Fujitsu Semiconductor Europe
User Manual

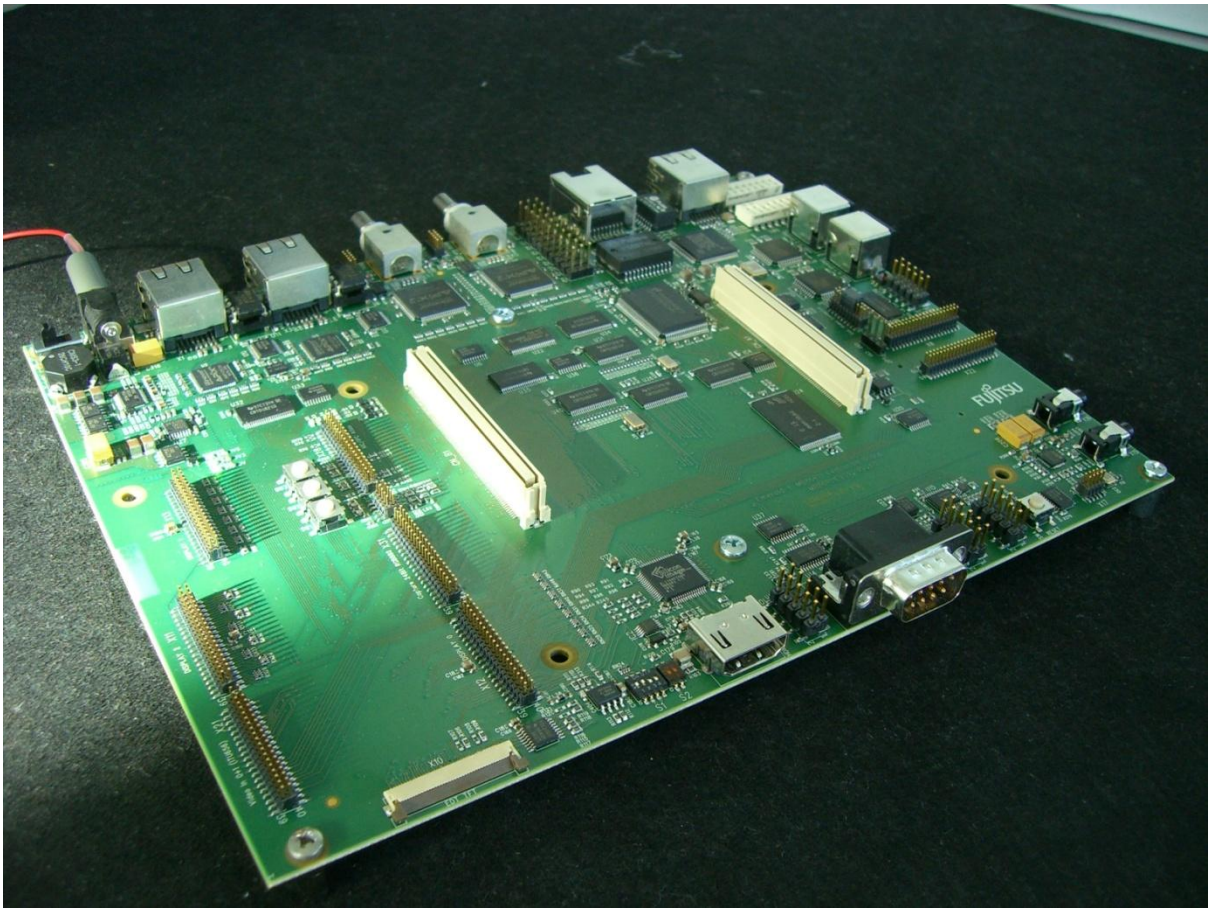
FSEUGCC-UM_MB86R11_Rev1.4

EMERALD-L

EVALUATION BASE BOARD

SK-86R11-BASE

USERGUIDE



FUJITSU

Revision History

Date	Issue
12 Oct 2010	V1.0 Herbert Hönig First draft
04 Nov 2010	V1.1 Herbert Hönig Added pictures, changed SAP item number
26 Nov 2010	V1.2 Herbert Hönig Added Settings for external PHY
04 Mar 2011	V1.4 Herbert Hönig (V1.3 overleaped) Added Reset Information , new controller on Board V1.4

This document contains 25 pages.

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Contents

0 Introduction / Features

Here you will find a short summary and overview of the features that the SK-86R11-BASE Evaluation Board offers.

It provides

- Power supplies for the CPU module
- 2x RS232 interfaces (1x D-SUB9, 1x pin header)
- HOST SPI/I2C interface via Totalphase Aardvark
- CAN interface
- Media LB interface
- AIC / IPC interface (designed to work with ATLAS MCU)
- Nand Flash 16-Bit length (2GBit) on board
- Quad SPI Flash (16M-Bit) on board
- Ethernet (external Bus) 100Mb (MII)
- Ethernet (internal MAC of Emerald used, external PHY) 1Gb
- SD Card interface
- 2x APIX TX devices (1Gb)
- 1x APIX TX and 1x APIX RX device (3Gb)
- Sound Input/Ouput

Most of the interfaces can be accessed separately via control-switches on the board. This enables the possibility to use all multiplex modes that Emerald-L provides.

Mechanical dimensions:

- only PCB : 220 x 170 mm
- with mounted connectors: 220 x 195 mm
- Height (without CPU module) 25 mm

For details refer to the Emerald-L Hardware Manual (see appendix).

