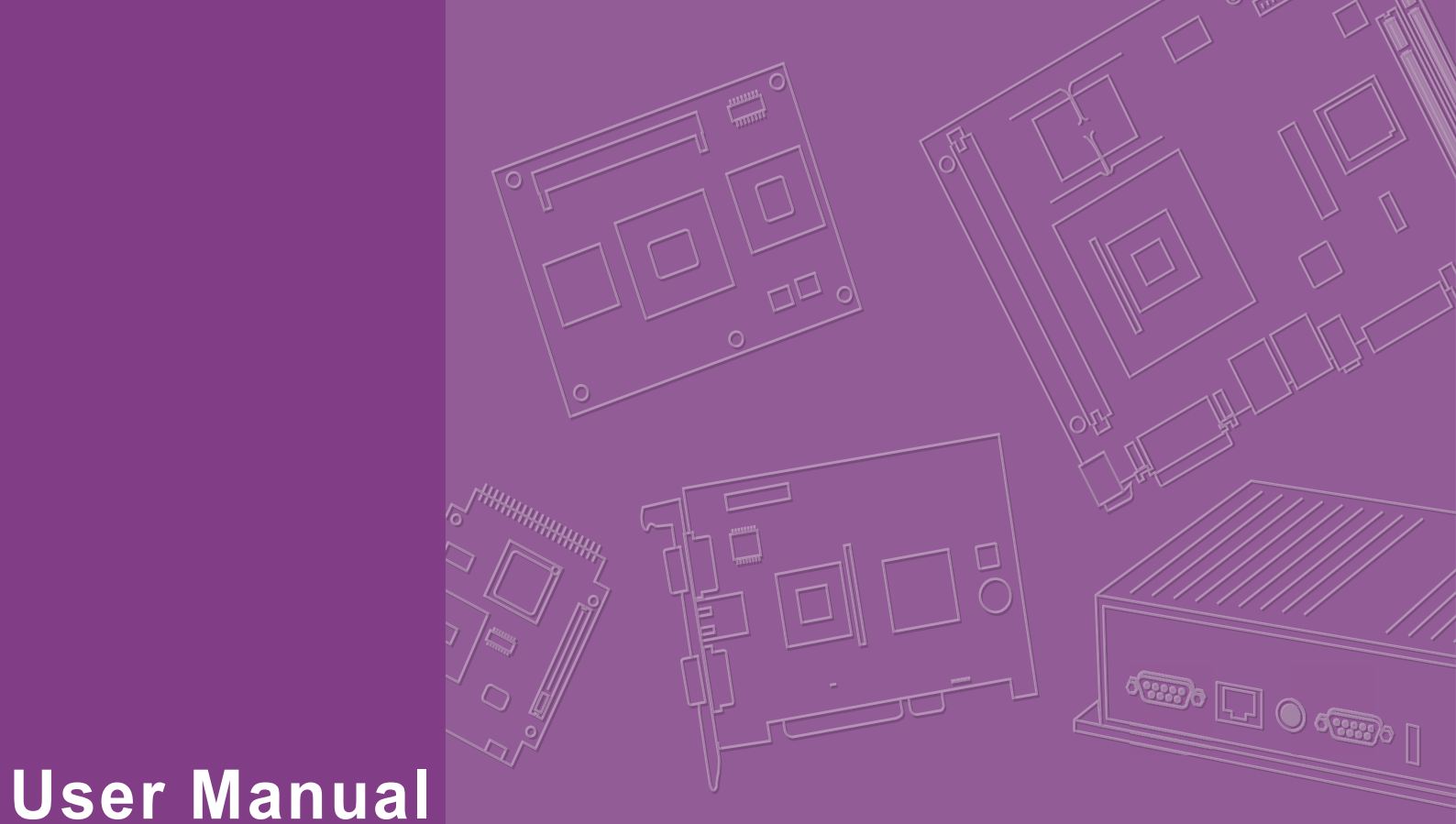




User Manual

AFE-E420

NXP® i.MX 93
Dual Arm® Cortex-A55 4" SBC

ADVANTECH

Enabling an Intelligent Planet

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This manual is for the AFE-E420.

Product Warranty (2 Years)

Advantech warrants the original purchaser that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products that have been repaired or altered by persons other than repair personnel authorized by Advantech, or products that have been subject to misuse, abuse, accident, or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced free of charge during the warranty period. For out-of-warranty repairs, customers will be billed according to the cost of replacement materials, service time, and freight. Please consult your dealer for more details.

If you believe your product to be defective, follow the steps outlined below.

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages displayed when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain a return merchandise authorization (RMA) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a completed Repair and Replacement Order Card, and a proof of purchase date (such as a photocopy of your sales receipt) into a shippable container. Products returned without a proof of purchase date are not eligible for warranty service.
5. Write the RMA number clearly on the outside of the package and ship the package prepaid to your dealer.

Packing List

Before you begin installing your card, please make sure that the following materials have been shipped:

- 1 x AFE-E420 SBC
- 2 x M.2 screws

Optional Accessories

Part Number	Description
1700031582-01	RS-232 only Cable D-SUB 9P(M)/1*5P-1.25 20cm
1700035016-01	RS-422/485 Cable D-SUB 9P(M)/1x5P-1.25 20cm
1700019584-01	Audio Cable 2*5P-2.0/Audio JACK*3 20cm
1700030406-01	USB Cable 2*5P-2.0/USB-A 4P(F)*2 20cm
1700030405-01	GPIO Cable D-SUB 9P(F)/1*10P-1.25 20cm
1700030518-01	CAN Bus Cable D-SUB 9P(M)/1x5P-1.25 20cm
EWM-C401CQE01	Cellular 4G M.2 3042 Key B, no SIM slot, no GNSS
TBD	Wi-Fi Module
96LCM-G070WV40L-A0	7" LCD, 400nits, 800x480
1700021883-01	LVDS cable 1x20P-1.0/2x20P-1.25 50cm
1700021882-01	BKL cable 1x4P-1.25/1x5P-2.0 50cm

Declaration of Conformity

CE

This product has passed the CE test for environmental specifications. Test conditions for passing included the equipment being operated within an industrial enclosure. In order to protect the product from being damaged by ESD (Electrostatic Discharge) and EMI leakage, we strongly recommend the use of CE-compliant industrial enclosure products.

FCC Class B

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for assistance.

Caution! *There is danger of a new battery exploding if it is incorrectly installed. Do not attempt to recharge, force open, or heat the battery. Replace the battery only with the same or equivalent type recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.*



Technical Support and Assistance

1. Visit the Advantech website at www.advantech.com/support to obtain the latest product information.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Please have the following information ready before calling:
 - Product name and serial number
 - Description of your peripheral attachments
 - Description of your software (operating system, version, application software, etc.)
 - A complete description of the problem
 - The exact wording of any error messages

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Chapter 1

General Information

This chapter gives background information on the AFE-E420

Sections include:

- Introduction
- Specifications
- Block diagram

1.1 Introduction

The AFE-E420 is a compact 4" SBC (single board computer) in the 165 x 115 mm form factor. It's part of the Compact Series and runs on the NXP® i.MX 93 processor, featuring a Dual Arm® Cortex-A55 core.

The AFE-E420 supports onboard LPDDR4x-3733 memory up to 2GB, and includes eMMC storage along with an SD card socket. Display options include either LVDS or HDMI.

For connectivity and I/O, it offers dual Gigabit Ethernet, three USB ports, six COM ports, four CAN bus interfaces, two PLC connections, and a 4-channel RTD input.

