SOM-PH8800 Core Board
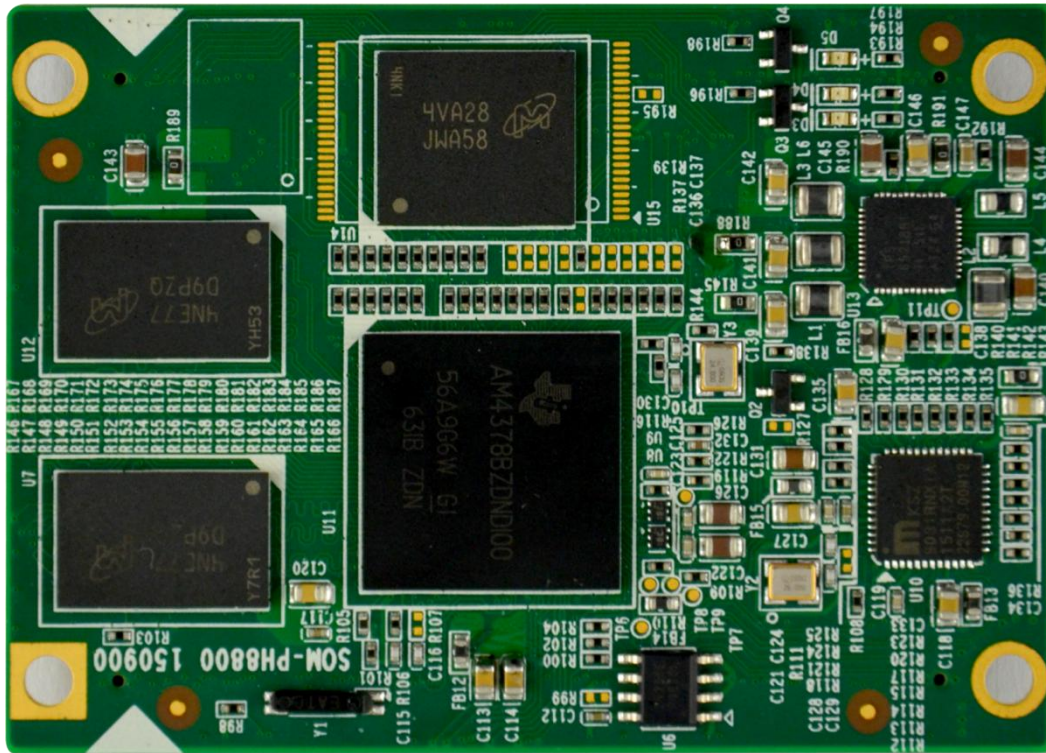

User Manual

Copyright Statement：

- The core board of SOM-PH8800 and related intellectual property owned by Shenzhen EMBEST Technology Co. Ltd.

- Shenzhen Embest Technology has the copyright of this document and reserves all rights. Any part of the document should not be modified, distributed or duplicated in any approach and form with the written permission issued by Embest Technology Co., Ltd.

Disclaimer：

- Shenzhen Embest Technology does not take warranty of any kind, either expressed or implied, as to the program source code, software and documents in the CD/DVD-ROMs provided along with the products, and including, but not limited to, warranties of fitness for a particular purpose; The entire risk as to the quality or performance of the program is with the user of products.

- Revision History：

Version	Updata Date	Describe
1.0		Original Version

Table of Contents

Chapter 1 Product Overview

1.1 Brief Introduction

SOM-PH8800 is developmented by EMBEST Technology Co., Ltd. Facing in medical instruments, industrial control, communications and other fields launched a core board based on Ti am437x .This processor integrates up to 1GHz ARM Cortex –A9 kernel and provides rich peripheral interfaces. Based on SOM-PH8800 extensions of the plate can provide a series of expansion interface, including network interface, audio input and output interface, USB, TF card interface, serial interface, SPI, IIC interface, CAN interface, RS485 interface, ADC interface, TFT screen output, touch screen and camera interface etc.

