EMB-2237-AI

Technical Specification Manual

Version: D0.01

Revisions

Version	Description of Version	Date Completed
D0.01	Draft	1/15/2020

Preface

This Technical Specification Manual (TSM) specifies the board layout, components, connectors, and the I/O connection ports, motherboards features.

Intended Audience

The TSM is intended to provide detailed, technical information about the EMB-2237-AI and its components to the vendors, system integrators, and other engineers and technicians who need this level of information. It is specifically not intended for general audiences.

What This Document Contains

Chapter	Description
1	Introduction
2	Product Description
3	Technical Reference
4	Operating System

1. Introduction

1.1 Product introduction

The EMB-2237-AI is a Pico-ITX (100x 72mm) industrial motherboard based on NXP i.MX8M Mini ARM application processor. The board features a Power over Ethernet (PoE) Ethernet port, on-board dual-core DSP that runs algorithms for voice control, noise suppression, and echo cancellation technology, a full set of I/Os including RS-232/485, and m.2 PCIe slot for Edge TPU AI-based solutions.

1.2 Form Factor

The EMB-2237-AI is based on Pico-ITX .It is a small Single Board Computer Form factor with 100 x 72 mm (3.9” x 2,8”).

2. Product Description

2.1 Specification

Table 1 summarizes the major features of the board.

Table 1. Specification

Platform	ARM Cortex-A53
Form Factor	Pico-ITX
Processor	i.MX8M Mini
Core	4x ARM Cortex-A53 @ 1.8GHz 1x Arm Cortex-M4 @ 400MHz
System Memory	LPDDR4 @3200MT up to 4GB
Ethernet	1 x 10/100 Mbps Ethernet with POE support
Wireless	1x WiFi/Bluetooth (AP6212A) module, 802.11 b/g/n + Bluetooth v4.0
Audio	1 x mono Class D speaker out, 2W(4Ω), 2 (R/L) x line-out and amplified (2x 1.5W) out headers
Voice Control Frontend	Dual digital MEMS microphone header via CS47L24 with dual DSP, support multi-mic noise suppression, acoustic echo cancellation (AEC), omni-directional spatial
Storage	8GB iNand Flash, up to 16GB, 265K EEPROM with write protect control
Graphic Controller	GC NanoUltra (1 shader), OpenGL ES 2.0; GC520L 2D
AI/ML	OpenCL CPU: 32 GOPS; Google Edge TPU coprocessor PCIe option, up to 4 TOPS
LCD Interface	1x MIPI 4-lane DSI, 1x Dual Channel LVDS and 24bit RGB for 5”, 7”, 8”, 10.1” and other size LCD panels
Display Resolution	Up to 1920x 1200
SD Card Socket	1 x micro SD Socket (not support hot plug)
USB	2 x 4-pin 2.0 mm pitch USB 2.0 pin header, 2 x USB 2.0 Type A
Boot Switch	1 x 2-bit DIP switch for iNAND and micro SD boot selection
I/O	8-pin header with two combination of RS-232, RS-485 and 4 x GPIO
RTC	1 x RTC input, 2-pin wafer heder,1.25mm
Power Input	12V DC barrel jack or POE via RJ45
OTG	1 x USB 2.0 OTG
Expansion	1x POE (Power over Ethernet) IEEE 802.3af Module, 1x M.2-2230 (E key) slot
Operating Temperature	-10 ~ 60° C (14 ~ 144° F)
Storage Temperature	-40 ~ 85° C (-40 ~ 185° F)
Operating Humidity	5% ~ 95%, 40ºC, non-condensing
Dimensions	100 x 72 mm (3.94" x 2.84")

2.2 Board Layout

Figure 1 shows the location of the major components on the top side of the EMB-2237-AI.