1.2 Specifications

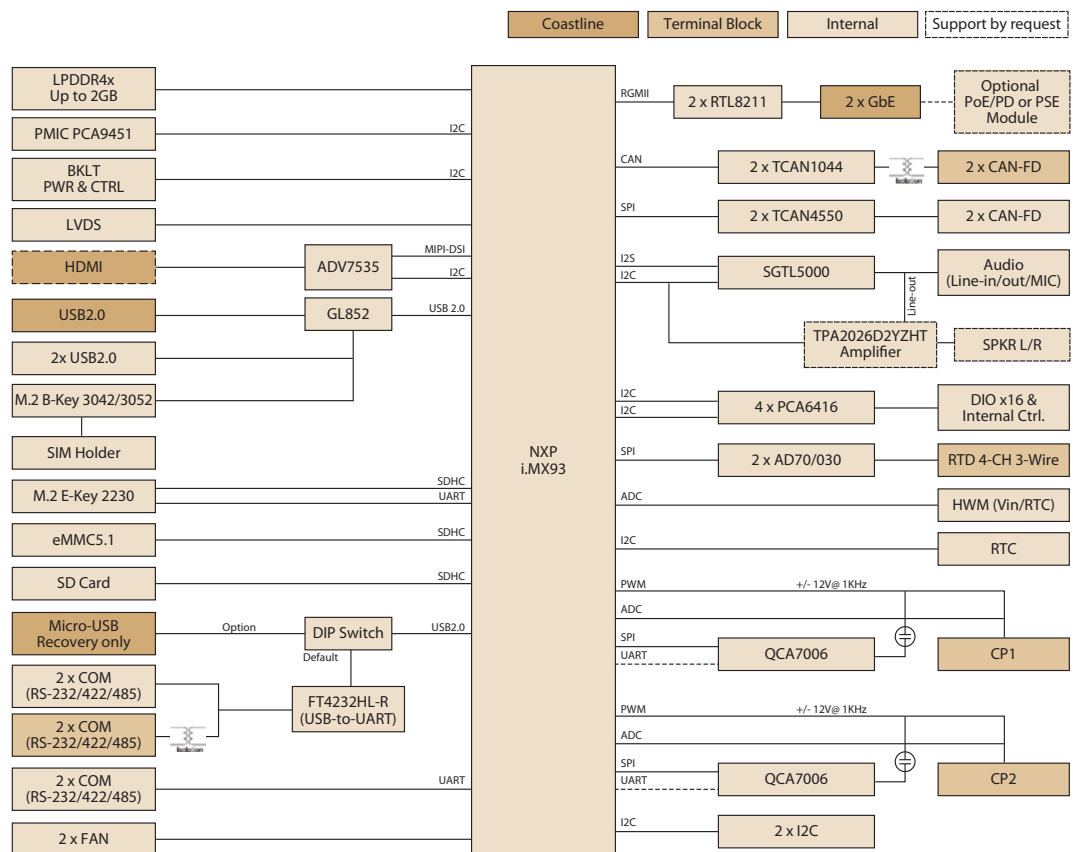
Table 1.1: Specifications

Platform	Processor	NXP i.MX 93 with Dual Arm® Cortex-A55
	Max. Frequency	1.70 GHz
	Core	Dual
Memory	Technology	LPDDR4x-3733MT/s
	Max. Capacity	Up to 2GB
	Channel/Socket	Single Channel / Onboard LPDDR4x
	ECC Support	Inline ECC
Display I/F	LCD	1 x LVDS, Single Channel 18-/24-bit, up to 1366 x 768 or 1280 x 800 (*other LVDS panel)
	*HDMI	1 x HDMI 1.3, up to 1920 x 1080 (*HDMI support by request)
	Display	Single Display, LVDS or HDMI
Ethernet	Controller	2 x LAN: Realtek 8211 (PHY)
	Speed	GbE
External I/O	Ethernet	2 x RJ-45
	HDMI	*1
	USB 2.0	1
	Micro-USB	1 (for debug only)
Internal I/O	USB 2.0	2
	Serial Bus	2 x I2C
	COM Port	6 x RS-232/422/485 (COM5 & COM6 with isolation)
	GPIO	16-bit general purpose input output
	CAN Bus	4 x CAN-FD (CAN1 & CAN2 with isolation)
	Audio	NXP SGTL5000, Line-in/Line-out/MIC
	Amplifier	YES (Stereo, 2.5W)
	RTD	4-channel (3-wire), PT1000/PT100 compatible sampling rate 100Hz
	Fan	2 x fans, 12V, 0.3A (4-wire)
	Front Panel Control	Power Button, Reset Button, 5V/3.3V Power Indicator
Power Line Communication	PLC Controller	2 x QCA7006
	Control Pilot	Dual ports with PWM & ADC
Storage	eMMC	16 GB

Table 1.1: Specifications		
Expansion	M.2 E-Key	1 x E-Key 2230 (SDHC x1, UART x1)
	M.2 B-Key	1 x B-Key 3042 (USB 2.0 x1) w/ Nano-SIM
	SD Card	1 x SD slot
Power	Supply Voltage	Vin: DC 12~24V +/- 10%; RTC Battery: Lithium 3V/210mAH
	Connector	2-pin Phoenix connector, optional ATX 2x2pin 180D
	Power Management	AT, ATX
	Max. Consumption	TBU
	Idle Consumption	TBU
Environment	Temperature	Operating: Standard: 0 ~ 60°C (32 ~ 140°F) for HDMI with 0.7m/s airflow Extend: -40 ~ 85°C (-40 ~ 185°F) for LVDS with 0.7m/s airflow Storage: -40 ~ 85°C (-40 ~ 185°F)
	Humidity	Operating: 40°C @ 95% relative humidity, non-condensing Storage: 60°C @ 95% relative humidity, non-condensing
	Vibration Resistance	3.5 Grms
Certification	EMC	CE, FCC Class B
Mechanical	Dimensions	165 x 115 mm (6.5" x 4.5")
	Net Weight	150 g

*Note: Support by request

1.3 Block Diagram



Chapter 2

Mechanical

This chapter gives mechanical information on the AFE-E420

Sections include:

- Mechanical Drawings

2.1 Board Layout: Dimensions

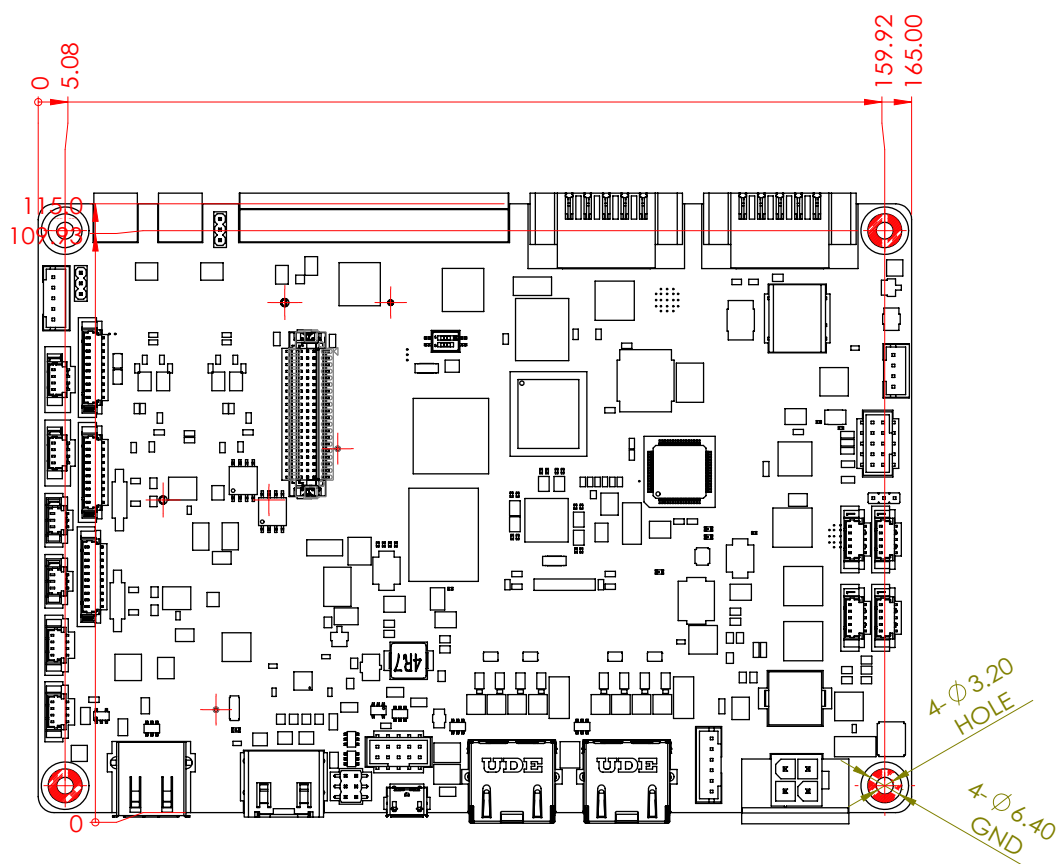


Figure 2.1 AFE-E420 Mechanical Drawing (Top Side)