1 System Overview

The Emerald-L system consists of three modules:

- CPU module (Emerald-L chip, USB connectors)
- Base board (supplies interfaces and power)
- Addon board (from Jade-L system), provides 2x DVI output and 2x CVBS input

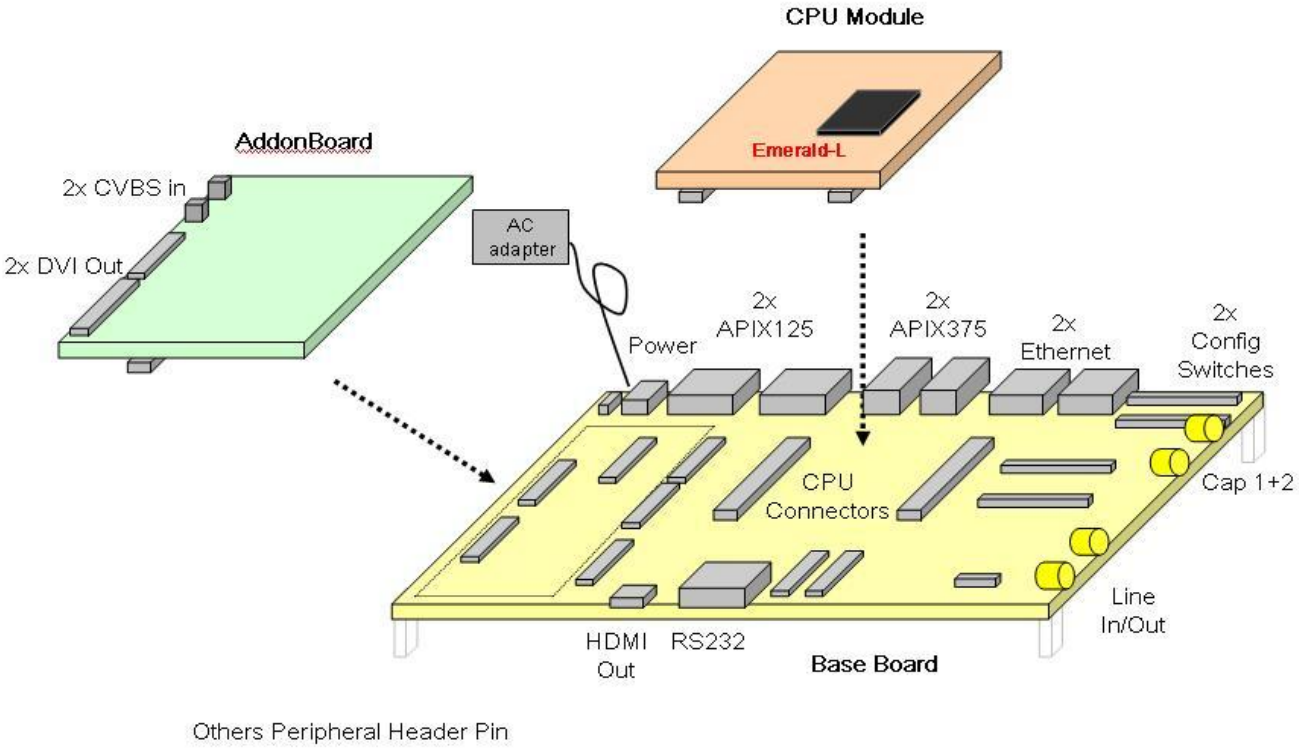


Figure 1-1: System Overview

2 Board Layout

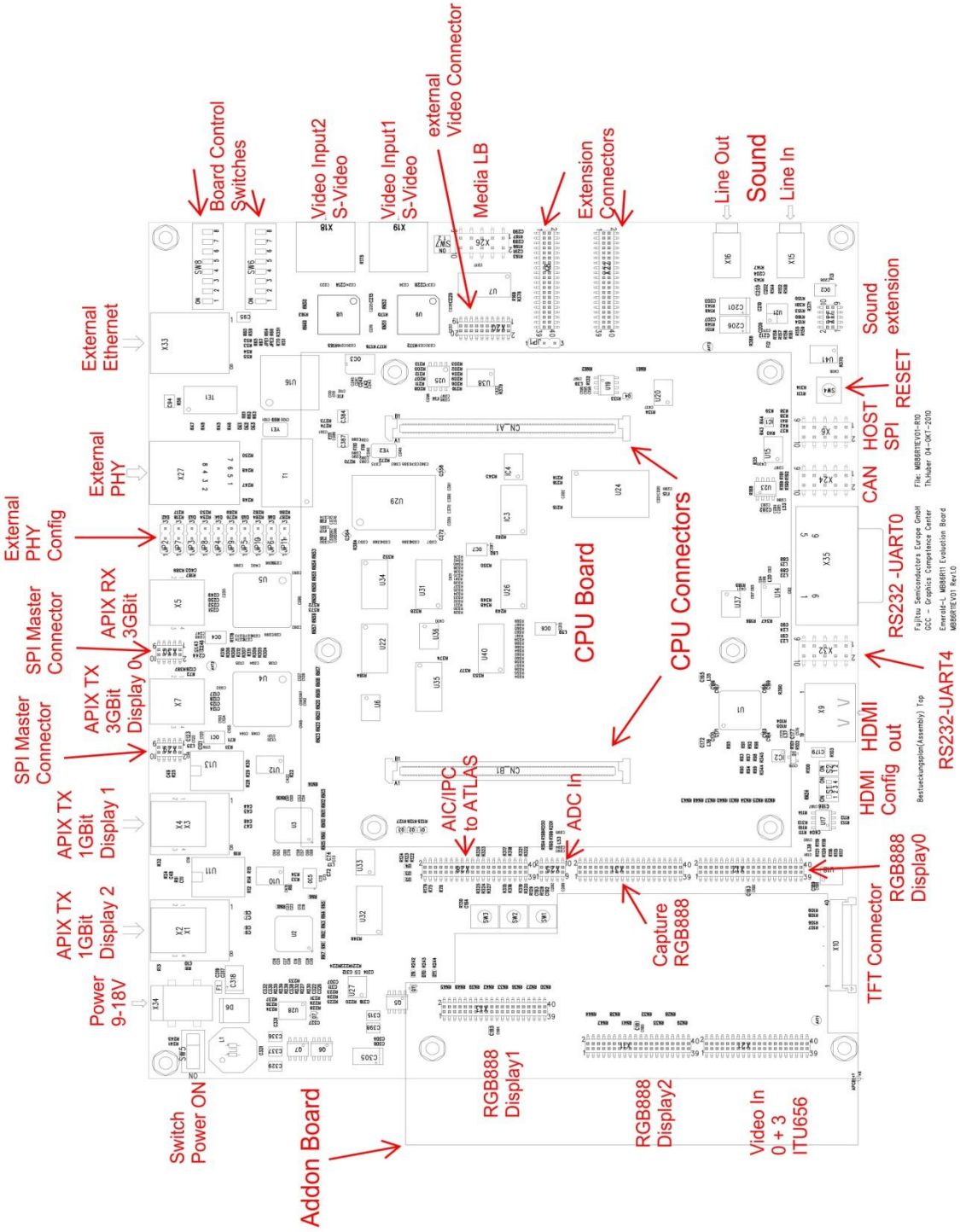


Figure 2-1: Board Layout

3 Running the board

Before powering up the board, please ensure that all multiplex modes are set correct and all interfaces connected accordingly.

