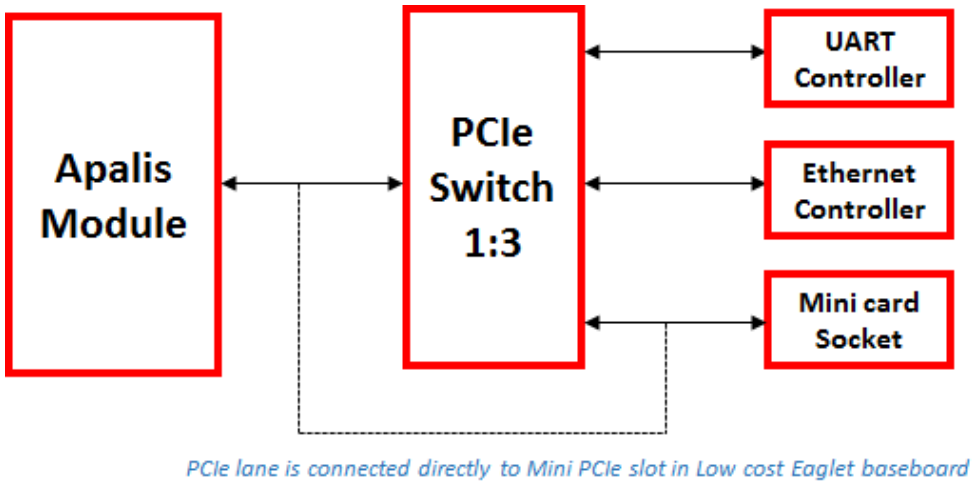


Figure 4 PCIe Interface

3.1.5 mSATA

Eagle and Eaglet baseboard supports the standard mSATA slot (**J28**). SATA signals are directly derived from Apalis module and connected to mSATA connector that allows a miniature SATA disk module to be installed to it and attached with a mounting spacer and screw.

3.1.6 Micro SD (MMC)

Eagle and Eaglet baseboard features 4 bit SD interface. Push-pull micro SD card slot (**J18**) is available on the edge of the baseboard for easy user access.

3.1.7 Display

Eagle and Eaglet baseboard provides 3 display outputs: one VGA, one HDMI and one LVDS. All the display interfaces comes directly from the Apalis module.
VGA interface is available on the 2x5 header (**J10**)
HDMI is available on the 2x10 header (**J9**).
Both the VGA and HDMI are available on standard connectors by using a Panel IO Board.
LVDS interface is available on 2x15 shrouded header (**J1**), LVDS backlight power and control signals are available on 1x6 header (**J2**)

Display resolution details:

VGA*: 1280x1024
HDMI: UltraHD (2160p)
LVDS: 1x 1280x1024x24bpp Single or 1x 2048x1536x24bpp Dual

***** VGA interface is supported only by iMX6 module.
* Display outputs are Apalis module dependent. Refer Apalis module specifications for more information.

Related Toradex link:
http://developer.toradex.com/knowledge-base/display-output-resolution-and-timings-linux
http://developer.toradex.com/knowledge-base/framebuffer-(linux)

3.1.8 Audio

Eagle and Eaglet supports standard Audio interface available on 2x5 Header (**J8**). Audio I/O signals include stereo line in, stereo line out and mic in. Audio signals are available on standard Audio connectors via a Panel IO Board.

Related Toradex link:
http://developer.toradex.com/knowledge-base/audio-(linux)

3.1.9 Serial Ports

Eagle baseboard supports up to 8 serial ports. 4 ports comes directly from Apalis module and Serial ports 5 to 8 are realized with PCIe to UART chip (XR17V354) All ports supports RS232/422/485 protocol based on the ARM module and the Eagle variant selected. Protocol selection is controlled using GPIOs from I2C to GPIO expander. (Refer GPIO Handling section for more information.)

Low cost Eaglet features only 4 serial ports, directly coming from Apalis module. Serial ports 1 and 2 are having RS232/422/485 (SP336) capability and serial ports 3 and 4 are fixed with RS232 capability. Jumpers (**JP2**) are used to enable termination resistor (121 Ohm) for RS422 and RS485 protocols.

Serial port 1 acts as a console port by default. Serial ports 1 and 2 are available on 2x5 header (**J11**) and also on standard DB9 connector via a Panel IO board. Serial ports 3 to 8 are available on the 2x5 headers (**J16, J21** and **J22**).

Related Toradex link:
http://developer.toradex.com/knowledge-base/uart-(linux)

3.1.10 GPIO

Eagle supports up to 16 GPIOs which are 3.3V compatible and 8 Opto-isolated GPIOs. The 8x 3.3 compatible GPIOs are coming directly from Apalis module and are available on 2x5 header (**J6**) and are also available on DB9 male connector via a Panel IO Board. 16x GPIOs are realized from I2C GPIO expander, of which 8 GPIOs are 3.3V compatible and are available on 2x5 header (**J25**). Other 8 GPIOs are configured as opto isolated with 4 input and 4 output configuration and are available on 2x10 header (**J24**)
Low cost Eaglet supports only 8 GPIOs with 3.3V compatibility, directly coming from Apalis.

Relate Toradex Link:
http://developer.toradex.com/knowledge-base/gpio-(linux)

3.1.11 Analog Input

Eagle and Eaglet baseboard provides 4 Analog input channels on 2x5 header (**J3**). Analog inputs have 12-bit resolution and input voltage span from 0 to 3.3V.

Related Toradex Link:
http://developer.toradex.com/knowledge-base/adc-(linux)

3.1.12 CAN

Eagle and Eaglet supports 2x CAN ports realized by mounting a CAN Add-on module on 2x10 header (**J14**).

Related Toradex Link:
http://developer.toradex.com/knowledge-base/can-(linux)

3.1.13 Serial Camera

Eagle supports 2x Dual lane MIPI CSI2 interface available on 2x10 header (**J26**). Currently the MIPI Add-on module is not supported.

3.1.14 Type Specific Mezzanine

Eagle provides access to the type specific pins on Apalis modules through a dedicated high speed connector.

3.1.15 LED Indicators

The Eagle board provides the following LED indicators. All LEDs are located near to a board edge or their respective features. All LEDs are labeled in silkscreen with their function.

Power on:	Green LED when board is powered on
PCIe MiniCard socket:	3 Green LEDs to support WWAN, WPAN, WLAN signals from the connector
SATA Activity:	Green LED for SATA activity.

Apalis Ethernet: Green LEDs for Link and Activity
Ethernet 10/100/1000: Green LEDs for Link and Activity (Not available on Eaglet)
PCIe to UART Power: Green LED for PCIe to UART chip Power OK (Not available on Eaglet)

3.1.16 Real-Time Clock (RTC)

The board contains an on-board RTC backup battery (BR-2330A/HDN). Connector (**J5**) is provided to enable the use of an external battery.
A jumper (**JP1**) is provided to disconnect the battery during long term storage.

3.1.17 Power Supply

Low cost Eaglet board is powered from +5VDC +/- 5% and Eagle baseboard is powered from a wide input voltage range of +9V to +36V.

Input power is provided to Eaglet and Eagle baseboard through pin header J28. All required supply voltages for the board, other than the +12V (for LCD back light), are derived from the input supply.

The on-board power supplies are able to support the below add-on features:

Eaglet:

5V	3.3V	Feature
	1.5A	PCIe mini card
	1.5A	mSATA
1.4A	0.7A	LVDS LCD
0.5A	0.5A	CAN Header
	0.1A	GPIO Header

Eagle:

5V	3.3V	Feature
	1.5A	PCIe mini card
	1.5A	mSATA
1.4A	0.7A	LVDS LCD
0.5A	0.5A	CAN Header
	0.3A	GPIO Headers (3)
	0.1A	CSI
	0.2A	Type Specific