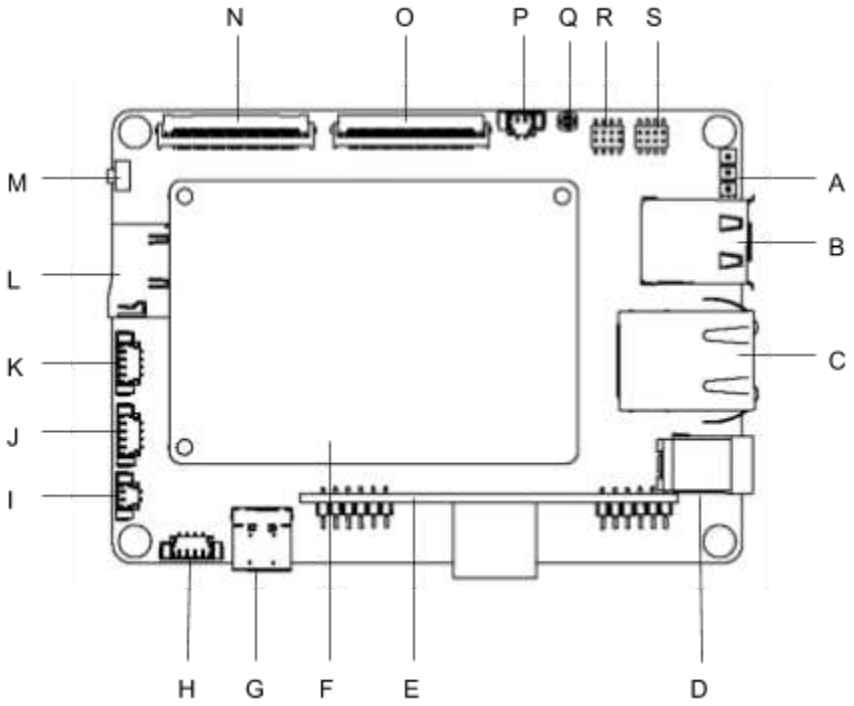

Figure1. Board Layout

Table 2. Components Show in Figure 1

Item from Figure 1	Connector	Description
A	CON1	RS-232 Console Port
B	J21	USB Type A for 2x Host USB 2.0
C	T1	RJ45 connector for 100M Ethernet with POE
D	J1	12V DC Input
E		POE Power module
F	SW1	4-bit switch for boot selection TF/eMMC (on SOM-2237)
G	J19	USB Type C for 1 x OTG USB 2.0
H	J8	L/R Line-Out/HP out
I	J5	Mono speaker out
J	J6	Stereo Amplified speaker out
K	J7	2x digital MEMS microphone in
L	J11	micro SD socket
M	SW1	4-bit switch for boot selection TF/eMMC
N	J12	FPC connector for LCD Touch Panel (LVDS, RGB, I2C, GPIOs)
O	J13	FPC connector for LCD Touch Panel and MIPI Camera (MIPI DSI, CSI, I2C, GPIOs)
P	J4	RTC Battery input
Q	J10	2.4G antenna for Wifi/BTE
R	J25	I/O Header (RS-232, 485, GPIOs/SPI)
S	J12	2x USB 2.0 headers

2.3 Block Diagram

Figure 2 is a block diagram of the major functional areas of the board.