- check board switches and select appropriate interfaces
  (Default: use HOST SPI and UART4 : SW6-3 and SW6-6 ON, others in SW6 and SW8 are in OFF state)
- connect CPU board on the base connectors CN_A and CN_B
- connect external interfaces (HDMI, JTAG, RS232 etc.)
  (Default : Aardvark SPI Interface connected, RS232 connected)
- connect power supply on X34 (9-18V), recommended 12V
  The polarity of the supply is : the inner pin has to be set to Positive (+), the outer ring has to be set to GND (-)
  (Default: use power supply that is delivered with the board, 12V)
- start up the board using switch SW5
- power indicating LEDS (D9,D10,D11) should light up
- at 12V a current of around 600 mA will be needed in power up mode
- **Reset behaviour: due to software limitation sometimes it will be necessary to reset the board three times. Please be aware: press the RESET button for at least two seconds to generate a reset !**

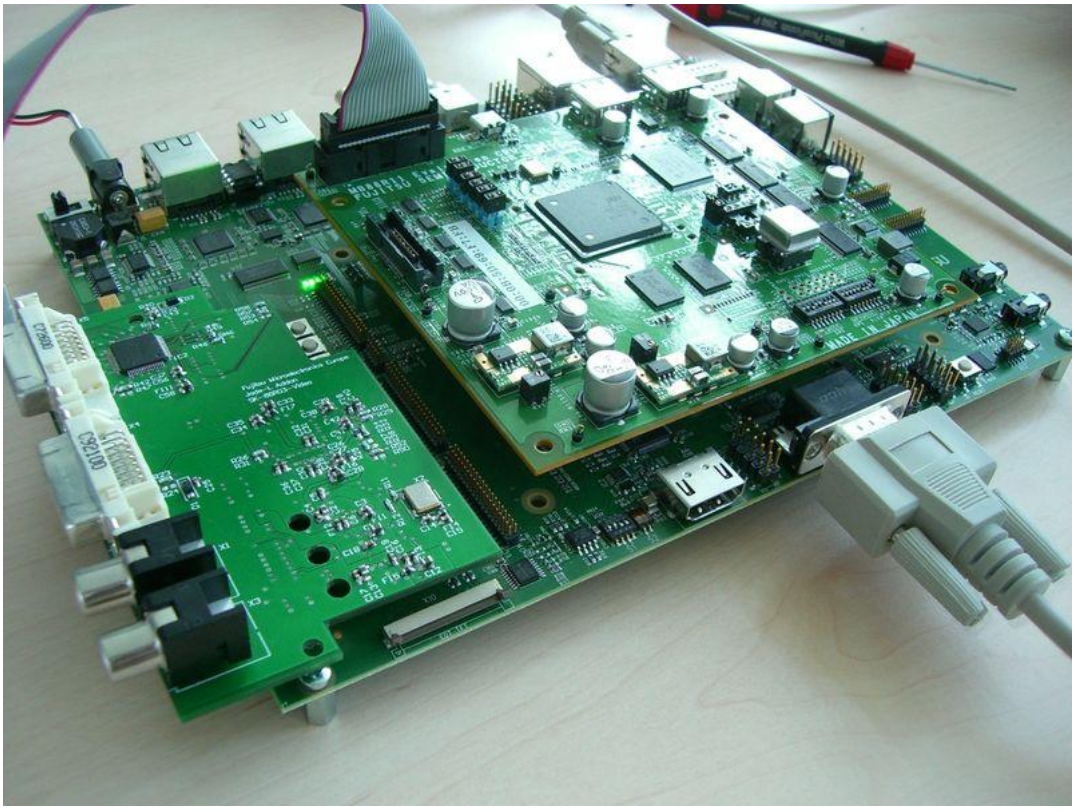


Figure 3-1: Running Board

4 Power Supply

The Emerald-L baseboard is supplied via an external DC power adapter, the input voltage must be in the range from 9V – 18V.

The generated supplies (5V, 3V3 and 1V8) are used to power the CPU module and the interface devices on the baseboard.

The external power is fused and secured to avoid damaging the board in case of reverse polarity.

The possibility of start-up via an external control pin is available.
Pin 25 on connector X28 provides this functionality. A HIGH level is used for power-up, please see also section 8.5 of this document.

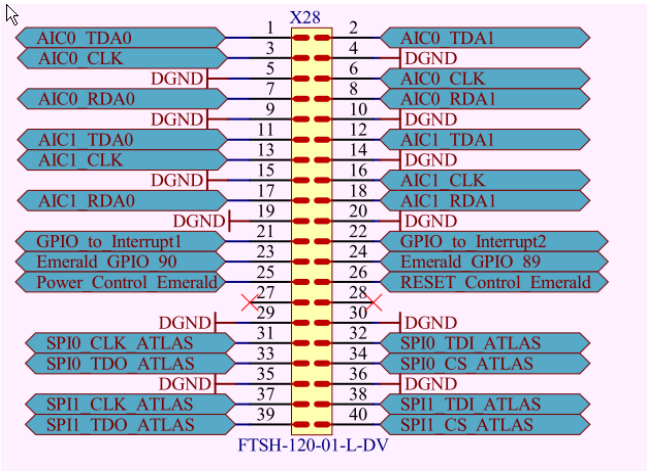


Figure 4-1: External Start-up (ATLAS Connector)

Please check page 19 of the board schematic.