SOM - PH8800 has a very wide range of application scenarios, to meet, including gaming peripherals, home and industrial automation, consumer medical devices, printers, intelligent charging system, intelligent vending machines, weighing system, terminal education, toys, and so on, in all areas of different needs.

1.1.1 Packing List

1.1.2 Product Features

- **Electrical Features**
  - Operating temperature：0~70°C（commercial）、-40~85°C（Industrial）
  - Input voltage：5V
  - Operating humidity：20% ~ 90%（no condensation）
  - Mainboard size：70 mm×50 mm
  - PCB specifications：8 layer design
- **Processor Features**
  - 1000 MHz ARM Cortex™-A9 32-Bit RISC Microprocessor
    - NEON™ SIMD Coprocessor and Vector Floating Point (VFPv3) Coprocessor

- ■ 32KB of Both L1 Instruction and Data Cache

- ■ 256KB of L2 Cache or L3 RAM

- ● SGX530 Graphics Engine

- ● Programmable Real-Time Unit Subsystem and Industrial Communication

  Subsystem (PRU-ICSS)

- ● Real-Time Clock (RTC)

- ● **Onboard Memory：**

  - • 1GB DDR3 SDRAM

  - • 4GB eMMC Flash

  - • 32KB EEPROM

  - • 32MB QSPI Flash

- ● **Communication Interfaces：**

  - • With two 90Pin 1.27mm pitch connectors（including I^{2}C、SPI、CAN、UART、

    MMC、I^{2}S、LCD、Camera、RGMII、GPIO、Power signal and so on）

- ● **Debugging Interfaces**

  - • Support UART serial debugging

1.2 System Block Diagram

```
┌──────────┐           ┌─────────────────────┐           ┌──────────┐
│ 32KB     │   IIC0    │                     │   EMIF    │ 1GB      │
│ EEPROM   │◄────────► │                     │◄────────► │ DDR3L    │
│ Flash    │           │                     │           │ SDRAM    │
└──────────┘           │                     │           └──────────┘