4 Mechanical Drawings

4.1 Eaglet Baseboard

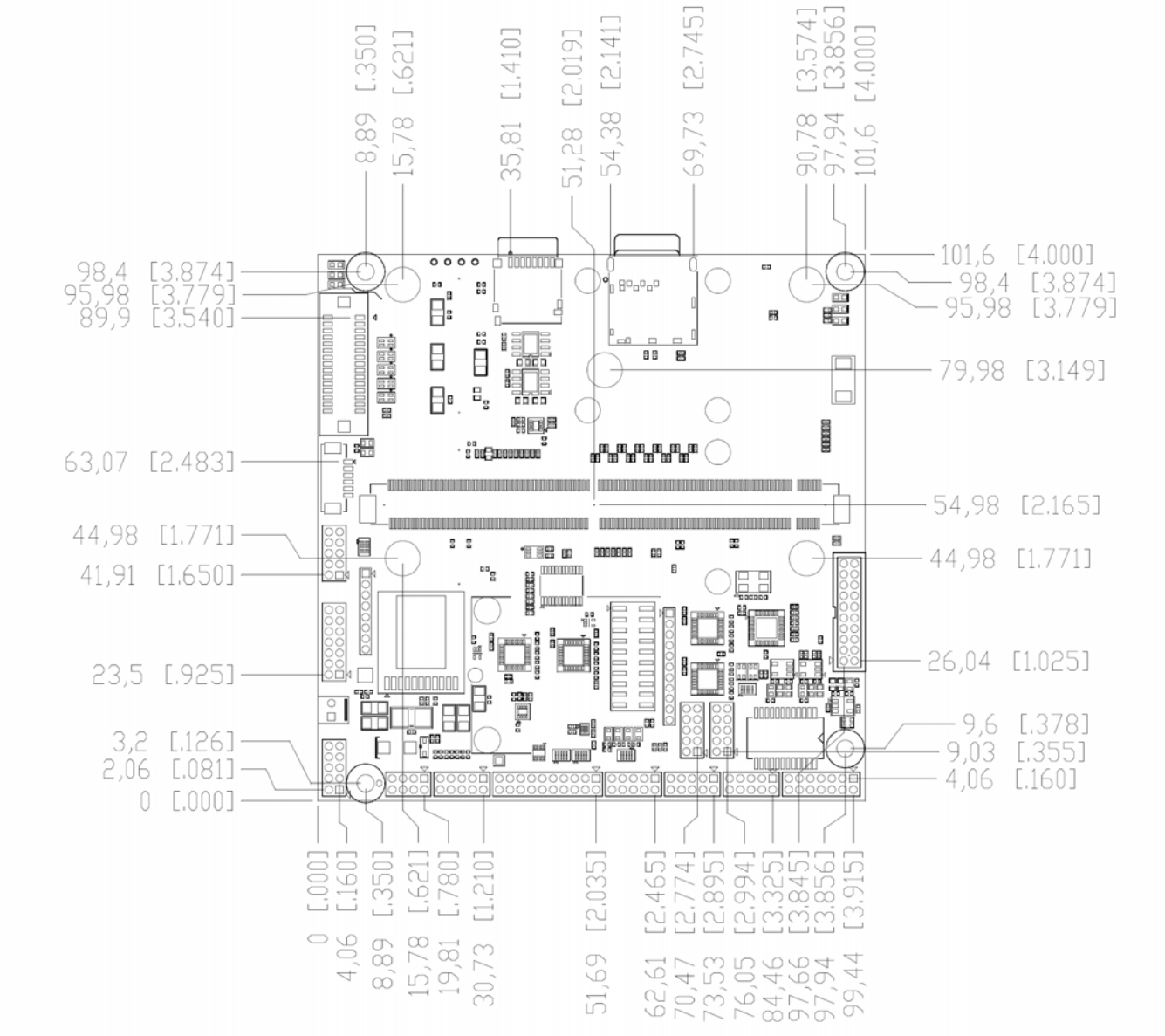


Figure 5 Eaglet Baseboard Mechanical drawing

4.2 Eagle Baseboard

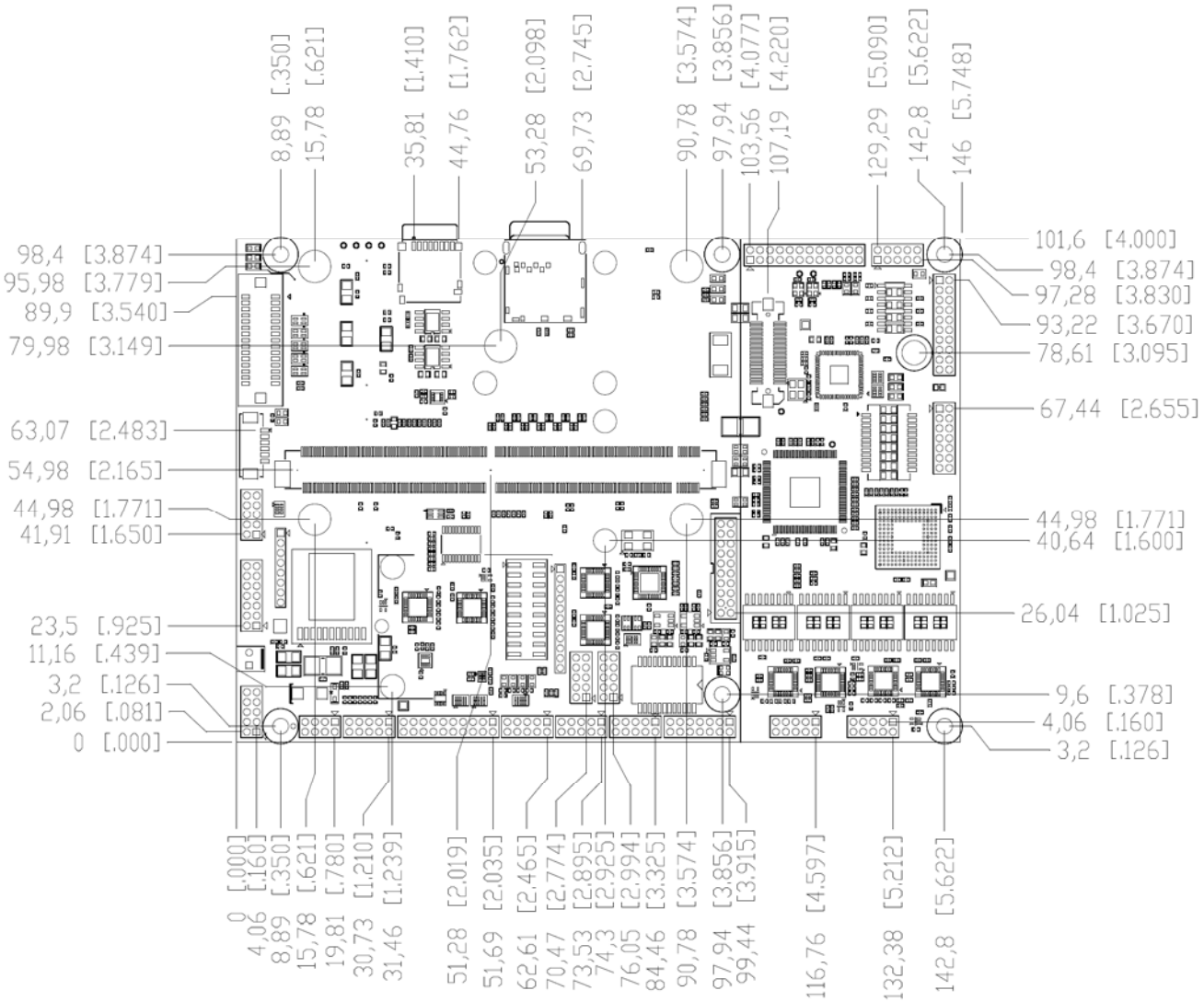


Figure 6 Eagle Baseboard Mechanical drawing

5 Board Layout (Connector and Jumper Locations)

5.1 Eagle Baseboard

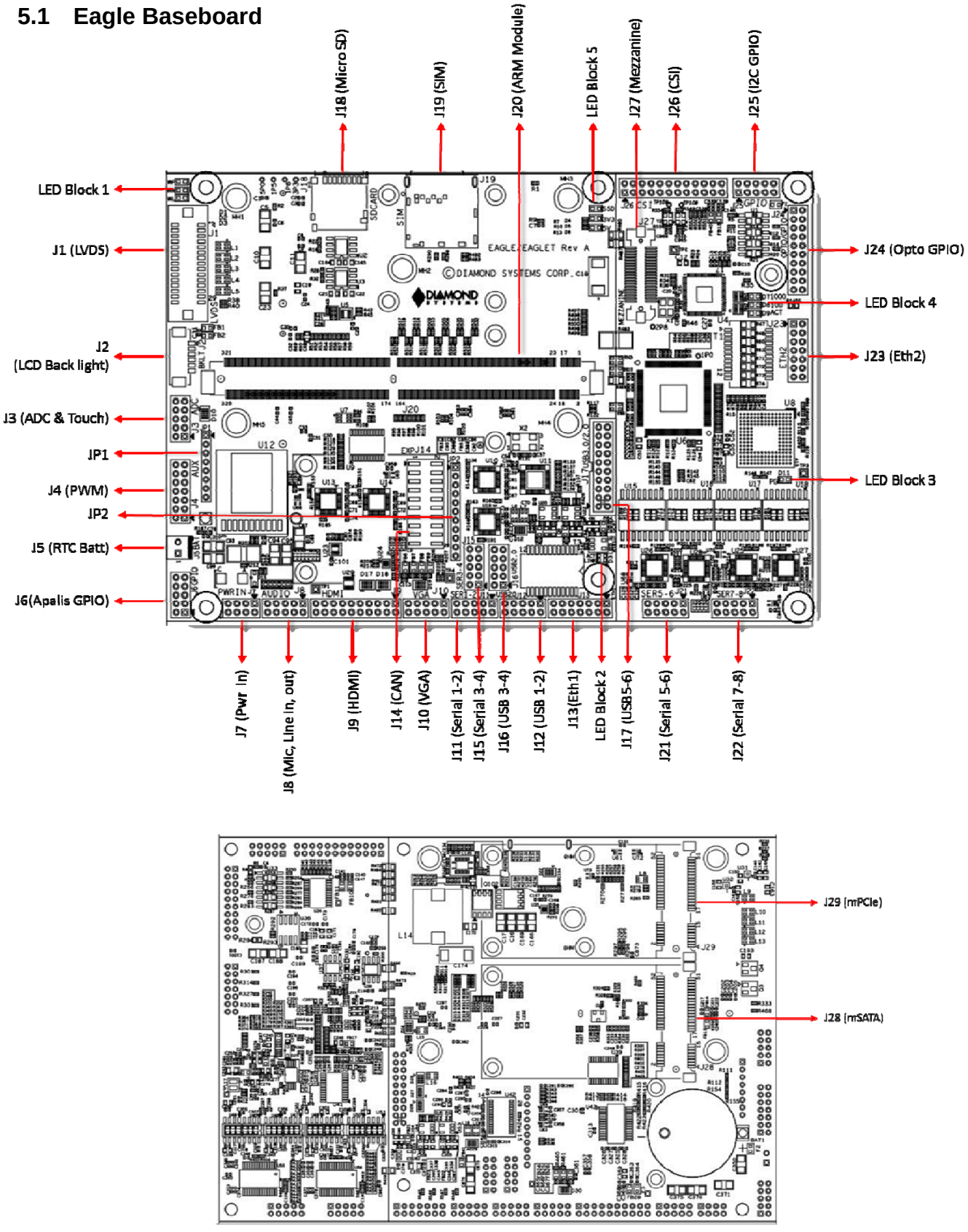


Figure 7 Board Layout, Top view and bottom view

I/O Connectors, Jumpers and LED Summary for Eagle

Connector	*Function*	*Jumper*	*Function*
J1	LVDS LCD	JP1	LVDS Supply, Back light and NVRAM supply selection
J2	LCD Backlight	JP2	USB Port 5 Mode and RS422/485 termination
J3	Touch/Analog Inputs	***LED Block 1***	
J4	Auxiliary/PWM	1st LED (Topmost in block)	WPAN (WP)
J5	External Battery - RTC	2nd LED (Second from top in block)	WWAN (WW)
J6	Apalis GPIOs	3rd LED (Third from top in block)	WLAN (WL)
J7	Power supply and LCD backlight supply Input	***LED Block 2***	
J8	Audio	1st LED (Topmost in block)	Eth-1 Activity (Red color)
J9	HDMI	2nd LED (Second one in block)	Eth-1 Link (Green color)
J10	VGA	***LED Block 3***	
J11	Apalis UARTs – Port 1 &2	1st LED (D11)	EXAR PGOOD
J12	USB 2.0 Ports 1 & 2	***LED Block 4***	
J13	Apalis Ethernet (Eth-1)	1st LED (Topmost in the block)	Eth-2 1000BASE-T Link
J14	CAN Add on card connector	1st LED (Second one in the block)	Eth-2 100BASE-T Link
J15	Apalis UARTs – Port 3 & 4	1st LED (Bottom one in the block)	Eth-2 Activity
J16	USB 2.0 Ports 3 & 4	***LED Block 5***	
J17	USB 3.0 Ports – 5 & 6	1st LED (Topmost in the block)	SATA Activity
J18	SD Card	1st LED (Second one in the block)	3.3V Supply
J19	SIM	1st LED (Bottom one in the block)	5V Supply
J20	ARM Module		
J21	EXAR UARTs Port 5 & 6		
J22	EXAR UARTs Port 7 & 8		
J23	PCIe Ethernet (Eth-2)		

J24	I2C Opto GPIOs
J25	I2C GPIOs
J26	CSI
J27	Mezzanine Connector
J28	mSATA
J29	Mini Card

5.2 Eaglet Baseboard

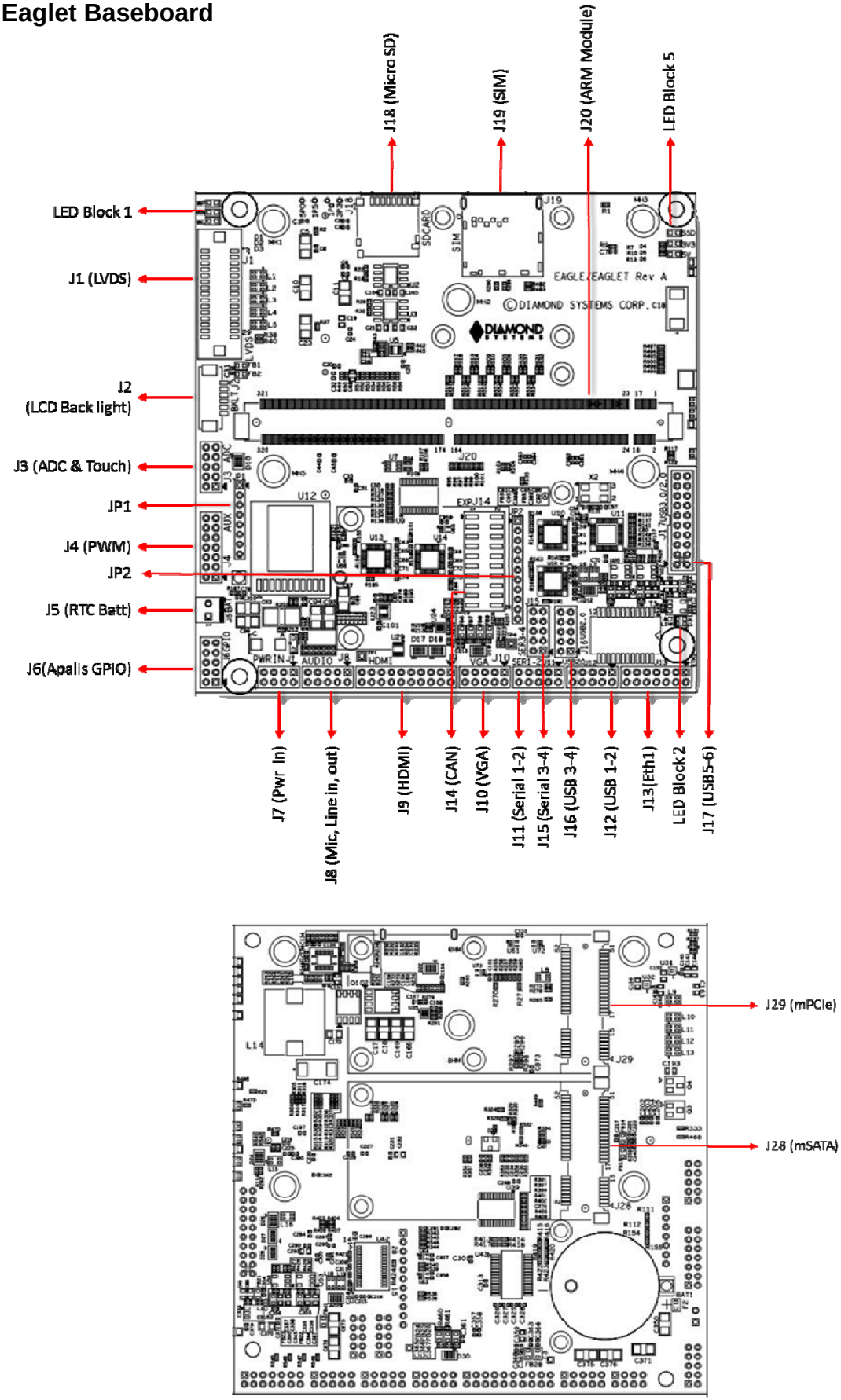


Figure 8 Eaglet board layout, Top and bottom view

5.2.1 I/O Connectors, Jumpers and LED Summary for Eaglet

Connector	*Function*	*Jumper*	*Function*
J1	LVDS LCD	JP1	LVDS Supply, Back light and NVRAM supply selection
J2	LCD Backlight	JP2	USB Port 5 Mode and RS422/485 termination
J3	Touch/Analog Inputs	***LED Block 1***	
J4	Auxiliary/PWM	1st LED (Topmost in block)	WPAN (WP)
J5	External Battery - RTC	2nd LED (Second from top in block)	WWAN (WW)
J6	Apalis GPIOs	3rd LED (Third from top in block)	WLAN (WL)
J7	Power supply and LCD backlight supply Input	***LED Block 2***	
J8	Audio	1st LED (Topmost in block)	Eth-1 Activity (Red color)
J9	HDMI	2nd LED (Second one in block)	Eth-1 Link (Green color)
J10	VGA	***LED Block 5***	
J11	Apalis UARTs – Port 1 &2	1st LED (Topmost in the block)	SATA Activity
J12	USB 2.0 Ports 1 & 2	1st LED (Second one in the block)	3.3V Supply
J13	Apalis Ethernet (Eth-1)	1st LED (Bottom one in the block)	V Supply
J14	CAN Add on card connector		
J15	Apalis UARTs – Port 3 & 4		
J16	USB 2.0 Ports 3 & 4		
J17	USB 3.0 Ports – 5 & 6		
J18	SD Card		
J20	ARM Module		
J23	PCIe Ethernet (Eth-2)		
J28	mSATA		
J29	Mini Card		

6 IO Connectors

6.1 Connector Pin-out and Signal Description

6.1.1 Eaglet and Eagle Baseboard

Following section describes the IO connector details available in both Eaglet and Eagle Baseboard.

6.1.1.1 SD/MMC (J18)

4 bit SD lines are connected to standard micro SD card with following pinout

1	MMC1_D2
2	MMC1_D3
3	MMC1_CMD
4	V_3P3/1P8
5	MMC1_CLK
6	GNDA_REG
7	MMC1_D0
8	MMC1_D1
9	GND_SD_SHEILD
10	GND_SD_SHEILD
11	GNDA_REG
12	MMC1_CD#
13	GND_SD_SHEILD
14	GND_SD_SHEILD

Connector Type: Standard micro SD card slot

6.1.1.2 LVDS (J1)

J1 is a LVDS connector. Pinout is as given below.