5 Board Control Switches

Switch: (set to ON to enable function)	Function:	Schematic page:
SW8 / 1	Use MII PHY of APIX INAP375	12
SW8 / 2	Enable SPI communication to APIX INAP375R	12
SW8 / 3	Enable I2S interface to APIX INAP375R	12
SW8 / 4	Enables capture interface from LVDS converter (RGB666)	12
SW8 / 5	Enables sideband communication to APIX INAP125TX 1 (Display 1)	10
SW8 / 6	Enables sideband communication to APIX INAP125TX 2 (Display 2)	8
SW8 / 7	Feedback APIX INAP375R data directly to INAP125TX	9
SW8 / 8	Enables DISP2 output on APIX INAP125TX	9
SW6 / 1	Enables SPI communication to INAP375TX	11
SW6 / 2	Enables I2S communication to INAP375TX	11
SW6 / 3	Enables HOST SPI interface	14
SW6 / 4	Enables SD Card interface	15
SW6 / 5	Enables external PHY	21
SW6 / 6	Enables UART4	14
SW6 / 7	Enables I2S0 interface to soundchip	16
SW6 / 8	Enable QUAD SPI Flash	20
SW7 / A	Enables Capture 1 (ITU656)	18
SW7 / B	Enables Capture 2 (ITU656)	18

Figure 5-1: Overview Switches

6 CPU Connectors

Please find here an overview of the signals connected to the CPU baseboard connectors.

MOLEX 52837-1679 connectors are used on the baseboard.

For connecting, on CPU module MOLEX 53647-1674 connectors needs to be used.

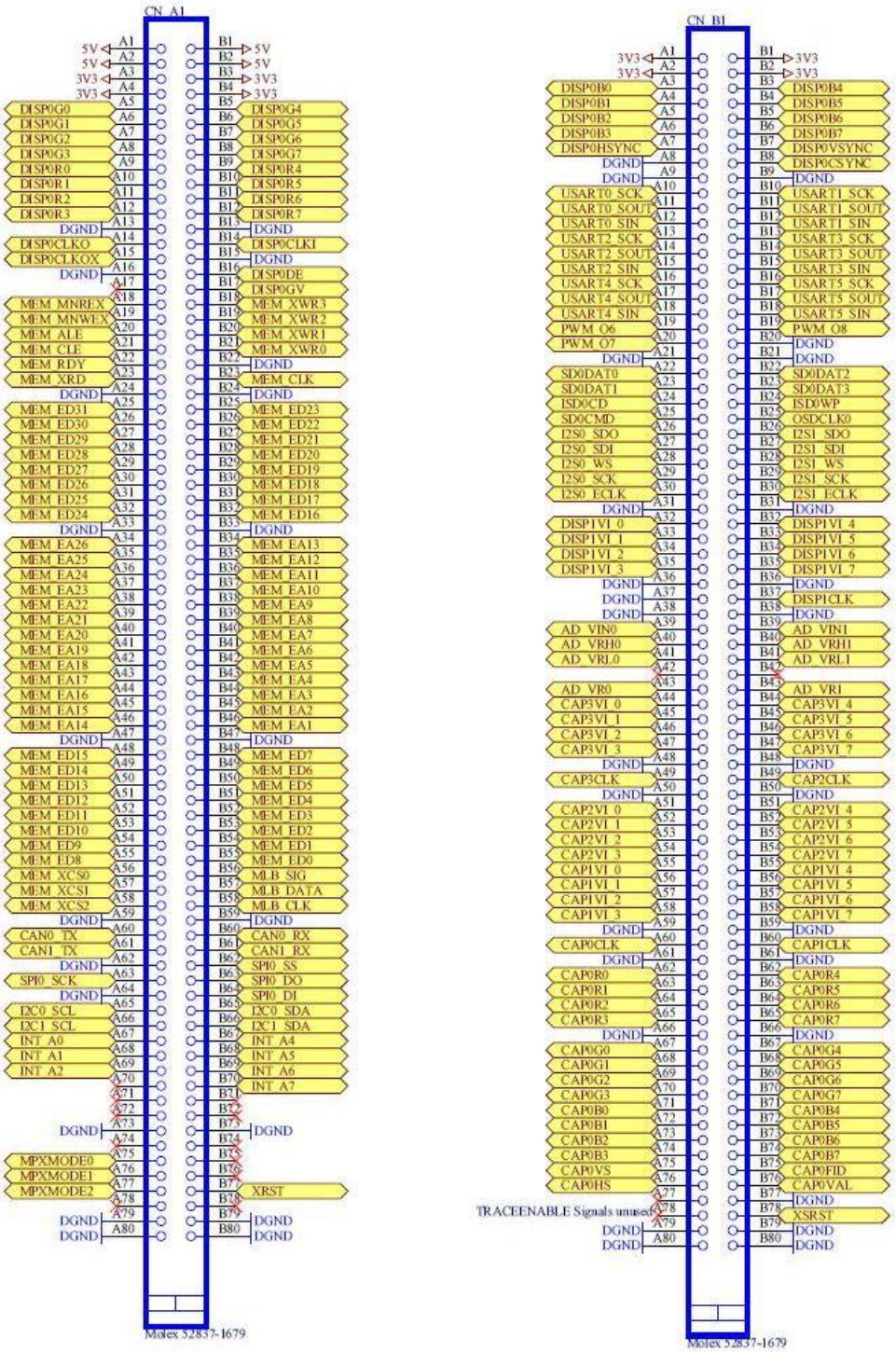


Figure 6-1: CPU Connectors

7 Display Output

7.1 HDMI Output (Display 0)

On the board a DVI/HDMI Transmitter SIL164CTG is used to supply a HDMI connector with data.

The HDMI output can only be used with Display 0, PinMuxGroup #D / MuxMode #0.

To configure the HDMI output set switches S1 accordingly to datasheet of SIL164 device. Switch S2 enables hot plug function for DVI/HDMI (default disabled).

Please refer for details in schematic page 6.

7.2 TFT Panel Output (Display 0)

Display 0 can also be used to display data on a TFT panel connected to X10.

The pinning is compatible to the GLYN / EDT Familiy TFT series, please find available TFTs here:
http://www.glyn.de/content_xl.asp?wdid=2214&sid=000000267A5E51505D5241605359415347
or contact Fujitsu Semiconductors for more information (see appendix).

The pin CAP2VI_7 can be used to enable the panel via software, SPI0_D0 can be used to dim the panel using a PWM, schematics page 7.

This display family offers touchscreen and fixed connector layout for a wide set of different resolutions and sizes.