                       │                     │
┌──────────┐           │                     │           ┌──────────┐
│ 1 PWR LED│  GPIOs    │                     │   GPMC    │ 512MB    │
│ 2 User LED│─────────►│                     │◄────────► │ Nand     │
└──────────┘           │       TI            │           │ Flash    │
                       │     AM4378          │           └──────────┘
┌──────────┐           │ Cortex(R)-A9 Processor│               OR
│ Gbit PHY │  RGMII1   │                     │   QSPI    ┌──────────┐
│ KSZ9031  │◄────────► │                     │─────────► │ 32MB     │
└──────────┘           │                     │           │ QSPI     │
                       │                     │           │ Flash    │
┌──────────┐           │                     │   MMC1    ┌──────────┐
│ PMIC     │ Power Rails│                    │─────────► │ 4GB      │
│ TPS65218 │◄────────► │                     │           │ eMMC     │
└──────────┘           └─────────────────────┘           │ Flash    │
                                                          └──────────┘
   GBE1   5V In                  IOs

┌──────────────────────────────────────────────────────────────────┐
│        PH180 Connector (45*2*2=90*2=180Pin 1.27MM)                 │
│   MMC0, MMC2, SPI2, SPI4, UART0, UART3, UART5, IIC1, IIC2, CAN0,   │
│   CAN1, CAM0, CAM1, GBE1, RGMII2, USB0, USB1, MCASP0, ADC0, LCD,   │
│   GPIOs, ...                                                       │
└──────────────────────────────────────────────────────────────────┘
```
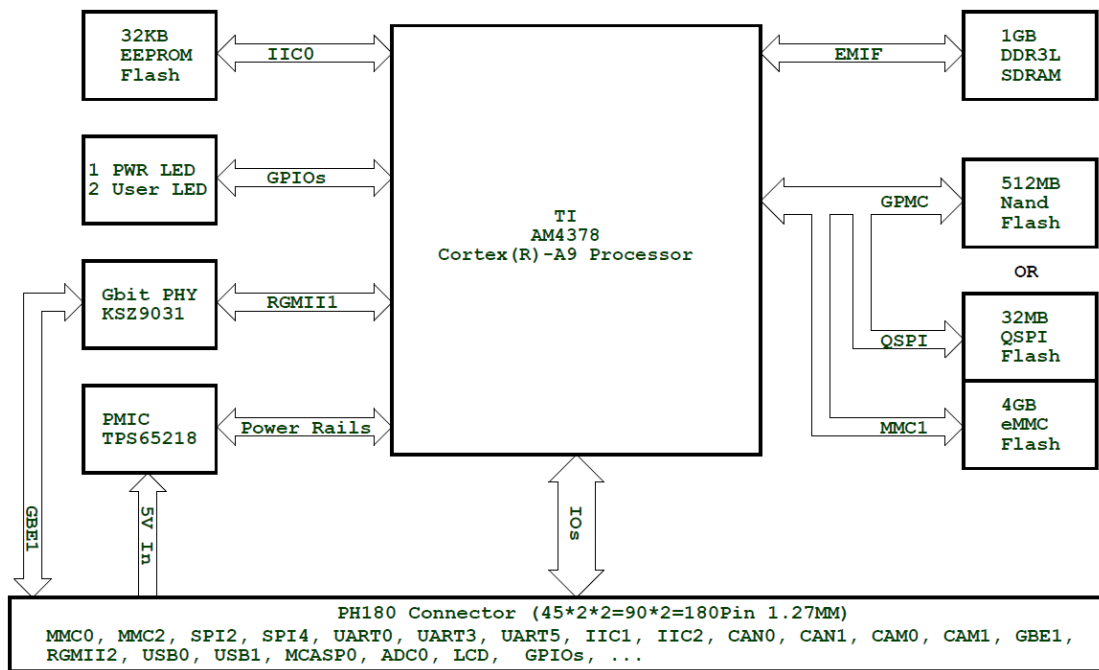
Figure 1-1 SOM-PH8800 System Block
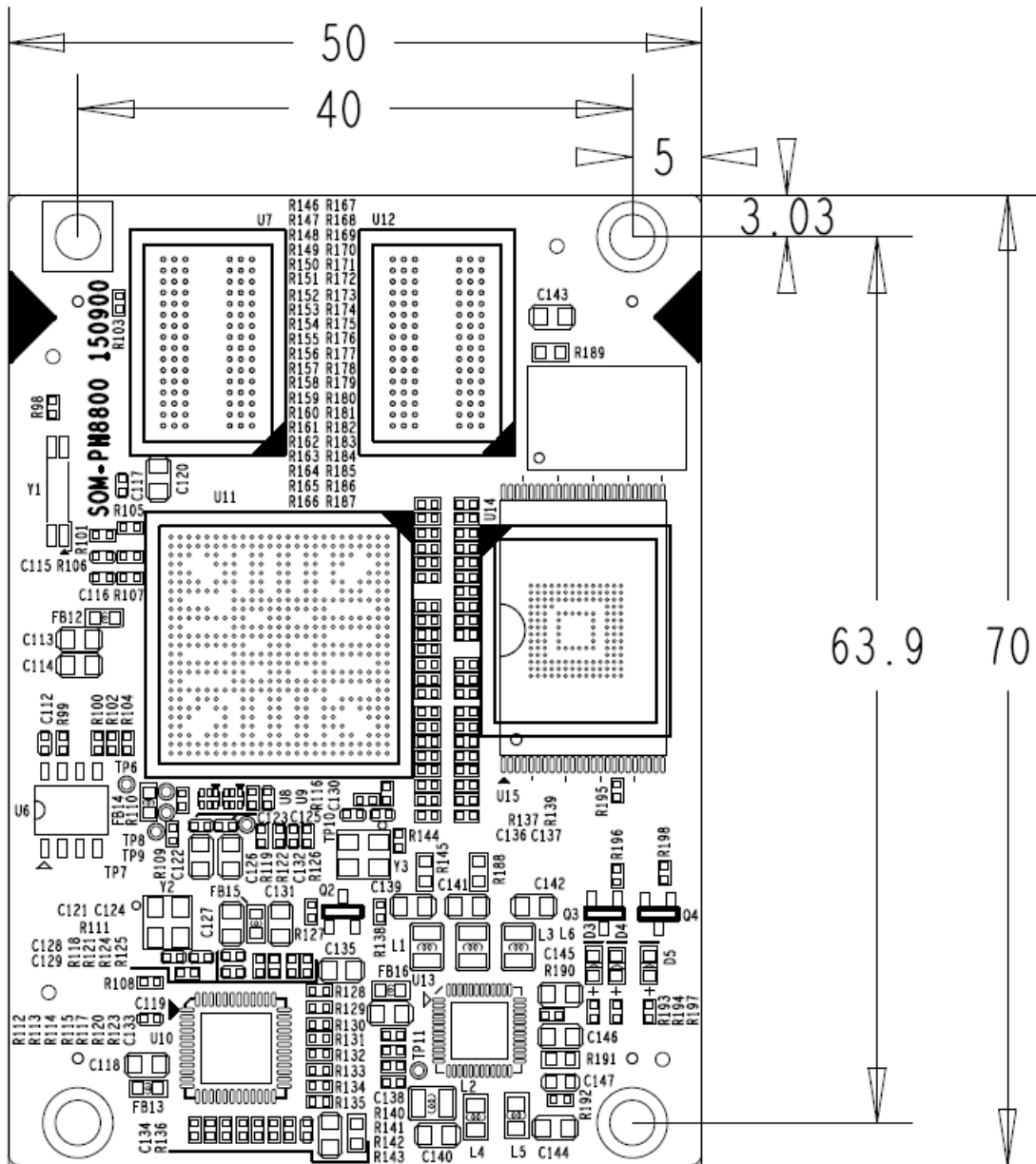
1.3 Product Dimensions (unit：mm)