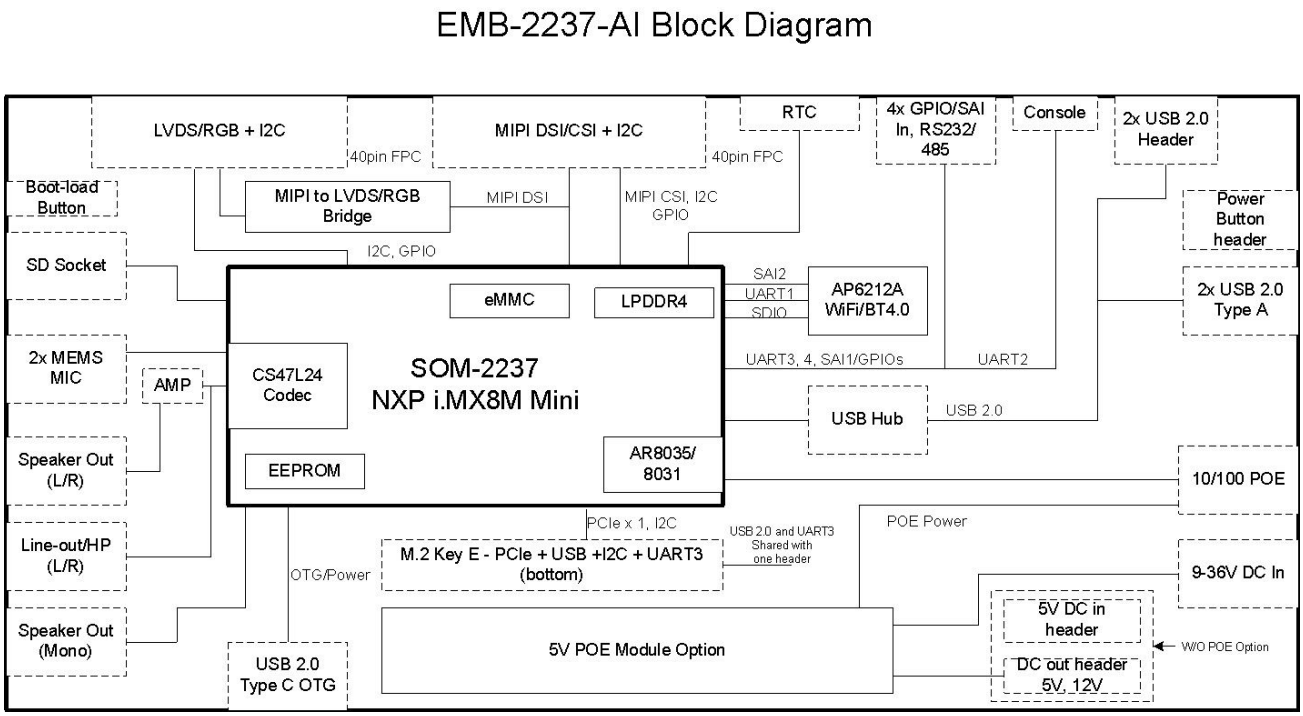

Figure 2. Block Diagram

2.4 Dimensions

Figure 3 is board layout dimensions (unit: mm).