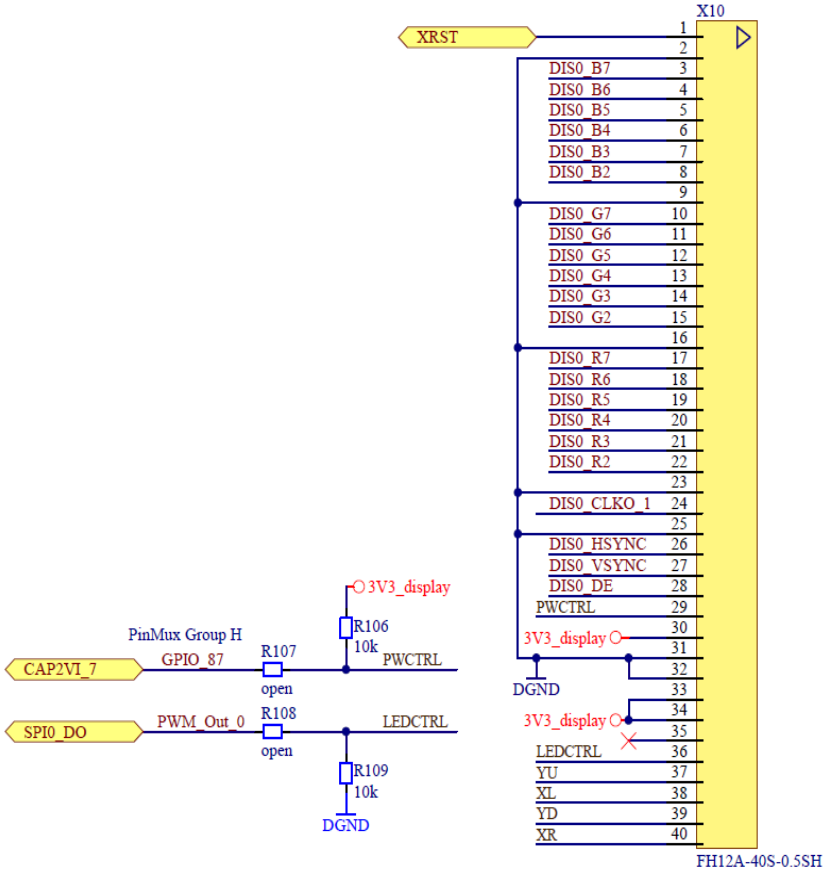
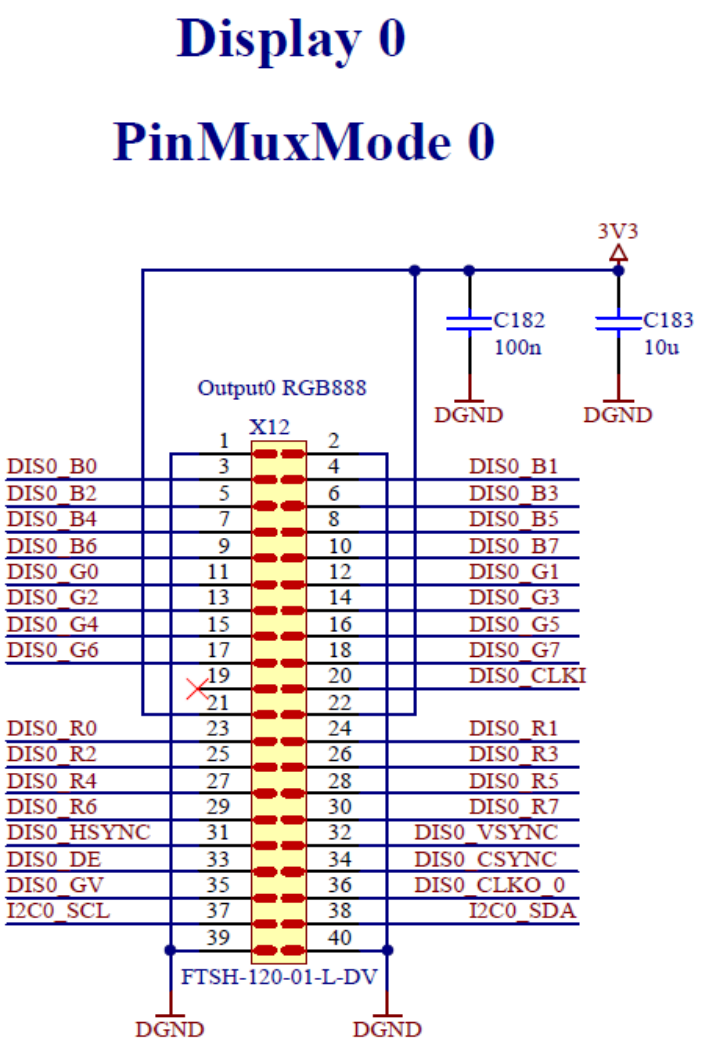


Figure 7-1: TFT Panel Connector

7.3 Pin Headers for Display output (RGB888 / Display 0 – 2)

On schematics page 7 you can find also all available display outputs on pin headers (X11, X12, X13). All displays have RGB88 output, please see the example here:



(Display ouput 0).

Figure 7-2: Display Output Pin Header

PinMuxModes :

Display0 uses PinMuxGroup #D / PinMuxMode0

Display1 uses PinMuxGroup #F / PinMuxMode1

Display2 uses PinMuxGroup #I / PinMuxMode3

7.4 APIX (Display 0) 3GBit Link

Display 0 can also be transmitted via APIX 3GBit link.

For this an external INAP375T is used on the board. This device is always on.

It can be configured via SPI1 interface, for this switch SW6/1 (Enable_SPI_TO_TX) needs to be enabled.

Using I2S1 bus with this device needs to have SW6/2 enabled (Enable_I2S_TO_TX).

For details refer to page 11 of the board schematic.

For details of programming the INAP device, please refer to datasheet of Inova semiconductors (INAP375T, see appendix).

7.5 APIX (Display 1) 1GBit Link

Display 1 can be transmitted via APIX 1GBit link.

For this an external INAP125T24 is used on the board. This device is always on.

It can be configured via EEPROM that needs to be programmed. For details refer to datasheet of Inova semiconductors (INAP125T24, see appendix)

When using sideband data (GPIOs) bus switch U12 needs to be enabled via SW8/5 (ENABLE_SB_TX1). Also the ATLAS interface can be connected here, schematic page 10 shows connectivity.

The board offers the possibility to use either CAT5 or Rosenberger connectors for the APIX link. Only one of them can be mounted.

7.6 APIX (Display 2) 1GBit Link

Display 2 can be transmitted via APIX 1GBit Link.

For this an external INAP125T24 is used on the board. This device is always on.