Figure 1-2 Product Dimensions

Chapter 2 Introduction to Hardware System

This chapter will introduce in detail the structure, expansion and peripheral interfaces of SOM-PH8800 hardware system.

2.1 Overview of CPU

TI AM437x has a high performance processor based on ARM Cortex –A9 kernel.

The processor has enhanced 3D graphics acceleration function, can achieve a rich graphical user interface, a coprocessor for deterministic real-time processing, such as industrial communication protocols EtherCAT, PROFIBUS, EnDat and so on.

These devices support system for the lower performance of ARM kernel upgrade, and provide updated peripherals, including QSPI-NOR and LPDDR2 memory.

The processor contains the subsystem shown in Figure 2-1, and a brief description of each subsystem is given below.

ARM based on Cortex-A9 kernel processor subsystem, POWERVR SGX graphics accelerator subsystem provides 3D graphics acceleration function to support the display and advanced user interface.

The Programmable Real-Time Unit Subsystem and Industrial Communication Subsystem (PRU-ICSS) is separate from the ARM core, allowing independent operation and clocking for greater efficiency and flexibility, in order to achieve higher efficiency and flexibility.PRU-ICSS support more peripheral interface and EtherCAT、PROFINET、Ethernet/IP、PROFIBUS、Ethernet Powerlink、SERCOS、EnDat、real time protocol.

The PRU-ICSS enables additional peripheral interfaces and real-time protocols such as EtherCAT, PROFINET, EtherNet/IP, PROFIBUS, Ethernet Powerlink, Sercos, and others. Additionally, the programmable nature of the PRU-ICSS, along with its access to pins, events and all system-on-chip (SoC) resources, provides flexibility in implementing fast, real-time responses, specialized data handling operations, custom peripheral interfaces, and in offloading tasks from the other processor cores of SoC.

High performance interconnection for multiple initiator to provide internal and external memory controller and high bandwidth data on transmission. The device also provides the clock with comprehensive management mechanism.