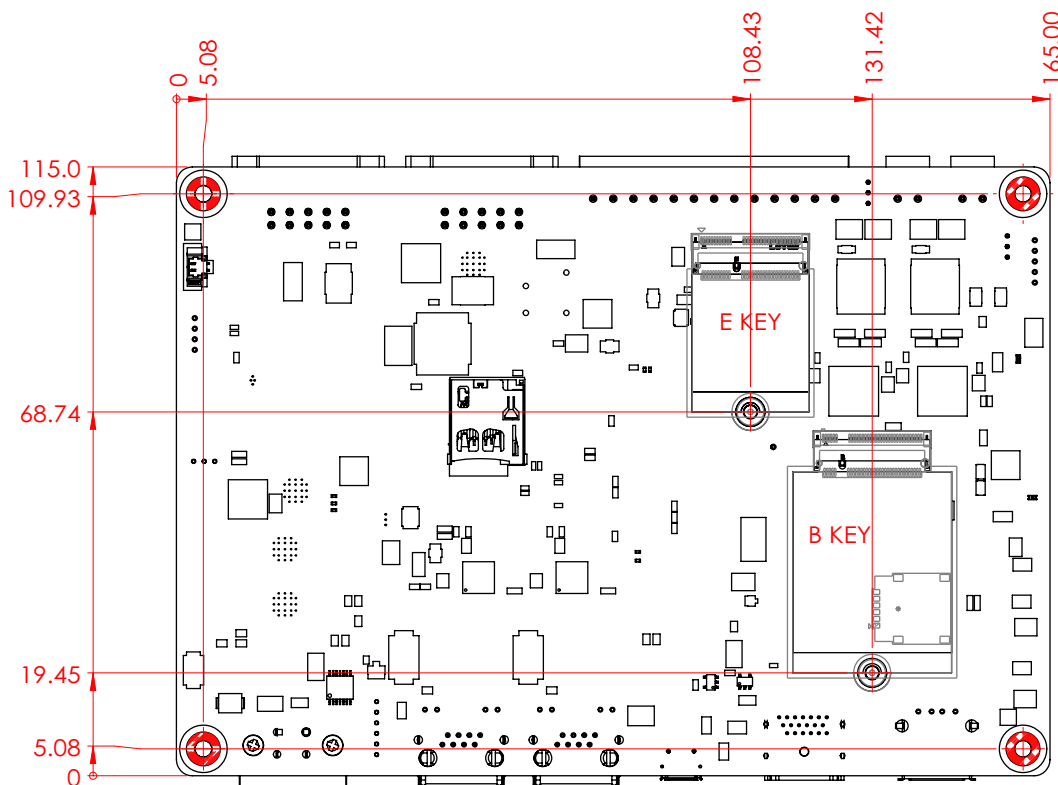


Figure 2.2 AFE-E420 Mechanical Drawing (Bottom Side)

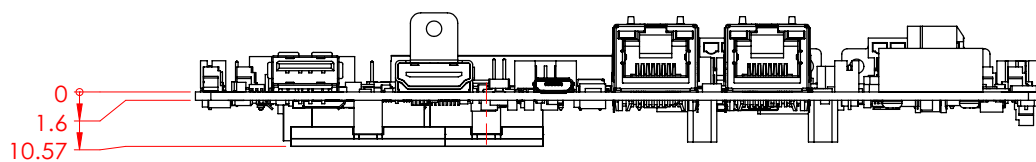


Figure 2.3 AFE-E420 Mechanical Drawing (Coastline)

Chapter 3

Hardware Installation

This chapter explains the setup procedures for the AFE-E420 hardware, including instructions on setting jumpers and connecting peripherals, switches, and indicators. Be sure to read all safety precautions before you begin the installation procedure.

3.1 Jumpers & Switches

The AFE-E420 has a number of jumpers that allow you to configure your system to suit your application. The table below lists the functions of the various jumpers.

Table 3.1: Jumpers & Switches

LVDS_BKLT_SLT	Backlight Voltage Selection Jumper
AT1	Auto Power On Selection Jumper
J1	USB Switch Jumper
LVDS_VDD_SLT	Panel Voltage Selection Jumper
SW1	BOOT Selection Switch
CAN_SW1	CAN Bus Terminal Switch
CAN_SW2	CAN Bus Terminal Switch

3.2 Connectors

Onboard connectors link the AFE-E420 to external devices such as hard disk drives and a keyboard. The table below lists the function of each of the board's connectors.

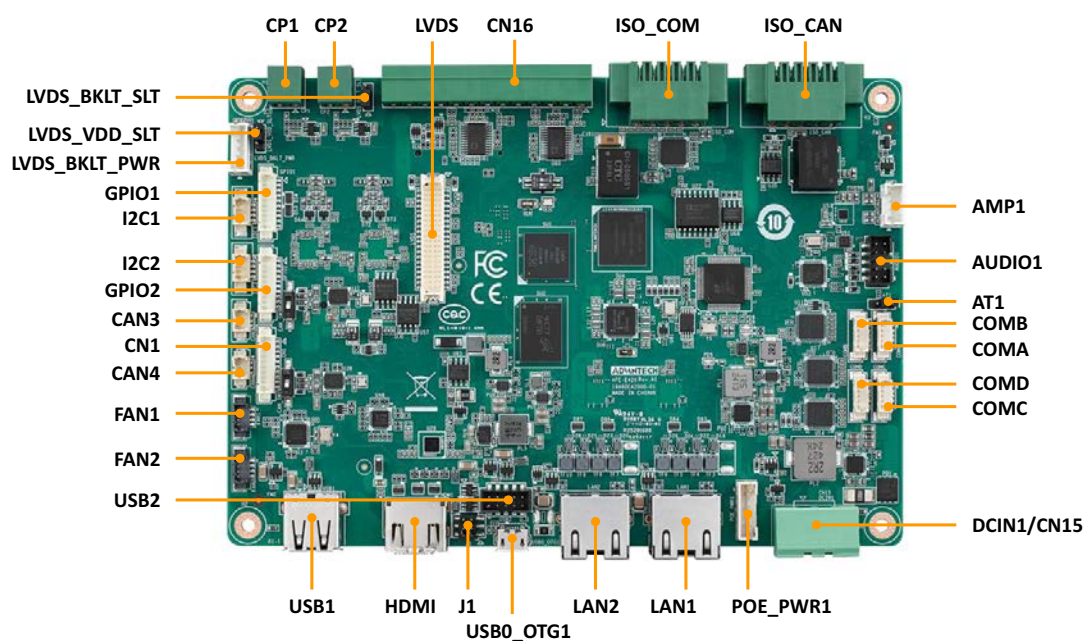
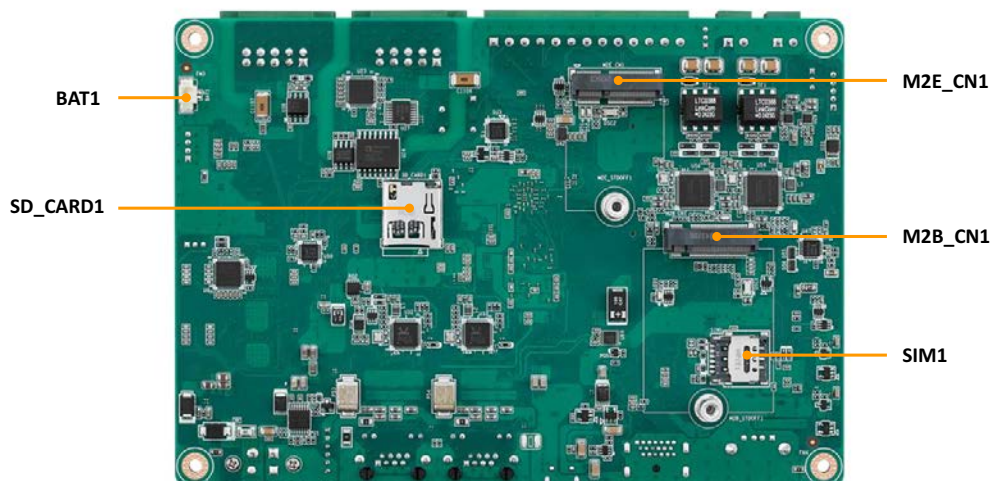
Table 3.2: Connector and Header List

No	Location name	Description
1	CP1	Control Pilot 1
2	CP2	Control Pilot 2
3	CN16	RTD Connector
4	AMP1	SPKR Connector
5	AUDIO1	Audio Internal Connector
6	AT1	Auto Power On Selection Jumper
7	ISO_COM	Isolate COM Connector
8	COMA	COM Port Connector
9	COMB	COM Port Connector
10	COMC	COM Port Connector
11	COMD	COM Port Connector
12	CN15	DC Power Input Connector (4-pin)
13	DCIN1	DC Power Input Connector (Phoenix)
14	POE_PWR1	POE Power Connector
15	LAN1	RJ-45 Connector
16	LAN2	RJ-45 Connector
17	USB1	USB 2.0 Connector
18	USB2	USB 2.0 Internal Connector
19	USB0_OTG1	USB OTG Connector
20	J1	USB Switch Jumper
21	HDMI	HDMI Connector
22	FAN1	FAN Internal Connector
23	FAN2	FAN Internal Connector
24	ISO_CAN	Isolate CAN Bus Connector
25	CAN3	CAN Bus Connector
26	CAN4	CAN Bus Connector
27	CN1	Front Panel Internal Connector
28	GPIO1	GPIO Connector
29	GPIO2	GPIO Connector