There are two different use cases that can be enabled here.

- using Display2 output (RGB888) of Emerald: set SW8/ (ENABLE_TX_DISPLAY2) PinMuxGroup #I / MuxMode #3 is used here.
- using as loop through from APIX RX(RGB666) to TX: set SW8/ (EN_RX_TO_TX) Here the RGB666 data stream from the external INAP375R device will be fed to this TX device

It can be configured via EEPROM that needs to be programmed. For details refer to datasheet of Inova semiconductors (INAP125T24, see appendix)

When using sideband data (GPIOs) bus switch U10 needs to be enabled via SW8/5 (ENABLE_SB_TX2). Also the ATLAS interface can be connected here, schematic page 8+9 shows connectivity.

The board offers the possibility to use either CAT5 or Rosenberger connectors for the APIX link. Only one of them can be mounted.

8 Capture Functionality

8.1 Capture via APIX RX (RGB666) 3GBit Link

This mode enables capturing data from APIX Link (3GBit) via an external INAP375R device.

8.1.1 Capturing Display Data (RGB666 + LVDS666)

The captured data needs be fed into the device in a special way: APIX2 Mode enabled (3GBit), Configuration is set to receive 18-Bit RGB and 18-Bit LVDS.

From external two video streams are fed in, stream 1 (RGB666) will be transferred directly to APIX device TX2 (see section 6.6.), stream 2 will be received in LVDS 666 mode, this stream will be decoded using U22 (page 12) into RGB666 and fed into Emerald L capture unit RGB666 (PinMuxGroups #I+H, MuxMode #1).

The LVDS capture mode needs to be enabled using SW8/4 (CAP_LVDS_RGB666)

The INAP device needs to be configured via SPI0 interface, set SW8/2 to ON (ENABLE_SPI_TO_RX), PinMuxGroups #B+G, MuxModes #3+5

The I2S0 interface can also be used, set SW8/3 to ON (ENABLE_I2S_TO_RX), PinMuxGroups #G, MuxModes #3

Please refer to page 6 of the board schematics and to the INAP datasheet (see appendix)

8.1.2 Capturing Ethernet data (using INAP as external PHY)

This mode enables the the INAP375R to work as an external ethernet device in MII mode.

For this SW8/1 needs to be set ON (ENABLE_PHY_TO_RX).

Please refer here to page 6 of the board schematics and the INAP datasheet for details (see appendix).

8.2 Capture Video using Capture interfaces 1 and 2 (ITU656)

The board offers the possibility to capture two video streams via 2x S-Video ports (X18 and X19), both streams are converted to ITU656 using an external converter SAA7113H. PinMuxGroups #H+I, MuxMode #0

Both can be used independently,

- selecting switch SW7A for capture interface1 (ENABLE_CAPTURE_1),
- selecting switch SW7B for capture interface2 (ENABLE_CAPTURE_2),
- additionally this ports are also accessible via pinheader X20

The SAA7113H can be programmed via I2C, please look at the datasheet for details (see appendix).

Please refer to page 18 of the board schematics for details.

8.3 Capture Video using Capture interfaces 0 and 3 (ITU656)

The board has a 1.27mm pin header that can be used to capture signals through capture interfaces 0 and 3 in ITU-656 format.

The pin header is designed to work with an Add-on-Board (from Jade-L Series) that provides 2x CBVS inputs for capturing video.
PinMuxGroup #I, MuxMode #1 is needed for CAP0, PinMuxGroup #H, MuxMode #0 is needed for CAP3.

The figure shows the connection table for this connector X21:

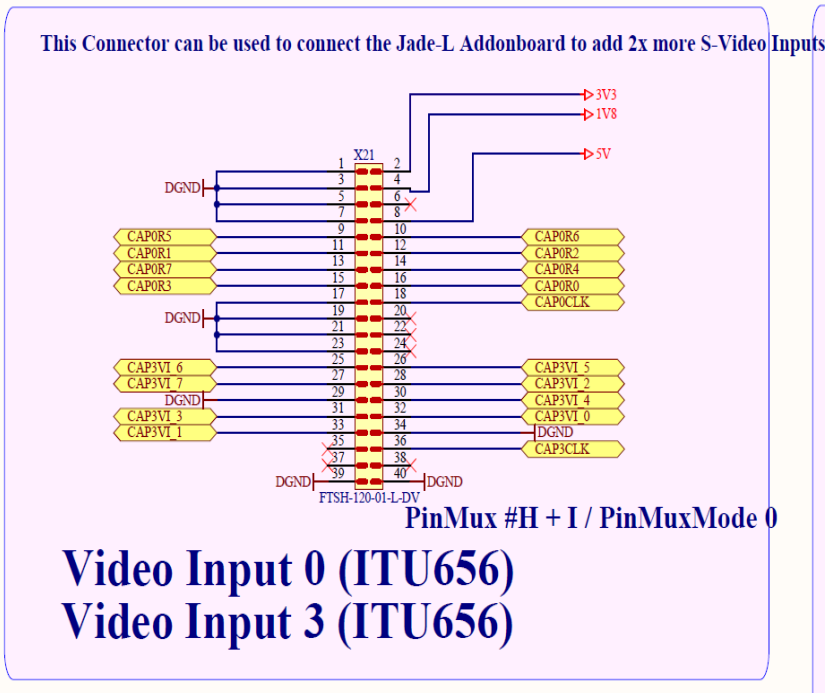


Figure 8-1: Video Input Connector ITU656

Please refer to page 19 of the board schematics for details.

8.4 Capture Video using RGB888 capture interface 0

To capture RGB888 signal use pin header X31, 1.27mm pitch header.

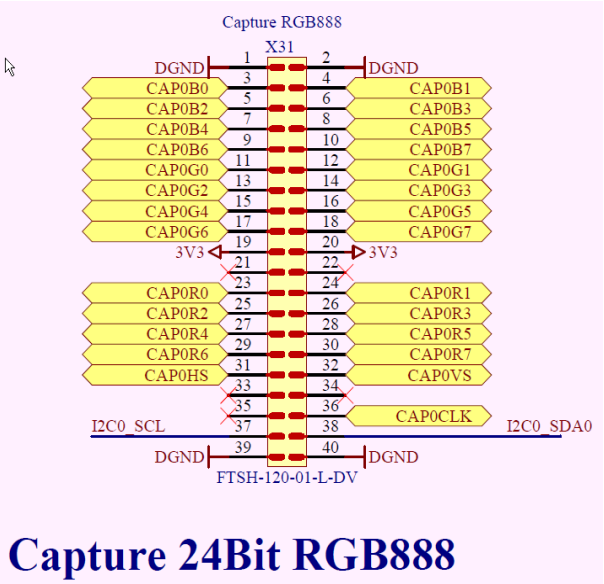


Figure 8-2: Video Input Connector RGB888

PinMuxGroup #I, MuxMode #0 is used here.