An on-chip analog-to-digital converter (ADC0) can be combined with the display subsystem, providing integrated touch screen solutions. Another ADC (ADC1) can be combined with the pulse width module, create a closed-loop motor control solution.

Real time clock (RTC) provides a separate power domain base of the clock, and the clock can achieve the clock battery backup reference benchmark.

Camera interface providing parallel port configuration for single camera or dual camera.

Each AM437x device has acceleration and encryption functions, also can realize safe boot to prevent illegal cloning and software updates.
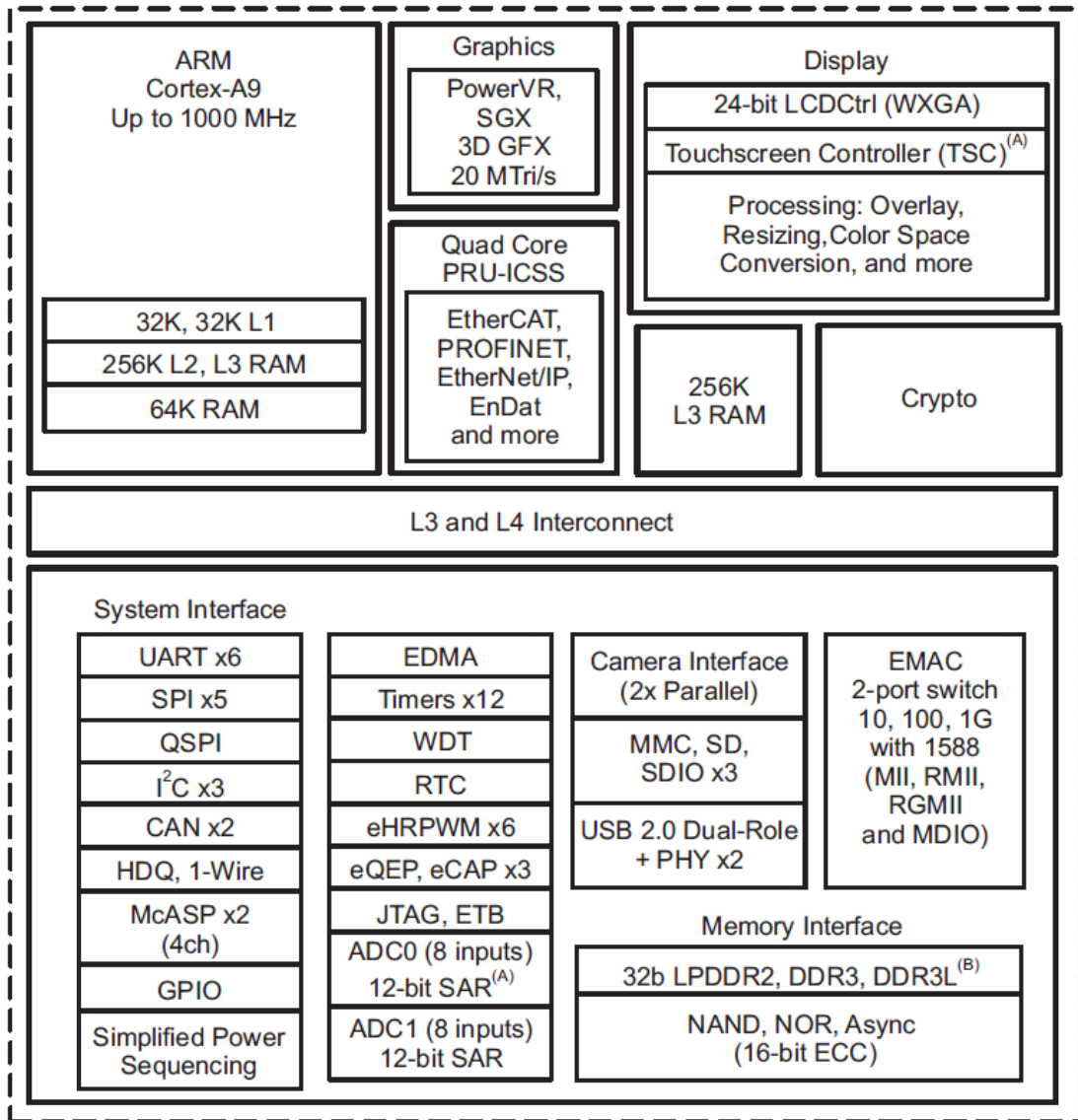
Figure 2-1 Functional Block Diagram