Table 3.2: Connector and Header List

30	I2C1	I2C Connector
31	I2C2	I2C Connector
32	LVDS_BKLT_SLT	Backlight Voltage Selection Jumper
33	LVDS_BKLT_PWR	Panel Inverter Connector
34	LVDS_VDD_SLT	Panel Voltage Selection Jumper
35	LVDS	LVDS Connector
36	BAT1	RTC battery Connector
37	M2E_CN1	M.2 E-Key Connector
38	SD_CARD1	SD Card Connector
39	M2B_CN1	M.2 B-Key Connector
40	SIM1	NANO SIM

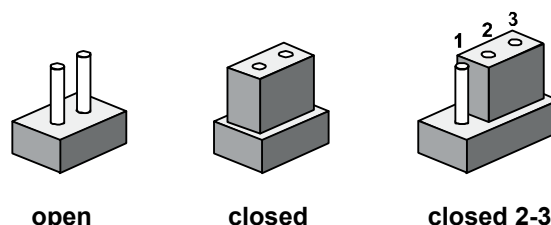
3.3 Locating Connectors

**Figure 3.1 AFE-E420 Connector Locations (Top Side)****Figure 3.2 AFE-E420 Connector Locations (Bottom Side)**

3.4 Jumpers & Switches

You may configure your card to match the needs of your application by setting jumpers. A jumper is a metal bridge used to close an electric circuit. It consists of two metal pins and a small metal clip (often protected by a plastic cover) that slides over the pins to connect them. To "close" a jumper, you connect the pins with the clip. To "open" a jumper, you remove the clip. Sometimes a jumper will have three pins, labeled 1, 2 and 3. In this case you would connect either pins 1 and 2, or 2 and 3.

The jumper settings are schematically depicted in this manual as follows:



A pair of needle-nose pliers may be helpful when working with jumpers. If you have any doubts about the best hardware configuration for your application, contact your local distributor or sales representative before you make any changes. Generally, you simply need a standard cable to make most connections.

3.4.1 Backlight Voltage Selection Jumper: LVDS_BKLT_SLT

Table 3.3: Backlight Voltage Selection Jumper: LVDS_BKLT_SLT

Jumper Short	Backlight Voltage
1-2	+V5
2-3	+V12 (Default)



3.4.2 Auto Power On Selection Jumper: AT1

Table 3.4: Auto Power On Selection Jumper: AT1

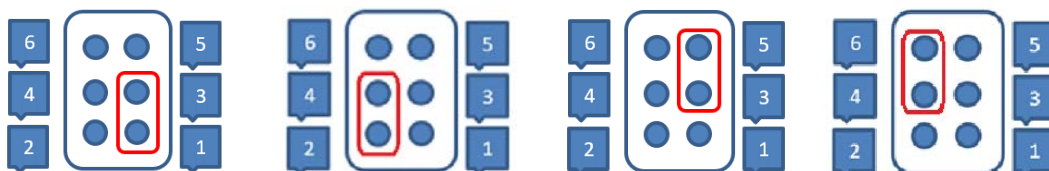
Jumper Short	Functional
1-2	Push-button Power On (ATX)
2-3	Auto Power On (Default)



3.4.3 USB Switch Jumper: J1

Table 3.5: USB Switch Jumper: J1

Jumper Short	Functional
1-3 2-4	USB to UART (FT4232HQ)(Default)
3-5	Micro-USB
4-6	USB1_OTG



3.4.4 Panel Voltage Selection Jumper: LVDS_VDD_SLT

Table 3.6: Panel Voltage Selection Jumper: LVDS_VDD_SLT

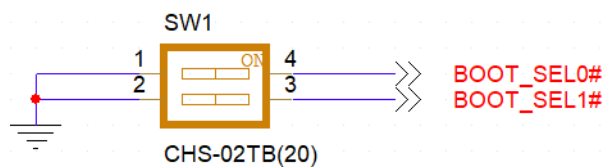
Jumper Short	Panel Voltage
1-2	+V3.3 (Default)
2-3	+V5



3.4.5 Boot Selection Switch: SW1

Table 3.7: Boot Selection Switch: SW1

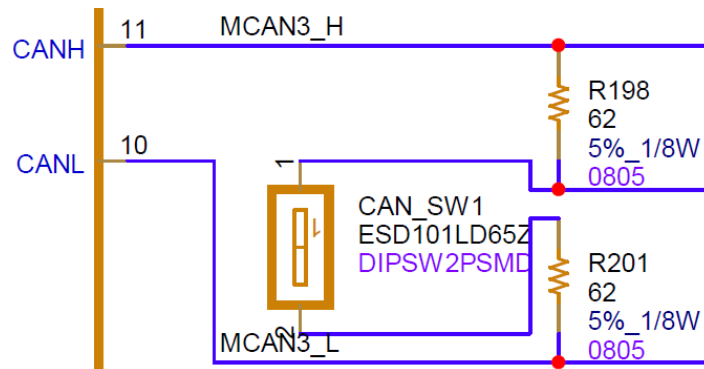
	Pin1	Pin2
SD card	ON	ON
eMMC	OFF	ON
Serial download	ON	OFF



3.4.6 CAN Bus Terminal Switch: CAN_SW1

Table 3.8: CAN Bus Terminal Switch: CAN_SW1

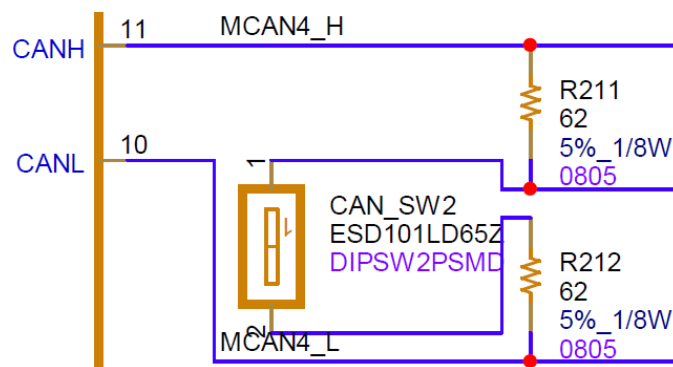
SWITCH	Function
On	Enable 124ohm Terminal
Off	Disable 124ohm Terminal



3.4.7 CAN Bus Terminal Switch: CAN_SW2

Table 3.9: CAN Bus Terminal Switch: CAN_SW2

SWITCH	Function
On	Enable 124ohm Terminal
Off	Disable 124ohm Terminal

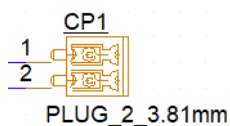


3.5 Connectors (Internal)

3.5.1 Control Pilot 1: CP1

Table 3.10: Control Pilot 1: CP1

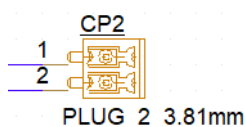
Pin	Signal Pin Definition
1	PILOT_OUT_1
2	PLC_CE_1



3.5.2 Control Pilot 2: CP2

Table 3.11: Control Pilot 2: CP2

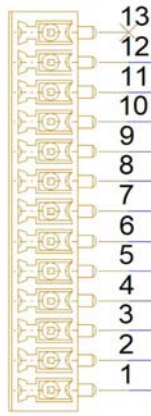
Pin	Signal Pin Definition
1	PILOT_OUT_2
2	PLC_CE_2



3.5.3 RTD Internal Connector: CN16

Table 3.12: RTD Internal Connector: CN16

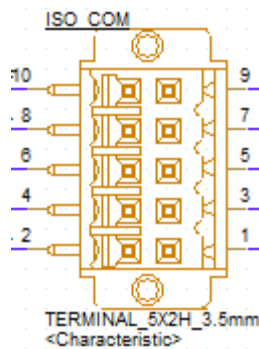
Pin	Signal Pin Definition
1	RTD1_PL1
2	RTD1_PL2
3	RTD12_RL3
4	RTD2_PL1
5	RTD2_PL2
6	RTD12_RL3
7	RTD3_PL1
8	RTD3_PL2
9	RTD34_RL3
10	RTD4_PL1
11	RTD4_PL2
12	RTD34_RL3
13	NC



3.5.4 Isolate COM Connector: ISO_COM

Table 3.13: Isolate COM Connector: ISO_COM

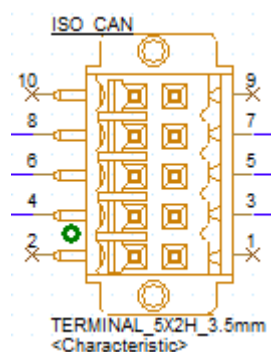
Pin	RS232	RS422	RS485
1	RXD	TX+	DAT+
2	RXD	TX+	DT+
3	RTS	RX-	
4	RTS	RX-	
5	TXD	RX+	
6	TXD	RX+	DAT-
7	CTS	TX-	DAT-
8	CTS	TX-	
9	GND		
10	GND		