VDD 5V	1	2	VDD 5V
VDD 3.3V	3	4	VDD 3.3V
CLK+ Odd	5	6	CLK+ Even
CLK- Odd	7	8	CLK-Even
GND	9	10	GND
D0+ Odd	11	12	D0+ Even
D0- Odd	13	14	D0- Even
D1+ Odd	15	16	D1+ Even
D1- Odd	17	18	D1- Even
D2+ Odd	19	20	D2+ Even
D2- Odd	21	22	D2- Even
D3+ Odd	23	24	D3+ Even
D3- Odd	25	26	D3- Even
GND	27	28	GND
DDC CLK	29	30	DDC DATA

Connector Type: Thirty pin connector from Hirose, DF13A-30DP-1.25V

6.1.1.3 Gigabit Ethernet (J13)

Gigabit Ethernet from Apalis module are directly connected to J13.Pinout is as below.

NC	1	2	GND
DA+	3	4	DA-
DB+	5	6	DB-
DC+	7	8	DC-
DD+	9	10	DD
ACT	11	12	LINK_1000
LINK_100	13	14	V_3P3

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.4 LCD Backlight Connector (J2)

Connector J2 is used for the LCD backlight control. Input power source is user selectable using jumpers (**JP1**) to 5V or 12V.
Brightness may be controlled over PWM (pin 6) on this connector. Option is available to set the PWM voltage level to 3.3V or 5V using jumper (JP1).

1	Power +5V/+12V, jumper selectable
2	Power (same as pin 1)
3	Ground
4	Ground
5	Enable (GPIO output), 0 = off, open circuit = on
6	PWM, 5V/ 3.3V level jumper selectable

Connector Type: 6 pin RA 1.25mm pitch SMD header (053261-0671 from Molex).

Mating Housing: 51021-0600
Crimp terminal: 50058-8000

6.1.1.5 Analog IO/ Resistive Touch (J3)

Analog IOs and Resistive touch signals are terminated at J3 with below pinouts.

AN1_ADC0	1	2	AN1_ADC3
AN1_ADC1	3	4	AN1_ADC2
AGND	5	6	AGND
AN1_TSMX	7	8	AN1_TSPX
AN1_TSMY	9	10	AN1_TSPY

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.6 USB3.0 Ports (J17)

1x USB3.0 and 1xOTG signals are available at J17. Standard pinout from Intel is followed.

VCC_USBH4	1	2	KEY
USBH4_SSRX_N	3	4	VCC_USBO1
USBH4_SSRX_P	5	6	USBO1_SSRX_N
GND	7	8	USBO1_SSRX_P
USBH4_SSTX_N	9	10	GND
USBH4_SSTX_P	11	12	USBO1_SSTX_N
GNDA_REG	13	14	USBO1_SSTX_P
USBH4_D_CON_N	15	16	GND
USBH4_D_CON_P	17	18	USBO1_D_CON_N
USBO1_ID	19	20	USBO1_D_CON_P

Connector Type: Standard 2mm dual row straight pin header for USB3.0.

6.1.1.7 I2C/PWM/SPI/SPDIF Header (J4)

I2C, SPI, PWM and S/PDIF signals from Apalis module are connected to J4. Below are the pinout details.

PWM1	1	2	V_3P3
PWM2	3	4	I2C3_CAM_SCL
PWM3	5	6	I2C3_CAM_SDA
SPDIF_IN	7	8	SPI2_SCLK
SPDIF_OUT	9	10	SPI2_CSN
AUX_GPIO0_7	11	12	SPI2_MISO
GND	13	14	SPI2_MOSI

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.8 CAN Header (J14)

2x CAN ports from Apalis module are terminated to J14. CAN Mezzanine module to be fixed to J14 to avail the CAN ports. Below is the pinout details

VCC_5V	**1**	**2**	V_3P3
CAN1_TX	**3**	**4**	CAN1_RX
CAN2_TX	**5**	**6**	CAN2_RX
I2C1_SCL	**7**	**8**	SPI1_CLK
I2C1_SDA	**9**	**10**	SPI1_CSN
CAN_GPIO1	**11**	**12**	SPI1_MISO
CAN_GPIO2	**13**	**14**	SPI1_MOSI
CAN_GPIO3	**15**	**16**	NC
NC	**17**	**18**	NC
GND	**19**	**20**	GND

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.9 External Battery (J5)

Connector J5 may be used to enable the use of an external battery.

1	VBAT
2	Ground

VBAT = +3.3V

Connector Type: Hirose DF13A-2P-1.25H right-angle friction lock pin header.

6.1.1.10 Serial Ports 1-4 (J11, J15)

There are two serial port connectors J11 and J15, supporting two ports per connector.
Serial ports 1 and 2 (**J11**) are available on Panel IO board with standard DB9 connector

For Eaglet variant, Serial ports 1-2 supports RS232, RS485 and RS422 mode (SP336). For RS422/RS485 mode 120E termination to be enabled by placing the jumpers on JP2. Serial port 3-4 supports only RS232 mode in low cost Eaglet model.

For Full feature Eagle model, Serial Ports 1-4 supports RS232, RS485 and RS422 modes (SP335).
Pinout for SP336 and SP335 featured board differs for RS422/RS485 mode.

RS232

TX1	1	2	RTS1
RX1	3	4	CTS1
GND	5	6	GND
TX2	7	8	RTS2
RX2	9	10	CTS2

RS422/SP336 (Eaglet)

TX1+	1	2	TX1-
RX1+	3	4	RX1-
GND	5	6	GND
TX2+	7	8	TX2-
RX2+	9	10	RX2-

RS422/SP335 (Eagle)

TX1-	1	2	TX1+
RX1+	3	4	RX1-
GND	5	6	GND
TX2-	7	8	TX2+
RX2+	9	10	RX2-

RS485/SP336 (Eaglet)

TX1/RX1+	1	2	TX1/RX1-
NC	3	4	NC
GND	5	6	GND
TX2/RX2+	7	8	TX2/RX2-
NC	9	10	NC

RS485/SP335 (Eagle)

TX1/RX1-	1	2	TX1/RX1+
NC	3	4	NC
GND	5	6	GND
TX2/RX2-	7	8	TX2/RX2+
NC	9	10	NC

Connector Type: Standard 2mm dual row straight pin header.
Following table provides details about serial ports available on different connector.

Connector	Serial Ports	Comments
J11	Port 1	Pins 1 to 4
	Port 2	Pins 7 to 10
J15	Port 3	Pins 1 to 4
	Port 4	Pins 7 to 10

6.1.1.11 USB2.0 Ports (J12, J16)

There are two USB2.0 connectors with identical pinouts, J12 and J16. Each connector provides access to two USB 2.0 ports summing up to four USB2.0 ports. Connector J16 is available only in Full feature Eagle baseboard.

Key	**1**	**2**	Shield
USB1 Pwr-	**3**	**4**	USB0 Pwr-
USB1 Data+	**5**	**6**	USB0 Data+
USB1 Data-	**7**	**8**	USB0 Data-
USB1 Pwr+	**9**	**10**	USB0 Pwr+

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.12 GPIOs (J6)

GPIOs from Apalis are available on J6. Numbers inside brackets are the alphanumeric mappings for the corresponding GPIOs based on the ARM module used.

GPIO1 (iMx-36, T30-146)	**1**	**2**	GPIO2(iMx-37, T30-147)
GPIO3(iMx-38, T30-148)	**3**	**4**	GPIO4 (iMx-39, T30-149)
GPIO5(iMx-169, T30-150)	**5**	**6**	GPIO6 (iMx-170, T30-129)
GPIO7(iMx-2, T30-151)	**7**	**8**	GPIO8 (iMx-6, T30-129)
RESET_MICOn	**9**	**10**	GND

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.13 HDMI (J9)

HDMI signals are connected to J9. Pinout is as below.

HDMI_TXD2_P	1	2	GND
HDMI_TXD2_N	3	4	HDMI_TXD1_P
GND	5	6	HDMI_TXD1_N
HDMI_TXD0_P	7	8	GND
HDMI_TXD0_N	9	10	HDMI_TXC_P
GND	11	12	HDMI_TXC_N
HDMI_CEC	13	14	NC
HDMI_DDC_CLK	15	16	HDMI_DDC_DATA
GND	17	18	5V
HDMI_HPD	19	20	NC

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.14 Audio (J8)

Audio signals are terminated onto connector J8 with following pinout.

LineOut-L	1	2	LineOut-R
GND_Audio	3	4	GND_Audio
LineIn-L	5	6	LineIn-R
GND_Audio	7	8	GND_Audio
NC	9	10	MIC_R

Connector Type: Standard 2mm dual row straight pin header

6.1.1.15 VGA (J10)

A VGA monitor can be plugged into connector J10.

RED	1	2	Ground
GREEN	3	4	**Key**
BLUE	5	6	Ground
HSYNC	7	8	DDC-Data
VSYNC	9	10	DDC-Clock

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.16 Power in (J7)

Input power maybe supplied through J7.

GND	1	2	+VIN/V_5P0
GND	3	4	+VIN/V_5P0
GND	5	6	+VIN/V_5P0
V_12P0	7	8	+VIN/V_5P0

Connector Type: Standard 2mm dual row straight pin header.

6.1.1.17 Mini PCIe Card (J29)

All TX/RX signals are with respect to the host. TX on the socket drives RX on the installed module, and RX on the socket is driven by TX on the installed module.
Provided an option to mount both half sized and full sized mini card.

	1	2	+3.3V
	3	4	Gnd
	5	6	+1.5V
Clkreq-	7	8	
Gnd	9	10	
PCIe 1 Clk-	11	12	
PCIe 1 Clk+	13	14	
Gnd	15	16	
	KEY		
	17	18	Gnd
	19	20	Disable-
Gnd	21	22	PCIe Reset-
PCIe 1 RX-	23	24	+3.3V
PCIe 1 RX+	25	26	Gnd
Gnd	27	28	+1.5V
Gnd	29	30	SMB Clk
PCIe 1 TX-	31	32	SMB Data
PCIe 1 TX+	33	34	Gnd
Gnd	35	36	
Gnd	37	38	
+3.3V	39	40	Gnd
+3.3V	41	42	WWAN LED-
Ground	43	44	WLAN LED-
	45	46	WPAN LED-
	47	48	+1.5V
Pull-up to +3.3V	49	50	Gnd
	51	52	+3.3V

Connector Type: 52-pin MiniCard, full size/half size, with PCB mount threaded spacers

6.1.1.18 mSATA (J28)

All TX/RX signals are with respect to the host. TX on the socket drives RX on the installed module, and RX on the socket is driven by TX on the installed module.

	1	**2**	+3.3V
	3	**4**	Gnd
	5	**6**	+1.5V
	7	**8**	
Gnd	**9**	**10**	
	11	**12**	
	13	**14**	
Gnd	**15**	**16**	
	KEY		
	17	**18**	Gnd
	19	**20**	Disable-
Gnd	**21**	**22**	
SATA 0 RX+	**23**	**24**	+3.3V
SATA 0 RX-	**25**	**26**	Gnd
Gnd	**27**	**28**	+1.5V
Gnd	**29**	**30**	SMB Clk
SATA 0 TX-	**31**	**32**	SMB Data
SATA 0 TX+	**33**	**34**	Gnd
Gnd	**35**	**36**	
Gnd	**37**	**38**	
+3.3V	**39**	**40**	Gnd
+3.3V	**41**	**42**	
Ground	**43**	**44**	
	45	**46**	
	47	**48**	+1.5V
Pull-up to +3.3V	**49**	**50**	Gnd
	51	**52**	+3.3V

Connector Type: 52-pin MiniCard, full size, with PCB mount threaded spacers

6.1.2 Eagle Baseboard

In addition to the list of connectors mentioned in the section 6.1.1, Eagle has the following additional connectors.
(These connectors are available only in Eagle)

6.1.2.1 GPIO Header (J25)

GPIO Signals from I2C GPIO expander are connected to J25 with following pinout. Numbers inside brackets are the alphanumeric mappings for the corresponding GPIOs to be used in the GPIO utility.

EXP_GPIO1_0 (456)	1	2	EXP_GPIO1_1 (457)
EXP_GPIO1_2 (458)	3	4	EXP_GPIO1_3 (459)
EXP_GPIO1_4 (460)	5	6	EXP_GPIO1_5 (461)
EXP_GPIO1_6 (462)	7	8	EXP_GPIO1_7 (463)
V_3P3	9	10	GND

Connector Type: Standard 2mm dual row straight pin header.

6.1.2.2 CSI (J26)

Dual lane CSI2 MIPI signals are available on J26 with following pinout. MIPI Add-on module can be fixed to J26 to connect standard MIPI camera.

CSI1_D1A_P	1	2	CSI1_CLKA_P
CSI1_D1A_N	3	4	CSI1_CLKA_N
CSI1_D2A_P	5	6	VCA1P8
CSI1_D2A_N	7	8	CSI1_D1B_P
GND_DIG	9	10	CSI1_D1B_N
CSI1_D2B_P	11	12	VCA3P3
CSI1_D2B_N	13	14	VCA1P5
CSI2_CLKB_P	15	16	VCA2V8
CSI2_CLKB_N	17	18	I2C_CSI_SCL
GND_DIG	19	20	I2C_CSI_SDA

Connector Type: Standard 2mm dual row straight pin header.

6.1.2.1 Micro SIM Card Slot (J19)

SIM interface from mini PCIe card is connected to micro SIM card slot J19 with following pinout.
SIM card slot is available on request basis.

C1	SIM_VDD
C2	R_SIM_RST
C3	R_SIM_CLK
C5	GNDA_REG
C6	SIM_VPP
C7	R_SIM_DATA
SW	SIM_CD

Connector Type: Standard micro SIM card slot

6.1.2.2 Opto GPIO (J24)

8 Opto isolated GPIOs are connected to J24 with following pinout. Numbers inside brackets are the alphanumeric mappings for the corresponding GPIOs to be used in the GPIO utility.