2.2 Introduction of Peripheral Chips

2.2.1   DDR3

AM437x provides a memory controller for expanding external dynamic storage space. SOM-PH8800 board extended 2 Micron DDR3 particles (MT41K256M16HA-125), can provide 1GB RAM access to external space.

2.2.2   EMMC Flash

AM437x provides three routes MMC interfaces, supporting memory card and eMMC memory, and SOM-PH8800 board a size of 4GB eMMC Flash.

2.2.3   KSZ9031

Low power consumption KSZ9031, high performance Ethernet PHY chip.It has integrated the 10 / 100 / 1000 Mbit transceiver. It is single port 10 / 100 / 1000 Mbps triple speed Ethernet PHY, and support MAC.TM RGMII interface.

2.2.4   EEPROM

SOM-PH8800 has a 32KB EEPROM, and the type is CAT24C256W. As a non-volatile memory, the memory can be used to store some important information, such as card configuration information.

2.2.5   QSPI Flash

SOM-PH8800 has a QSPI Flash of 32MB, N25Q256A13EF840. It can be used as high-speed storage devices, and can also be used as a boot disk.

If the QSPI Flash has been updated with Image, the SOM-PH8800 will boot the system from the Flash default, and we can get detailed introduction with the software manual.

2.2.6   LED

SOM-PH8800 built three green LEDs, the D5 is 3.3V power LED, indicated that the system power on; D3 and D4 can be programmable with GPIO defined by users.

2.3   POWER Distribution

SOM-PH8800 has a TPS65218 power management chip designed for TI AM437x and AM335x as a high-performance PMIC, which contains multiple output powers used to provide the various powers of AM437x.

Only 5V power and RTC battery (3V) are needed to supply for SOM-PH8800 from the base board.Other power will be suppled by the PMIC, about the IO level ,except for special signal (such as USB, GBE etc.), the other is 3.3V level.

2.4 Details of Interfaces

SOM-PH8800 has two 1.27mm 90Pin connectors（as shown in Figure 2-2 J1 and J2）to extend, including take power from the outside,and allocate the CPU pin resource.
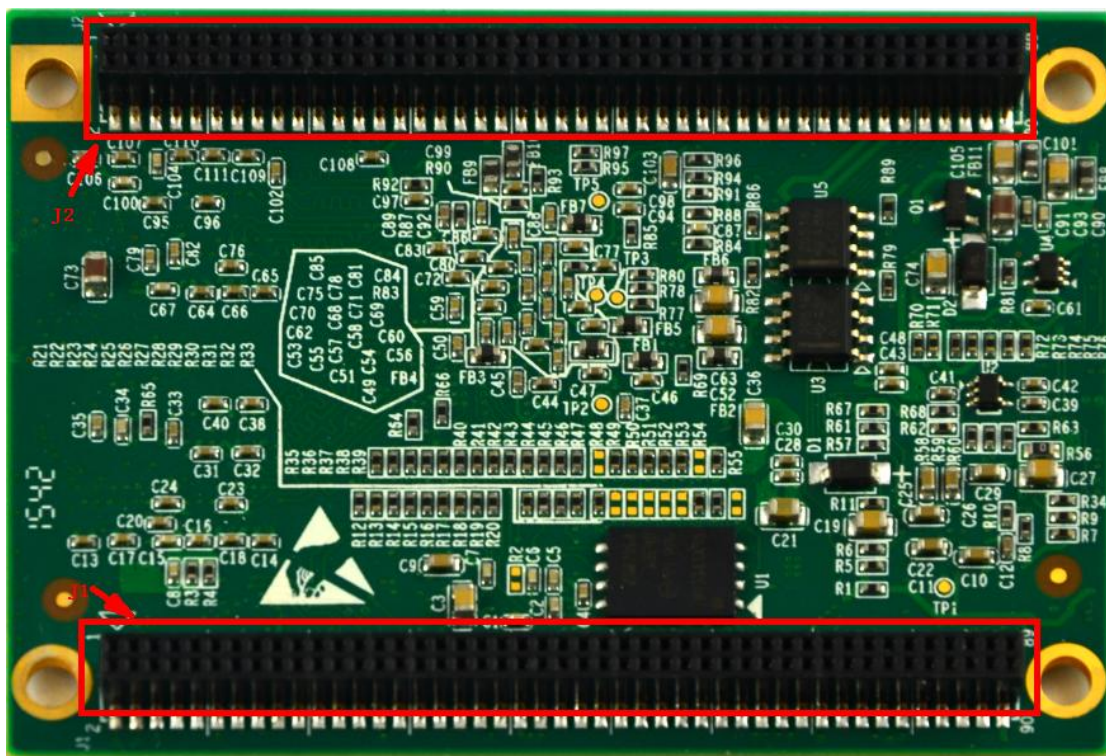