3.5.5 Isolate CAN Connector: ISO_CAN

Table 3.14: Isolate CAN Connector: ISO_CAN

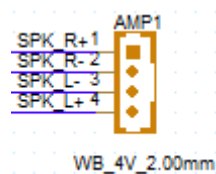
Pin	Signal Pin Definition
1	NC
2	NC
3	GND_CAN
4	GND_CAN
5	CANA_L
6	CANB_L
7	CANA_H
8	CANB_H
9	NC
10	NC



3.5.6 SPKR Connector: AMP1

Table 3.15: SPKR Connector: AMP1

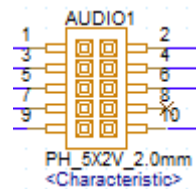
Pin	Signal Pin Definition
1	SPK_R+
2	SPK_R-
3	SPK_L-
4	SPK_L+



3.5.7 Audio Internal Connector: AUDIO1

Table 3.16: Audio Internal Connector: AUDIO1

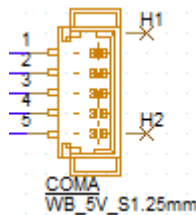
Pin	Signal Pin Definition
1	LINEOUT_L
2	LINEIN_R
3	AGND
4	AGND
5	LINEOUT_R
6	LINEIN_L
7	AGND
8	NC
9	MIC_IN
10	MIC_IN



3.5.8 COM Port Connector: COMA

Table 3.17: COM Port Connector: COMA

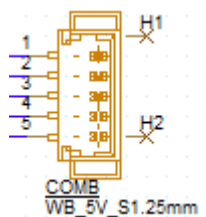
Pin	RS232	RS422	RS485
1	TXD	RX+	
2	RTS	RX-	
3	RXD	TX+	DAT+
4	CTS	TX-	DAT-
5	GND		



3.5.9 COM Port Connector: COMB

Table 3.18: COM Port Connector: COMB

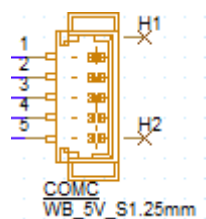
Pin	RS232	RS422	RS485
1	TXD	RX+	
2	RTS	RX-	
3	RXD	TX+	DAT+
4	CTS	TX-	DAT-
5	GND		



3.5.10 COM Port Connector: COMC

Table 3.19: COM Port Connector: COMC

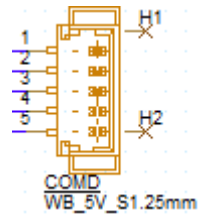
Pin	RS232	RS422	RS485
1	TXD	RX+	
2	RTS	RX-	
3	RXD	TX+	DAT+
4	CTS	TX-	DAT-
5	GND		



3.5.11 COM Port Connector: COMD

Table 3.20: COM Port Connector: COMD

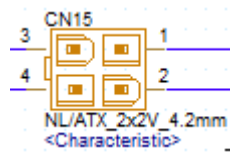
Pin	RS232	RS422	RS485
1	TXD	RX+	
2	RTS	RX-	
3	RXD	TX+	DAT+
4	CTS	TX-	DAT-
5	GND		



3.5.12 DC Power Input Connector (4-Pin): CN15

Table 3.21: DC Power Input Connector (4-Pin): CN15

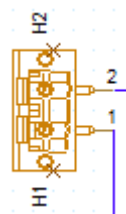
Pin	Signal Pin Definition
1	GND
2	GND
3	+VIN_DCIN
4	+VIN_DCIN



3.5.13 DC Power Input Connector (Phoenix): CN15

Table 3.22: DC Power Input Connector (Phoenix): CN15

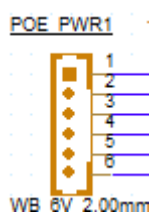
Pin	Signal Pin Definition
1	GND
2	+VIN_DCIN



3.5.14 POE Power Connector: POE_PWR1

Table 3.23: POE Power Connector: POE_PWR1

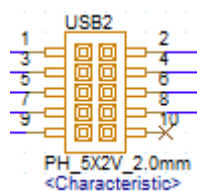
Pin	Signal Pin Definition
1	+V48_LAN2+
2	+V48_LAN2-
3	+V48_LAN3+
4	+V48_LAN3-
5	GND
6	+VDCIN



3.5.15 USB 2.0 Dual-Port Internal Connector: USB2

Table 3.24: USB 2.0 Dual-Port Internal Connector: USB2

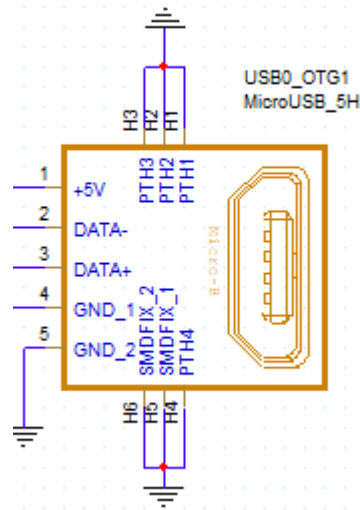
Pin	Signal Pin Definition
1	+V5_USB2_C
2	+V5_USB3_C
3	USB2_DN_C
4	USB3_DN_C
5	USB2_DP_C
6	USB3_DP_C
7	GND
8	GND
9	GND
10	NC



3.5.16 USB OTG Connector: USB0_OTG1

Table 3.25: USB OTG Connector: USB0_OTG1

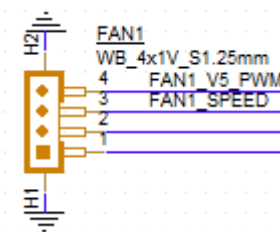
Pin	Signal Pin Definition
1	+V5_USBOTG_C
2	USBA_DN_C
3	USBA_DP_C
4	USB_A_ID_C
5	GND



3.5.17 Internal Fan Connector: FAN1

Table 3.26: Internal Fan Connector: FAN1

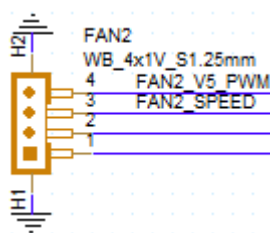
Pin	Signal Pin Definition
1	GND
2	+V12
3	FAN1_SPEED
4	FAN1_V5_PWM



3.5.18 Internal Fan Connector: FAN2

Table 3.27: Internal Fan Connector: FAN2

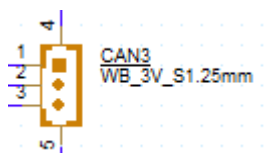
Pin	Signal Pin Definition
1	GND
2	+V12
3	FAN2_SPEED
4	FAN2_V5_PWM



3.5.19 CAN Bus Connector: CAN3

Table 3.28: CAN Bus Connector: CAN3

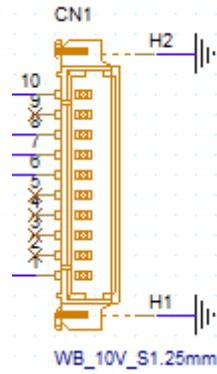
Pin	Signal Pin Definition
1	CAN3_H
2	CAN3_L
3	GND



3.5.20 Front Panel Internal Connector: CN1

Table 3.29: Front Panel Internal Connector: CN1

Pin	Signal Pin Definition
1	GND
2	NC
3	NC
4	NC
5	NC
6	FP_a_PSIN#
7	SYS_RST#
8	+V3.3
9	NC
10	+V5



3.5.21 CAN Bus Connector: CAN4

Table 3.30: CAN Bus Connector: CAN4

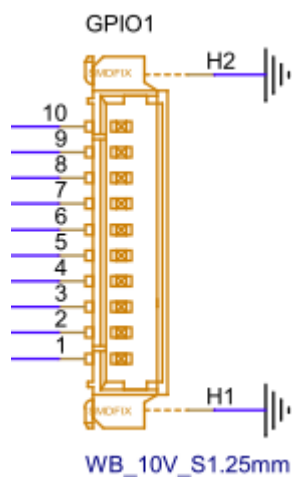
Pin	Signal Pin Definition
1	CAN4_H
2	CAN4_L
3	GND



3.5.22 GPIO Internal Connector: GPIO1

Table 3.31: GPIO Internal Connector: GPIO1

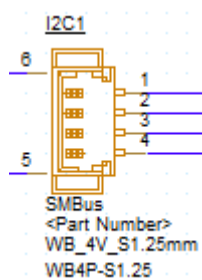
Pin	Signal Pin Definition
1	GND
2	GPIO_A_7
3	GPIO_A_2
4	GPIO_A_6
5	GPIO_A_1
6	GPIO_A_5
7	GPIO_A_0
8	GPIO_A_4
9	+V3.3_P1_GPIO
10	GPIO_A_3