V_OPTO	**1**	**2**	NC
OPTO_EXP_DIN1+ (448)	**3**	**4**	OPTO_EXP_DIN2+ (449)
OPTO_EXP_DIN3+ (450)	**5**	**6**	OPTO_EXP_DIN4+ (451)
OPTO_EXP_DOUT1+ (452)	**7**	**8**	OPTO_EXP_DOUT2+ (453)
OPTO_EXP_DOUT3+ (454)	**9**	**10**	OPTO_EXP_DOUT4+ (455)
OPTO_EXP_DIN1-	**11**	**12**	OPTO_EXP_DIN2-
OPTO_EXP_DIN3-	**13**	**14**	OPTO_EXP_DIN4-
OPTO_EXP_DOUT1-	**15**	**16**	OPTO_EXP_DOUT2-
OPTO_EXP_DOUT3-	**17**	**18**	OPTO_EXP_DOUT4-
V_3P3	**19**	**20**	GND

Non Opto Verision (J24)

NC	**1**	**2**	NC
NC	**3**	**4**	NC
NC	**5**	**6**	NC
NC	**7**	**8**	NC
NC	**9**	**10**	NC
I2C_EXP_DIN1 (448)	**11**	**12**	I2C_EXP_DIN2 (449)
I2C_EXP_DIN3 (450)	13	14	I2C_EXP_DIN4 (451)
I2C_EXP_DOUT1 (452)	15	16	I2C_EXP_DOUT2 (453)
I2C_EXP_DOUT3 (454)	17	18	I2C_EXP_DOUT4 (455)
V_3P3	19	20	GND

Connector Type: Standard 2mm dual row straight pin header.

6.1.2.3 Type Specific (J27)

Type specific IOs from Apalis module are available at J27. Pinouts are as below.

V_3P3	**1**	**2**	V_1P8
TS_4	**3**	**4**	TS_1
TS_5	**5**	**6**	TS_2
TS_6	**7**	**8**	TS_3
GND	**9**	**10**	GND
TS_DIFF1_N	**11**	**12**	TS_DIFF2_N
TS_DIFF1_P	**13**	**14**	TS_DIFF2_P
TS_DIFF3_N	**15**	**16**	TS_DIFF4_N
TS_DIFF3_P	**17**	**18**	TS_DIFF4_P
GND	**19**	**20**	GND
TS_DIFF5_N	**21**	**22**	TS_DIFF6_N
TS_DIFF5_P	**23**	**24**	TS_DIFF6_P
TS_DIFF7_N	**25**	**26**	TS_DIFF8_N
TS_DIFF7_P	**27**	**28**	TS_DIFF8_P
GND	**29**	**30**	GND

TS_DIFF9_N	**31**	**32**	TS_DIFF10_N
TS_DIFF9_P	**33**	**34**	TS_DIFF10_P
TS_DIFF11_N	**35**	**36**	TS_DIFF12_N
TS_DIFF11_P	**37**	**38**	TS_DIFF12_P
GND	**39**	**40**	GND

Connector Type: Dual row 40 position receptacle from Molex, 0528850474

6.1.2.4 Ethernet (PCIe) (J23)

Gigabit Ethernet from PCIe to Ethernet are connected to J23 with necessary magnetics. Pinout is as below.

NC	**1**	**2**	GND
DA+	**3**	**4**	DA-
DB+	**5**	**6**	DB-
DC+	**7**	**8**	DC-
DD+	**9**	**10**	DD
ACT	**11**	**12**	NC
LINK	**13**	**14**	V_3P3

Connector Type: Standard 2mm dual row straight pin header.

6.1.2.5 Serial Ports 5-8 (J21, J22)

There are two serial port connectors J21 and J22, supporting two ports per connector. All the serial ports supports RS232, RS485 and RS422 modes. For simplicity only the pinout for ports 5 and 6 are shown; ports 7 and 8 are similar.

RS-422

TX5	1	2	RTS5
RX5	3	4	CTS5
GND	5	6	GND
TX6	7	8	RTS6
RX6	9	50	CTS6

RS-422

TX5-	1	2	TX5+
RX5+	3	4	RX5+
GND	5	6	GND
TX6-	7	8	TX6+
RX6+	9	50	RX6-

RS-485

TX5/RX5-	1	2	TX5/RX5+
NC	3	4	NC
GND	5	6	GND
TX6/RX6-	7	8	TX6/RX6+
NC	9	10	NC

The following table provides details about the serial ports available on the two connectors.

Connector	Serial Ports	Connector Pins
J21	Port 5	Pins 1 to 4
	Port 6	Pins 7 to 10
J22	Port 7	Pins 1 to 4
	Port 8	Pins 7 to 10

6.2 List of Connectors

6.2.1 Eaglet Baseboard

The following table provides a summary of all I/O connectors on the Eaglet baseboard and their associated DSC cable part number.

Function	Reference	Manufacturer	Part no.	Description	Mating Cable
Analog IO	J3	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981169
Serial Ports Qty=2	J11,J15,J216,J22	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981075
GPIO	J25	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981169
Audio	J8	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981076
VGA	J10	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981084
USB2.0	J12,J16	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6091082
HDMI	J9	Pinrex	220-9210GB01	2x10, 2mm pitch, TH header	6980522
I2C/PWM	J4	Pinrex	220-9207GB01	2x7, 2mm pitch, TH header	6980523
10/100/1000 Ethernet	J23,J13	Pinrex	220-9207GB01	2x7, 2mm pitch, TH header	6980521
Power In	J7	Pinrex	220-9204GB01	2x4, 2mm pitch, TH header	6980520
External Battery	J5	TE	640456-2	2 pos. 1.27mm pitch, SMT	6981011
CAN	J14	Pinrex	222-9210GB01	Conn 2mm housing SMD 20pos dual	NA
LVDS	J1	Hirose Electric	DF13A-30DP-1.25V	2x 15, 1.25MM SMT, Vertical	6981215
USB3.0/OTG	J17	Win Win precision	WUIR-19A1N4BU3N	2x10, 2mm pitch, TH header	6980100
mini PCIe	J29	JAE	MM60-52B1-E1-R650	52-pin MiniCard, full size, with PCB mount threaded spacers	NA
mSATA	J28	JAE	MM60-52B1-E1-R650	52-pin MiniCard, full size, with PCB mount threaded spacers	NA
LCD Backlight	J2	Molex	053261-0671	6 pos. 1.25mm pitch, SMT, RA	6981216
Micro SD	J18	Amphenol Corporation	114-00841-68	Conn micro SD card push-push RA	NA

6.2.2 Eagle Baseboard

The following table provides a summary of all I/O connectors on the Eagle baseboard.

Function	Reference	Manufacturer	Part no.	Description	Mating Cable
Analog IO	J3	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981169
Serial Ports Qty=4	J11,J15,J216,J22	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981075
GPIO	J25	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981169
Audio	J8	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981076
VGA	J10	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981084
USB2.0	J12,J16	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6091082
HDMI	J9	Pinrex	220-9210GB01	2x10, 2mm pitch, TH header	6980522
I2C/PWM	J4	Pinrex	220-9207GB01	2x7, 2mm pitch, TH header	6980523
10/100/1000 Ethernet Qty=2	J23,J13	Pinrex	220-9207GB01	2x7, 2mm pitch, TH header	6980521
Power In	J7	Pinrex	220-9204GB01	2x4, 2mm pitch, TH header	6980520
External Battery	J5	TE	640456-2	2 pos. 1.27mm pitch, SMT	6981011
CAN	J14	Pinrex	222-9210GB01	Conn 2mm housing SMD 20pos dual	NA
LVDS	J1	Hirose Electric Co Ltd	DF13A-30DP-1.25V	2x 15, 1.25MM SMT, Vertical	6981215
USB3.0/OTG	J17	Win Win precision	WUIR-19A1N4BU3N	2x10, 2mm pitch, TH header	6980100
mini PCIe	J29	JAE	MM60-52B1-E1-R650	52-pin MiniCard, full size, with PCB mount threaded spacers	NA
mSATA	J28	JAE	MM60-52B1-E1-R650	52-pin MiniCard, full size, with PCB mount threaded spacers	NA
LCD Backlight	J2	Molex	053261-0671	6 pos. 1.25mm pitch, SMT, RA	6981216
Micro SD	J18	Amphenol Corporation	114-00841-68	Conn micro SD card push-push RA	NA
I2C Expander GPIO	J25	Pinrex	220-9205GB01	2x5, 2mm pitch, TH header	6981169
CSI	J26	Pinrex	220-9210GB01	2x10, 2mm pitch, TH header	NA
Opto GPIO	J24	Pinrex	220-9210GB01	2x10, 2mm pitch, TH header	6981164
Mezzanine	J27	Molex	528850474	2x20, 0.67mm, SMT	NA
micro SIM	J19	TE Connectivity	2174803-2	Micro SIM card slot	NA

7 I/O Cables

7.1 Eagle Baseboard

The following Table provides I/O cable details for Eaglet baseboard

Function	DSC cable no.	Ref	Remarks
LVDS LCD	6981213	J1	Not part of cable kit
LCD backlight	6981214	J2	Not part of cable kit
A/D, GPIO, resistive touch	6981169	J3	
Misc. I/O: SPI, I2C, SPDIF	6980523	J4	
External battery input	6981011	J5	
GPIO - Module	6981169	J6	
Power in	6980520	J7	
Audio	6981076	J8	
HDMI	6980522	J9	
VGA	6981084	J10	
Serial ports 1, 2	6981075	J11	
USB 2.0 dual (3,4)	6981082	J12	
Gigabit Ethernet from module	6981080	J13	
CAN Header 1	NA	J14	6981182 for DS-MPE-CAN2L Module
CAN Header 2	NA	J14	
Serial ports 3, 4	6981075	J15	
USB 2.0 dual (1,2)	6981082	J16	
USB 3.0 dual	6980100	J17	
Serial ports 5, 6	6981075	J21	
Serial ports 7, 8	6981075	J22	
Gigabit Ethernet from expansion	6981080	J23	
Opto GPIO	6981164	J24	
GPIO - I2C expander	6981169	J25	

7.2 Eaglet Baseboard

Following Table provides I/O cable details for Eaglet baseboard

SL No.	Function	DSC cable no.	Ref	Remarks
1	LVDS LCD	6981213	J1	Not part of cable kit
2	LCD backlight	6981214	J2	Not part of cable kit
3	A/D, GPIO, resistive touch	6981169	J3	
4	Misc. I/O: SPI, I2C, SPDIF	**6980523**	J4	
5	External battery input	6981011	J5	
6	GPIO - Module	6981169	J6	
7	Power in	**6980520**	J7	
8	Audio	6981076	J8	
9	HDMI	**6980522**	J9	
10	VGA	6981084	J10	
11	Serial ports 1, 2	6981075	J11	
12	USB 2.0 dual (3,4)	6981082	J12	
13	Gigabit Ethernet from module	6981080	J13	
14	CAN Header 1	NA	J14	6981182 for CAN Transceiver Module
15	CAN Header 2	NA	J14	
16	Serial ports 3, 4	6981075	J15	
17	USB 2.0 dual (1,2)	6981082	J16	
18	USB 3.0 dual	**6980100**	J17	

8 Jumper Description

Following drawing shows only the connectors and jumper blocks on both Eagle and Eaglet. The default jumper positions are shown in red.

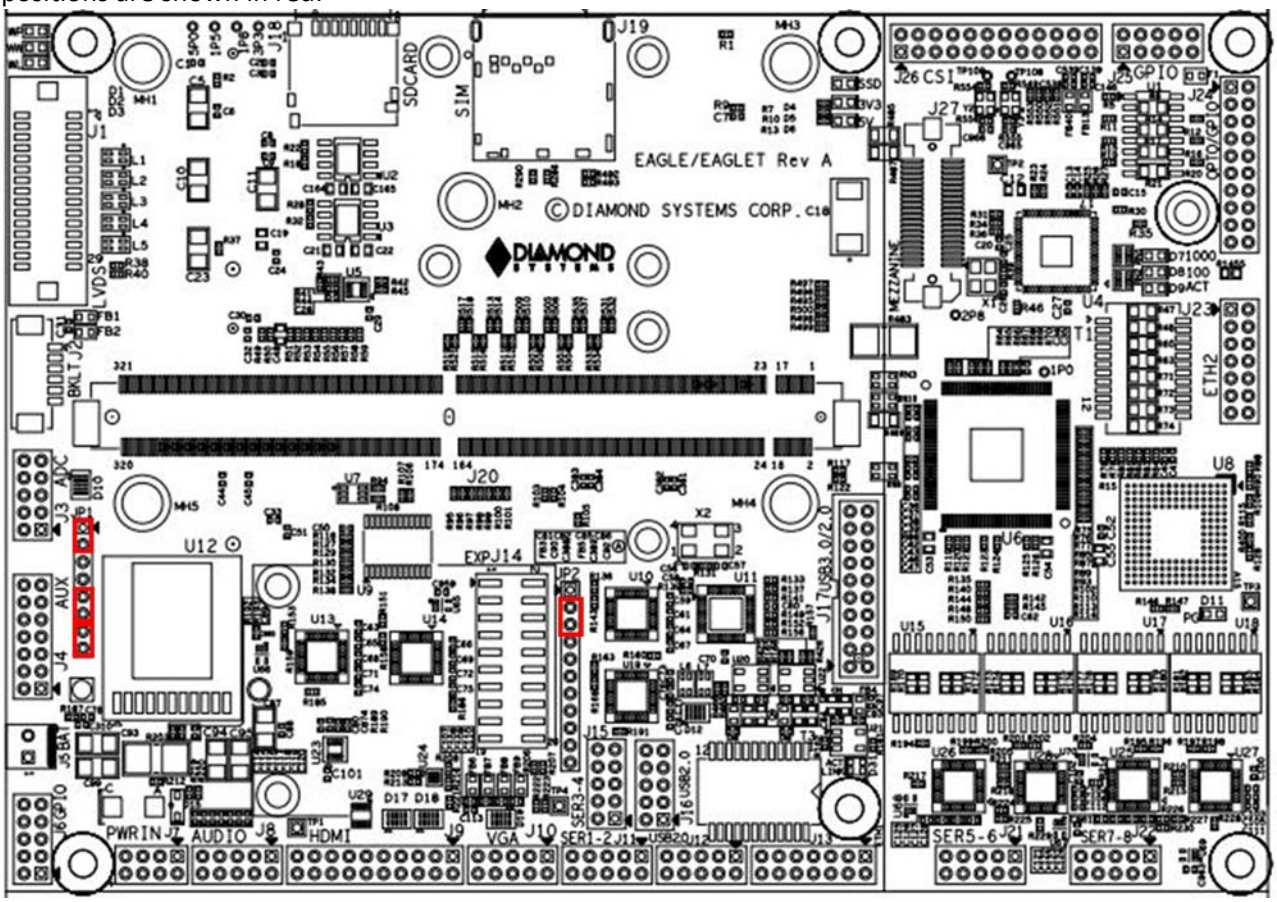


Figure 9 Default Jumper locations

Jumper	*Description*
JP1	LVDS Supply, Back light and NVRAM supply selection
JP2	USB Port 5 Mode and RS422/485 termination

8.1 LVDS VCC, Backlight & RTC (JP1)

Jumper block JP1 configures the voltage supply for the LVDS backlight and for LVDS VDD as well. The orientation of the block in the diagrams matches the orientation of the jumper block when the board is rotated so that the Apalis module is on the Top edge.