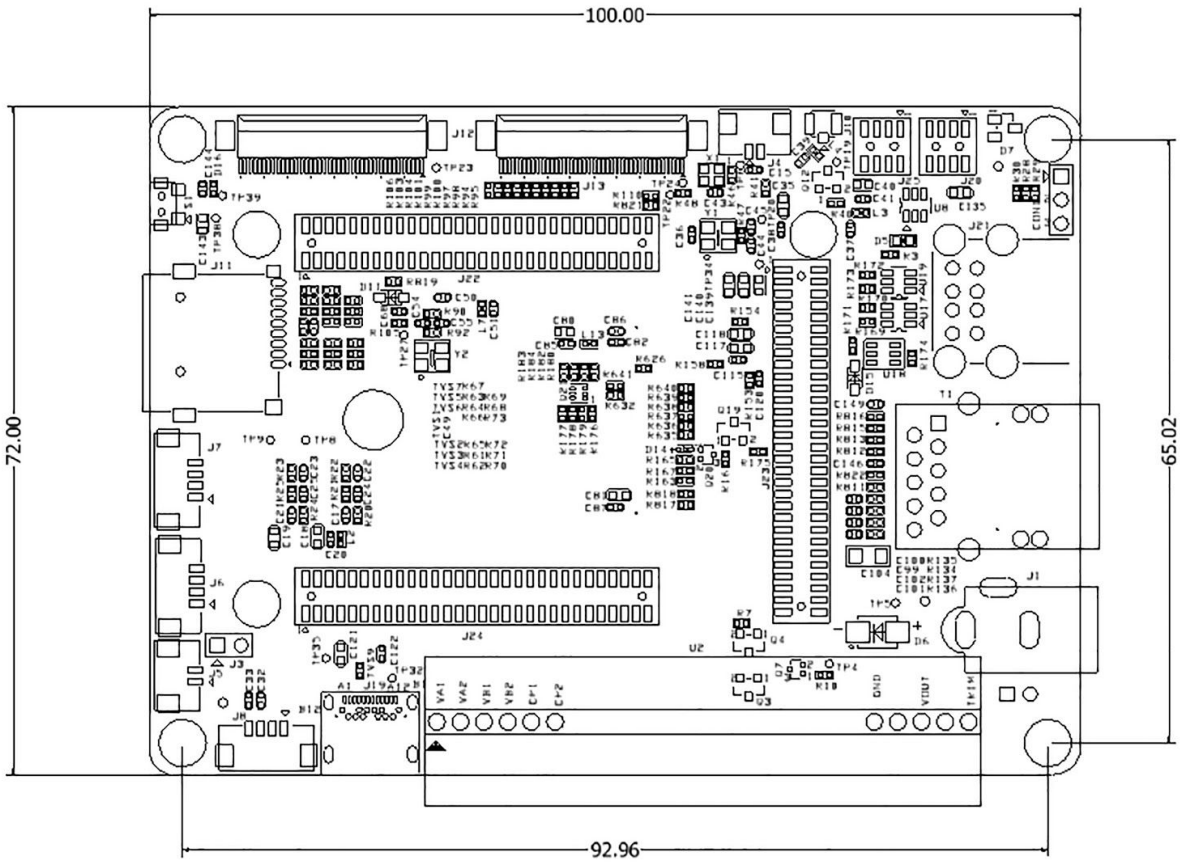

Figure 3. Dimensions

3. Technical Reference

3.1 Connectors and Headers

Table 4. CON1 RS-232 Console Port Header (Figure. 1. A)

Pin	Signal Name
1	GND
2	DEBUG_RXD
3	DEBUG_TXD

Table 5. J19 OTG Type C Port (Figure. 1. G)

Pin	Signal Name	Pin	Signal Name
A1	GND	B1	GND
A2	NC	B2	NC
A3	NC	B3	NC
A4	GND	B4	GND
A5	CC1	B5	CC2
A6	USB1_DP	B6	USB1_DP
A7	USB1_DN	B7	USB1_DN
A8	NC	B8	NC
A9	GND	B9	GND
A10	NC	B10	NC
A11	NC	B11	NC
A12	GND	B12	GND

Table 6. J8 Headphone Out (Figure. 1. H)

Pin	Signal Name (Default)	
1	NC	
2	GND	
3	HP_out (R)	
4	HP_out (L)	

Table 7. J5 Mono Speaker Out Header (Figure. 1. I)

Pin	Signal Name	Pin	Signal Name
1	SPKOUTP	2	SPKOUTN

Table 8. J6 Stereo Amplified Speaker Out (Figure. 1. J)

Pin	Signal Name (Default)	

1	SPK1A	
2	SPK1B	
3	SPK2A	
4	SPK2B	

Table 9. J7 DMIC In (Figure. 1. K)

Pin	Signal Name
1	MICBIAS1
2	MICBIAS2
3	DMICCLK
4	DMICDAT

Table 10. J12 LVDS/RGB/TP FPC Header (Figure. 1. N)

Pin	Signal Name	Pin	Signal Name
1	DC5V_EXT	21	LVDS1_TX0_N
2	DC5V_EXT	22	GND
3	BL_PWM/GPIO1_IO15	23	LVDS1_TX1_P
4	GND	24	LVDS1_TX1_N
5	LVDS0_TX0_P	25	GND
6	LVDS0_TX0_N	26	LVDS1_TX2_P
7	GND	27	LVDS1_TX2_N
8	LVDS0_TX1_P	28	GND
9	LVDS0_TX1_N	29	LVDS1_CLK_P
10	GND	30	LVDS1_CLK_N
11	LVDS0_TX2_P	31	GND
12	LVDS0_TX2_N	32	LVDS1_TX3_P
13	GND	33	LVDS1_TX3_N
14	LVDS0_CLK_P	34	GND
15	LVDS0_CLK_N	35	I2C2_SCL_L
16	GND	36	I2C2_SDA_L
17	LVDS0_TX3_P	37	DSI_EN/GPIO1_IO08
18	LVDS0_TX3_N	38	TP_nINT/GPIO1_IO09
19	GND	39	TP_RST/GPIO1_IO06
20	LVDS1_TX0_P	40	VDD_3V3

Table 11. J13 MIPI CSI DSI Header (Figure. 1. O)

Pin	Signal Name	Pin	Signal Name
1	DC5V_EXT	21	I2C2_SCL_M
2	DC5V_EXT	22	I2C2_SDA_M
3	GPIO1_IO14/CLKO_1.8V	23	TP_RST/GPIO1_IO06
4	TP_nINT/GPIO1_IO09	24	DSI_EN/GPIO1_IO08
5	CSI_PWR_EN/GPIO1_IO07	25	BL_PWM/GPIO1_IO15
6	CSI_CLK_P	26	GND