Please refer to page 19 of the board schematics for details.

9 Interfaces

9.1 RS232 – UARTs

The Emerald-L board provides two RS232 interfaces.

UART0 is set by default and hardwired to a standard D-SUB connector (X35).

A second one (UART4) is wired through a MAX3387 device to be used as an external RS232 port. This lines were wired to a 2.54mm pin header, an additional adapter (like the Jade-L RS232 adapter) can be used here.

Please refer to page 14 of the board schematics for details.

9.2 SPI/I2C – Aardvark Interface

The Emerald-L supports a HOST-SPI interface to control chip and registers, the Aardvark tool from Totalphase is recommended.

http://www.totalphase.com/products/aardvark_i2cspi/

The connector X6 is designed for use with Aardvark, also I2C control is possible here.

Especially benefit could be reached when using Fujitsu's GDC Studio, a great tool for manipulating processor registers online.
http://www.fujitsu.com/emea/services/microelectronics/gdc/swtools/gdc-studio.html

To enable the HOST SPI Interface, switch SW6/3 (ENABLE_SPI_HOST) needs to be set to “ON”.

Please refer to page 14 of the board schematics for details.

9.3 CAN Bus

The board is equipped with an external connector to the CAN bus, X24.

The RS232 adapter from Jade-L system can be used here to connect to a D-SUB9 connector.

Please refer to page 17 of the board schematics for details.

9.4 Media LB

Also a Media LB connector is on-board, X26.

Please refer to page 17 of the board schematics for details.

9.5 AIC / IPC (to ATLAS)

The board is designed to work with the ATLAS chip, a MCU device from Fujitsu Semiconductor. The AIC/IPC (Automotive Inter Connect / Inter Process Connect) Interface is identical to the one on the ATLAS board, however it can be used also with other MCUs.

Pleas find below the pin out of the connector X28:

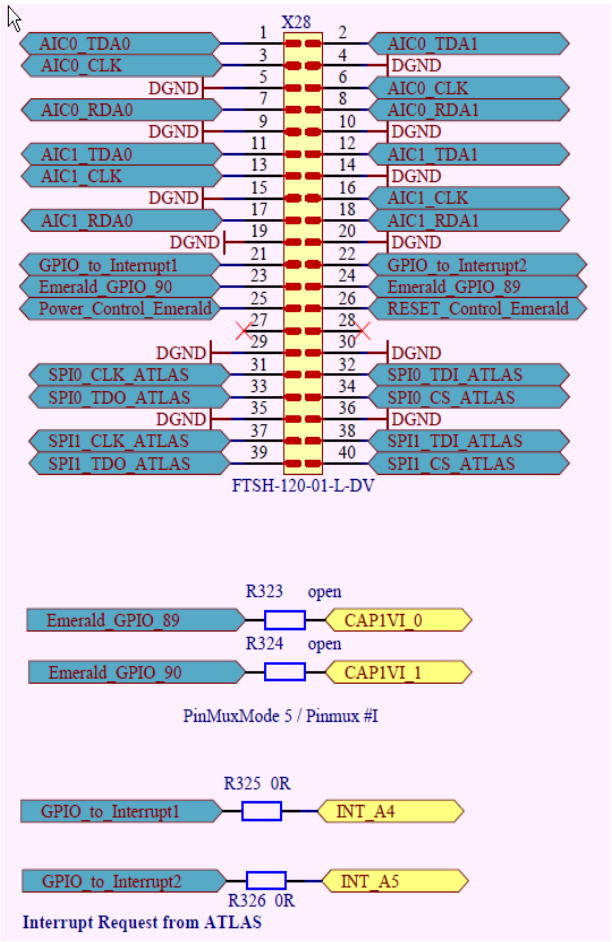


Figure 9-1: AIC/IPC Connector

Short pin description:

- AICxx_TDxx : serial bus, transmit direction
- AICxx_RDxx : serial bus, receive direction
- AICxx_CLK : serial bus, clock
- GPIO_to_Interruptxx : ATLAS can use GPIOs to trigger interrupts on Emerald
- Emerald_GPIO_xx: two GPIOs from Emerald that can be used outside
- SPI0_xxxxx : SPI0 interface from ATLAS
- SPI1_xxxxx : SPI1 interface from ATLAS
- Power_Control_Emerald: softstart for Emerald board (also see section 3), HIGH starts up the board

Please refer to page 19 of the board schematics for details.

9.6 Ethernet (external bus), 100MBit

The board contains an ethernet interface, MII (100MBit) mode can be used here.

The device is connected to the external bus of Emerald-L, 8-address lines and 16data lines were used. Chip Select CS2 activates this device, interrupt A0 is used for that.

Please look at the datasheet (LAN9218) for details (see appendix).

Please refer to page 19 of the board schematics for details.

9.7 Ethernet (internal MAC, external PHY) 1GBit

Emerald-L provides an internal MAC, to make use of this function an external PHY needs to be connected. The maximum speed is 1GBit, the PHY is configured to achieve this speed.

Please set jumpers JP2- JP11 accordingly to spec of the DP83865DVH device (see appendix) to define your needs.

A recommendation is as followed:

- Autonegotiation is ON
- Modes enabled: 1000BASE-T, 100BASE-TX, 10BASE-T
- Duplex Mode enabled
- Jumpers to be set:

  JP2 set to 2-3 , JP7 set to 1-2 (Speed0 Strap = 0 = all Modes enabled)

  JP3 set to 2-3 , JP8 set to 1-2 (Speed1 Strap = 0 = all Modes enabled)

  JP4 set to 1-2, JP9 set to 2-3 (Duplex Mode enabled=1)

  JP5 set to 1-2, JP10 set to 2-3 (Auto Negotiation enabled=1)

  JP6 set to 1-2, JP11 set to 2-3 (PHY Address set to 0001)

Please note: As this device has no Power-ON-Reset an external reset needs to be done after power up the board

To activate the external PHY, switch SW6/5 (ENABLE_EXT_PHY) needs to be set to “ON” Interrupt A1 is used for the PHY. PinMuxGroup #I, MuxMode #1 or 2 needs to be set.