3.5.23 I2C Connector: I2C1

Table 3.32: I2C Connector: I2C1

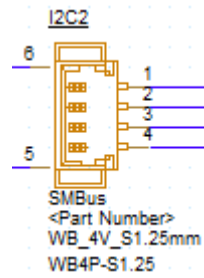
Pin	Signal Pin Definition
1	GND
2	I2C2_SDA
3	I2C2_SCL
4	+V3.3_I2CCONN1



3.5.24 I2C Connector: I2C2

Table 3.33: I2C Connector: I2C2

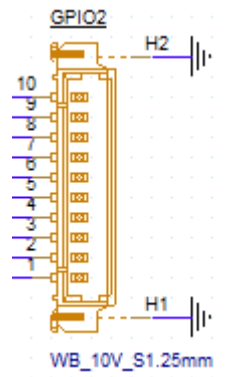
Pin	Signal Pin Definition
1	GND
2	I2C3_SDA
3	I2C3_SCL
4	+V3.3_I2CCONN2



3.5.25 GPIO Internal Connector: GPIO2

Table 3.34: GPIO Internal Connector: GPIO2

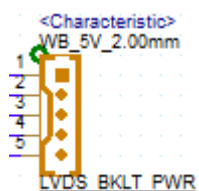
Pin	Signal Pin Definition
1	GND
2	GPIO_B_7
3	GPIO_B_2
4	GPIO_B_6
5	GPIO_B_1
6	GPIO_B_5
7	GPIO_B_0
8	GPIO_B_4
9	+V3.3_P2_GPIO
10	GPIO_B_3



3.5.26 Panel Inverter Connector: LVDS_BKLT_PWR

Table 3.35: Panel Inverter Connector: LVDS_BKLT_PWR

Pin	Signal Pin Definition
1	+VDD_BKLT
2	GND
3	LVDS_BL_EN
4	LVDS_BL_PWM
5	+V5



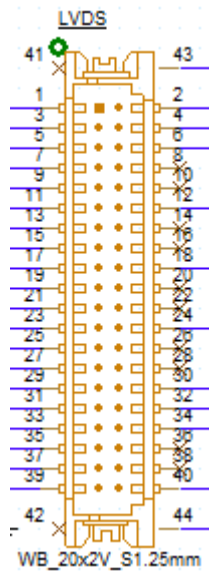
3.5.27 LVDS Connector: LVDS

Table 3.36: LVDS Connector: LVDS

Pin	Signal Pin Definition
1	+VDD_LVDS
2	+VDD_LVDS
3	GND
4	GND
5	+VDD_LVDS
6	+VDD_LVDS
7	LVDS_A_LANE0_N
8	NC
9	LVDS_A_LANE0_P
10	NC
11	GND
12	GND
13	LVDS_A_LANE1_N
14	NC
15	LVDS_A_LANE1_P
16	NC
17	GND
18	GND
19	LVDS_A_LANE2_N
20	NC
21	LVDS_A_LANE2_P
22	NC
23	GND
24	GND
25	LVDS_A_CLK_N
26	NC

Table 3.36: LVDS Connector: LVDS

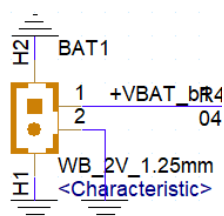
27	LVDS_A_CLK_P
28	NC
29	GND
30	GND
31	I2C_SCL_LVDS
32	I2C_SDA_LVDS
33	GND
34	GND
35	LVDS_A_LANE3_N
36	NC
37	LVDS_A_LANE3_P
38	NC
39	NC
40	LVDS_CTRL
41	NC
42	NC
43	NC
44	NC



3.5.28 RTC Battery Connector: BAT1

Table 3.37: RTC Battery Connector: BAT1

Pin	Signal Pin Definition
1	+VBAT_b1
2	GND



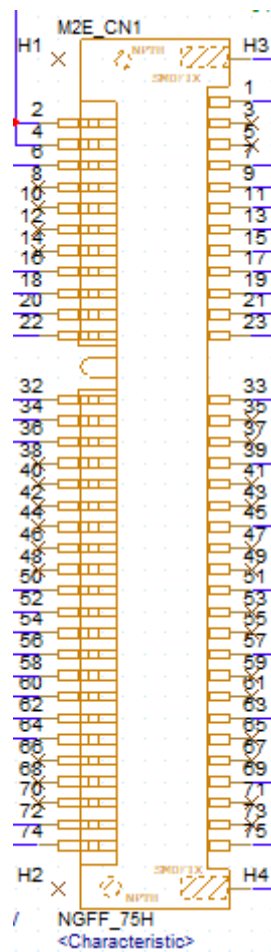
3.5.29 M.2 E-Key Connector: M2E_CN1

Table 3.38: M.2 E-Key Connector: M2E_CN1

Pin	Signal Pin Definition
1	GND
2	+V3.3_M2E
3	NC
4	+V3.3_M2E
5	NC
6	LED_OUT_WLAN#
7	GND
8	NC
9	SD3_CLK
10	NC
11	SD3_CMD
12	NC
13	SD3_DATA0
14	NC
15	SD3_DATA1
16	LED_OUT_BT#
17	SD3_DATA2
18	GND
19	SD3_DATA3
20	M2E_UR_WAKE#
21	M2_SDIO_WAKE#
22	UART5_RXD
23	M2_SDIO_RST#
32	UART5_TXD
33	GND
34	UART5_CTS
35	NC
36	UART5_RTS

Table 3.38: M.2 E-Key Connector: M2E_CN1

37	NC
38	NC
39	GND
40	NC
41	NC
42	NC
43	NC
44	NC
45	GND
46	NC
47	NC
48	NC
49	NC
50	M2_SYSCLK_R
51	GND
52	M2E_RST#
53	NC
54	M2E_W_DISABLE2#_C
55	NC
56	M2E_W_DISABLE1#_C
57	GND
58	I2C_A_SDA
59	NC
60	I2C_A_SCL
61	NC
62	M2E_nALERT_C
63	GND
64	NC
65	NC
66	NC
67	NC
68	NC
69	GND
70	NC
71	NC
72	+V3.3_M2E
73	NC
74	+V3.3_M2E
75	GND
H1	NC
H2	NC
H3	GND
H4	GND



3.5.30 M.2 B-Key Connector: M2B_CN1

Table 3.39: M.2 B-Key Connector: M2B_CN1

Pin	Signal Pin Definition
1	NC
2	+V3.8
3	GND
4	+V3.8
5	GND
6	M2B_POWER_OFF#
7	USB_M2B_DP
8	M2B_W_DISABLE1#
9	USB_M2B_DN
10	LED_M2B#
11	GND
20	NC
21	NC
22	NC
23	NC
24	NC
25	M2B_DPR

Table 3.39: M.2 B-Key Connector: M2B_CN1

26	M2B_W_DISABLE2#
27	GND
28	NC
29	NC
30	UIM_A_RESET
31	NC
32	UIM_A_CLK
33	GND
34	UIM_A_DATA
35	NC
36	+VUIM_PWR
37	NC
38	NC
39	GND
40	NC
41	NC
42	NC
43	NC
44	M2B_ALERT#
45	GND
46	NC
47	NC
48	NC
49	NC
50	NC
51	GND
52	M2B_CLKREQ#
53	NC
54	M2B_WAKE#
55	NC
56	NC
57	GND
58	NC
59	M2B_ANTCTL0
60	NC
61	NC
62	NC
63	NC
64	NC
65	NC
66	SIM_DETECT
67	M2B_RST#
68	NC
69	NC
70	+V3.8
71	GND
72	+V3.8

Table 3.39: M.2 B-Key Connector: M2B_CN1

73	GND
74	+V3.8
75	NC
H1	NC
H2	NC
H3	GND
H4	GND



Chapter 4

Software Functionality

4.1 User Guide

For detailed operating instructions, please refer to the Yocto Linux BSP Version A User Guide. The following link directs you to the Imx93 series Wikipedia page: wiki.advantech.com.tw/view/IoTGateway/BSP/Linux/iMX93/Yocto_LBVA_User_Guide

4.2 Test Functions

4.2.1 CPU

```
$ cat /proc/cpuinfo
```

```
processor      : 0
```

```
BogoMIPS      : 48.00
```

```
Features      : fp asimd evtstrm aes pmull sha1 sha2 crc32 atomics fphp asimdhp  
cpuid asimdrdm lrcpc dcpop asimddp
```

```
CPU implementer : 0x41
```

```
CPU architecture: 8
```

```
CPU variant    : 0x2
```

```
CPU part       : 0xd05
```

```
CPU revision   : 0
```

```
processor      : 1
```

```
BogoMIPS      : 48.00
```

```
Features      : fp asimd evtstrm aes pmull sha1 sha2 crc32 atomics fphp asimdhp  
cpuid asimdrdm lrcpc dcpop asimddp
```

```
CPU implementer : 0x41
```

```
CPU architecture: 8
```

```
CPU variant    : 0x2
```

```
CPU part       : 0xd05
```

```
CPU revision   : 0
```

4.2.2 DDR

```
$ cat /proc/meminfo
```

```
VmallocUsed:    6472 kB
```

```
VmallocChunk:    0 kB
```

```
Percpu:         616 kB
```

```
HardwareCorrupted: 0 kB
```

```
AnonHugePages:   0 kB
```

```
ShmemHugePages:   0 kB
```

```
ShmemPmdMapped:   0 kB
```

```
FileHugePages:    0 kB
```

```
FilePmdMapped:    0 kB
```

```
CmaTotal:        524288 kB
```

```
CmaFree:         521460 kB
```

```
HugePages_Total: 0
```

```
HugePages_Free:  0
```

```
HugePages_Rsvd:    0
HugePages_Surp:    0
Hugepagesize:      2048 kB
Hugetlb:           0 kB
```

4.2.3 SD Card

Mount and read/write/verify data under kernel

4.2.4 eMMC

Write/Read/Verify data

4.2.5 RS-232

COM-A:

Verify according to the debug port method.