7	CSI_CLK_N	27	DSI_CKP
8	GND	28	DSI_CKN
9	CSI_DP0	29	GND
10	CSI_DN0	30	DSI_DP0
11	GND	31	DSI_DN0
12	CSI_DP1	32	GND
13	CSI_DN1	33	DSI_DP1
14	GND	34	DSI_DN1
15	CSI_DP2	35	GND
16	CSI_DN2	36	DSI_DP2
17	GND	37	DSI_DN2
18	CSI_DP3	38	DSI_DP3
19	CSI_DN3	39	DSI_DN3
20	GND	40	VDD_3V3

Table 12. J4 RTC Battery Header (Figure. 1. P)

Pin	Signal Name	Pin	Signal Name
1	RTC Battery +	2	RTC Battery -

Table 13. J25 IO Header (Figure. 1. R)

Pin	Signal Name
1	RS485_B
3	RS485_A
5	RS232_B_RXD
7	RS232_B_TXD
2	SAI1_RXD1/GPIO4_IO03
4	SAI1_RXD0/GPIO4_IO02
6	SAI1_RXFS/GPIO4_IO00
8	SAI1_RXC/GPIO4_IO01

Table 14. J20 USB Header (Figure. 1. S)

Pin	Signal Name
1	USB_HOST_VBUS
3	USB_HUB_DM4
5	USB_HUB_DP4
7	GND
2	USB_HOST_VBUS
4	USB_HUB_DM3
6	USB_HUB_DP3
8	GND

Table 15. Test Pads

Pin	Signal Name	Pin	Signal Name
TP1	DMICCLK	TP20	CLK_REQ (WIFI)
TP2	DC5V	TP21	nRST_WIFI
TP3	EN_SNK (PWR)	TP22	LPO/SLOW_CLK
TP4	EN_SRC (PWR)	TP23	DC5V_EXT (LVDS LCD)
TP5	POEIN	TP24	DC5V_EXT (MIPI LCD)
TP6	VCC_RTC	TP25	3.3V_Display
TP7	DC5V_EXT (Audio)	TP26	1.8V_Display
TP8	R_OUT (Line-out)	TP27	LT9211_nRST (LCD)
TP9	L_OUT (Line-out)	TP28	LT9211_INT (LCD)
TP10	MICBIAS1	TP29	LT9211_CSDA (LCD)
TP11	DMICCLK	TP30	LT9211_CSCL (LCD)
TP12	DMICDAT	TP32	OTG_PWR
TP15	RS232_B_RXD	TP33	Int_USB
TP16	RS232_B_TXD	TP34-36	DC5V
TP17	RS485_B	TP37	VDD_3V3
TP18	RS485_A	TP38	VDD_1V8
TP19	3.3V_WIFI	TP39	BOOT_LOARD

3.2 Signal and Power Considerations

1. When providing power from the POE, not required connect the 12V DC power input jack (J1) on the mainboard at the same time.
2. The VCC_5V output current from the headers output has a limit of 1A
3. The USB_5V output current from the USB headers has a limit of 1A
4. When providing power header, make sure to provide enough current (2A or more) to the mainboard
5. Mono speaker amplifier output: 2W/CH Into 4ohm 1.4W /CH Into 8ohm.

3.3 Boot Options

The board can be selected to boot up from on-board eMMC or micro-SD card. See Table 17.

Table 16. SW1 4bit Switch (Figure. 1. M)

Bit 1 (1,8)	Bit 2 (2, 7)	Bit 3 (3, 6)	Description
OFF			Boot eSDHC1
ON			Boot eSDHC2
OFF	OFF	ON	Boot MMC/eMMC
ON	ON	OFF	Boot SD/eSD

3.4 GPIO Configuration Table

Table 17. J25 8-pin IO Header GPIO (Figure. 1. R/Table 13)

Pad	Pin	MUX MODE						
		ALT6	ALT5	ALT4	ALT3	ALT2	ALT1	ALT0
SAI1_RXD1	2		GPIO4_IO03					SAI1_RX_DATA1
SAI1_RXD0	4		GPIO4_IO02					SAI1_RX_DATA0
SAI1_RXFS	6		GPIO4_IO00					SAI1_RX_SYNC
SAI1_RXC	8		GPIO4_IO01					SAI1_RX_BCLK