Please refer to page 22 of the board schematics for details.

9.8 SD Card

The Emerald-L Board provides a fully usable SD-Card interface with card reader (X14) on board.

Using this switch SW6/4 (ENABLE_SD_CARD) needs to be set to “ON”

PinMuxGroup #F, MuxMode #0 is used here.

Please refer to page 22 of the board schematics for details.

9.9 Sound

An external sound codec (WM8976) is integrated on the board.

It is internally connected to the I2S0 interface (using PinMuxGroup #F, MuxMode #0 or 4).

Connectors are X15 for a LINE_OUT and X16 for LINE_INPUT (both stereo)

The Codec can be programmed via I2C, please look at the datasheet for details (see appendix).

To activate the sound codec, switch SW6/7 (ENABLE_I2S0_SOUND) needs to be set to "ON"

Please refer to page 16 on the board schematics for details.

9.10 GPIOs

On the Emerald-L board some GPIOs can be used for special input and output.

When using PinMuxGroup #E, MuxMode #5, GPIOs 61, 64 and 65 can be used as LED output. GPIOs 60, 62 and 63 are connected to a button that can be read.

Please refer to page 15 on the board schematics for details.

9.11 ADC

The ADC of Emerald-L is prepared to work with a voltage of 3.3V on the baseboard.

The rails are predefined to be near 3.3V (VRH) and GND (VRL), the inputs can be used via connector X25.

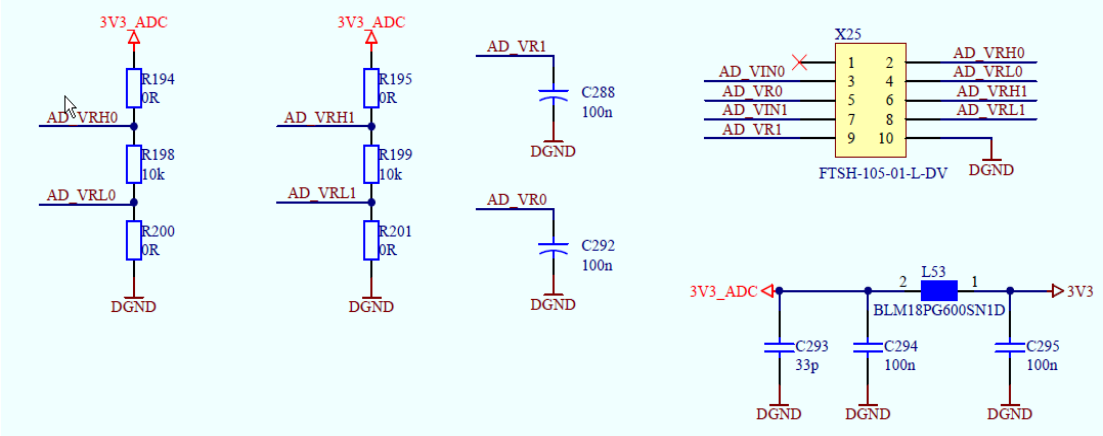


Figure 9-2: ADC Input Connector

Please refer to page 17 of the board schematics for details.

10 Flash

10.1 QUAD SPI Flash

On the Emerald-L baseboard a QUAD SPI flash is included, the Winbond device W25Q16BVSSIG (16 Mbit) is used here.

To activate the bus, switch SW6/8 (ENABLE_QUAD_SPI_FLASH) needs to be set to “ON”.

PinMuxGroup #B, MuxMode #2 is used here.

For programming this device please refer to the datasheet of this device (see appendix).

Please refer to page 20 on the board schematics for details.

10.2 NAND Flash

Also on the board a 2GBit NAND Flash (here with 1-Bit ECC) is used. The device has 16Bit data lines and can be selected via chip select XCS0 or XCS1, jumper JP1 needs to be set to define this.

Fujitsu suggests to use MICRON devices for use with Emerald-L as most of the parts are available according to automotive spec as well.

MICRON MT29F2G16AADWP-ET is used here.
For programming this device please refer to the datasheet of this device (see appendix).

Please refer to page 20 of the board schematics for details.

11 Appendix

11.1 Used literature

- Emerald-L Hardware Manual:
  Emerald-L_MB86R11_Specifications_rev03_en.pdf
- Emerald-L Base Board Schematics:
  Emerald-L FSEUGCC Baseboard Schematics 1v4.pdf
- Datasheet INAP125T24:
  http://www.inova-semiconductors.de/en/datasheets/Q_PP_APIX.pdf
- Datasheet INAP375R:
  DS_APIX_INAP375R_0_4.pdf
- Datasheet INAP375T:
  DS_APIX_INAP375T_0_4.pdf
- Datasheet Video Processor SAA7113H:
  http://www.nxp.com/pip/SAA7113H.html
- Datasheet Wolfson WM8976 Sound Codec:
  http://www.wolfsonmicro.com/products/codecs/WM8976/
- Datasheet SIL164CTG DVI Transmitter:
  http://www.siliconimage.com/docs/SiI_164_Product_Brief.pdf
- Datasheet LAN9218 LAN Controller:
  http://www.smsc.com/index.php?pid=123&tid=145
- Datasheet External PHY DP83865DVH:
  http://www.national.com/pf/DP/DP83865.html
- Datasheet Winbond QUAD SPI Flash W25Q16BVSSIG:
  http://www.winbond.com.tw/NR/rdonlyres/7EB3B29C-1B35-421C-AA24-F430B51C776A/0/W25Q16BV.pdf
- Datasheet NAND Flash Micron MT29F2G16AADWP-ET:
  http://download.micron.com/pdf/datasheets/flash/nand/2gb_nand_m29b.pdf
- Fujitsu GDC Studio – a great tool for manipulating registers on the fly:
  http://www.fujitsu.com/emea/services/microelectronics/gdc/swtools/gdc-studio.html
- Totalphase Aardvark SPI Adapter:
  http://www.totalphase.com/products/aardvark_i2cspi/

11.2 Figures