Available options for Back light are +5V and +12V. +12V is not used by any circuit on the Eagle. +12V is needed for the LCD backlight, and the backlight is to be powered via the backlight power connector J10, hence +12V is supplied on the main power input connector along with +VIN.

By default LVDS backlight is provided with +12V and the LVDS VDD is provided with 3.3V. Figure 10 shows the default jumper locations.

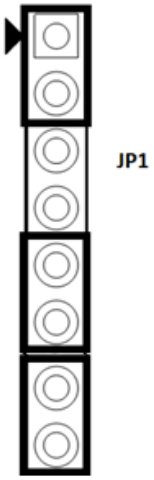


Figure 10 Jumper Block JP1

The following table shows different combinations of jumper locations on JP1.

1-2	2-3	4-5	5-6	LVDS Backlight	LVDS VDD
In	Out	In	Out	12V	5V
In	***Out***	***Out***	***In***	***12V***	***3.3V***
Out	In	In	Out	5V	5V
Out	In	Out	In	5V	3.3V

7-8	RTC
In	***On board battery***
Out	External 3.3V batter

Note:

1. The voltage selected on the backlight connector will not depend on or affect the voltage supply on the LVDS connector.
2. **Do not install a jumper on 3-4 and 6-7 positions.**

8.2 USB OTG & RS422/RS485 Terminations (JP2)

Jumper JP2 is used to enable 120 Ohm termination for serial port in RS485 and RS422 modes.JP2 will be available in Low cost Eaglet baseboard only.

RS-485 Mode Termination Enabled **RS-422 Mode Termination Enabled**

Figure 11 Jumper Block JP2

1-2	2-3	USBO1 Mode
In	Out	Peripheral mode
Out	In	Host mode (USB A to A cable should be used)

4-5	6-7	8-9	10-11	Mode
In	Out	In	Out	120 Ohm termination enabled on pairs TX3 and RX3 (For RS-485 Mode)
In	In	In	In	120 Ohm termination enabled on all four pairs (For RS-422 Mode)
Out	**Out**	**Out**	**Out**	**Termination Disabled (RS-232 Mode)**

Note:

1. Do not install a jumper on 3,4,5-6, 7-8 and 9-10 positions.

9 Getting Started

This section describes the steps needed to get Eagle and Eaglet up and running, and assumes that user also has an Eagle Development Kit or Eagle Cable Kit.

9.1 Development Kit

Model Number	*Description*
To be Updated	

9.2 Quick Setup

1. Insert the Apalis Module into the MXM connector on the Eaglet: Remove the 2 screws on the mounting spacers. Insert the module at an angle of approximately 45 degrees relative to the board and push in all the way. After the module is properly inserted, press down to seat the module on the two mounting spacers, and fix in place with the 2 screws. Note the middle spacer is intended as a support mechanism to prevent the Apalis module from deflecting when a heat sink is installed over it and pressing down on the processor chip.
2. Attach the required cables. A minimum set generally consists of power, keyboard, mouse, and one of the displays.
3. Attach display, keyboard, and mouse (if needed) to the cables.
4. Connect the jumpers as mentioned in Jumper Description for a default settings or can be changed as desired by the user.
5. Connect power to power input connector **J7** (OR can be fed through connector J1 and J14 on Panel IO Board if used) to your power supply. The input connector and cable are keyed to prevent incorrect connection.
   WARNING: Attaching the power connector incorrectly will destroy the board!
   WARNING: Be sure the input voltage is within the allowed range for the board. An input voltage exceeding the board's limit will destroy the board.
6. Connect the debug serial port to a PC using terminals like Teraterm with the below settings.
   Debug port details:
   Communication : RS232
   Serial Port : Port1
   Baud rate : 9600
   Flow control : None
   Stop bits : 1

9.3 Booting

Apalis modules will be booted through on-module eMMC by default.

9.3.1 Updating Software Image from SD card [for systems with U boot available]

Following steps depicts software update on module assuming that module has U-BOOT in it.

1. Preparing SD card
   a. Download image
   b. Unzip the downloaded compressed image. [it is compressed with 7zip]
   c. Flash the SD card with downloaded image.
      One can flash SD card as follows
      Get any microSD card of at least 2GB memory or higher.
      Get a USB SD card adapter, insert SD card and connect to PC.
      In Windows, Get any disk cloning application and flash the SD card with image.

   Steps to flash SD card using Win32DiskImager
      a. Download Win32DiskImager from https://sourceforge.net/projects/win32diskimager/
      b. Install the program
      c. Map image file and sd card in Win32DiskImager.
      d. Click on Write button
      e. You are ready to Go once it finish writing.
2. Setting up hardware
   a. Ensure necessary power supply based on the module variant (5V or 9 to 36V).
   b. Ensure the Debugging serial port (Port1) is connected to external PC
   c. Initial serial port settings are baud=115200, 8 data bits, No parity and 1 stop bit.
3. Updating image from SD card
   a. Insert SD card into slot.
   b. Power on the board.
   c. Interrupt U boot by pressing any key.
   d. Once in u boot prompt, type ‘run setupdate’, Enter.
   e. Type ‘run update’, Enter. This updates image, device tree and rootfs all at once.
   f. After update, system re boots itself and its ready to go.
   g. Login with default username and continue. Default username is ‘root’.

10 Start-up scripts

Start-up script [custom_startup_script.sh] is added along with the image. Start-up script exports the GPIO's and initializes the display settings

It helps to configure Default states for I2C GPIOs and for setting default display configuration.

Start-up configuration script can be found in /etc/init.d/.

Default states for GPIOs available in J24 and J25 are configured using gpioconfig.xml file

gpio-number – gpio number to configure
dir - direction, in or out
val - value, high or low

Refer section 13.4.3 for default GPIO states configured in the release image.

Default display setting can be configured using dispconfig.xml file.

Example for display configuration found in dispconfig.xml [For T30 modules].

```
<startupconfig>
        <video frmbuff="tegrafb0" res="1920x1200M-16" rate="60">
        <video frmbuff="tegrafb1" res="1920x1200M-16" rate="60">
</startupconfig>
```

frmbuff - framebuffer to configure
res - resolution to use
rate - refresh rate

Example for display configuration found in dispconfig.xml [For i.MX6 modules].

```
<startupconfig>
        <video frmbuff="mxcfb2" dev="hdmi" res="1360x768M" rate="50" opf="RGB24">
</startupconfig>
```

frmbuff - framebuffer to configure
dev - interface, vdac, hdmi or lvds.
res - resolution to use
rate - refresh rate
opf - video output format.

Please refer Toradex website for available options for each parameter in video configuration.
[http://developer.toradex.com/knowledge-base/display-output-resolution-and-timings-linux].

Note : If display parameters are set with config files, it will take two reboots for them to make effect.

Note : In case the display is not available initially, dispconfig.xml should be updated with proper configuration through debug port
or
Disable startup scripts from running, by renaming the dispconfig.xml file available at /etc/init.d/ and configure the display interface through U-boot video arguments (Instruction available in the Toradex links).
Below are some video arguments tested during development for each display interface

For VGA Interface:
setenv vidargs 'video=mxcfb0:dev=vdac,1024x768M@50,if=RGB565 video=mxcfb1:off video=mxcfb2:off video=mxcfb3:off fbmem=32M'
For HDMI Interface:
setenv vidargs ‘video=mxcfb0:dev=hdmi,1920x1080M@50,if=RGB24 video=mxcfb1:off video=mxcfb2:off video=mxcfb3:off fbmem=32M’

For LVDS Interface:
setenv vidargs ‘video=mxcfb0:dev=ldb,1920x1080M@50,if=RGB24 video=mxcfb1:off video=mxcfb2:off video=mxcfb3:off fbmem=32M’

11 Display Features

Eagle and Eaglet supports HDMI, VGA and LVDS LCD as display device options.

11.1 VGA

VGA display can be set as primary or secondary Display using the "*setenv vidargs*" command during boot stage. Maximum VGA resolution is 1280x1024 @ 60Hz. VGA display is supported only in Apalis iMX6. Apalis T30 and TK1 module does not support VGA display output.

11.2 HDMI

HDMI display is supported for all the three Apalis modules. Maximum resolution supported by different Apalis modules is as below.

Apalis Module	Maximum Resolution
iMX6	V1.4a,1080p
T30	V1.4a,1080p
TK1	V1.4b, 2160p

11.3 LVDS

LVDS display is supported for all the three Apalis modules. Maximum resolution supported by different Apalis modules is as below.

Apalis Module	Maximum Resolution
iMX6	2x 1366x768x24bpp Single or 1x 1920x1200x24bpp Dual
T30	1x 1280x1024x24bpp Single or 1x 2048x1536x24bpp Dual
TK1	1x 1920x1200x24bpp Single

Setting the LVDS display for iMx6:

To use the LVDS display across the restarts, /etc/init.d/dispconfig.xml file needs to be updated as follows,

```
<startupconfig>
        <video frmbuff="mxcfb0" dev="ldb"
        <video frmbuff="mxcfb2" dev="off">
        <video frmbuff="mxcfb1" dev="off">
        <video frmbuff="mxcfb3" dev="off">
</startupconfig>
```

Or

Disable startup script and use the following command line argument in Uboot,

```
$setenv vidargs 'video=mxcfb0:dev=ldb'
$saveenv
```

To set the brightness

0% Brightness

echo 0 > /sys/class/backlight/backlight.17/brightness

100 % Brightness

echo 6 > /sys/class/backlight/backlight.17/brightness

Note:

- Internal to the T30 module, it serializes the parallel RGB and control signals into differential LVDS pairs. Additional internal GPIOs need to be controlled for setting up the LVDS display when using T30 ARM module. Refer Section 5.5.2 of T30 datasheet for information.
- GPIO_480 controls the 5V/3V Power enable for LVDS display and it should be enabled for LVDS interface functionality. GPIO_480 is enabled by default through the startup scripts. Refer GPIO Handling section for more information.
- Make sure 12V power input is fed to Eaglet/Eagle at J7. (Connect 12V at J1 on Panel IO, if used)

11.3.1 LCD Backlight

The LCD backlight control is provided by a PWM circuit. LCD backlight power and control are on a separate latching connector (**J10**). Duty cycle (Brightness) can be varied as instructed in the link below http://developer.toradex.com/knowledge-base/backlight-(linux)

Refer LVDS VCC & Backlight (JP1) section for jumper configuration details.

11.4 Dual Display

Eagle supports dual display operation i.e., Multiple displays can be enabled at the same time based on the ARM module support. This feature can be enabled by setting the environment variables during boot stage. Display can be either extended or duplicated to secondary display.
In T30, dual display can be configured using the options available in Monitor preferences
In iMx6, extended display can be achieved using applications like Cairo to load data on the secondary frame buffer.
Note: In Extended display mode the total resolution of the combined displays should not exceed the maximum resolution supported by the processor

Sample test set up for demonstrating dual display with iMx6:

Dual display feature can be demonstrated using the Cairo Library. Copy the Cairo & sample *.png image to the target device and enter the following command.

```
# ./cairo sample.png
Enter frame buffer number:    2
```

Sample image will be displayed on the secondary display.
NOTE: Before running cairo utility user has to set the appropriate video arguments. For example to test dual display on VGA and HDMI set the following video argument in Uboot

Note: U boot arguments set manually from U boot prompt may be modified by start-upcscripts at boot time. So if someone wants to set these extra u boot parameters permanently, then disable start up scripts.

```
$ setenv vidargs 'video=mxcfb2:dev=vdac,1024x768M@50,if=RGB565
video=mxcfb0:dev=hdmi,1280x1024M@50,if=RGB24 video=mxcfb1:dev=off video=mxcfb3:dev=off'
$saveenv
```

11.5 USB Interface

Eagle supports 6 USB ports and it is limited based on the Eagle variant and ARM module used. Below table list all the USB ports supported by Eagle variant/ARM Modules.

EAGLET	Panel IO		J17 (USB 3.0 Header)	
Apalis Variant	Port 1	Port 2	Port 3	Port 4
iMx	USBH2 (2.0)	USBH3 (2.0)	OTG_USBH1(2.0)	USBH4(2.0)
T30	USBH2 (2.0)	USBH3 (2.0)	OTG_USBH1(2.0)	**Not Available**
TK1	USBH2 (2.0)	**Not Available**	OTG_USBH1(**3.0**)	USBH4 (**3.0**)

EAGLE	Panel IO or J12 (2x5 Header)		J17 (USB 3.0 Header)		J16 (2x5 header)	
ARM	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6
iMx	From Hub	USBH3 (2.0)	OTG_USBH1(2.0)	USBH4(2.0)	From Hub	From Hub
T30	From Hub	USBH3 (2.0)	OTG_USBH1(2.0)	**Not Available**	From Hub	From Hub
TK1	From Hub	**Not Available**	OTG_USBH1(**3.0**)	USBH4(**3.0**)	From Hub	From Hub

In both Eagle and Eaglet variants, Port 3 (USBO1 from ARM module) supports OTG. The port can be either configured as Host or as peripheral using Jumper JP1. Refer LVDS VCC & Backlight (JP1) for more details.