Table 18. J25 8-pin IO Header RS-232/485 (Figure. 1. R/Table 13)

Pad	Pin	MUX MODE						
		ALT6	ALT5	ALT4	ALT3	ALT2	ALT1	ALT0
UART2_TXD	7	RS-232 RX, TX						UART2_TX
UART2_RXD	5							UART2_RX
UART4_RXD	3	RS-485 A, B						UART4_RX
UART4_TXD	1							UART4_TX
SAI5_RXFS			GPIO3_IO19					

Table 19. J12 LVDS/RGB/TP FPC Header (Figure. 1. N/Table 10)

Pad	Pin	MUX MODE						
		ALT6	ALT5	ALT4	ALT3	ALT2	ALT1	ALT0
GPIO1_IO15	3 (BL_PWM)	CCM_CLKO2	PWM4_OUT					GPIO1_IO15
I2C2_SCL	35 (I2C2_SCL_L)		GPIO5_IO16					I2C2_SCL
I2C3_SDA	36 (I2C2_SDA_L)		GPIO5_IO17					I2C2_SDA
GPIO1_IO08	37 (DSI_EN)							GPIO1_IO08
GPIO1_IO09	38 (TP_nINT)							GPIO1_IO09
GPIO1_IO06	39 (TP_RST)	CCM_EXT_CLK3						GPIO1_IO06

Table 20. J13 MIPI CSI DSI Header (Figure. 1. O/Table 11)

Pad	Pin	MUX MODE						
		ALT6	ALT5	ALT4	ALT3	ALT2	ALT1	ALT0
GPIO1_IO14	3 (CLKO_1.8V)	CCM_CLKO1	PWM3_OUT					GPIO1_IO14
GPIO1_IO09	4 (TP_nINT)							GPIO1_IO09
GPIO1_IO07	5(CSI_PWR_EN)							GPIO1_IO07
I2C2_SCL	21(I2C2_SCL_M)		GPIO5_IO16					I2C2_SCL
I2C3_SDA	22(I2C2_SDA_M)		GPIO5_IO17					I2C2_SDA
GPIO1_IO06	23 (TP_RST)	CCM_EXT_CLK3						GPIO1_IO06
GPIO1_IO08	24 (DSI_EN)							GPIO1_IO08
GPIO1_IO15	25 (BL_PWM)	CCM_CLKO2	PWM4_OUT					GPIO1_IO15

4. Operating System

4.1 Host Operating System

a. Host OS:Ubuntu 18.04 64-bit or newer
b. Host Build System: Yocto Embedded Linux

4.2 Target Operating System

a. Board u-boot version: based on NXP v2018.03 i.MX U-Boot version
b. Board kernel version: based on NXP I.MX Linux L4.14.98-2.0.0_ga
c. UI framework: Qt version 5.11, Wayland
d. Embedded Linux Distribution: Sumo 2.5
e. Amazon AVS Device SDK V.1.1x
f. Support Sensory TrulyHandsfree Wake Word Engine 6.4.0
g. BSP: http://wiki.estonetech.com/wiki/EMB-2237-AI

4.3 U-boot Features

a. Support 5”, 7", 10" MIPI LCD panel option (models: 5” RK050BR62-CTG (RGB), 7” N070ICN-GB1(MIPI), 7” RK070BI43E(MIPI), 7” RK070CU01 (LVDS), 10.1” AUO B101UAN01.7 (MIPI)
b. Support external USB drive image update via u-boot with push button
c. Support MFG/UUU tool image update via OTG
d. Support I2C and USB touch panels

4.4 Kernel Features

a. Based on NXP I.MX Linux L4.14.98-2.0.0_ga
b. Support LVDS, MIPI, RGB LCD displays
c. Support analog speaker, digital audio interfaces
d. USB to Ethernet support (AX88772C)
e. WiFi/BT support (AP6212A SDIO)

4.5 Other OS Support

a. Android Android 9 based on i.MX Android™ P9.0.0_2.0.0-ga
b. Linux Debian 9
c. Mendel Linux (derivative of Debian) for TPU support

Refer to http://wiki.estonetech.com/wiki/EMB-2237-AI for instructions of building the file systems.