COM-B:

MODE0 = 457, MODE1 = 456, DEV = /dev/ttyLP3

COM-C:

MODE0 = 499, MODE1 = 500, DEV = /dev/ttyUSB0

COM-D:

MODE0 = 503, MODE1 = 504, DEV = /dev/ttyUSB1

COM-E_ISO_TOP:

MODE0 = 440, MODE1 = 441, DEV = /dev/ttyUSB2

COM-F_ISO_Bottom:

MODE0 = 447, MODE1 = 446, DEV = /dev/ttyUSB3

Steps:

Config to RS-232:

```
$ echo ${MODE0} > /sys/class/gpio/export
$ echo ${MODE1} > /sys/class/gpio/export
$ echo out > /sys/class/gpio/gpio${MODE0}/direction
$ echo out > /sys/class/gpio/gpio${MODE1}/direction
$ echo 1 > /sys/class/gpio/gpio${MODE0}/value
$ echo 0 > /sys/class/gpio/gpio${MODE1}/value
```

Test Command:

```
$ stty -F ${DEV} -echo -onlcr 115200
$ cat ${DEV} &
$ echo "Serial Port Test" > ${DEV}
```

4.2.6 RS-485/422

COM-A:

MODE0 = 453, MODE1 = 452, DEV = /dev/ttyLP0

This port is used as a debug console, so the following additional steps are required before testing RS-485/RS-422.

1. Change debug port from COM-A to COM-B:

(U-Boot Console)

```
$ setenv console "ttyLP3,115200 earlycon"; saveenv
```

(Linux Kernel)

```
$ systemctl enable serial-getty@ttyLP3.service
```

```
$ systemctl disable serial-getty@ttyLP0.service
```

```
$ systemctl stop serial-getty@ttyLP0.service
```

2. System reboot.

3. Follow normal RS-485/422 test method like COM-B to F.

4. Recovery system

(Linux Kernel)

```
$ systemctl enable serial-getty@ttyLP0.service
```

```
$ systemctl disable serial-getty@ttyLP3.service
```

```
$ systemctl stop serial-getty@ttyLP3.service
```

(U-Boot Console)

```
$ env default -a; saveenv
```

COM-B:

MODE0 = 457, MODE1 = 456, DEV = /dev/ttyLP3

COM-C:

MODE0 = 499, MODE1 = 500, DEV = /dev/ttyUSB0

COM-D:

MODE0 = 503, MODE1 = 504, DEV = /dev/ttyUSB1

COM-E_ISO_TOP:

MODE0 = 440, MODE1 = 441, DEV = /dev/ttyUSB2

COM-F_ISO_Bottom:

MODE0 = 447, MODE1 = 446, DEV = /dev/ttyUSB3

Steps:

Change MODE0/MODE1 to switch mode, (01: 485, 11: 422)

Config to RS-485:

```
$ echo ${MODE0} > /sys/class/gpio/export
$ echo ${MODE1} > /sys/class/gpio/export
$ echo out > /sys/class/gpio/gpio${MODE0}/direction
$ echo out > /sys/class/gpio/gpio${MODE1}/direction
$ echo 0 > /sys/class/gpio/gpio${MODE0}/value
$ echo 1 > /sys/class/gpio/gpio${MODE1}/value
```

Config to RS-422:

```
$ echo ${MODE0} > /sys/class/gpio/export
$ echo ${MODE1} > /sys/class/gpio/export
$ echo out > /sys/class/gpio/gpio${MODE0}/direction
$ echo out > /sys/class/gpio/gpio${MODE1}/direction
$ echo 1 > /sys/class/gpio/gpio${MODE0}/value
$ echo 1 > /sys/class/gpio/gpio${MODE1}/value
```

Setup RS-485 wiring:

Adam-4520. Adam-4520 Pin Data- and Pin Data+ connect to DB9 Pin1 and Pin 2

Setup RS-422 wiring:

Adam-4520. Adam-4520 RX- <-->DB9 Pin 1, Adam-4520 RX+ <-->DB9 Pin 2, Adam-4520 TX- <-->DB9 Pin 4, Adam-4520 TX+ <--> DB9 Pin 3

Remember to set up RS-485/422 before test.

```
$ stty -F ${DEV} speed 115200 ignbrk -brkint -icrnl -imaxbel -opost -onlcr -isig -icanon
-iexten -echo -echoe -echok -echoctl -echoke
$ cat ${DEV} &
$ echo "Serial Test" > ${DEV}
```

4.2.7 GPIO

GPIO_A_0 - GPIO_A_7

GPIO_B_0 - GPIO_B_7

Loopback test pairs:

1. A0-A4: 480 - 484
2. A1-A5: 481 - 485
3. A2-A6: 482 - 486
4. A3-A7: 483 - 487
5. B0-B4: 488 - 492
6. B1-B5: 489 - 493
7. B2-B6: 490 - 494
8. B3-B7: 491 - 495

Use A0-A4 to be example:

```
$ echo 480 > /sys/class/gpio/export
$ echo 484 > /sys/class/gpio/export
$ echo out > /sys/class/gpio/gpio480/direction
$ echo 1 > /sys/class/gpio/gpio480/value
$ cat /sys/class/gpio/gpio484/value (Have to return '1')
$ echo 0 > /sys/class/gpio/gpio480/value
$ cat /sys/class/gpio/gpio484/value (Have to return '0')
```

4.2.8 M.2 (B-Key) 4G

Verify by module EWM-C401CQE01.

(J1 jump to 1-3 2-4)

Test by AT command:

```
$ stty -F /dev/ttyUSB5 speed 115200 -echo
$ cat /dev/ttyUSB5 &
$ echo -e "AT+CSQ\r" > /dev/ttyUSB5
```

Console message:

AT+CSQ

+CSQ: 99,99

OK

Test by pppd:

```
$ pppd connect 'chat -v -s -t 10 "" "AT" "" "ATDT*99#" "CONNECT" ""' user username
password password /dev/ttyUSB6 460800 nodetach crtscts debug usepeerdhs
defaultroute &
```

4.2.9 M.2 (E-Key) Wi-Fi & BT

Verify by module AIW-167.

```
# Install Driver
$ modprobe moal mod_para=nxp/wifi_mod_para.conf
$ modprobe btnxpuart

#WIFI Test
$ ifconfig wlan0 up
$ wpa_passphrase ASUS-917C qwert12345 > /tmp/wpa.conf && wpa_supplicant -d -
B -i wlan0 -c /tmp/wpa.conf
$ udhcpc -i wlan0

#BT Test
$ hciconfig hci0 up
$ bluetoothctl
$ discoverable on
$ pairable on
$ scan on
[NEW] FC:18:3C:8D:75:F4 myphone
$ scan off
$ pair FC:18:3C:8D:75:F4
$ connect FC:18:3C:8D:75:F4
```

4.2.10 Ethernet

1. Check IP & DHCP
2. Throughput


```
$ iperf3 -c 192.168.0.2 -t 60 -i 10
```

4.2.11 USB

USB disk write/read/verify pattern.

4.2.12 Micro-USB OTG

Recovery mode only, flash image by uuu tool

4.2.13 HDMI

Display to HDMI screen.