The below figure illustrates the usage of OTG supported port-3 in both Host and Peripheral mode.

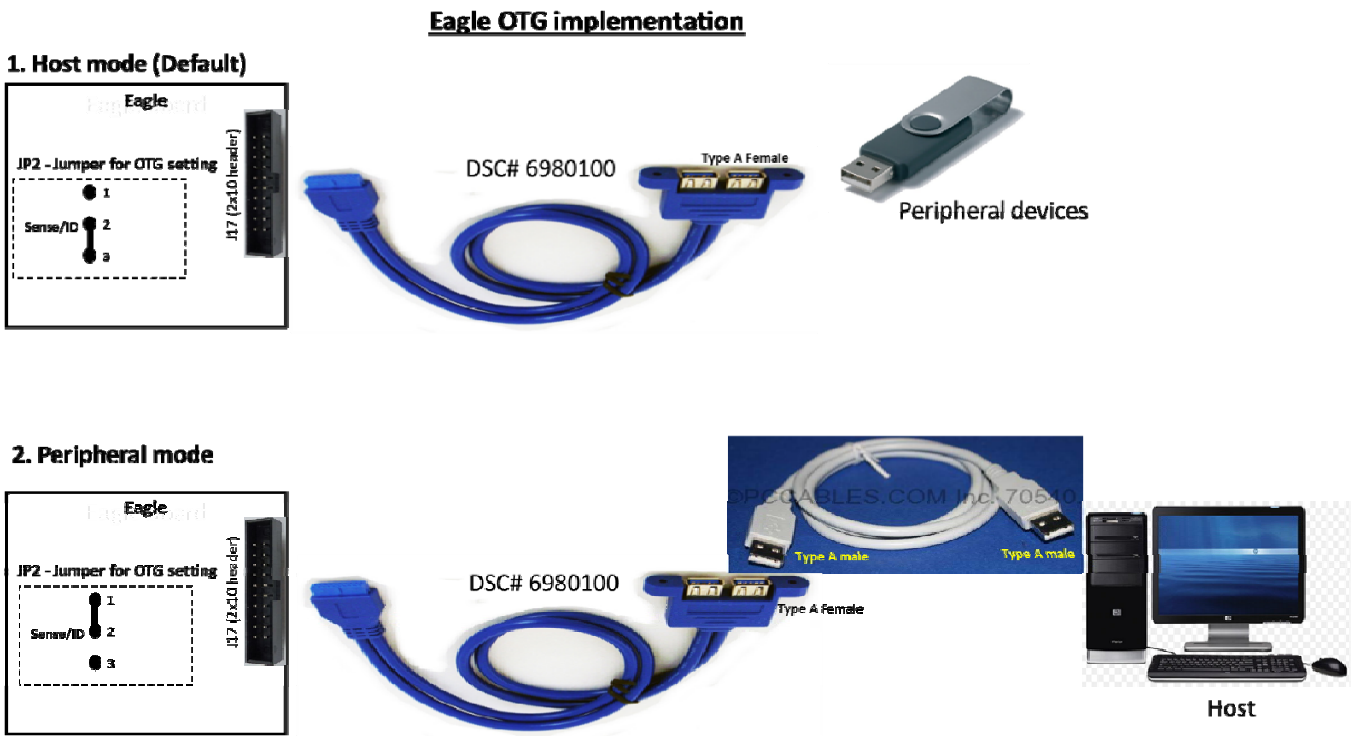


Figure 12 USB OTG Usage

12 Serial Ports and System Console

12.1 Configuration

Eaglet support 4 serial ports (Serial ports 1 to 4) and Eagle supports up to 8 serial ports (Serial ports 1 to 8). Serial ports 5 to 8 are realized using PCIe to UART chip.
For Eaglet, serial ports 1 and 2 supports RS232/422/485 modes and serial ports 3 and 4 supports only RS232 mode.
For Eagle, all the serial ports (1-8) supports RS232/422/485 modes. Mode selection is handled by I2C GPIO expander and all the ports are set in RS232 mode by default. Refer GPIO Handling section for more information.
Serial port multimode functionalities are ARM module dependent due to hardware limitations in the ARM modules.
Below tables illustrates the available Serial modes for each ARM module in Eagle.

ARM Module	Mode	UART1	UART2	UART3	UART4	UART5	UART6	UART7	UART8
iMx6	RS232	Available	Available	Available (TX,RX only)	Available (TX,RX only)	Available	Available	Available	Available
	RS422	Available	Available	Available	Available	Available	Available	Available	Available
	RS485 (Half duplex)	Available	Available	Available	Available	Available	Available	Available	Available
T30	RS232	Available	Available	Available (TX,RX only)	Available (TX,RX only)	Available	Available	Available	Available
	RS422	Available	Available	Available	Available	Available	Available	Available	Available
	RS485 (Half duplex)	Transmit only	Transmit only	Transmit only	Transmit only	Available	Available	Available	Available
TK1	RS232	Available	Available	Available (TX,RX only)	Available (TX,RX only)	Available	Available	Available	Available
	RS422	Available	Available	Available	Available	Available	Available	Available	Available
	RS485 (Half duplex)	To be tested	To be tested	To be tested	To be tested	Available	Available	Available	Available

Configuring Serial ports:
Serial Port configuration includes two steps:
Step 1: Configure the mode – RS232/RS422/RS485.
Mode configuration can be done using I2C GPIOs. Refer section 12.4 for mode configuration details.
Refer GPIO Handling section for configuring GPIO states
Note: By default all serial ports are configured for RS232 mode through startup scripts
Step 2: Enable RS485 direction control feature if port is configured for RS422 or RS485 mode.
When the port is used in RS422 and RS485 mode, this RS485 direction control utility should be enabled to control driver enable (DE) and Receiver enable (RE#) of the transceiver chip.
Note: When the serial port is in RS232 mode, RS485 direction control utility should be disabled to ensure RS232 flow control signals operation (RTS, CTS).

Enabling/Disabling RS485/RS422 direction control utility:

RS485_util gives the option to enable disable RS485/422 direction control on Apalis and Exar UART ports.

Syntax:

rs485_util<space><port_number><space><1/0>

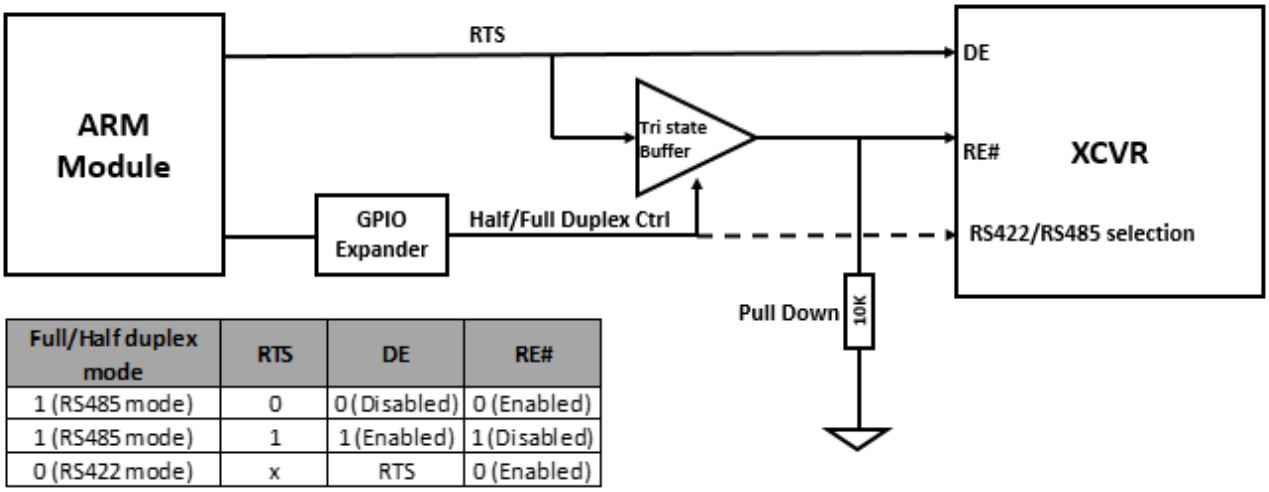
Example-1: Enable ttymxc0 for RS485/RS422

rs485_util ttymxc0 1

Example-2: Disable ttymxc0 for RS485/RS422

rs485_util ttymxc0 0

RS485 Direction control scheme:



Full/Half duplex mode	RTS	DE	RE#
1 (RS485 mode)	0	0 (Disabled)	0 (Enabled)
1 (RS485 mode)	1	1 (Enabled)	1 (Disabled)
0 (RS422 mode)	x	RTS	0 (Enabled)

Figure 13 RS-485 direction control hardware implementation

Above figure describes the RS485 direction control implementation in Eagle.
When Port is configure in RS485 mode, both DE and RE# are control by RTS signal.
When Port is configured in RS422 mode, DE is controlled by RTS and RE# is pulled down (enabled) independent of RTS.
In RS485 mode, RS485 direction control utility toggles the RTS line while sending data to enable/disable DE and RE# controls for half duplex communication.
In RS422 mode, although the Receiver is always enabled by pull down, RS485 direction control utility should be enabled for controlling the driver enable (DE).
Note: Due to limitation in T30 ARM module, RTS toggling is not possible in RS485 mode and the RTS line is driven high always by the RS485 direction control utility to ensure transmission. Data reception is not possible in Apalis UARTs (Port 1-4) in RS485 mode with T30 ARM module.

12.2 System Console

In both Eaglet and Eagle baseboard, serial port 1 acts as a console port (J11).
For using port 1 as a normal Serial port, the debug console functionality should be disabled by following the instruction given below

- Power on and Interrupt the Uboot in the debug console.
- Type 'setenv console '' ' and Enter. This sets the default debug console as none.
- Type 'saveenv', Enter.
- Type 'reset', Enter. This will reboot the board and it's ready to go

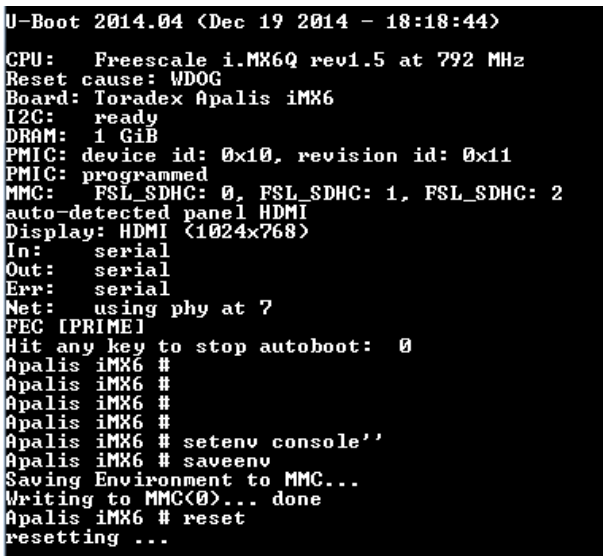


Figure 14 Screen shot – Configuring the Console debug port

Same procedure can be used to set port 1 as debug console again.

12.3 Serial port numbers

For Exar ports (Port 5 to 8), without any external serial device connected to the board, the device number detected are as follows

Port Name	Connector	Port Num (iMx6)	Port Num (T30)
Apalis Port 1	J11	ttymxc0	ttyS0
Apalis Port 2	J11	ttymxc1	ttyHS3
Apalis Port 3	J15	ttymxc3	ttyHS1
Apalis Port 4	J15	ttymxc4	ttyHS2
EXAR Port 5	J21	ttyS0	ttyS1
EXAR Port 6	J21	ttyS1	ttyS2
EXAR Port 7	J22	ttyS2	ttyS3
EXAR Port 8	J22	ttyS3	ttyS4

Refer http://developer.toradex.com/knowledge-base/uart-(linux) for additional information on UARTs.
Note: Serial port numbers for EXAR varies when some add on cards with serial devices are connected to the module.

12.4 UART configuration GPIO details for RS232/422/485 modes

12.4.1 Apalis UART ports

GPIO Number	RS232 Value	RS422 Value	RS485 Value
Apalis UART - 1 (imx6 - ttymxc0, T30-ttyS0)			
496	Low	High	High
497	Low	Low	High
498	Low	High	High
499	Low	High	Low
Apalis UART - 2 (imx6 - ttymxc1, T30-ttyHS3)			
500	Low	High	High
501	Low	Low	High
502	Low	High	High
503	Low	High	Low
Apalis UART - 3 (imx6 - ttymxc3, T30-ttyHS1)			
504	Low	High	High
505	Low	Low	High
506	Low	High	High
507	Low	High	Low
Apalis UART - 4 (imx6 - ttymxc4, T30-ttyHS2)			
508	Low	High	High
509	Low	Low	High
510	Low	High	High
511	Low	High	Low

12.4.2 Exar UART Ports

Pin Number	RS232 Value	RS422 Value	RS485 Value
EXAR UART - 5 (imx6 - ttyS0, T30-ttyS1)			
464	Low	High	High
465	Low	High	Low
466	Low	High	High
467	Low	Low	High
EXAR UART - 6 (imx6 - ttyS1, T30-ttyS2)			
468	Low	High	High
469	Low	High	Low
470	Low	High	High
471	Low	Low	High
EXAR UART - 7 (imx6 - ttyS2, T30-ttyS3)			
472	Low	High	High
473	low	Low	High
474	Low	High	High
475	Low	High	Low
EXAR UART - 8 (imx6 - ttyS3, T30-ttyS4)			
476	Low	Low	High
477	Low	High	High
478	Low	High	Low
479	Low	High	High

13 Utility connector features

13.1 I2C and PWM

Eagle and Eaglet features 14 pin utility connector where 3 PWM signal, 1x SPI, 1x I2C, 1xGPIO (3.3V) and S/PDIF interface can be accessed. Refer IO Connector details section for more information.