4.2.14 LVDS

```
# UBOOT-Console
$ setenv fdtfile imx93-afee320-a1-lvds.dtb
$ saveenv
$ boot
```

4.2.15 I2C

1.Support function from I2C

I2C-2:

0x0a: SGTL5000

0x32: RTC

0x20: GPIO exp

0x21: GPIO exp

0x25: PMIC

I2C-3:

0x20: GPIO exp

0x21: GPIO exp

2.Write/Read/Verify eeprom Hi/Low byte

```
$ modprobe at24
```

```
$ echo "ADVANTECH" > test
```

```
$ dd if=test of=/sys/bus/i2c/devices/1-0050/eeprom
```

```
$ hexdump -C /sys/bus/i2c/devices/1-0050/eeprom -n 64
```

4.2.16 RTC

RTC external (rtc0)

RTC internal (rtc1)

Example for rtc0

Stop/Disable time sync service :

```
$ systemctl stop systemd-timesyncd
```

```
$ systemctl disable systemd-timesyncd
```

Change system time and store into RTC :

```
$ date MMDDhhmm[[CC]YY][.ss]
```

```
$ hwclock -w -f /dev/rtc0
```

Check RTC current status :

```
$ hwclock -v -f /dev/rtc0
```

Enable/Start time sync service :

```
$ systemctl enable systemd-timesyncd
```

```
$ systemctl start systemd-timesyncd
```

4.2.17 PWM

PWM1:

```
# Check waveform by oscilloscope after follow steps
$ echo 0 > /sys/class/pwm/pwmchip0/export
$ echo 1000000 > /sys/class/pwm/pwmchip0/pwm0/period
$ echo 500000 > /sys/class/pwm/pwmchip0/pwm0/duty_cycle
$ echo 1 > /sys/class/pwm/pwmchip0/pwm0/enable
```

PWM2:

```
# Check waveform by oscilloscope after follow steps
$ echo 1 > /sys/class/pwm/pwmchip0/export
$ echo 1000000 > /sys/class/pwm/pwmchip0/pwm1/period
$ echo 500000 > /sys/class/pwm/pwmchip0/pwm1/duty_cycle
$ echo 1 > /sys/class/pwm/pwmchip0/pwm1/enable
```

FAN1 PWM:

```
# Check waveform by oscilloscope after follow steps
$ echo 1 > /sys/class/pwm/pwmchip8/export
$ echo 1000000 > /sys/class/pwm/pwmchip8/pwm1/period
$ echo 500000 > /sys/class/pwm/pwmchip8/pwm1/duty_cycle
$ echo 1 > /sys/class/pwm/pwmchip8/pwm1/enable
```

FAN2 PWM:

```
# Check waveform by oscilloscope after follow steps
$ echo 2 > /sys/class/pwm/pwmchip4/export
$ echo 1000000 > /sys/class/pwm/pwmchip4/pwm2/period
$ echo 500000 > /sys/class/pwm/pwmchip4/pwm2/duty_cycle
$ echo 1 > /sys/class/pwm/pwmchip4/pwm2/enable
```

4.2.18 Audio

Line-In:

```
$ amixer sset 'Capture Mux' 'LINE_IN'
$ arecord -D plughw:0,0 -r 16000 -f S16_LE ./f-16000-Line-In.wav
```

Mic-In:

```
$ amixer sset 'Capture Mux' 'MIC_IN'
$ amixer sset Mic 100%
$ arecord -D plughw:0,0 -r 16000 -f S16_LE ./f-16000.wav
```

Line-Out/Speaker/AMP:

```
$ amixer set Headphone 100%
$ amixer set Lineout unmute
$ amixer set Lineout 100%
$ aplay -D plughw:0,0 f-16000.wav
$ aplay -D plughw:0,0 f-16000-Line-In.wav
```

4.2.19 Watchdog

Watchdog Function Test Data:

(1) Timeout 10S:

/unit_tests/Watchdog/wdt_driver_test.out 10 1 0 ==> System will not reboot. Watchdog can be refreshed when feed dog before it timeout.

Ctrl + C ==> System will reboot after 10 sec. Watchdog does not refresh after it timeout.

(2) Timeout 20S:

/unit_tests/Watchdog/wdt_driver_test.out 20 1 0 ==> System will not reboot. Watchdog can be refreshed when feed dog before it timeout.

Ctrl + C ==> System will reboot after 20 sec. Watchdog does not refresh after it timeout.

(3) Timeout 50S:

/unit_tests/Watchdog/wdt_driver_test.out 50 1 0 ==> System will not reboot. Watchdog can be refreshed when feed dog before it timeout.

Ctrl + C? ==> System will reboot after 50 sec. Watchdog does not refresh after it timeout.

(4) Timeout 100S:

/unit_tests/Watchdog/wdt_driver_test.out 100 1 0 ==> System will not reboot. Watchdog can be refreshed when feed dog before it timeout.

Ctrl + C ==> System will reboot after 100 sec. Watchdog does not refresh after it timeout.

4.2.20 ADC

ADC-0:

```
$ cd /sys/bus/iio/devices/iio:device1
$ cat in_voltage0-voltage1_scale
$ cat in_voltage0-voltage1_sampling_frequency
$ cat in_voltage0-voltage1_raw
$ cat in_voltage2-voltage3_scale
$ cat in_voltage2-voltage3_sampling_frequency
$ cat in_voltage2-voltage3_raw
```

ADC-1:

```
$ cd /sys/bus/iio/devices/iio:device2
$ cat in_voltage0-voltage1_scale
$ cat in_voltage0-voltage1_sampling_frequency
$ cat in_voltage0-voltage1_raw
$ cat in_voltage2-voltage3_scale
$ cat in_voltage2-voltage3_sampling_frequency
$ cat in_voltage2-voltage3_raw
```

ADC-3 & ADC-4:

```
$ cd /sys/bus/iio/devices/iio:device0
$ cat in_voltage_scale
$ cat in_voltage_sampling_frequency
$ cat in_voltage0_raw
$ cat in_voltage1_raw
$ cat in_voltage2_raw
$ cat in_voltage3_raw
```

4.2.21 RTD

RTD-1:

```
$ /tools/rtd/rtd_ad7124_config.sh iio:device1 0
$ /tools/rtd/rtd_get_temperature.sh iio:device1 0
```

RTD-2:

```
$ /tools/rtd/rtd_ad7124_config.sh iio:device1 1
$ /tools/rtd/rtd_get_temperature.sh iio:device1 1
```

RTD-3:

```
$ /tools/rtd/rtd_ad7124_config.sh iio:device2 0
$ /tools/rtd/rtd_get_temperature.sh iio:device2 0
```

RTD-4:

```
$ /tools/rtd/rtd_ad7124_config.sh iio:device2 1
$ /tools/rtd/rtd_get_temperature.sh iio:device2 1
```

4.2.22 PLC

PLC-1:

```
$ plctool -i eth3 -l
```

PLC-2:

```
$ plctool -i eth2 -l
```

4.2.23 CAN Bus

ISO_CAN (can0):

ISO_CAN (can1):

Connect can0 and can1

```
$ ip link set can0 up type can bitrate 125000
```

```
$ ip link set can1 up type can bitrate 125000
```

```
$ candump can1 &
```

```
$ cansend can0 12345678#123412341234
```

The following shows the result

```
can1 12345678 [6] 12 34 12 34 12 34
```

TCAN4550 (can2):

TCAN4551 (can3):

CAN_SW1 & CAN_SW2 switch to On.

Connect can2 and can3

```
$ ip link set can2 up type can bitrate 125000
```

```
$ ip link set can3 up type can bitrate 125000
```

```
$ candump can3 &
```

```
$ cansend can2 12345678#123412341234
```

The following shows the result

```
can3 12345678 [6] 12 34 12 34 12 34
```

4.2.24 Fan

FAN-1:

FAN1_TACH:

(Check pulse by oscilloscope after follow steps)

```
$ echo 459 > /sys/class/gpio/export
```

```
$ echo out > /sys/class/gpio/gpio459/direction
```

```
$ echo 1 > /sys/class/gpio/gpio459/value
```

```
$ echo 0 > /sys/class/gpio/gpio459/value
```

FAN1_PWM:

> Follow above 'FAN1 PWM' test steps

FAN-2:

FAN2_TACH:

(Check pulse by oscilloscope after follow steps)

```
$ echo 460 > /sys/class/gpio/export
```

```
$ echo out > /sys/class/gpio/gpio460/direction
```

```
$ echo 1 > /sys/class/gpio/gpio460/value
```

```
$ echo 0 > /sys/class/gpio/gpio460/value
```

FAN2_PWM:

> Follow above 'FAN2 PWM' test steps

4.2.25 POE

LAN-1:

(Connect MIOe-PSE board to POE_PWR1 and connect QCAM-GM0640-121CE IP-Camera to LAN port)

```
$ ping 169.254.1.1 -I eth1
```

LAN-2:

(Connect MIOe-PSE board to POE_PWR1 and connect QCAM-GM0640-121CE IP-Camera to LAN port)

```
$ ping 169.254.1.1 -I eth0
```



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