14 DAQ Architecture overview

Eagle and Eaglet supports different provisions for Data Acquisition in the form of Analog input, GPIOs, Opto isolated IOs etc.

14.1 Analog input

Eagle and Eaglet supports 4 singled ended analog inputs. A/D section resides in Apalis module and has following features.

- 12-bit ADC
- Conversion rate up to 180KS/s for iMX and T30 module
- Conversion rate up to 818KS/s for TK1 module
- Input voltage range: 0V to 3.3V
- Absolute maximum input of +3.5V

For details, please refer to http://developer.toradex.com/knowledge-base/adc-(linux)

14.2 PWM

Eagle and Eaglet features four general purpose PWM outputs (3.3V) directly coming from Apalis module.
For T30 and TK1 Apalis Module, the duty cycle has an 8-bit resolution. The maximum output frequency is 187.5 kHz.
For iMX6 module the duty cycle has an 8-bit resolution.
For details, please refer to http://developer.toradex.com/knowledge-base/pwm-(linux)

14.3 GPIO

14.3.1 GPIOs form Apalis Module

Eagle and Eaglet supports eight GPIOs (3.3V). The GPIO direction and state can be software controlled.
For details, please refer to http://developer.toradex.com/knowledge-base/gpio-(linux)

Alpha numeric mapping for GPIOs are available along with the connector pinouts. Please refer GPIOs (J6)

14.3.2 GPIOs using I2C GPIO expander

Eagle and Eaglet supports I2C GPIO expander to realize the GPIOs for user access, UART mode controlling and others. Alpha numeric mapping for GPIOs are available along with the connector pinouts. Please refer Opto GPIO (J24) and GPIO Header (J25) pinout details.

14.3.2.1 User GPIOs

Eagle supports 8x GPIOs (3.3V) realized using I2C GPIO expander and are available on 2x5 header **J25.**
These IOs are not available on low cost Eaglet. Refer GPIO Handling section for configuring GPIO states

14.3.2.2 Opto-isolated GPIOs

Eagle supports 4x Opto isolated inputs and 4x Opto isolated outputs available at **J24**. Following table provides Electrical characteristics of opto-isolated inputs and outputs. Refer GPIO Handling section for configuring GPIO states

Isolated Digital Input:

4x Opto isolated inputs are supported at J5. Following table provides the DC characteristics of the Opto-isolated inputs.

Parameter	Min	Typ	Max
Isolated Digital Input VIL	0V		1.6V
Isolated Digital Input VIH	2.3V		28V
Isolated Digital Input Current	1mA	2.8mA	3.3mA

Isolated Digital Output:

4x Opto isolated outputs are available on J5. Opto isolated outputs are open collector outputs. External 4.75K pull-up to V_OPTO is provided. V_OPTO supply for pull-ups should be given externally. Refer Opto GPIO (J5) for pinout details.

Opto-isolated output characteristics are based on V_OPTO supply voltage.

Note: V_OPTO maximum supply voltage should not exceed 40V

Opto isolated GPIOs are not available on low cost Eaglet

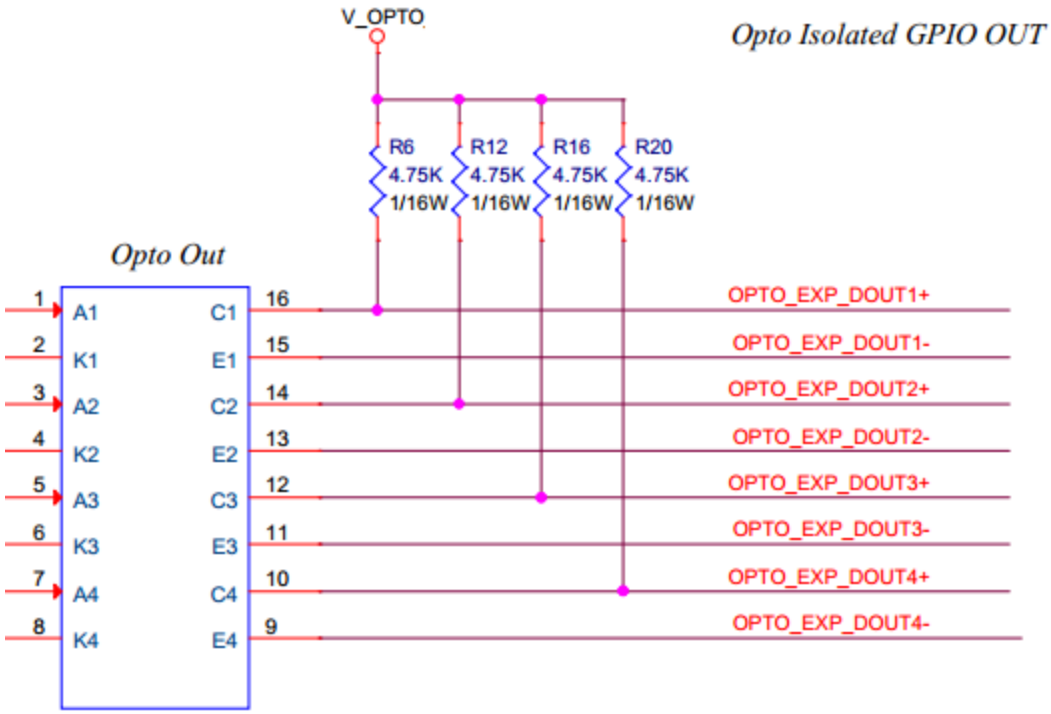


Figure 15 Opto isolated outputs hardware implementation

Note: For Isolated GPIOs, directions are configured by default (4 GPIOs as Inputs and 4GPIOs as outputs compatible for the isolation circuitary) and should not be reconfigured/changed using the GPIO configuration utility.

14.3.2.3 GPIO Handling

Following section provides the set of commands available to control the GPIOs available from I2C GPIO expander.

GPIO Utility is provided with the image file. User can use these utility to access GPIO's

GPIO Set Direction (setdir)

This command sets the direction for specified GPIO.

```
# gpio_util<space>setdir<space><pin_number><space><direction>
```

Please refer **14.3.2.4 List of I2C GPIOs** for valid GPIO numbers. Direction should be either "in" or "out"

GPIO Set Value (setval)

This command sets the value (state) for specified GPIO.

```
# gpio_util<space>setval<space><pin_number><space><state>
```

Please refer **14.3.2.4 List of I2C GPIOs** for valid GPIO numbers. Value should be either "high" or "low"

GPIO Get Direction (getdir)

This command reads the set direction of specified GPIO

```
# gpio_util<space>getdir<space><pin_number>
```

GPIO Get Value (getval)

This command reads the state of specified GPIO

```
# gpio_util<space>getval<space><pin_number>
```

Refer Section - **19.1** for GPIO Library API

Below Table provides valid arguments for "direction" and "state".

Function	Argument	Comments
Direction	out	Sets GPIO as output
	in	Sets GPIO as output
State	high	Sets GPIO as High (1)
	low	Sets GPIO as Low (0)

Arguments other than mentioned above will not be considered and the command gives back error.

14.3.2.4 List of I2C GPIOs

Below Table provides the details about all the GPIOs available

GPIO Signal Name	Default Direction	GPIO Number	Default state	Purpose
UART PORT 1 CONTROL				
UART_PORT1485/232-	Output	496	Low	UART Port 1 RS485 or RS232 Mode select
UART_PORT1HALF/FULL-	Output	497	Low	UART Port 1 Half/Full duplex enable
UART_PORT1TERM	Output	498	Low	UART Port 1 Full duplex termination enable
UART_PORT1FDTX	Output	499	Low	UART Port 1 Full duplex Driver termination
UART PORT 2 CONTROL				
UART_PORT2485/232-	Output	500	Low	UART Port 2 RS485 or RS232 Mode select
UART_PORT2HALF/FULL-	Output	501	Low	UART Port 2 Half/Full duplex enable
UART_PORT2TERM	Output	502	Low	UART Port 2 Full duplex termination enable
UART_PORT2FDTX	Output	503	Low	UART Port 2 Full duplex Driver termination
UART PORT 3 CONTROL				
UART_PORT3485/232-	Output	504	Low	UART Port 3 RS485 or RS232 Mode select
UART_PORT3HALF/FULL-	Output	505	Low	UART Port 3 Half/Full duplex enable
UART_PORT3TERM	Output	506	Low	UART Port 3 Full duplex termination enable
UART_PORT3FDTX	Output	507	Low	UART Port 3 Full duplex Driver termination
UART PORT 4 CONTROL				
UART_PORT4485/232-	Output	508	Low	UART Port 4 RS485 or RS232 Mode select
UART_PORT4HALF/FULL-	Output	509	Low	UART Port 4 Half/Full duplex enable
UART_PORT4TERM	Output	510	Low	UART Port 4 Full duplex termination enable
UART_PORT4FDTX	Output	511	Low	UART Port 4 Full duplex Driver termination
LCD VOLTAGE ENABLE				
LCD_VDD_EN	Output	480	High	Enable signal for LVDS Power
UART CONFIGURATION DETECT				
CONFIG_UART	Input	481	-	UART Configuration Indicator
SIM CARD DETECT				
SIM_CD	Input	482	-	Micro SIM card detect signal
CAN GPIOs				
CAN_GPIO1	Input	484	-	CAN Module GPIO1
CAN_GPIO2	Input	485	-	CAN Module GPIO2
CAN_GPIO3	Input	486	-	CAN Module GPIO3
AUXILIARY GPIO				
AUX_GPIO0_7	Input	487	-	Auxiliary Connector GPIO
UART PORT 5 CONTROL				
UART_PORT5TERM	Output	464	Low	UART Port 5 Full duplex termination enable
UART_PORT5FDTX	Output	465	Low	UART Port 5 Full duplex Driver termination
UART_PORT5485/232-	Output	466	Low	UART Port 5 RS485 or RS232 Mode select
UART_PORT5HALF/FULL-	Output	467	Low	UART Port 5 Half/Full duplex enable
UART PORT 6 CONTROL				
UART_PORT6TERM	Output	468	Low	UART Port 6 Full duplex termination enable
UART_PORT6FDTX	Output	469	Low	UART Port 6 Full duplex Driver termination
UART_PORT6485/232-	Output	470	Low	UART Port 6 RS485 or RS232 Mode select
UART_PORT6HALF/FULL-	Output	471	Low	UART Port 6 Half/Full duplex enable
UART PORT 7 CONTROL				
UART_PORT7485/232-	Output	472	Low	UART Port 7 RS485 or RS232 Mode select
UART_PORT7HALF/FULL-	Output	473	Low	UART Port 7 Half/Full duplex enable
UART_PORT7TERM	Output	474	Low	UART Port 7 Full duplex termination enable
UART_PORT7FDTX	Output	475	Low	UART Port 7 Full duplex Driver termination

UART PORT 8 CONTROL				
UART_PORT8HALF/FULL-	Output	476	Low	UART Port 8 Half/Full duplex enable
UART_PORT8485/232-	Output	477	Low	UART Port 8 RS485 or RS232 Mode select
UART_PORT8FDTX	Output	478	Low	UART Port 8 Full duplex Driver termination
UART_PORT8TERM	Output	479	Low	UART Port 8 Full duplex termination enable
OPTO GPIOs				
I2C_EXP_DIN1	Input	448	-	Opto/ GPIO Input 1 – J24-3,11
I2C_EXP_DIN2	Input	449	-	Opto/ GPIO Input 2 – J24-4,12
I2C_EXP_DIN3	Input	450	-	Opto/ GPIO Input 3 – J24-5,13
I2C_EXP_DIN4	Input	451	-	Opto/ GPIO Input 4 – J24-6,14
I2C_EXP_DOUT1	Output	452	High	Opto/ GPIO Output 1 – J24-7,15
I2C_EXP_DOUT2	Output	453	High	Opto/ GPIO Output 2 – J24-8,16
I2C_EXP_DOUT3	Output	454	High	Opto/ GPIO Output 3 – J24-9,17
I2C_EXP_DOUT4	Output	455	High	Opto/ GPIO Output 4 – J24-10,18
EXPANDER GPIOs				
EXP_GPIO1_0	Input	456	-	GPIO Header IO 0 - J25-1
EXP_GPIO1_1	Input	457	-	GPIO Header IO 1 - J25-2
EXP_GPIO1_2	Input	458	-	GPIO Header IO 2 - J25-3
EXP_GPIO1_3	Input	459	-	GPIO Header IO 3 - J25-4
EXP_GPIO1_4	Input	460	-	GPIO Header IO 4 - J25-5
EXP_GPIO1_5	Input	461	-	GPIO Header IO 5 - J25-6
EXP_GPIO1_6	Input	462	-	GPIO Header IO 6 - J25-7
EXP_GPIO1_7	Input	463	-	GPIO Header IO 7 - J25-8

15 Type-specific I/O Expansion

The Apalis form factor designates a group of pins on the connector for signals that vary from module to module. This enables the Apalis form factor to accommodate new features on new processors that were not available on prior modules or accounted for in the common module pinout. These signals are brought out to a connector J27 on the Eagle full-size board to give the user access to them. A custom daughterboard may be installed on J27 and fixed in place using the mounting hole provided on the board. The pinout of this connector is shown on page xxx. The definitions of the type specific pins for each module may be found in that module's user manual.
Board connector:
Mating connector for daughterboard:
Type specific daughterboard mechanical dimensions:

16 Programming I2C

Apalis modules support 3 I2C master interfaces.
The following table provides details about the various devices available on the Eagle and Eaglet baseboard.

I2C Master	Slave Device	Slave Address (7bit)
I2C1	PCA9535PW (GPIOs)	21h
	PCA9535PW UART port 5-8 control)	22h
	PCA9535PW (CONFIG, LCD_EN, SIM etc.)	23h
	PCA9535PW (UART port 1-4 control)	24h
	PI7C9X2G404 (PCIe Switch)	68h
I2C2	HDMI	-
	VGA (Optional-Not connected)	-
	LVDS Display	-
I2C3	CSI (1.8V)	-

Please refer to http://developer.toradex.com/knowledge-base/i2c-(linux) for more details on I2C handling for Apalis.

17 Factory reset and Recovering MAC address

Eagle module has two Ethernet interfaces, one directly from the ARM module and the other through i210 Ethernet controller. The first Ethernet interface from ARM modules carries the unique MAC address given by Toradex. MAC address for the second port are programmed during manufacturing test through U Boot argument.

If a reset of U boot arguments happen, all arguments modified over time will be lost and default arguments as shipped from Toradex will be present. Meaning, the MAC address for the second Ethernet port on the carrier card also will be lost. In such a case, user can check for MAC address present on the product sticker and recover it by entering the same in U boot arguments.

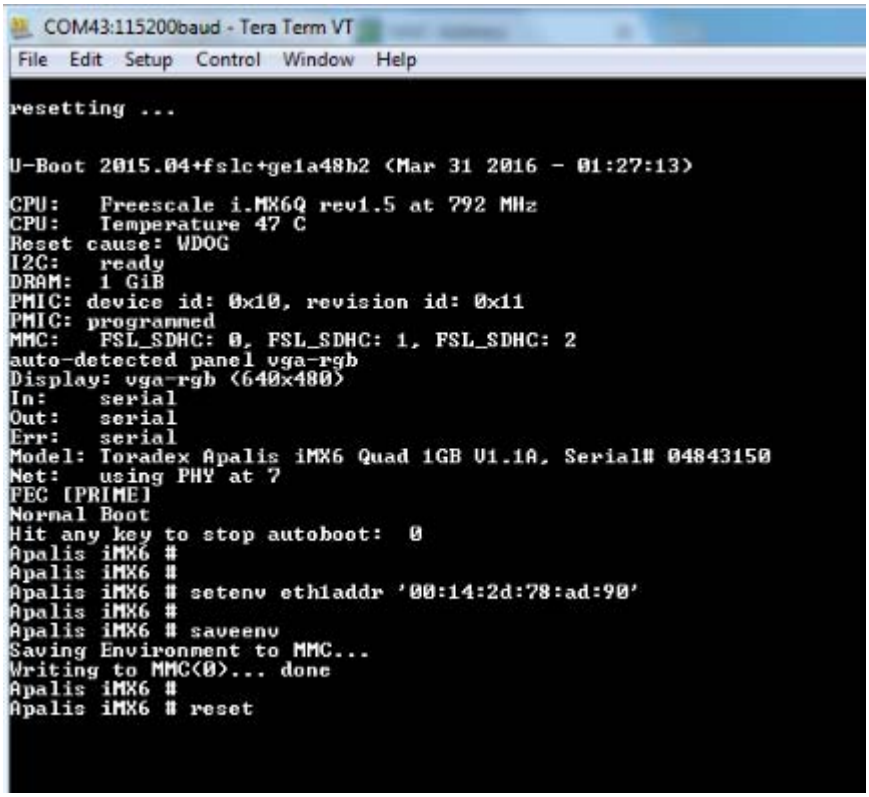


Figure 16 Screen shot – Recovering the MAC address for Eth-2 by updating UBoot arguement

18 Panel IO

Eagle and Eaglet supports an add-on board, which connects to the headers available on the bottom edge of the board (orientation with Apalis module on Top edge.). Panel IO board supports the standard connectors for the following interfaces terminated at dual row 2mm header on Eagle/Eaglet baseboard.

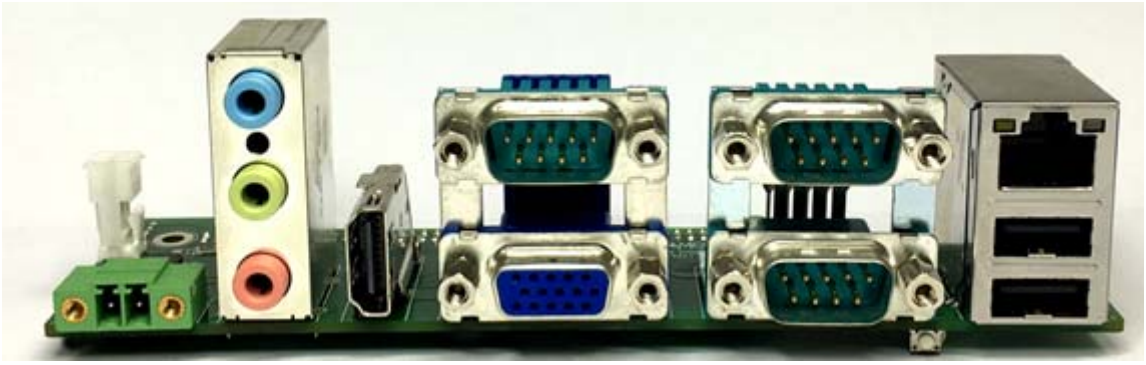


Figure 17 Panel IO board Front View

Below block diagram shows the connection between Eagle and Panel IO.

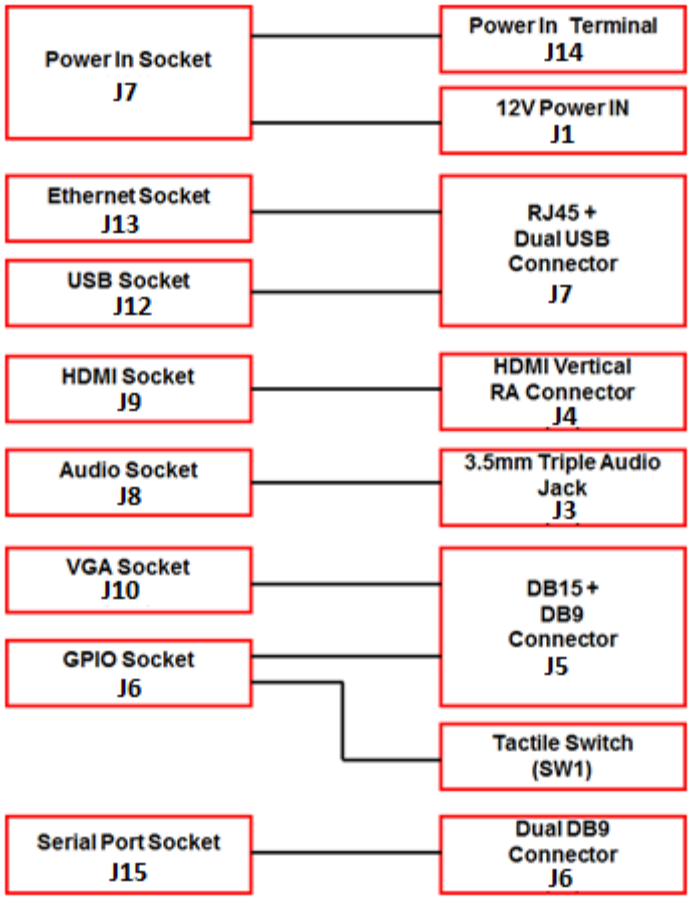
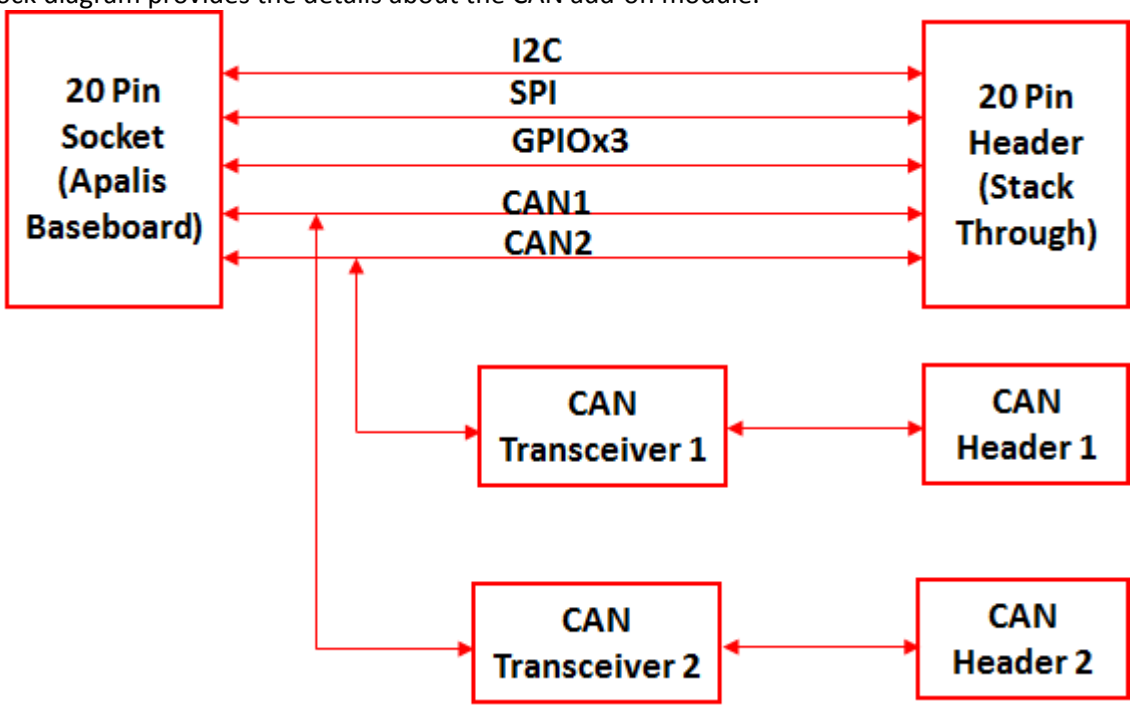
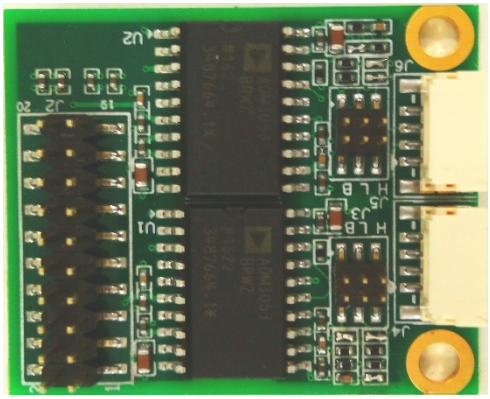


Figure 18 Panel IO to Eagle Connection

19 CAN Add-on Module

Eagle and Eaglet supports 2x CAN ports realized by mounting a CAN Mezzanine module on 2x10 header (**J14**). 2x CAN interface from Apalis module is directly routed to 20 pin Header on Eaglet/Eagle baseboard, along with 1x I2C and 1XSPI interface for general use. CAN transceivers are available on the CAN Add-on module. Below block diagram provides the details about the CAN add-on module.





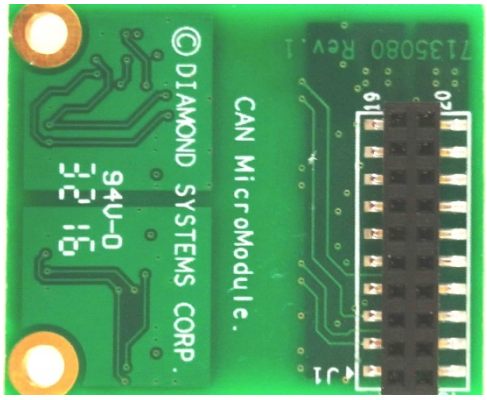


Figure 19 DS-MPE-CAN2L Front view (on left), rear view (on right)

Refer CAN Header section for pinout description.

19.1 GPIO LIBRARY API

We have 4 functions to set/get pin direction/value as follows.

set GPIO direction:

```
/**
* Function to set gpio pin direction
* @name DSC_Eagle_PCA9535_PinDirSet
* @param1 gpio number
* @param2 direction, in or out
* @return status, eSuccess, eInvalidParam, eFailure
*/
eStatus DSC_Eagle_PCA9535_PinDirSet(U16 gpio_no, Gpio_Direction direction);
```

get gpio direction:

```
/**
* Function to get gpio pin direction
* @name DSC_Eagle_PCA9535_PinDirGet
* @param1 gpio number
* @param2 pointer to direction variable
* @return status, eSuccess, eInvalidParam, eFailure
*/
eStatus DSC_Eagle_PCA9535_PinDirGet(U16 gpio_no, Gpio_Direction *direction);
```

set gpio State:

```
/**
* Function to set gpio pin state
* @name DSC_Eagle_PCA9535_PinStateSet
* @param1 gpio number
* @param2 state, high or low
* @return status, pass or fail
*/
eStatus DSC_Eagle_PCA9535_PinStateSet(U16 gpio_no, Gpio_State state);
```

get gpio state:

```
/**
* Function to get gpio pin state
```

```
* @name DSC_Eagle_PCA9535_PinStateGet
* @param1 gpio number
* @param2 pointer to state variable
* @return eSuccess, eInvalidParam, eFailure
*/
eStatus DSC_Eagle_PCA9535_PinStateGet(U16 gpio_no, Gpio_State *state);
```

Enumerated data types to use as input to above functions:

```
/* Enumerations  */
typedef enum {
GpioDirectionOut = 0,
GpioDirectionIn
} Gpio_Direction;

typedef enum {
GpioStateLow = 0,
GpioStateHigh
} Gpio_State;

typedef enum {
    eSuccess = 0,
    eInvalidParam,
eFailure,
eError
} eStatus;
```

20 Appendix

20.1 Compiling Custom Applications

To develop custom application, one need to install cross compiling tool chain as explained in Toradex website.
http://developer.toradex.com/knowledge-base/build-u-boot-and-linux-kernel-from-source-code#Toolchain

Then compile application and copy executable to board by any means suitable, by USB flash drive, ftp etc.
After giving file permissions to these added applications, they can be executed.

Example

```
# arm-linux-gnueabihf-gcc<space><filename1.c><filename2.c><space>-o<space><outputfilename>
```