Figure 2-2

The definition of two1.27mm 90Pin connectors as follows:

Table 2-1 J1

Pin No.	Net Name	Description	Voltage	Pin Out
1	WAKEUP	Wake Up Signal for PMIC	1.8V	AE3
3	MCASP0_AHCLKX	McASP Transmit Master Clock	3.3V	L24
5	MCASP0_FSX	McASP Transmit Frame Sync	3.3V	N22
7	MCASP0_AHCLKR	McASP Receive Master Clock	3.3V	M24
9	MCASP0_FSR	McASP Receive Frame Sync	3.3V	K23
11	VDDA_ADC	Supply Voltage For ADC	1.8V	AD14/AB12
13	ADC0_AIN0	Analog Input/Output	1.8V	AA12
15	ADC0_AIN2	Analog Input/Output	1.8V	Y13

17	GNDA_ADC	Ground For ADC	0	--
19	ADC0_AIN5	Analog Input/Output	1.8V	AC13
21	CAM1_DATA0	Camera data	3.3V	AB20
23	CAM1_DATA1	Camera data	3.3V	AC21
25	CAM1_DATA8	Camera data	3.3V	AD24
27	CAM1_DATA9	Camera data	3.3V	AC24
29	GPIO1_28	GPIO	3.3V	A3
31	BEEP_GPIO0_4	GPIO For Beep Output	3.3V	A12
33	GND	Ground	0	--
35	LCD_DATA0	LCD Data Bus	3.3V	B22
37	LCD_DATA1	LCD Data Bus	3.3V	A21
39	LCD_DATA2	LCD Data Bus	3.3V	B21
41	LCD_DATA3	LCD Data Bus	3.3V	C21
43	LCD_DATA4	LCD Data Bus	3.3V	A20
45	LCD_DATA5	LCD Data Bus	3.3V	B20
47	LCD_DATA6	LCD Data Bus	3.3V	C20
49	LCD_DATA7	LCD Data Bus	3.3V	E19
51	LCD_DATA8	LCD Data Bus	3.3V	A19
53	LCD_DATA9	LCD Data Bus	3.3V	B19
55	LCD_DATA10	LCD Data Bus	3.3V	A18
57	LCD_HSYNC	LCD Horizontal Sync	3.3V	A23
59	LCD_VSYNC	LCD Vertical Sync	3.3V	B23
61	GND	Ground	0	--
63	LCD_PCLK	LCD Clock	3.3V	A22
65	GND	Ground	0	--
67	RGMII2_TXCTL	RGMII Transmit Control	3.3V	C3
69	RGMII2_RXCTL	RGMII Receive Control	3.3V	C5
71	RGMII2_TXD2	RGMII Transmit Data Bit2	3.3V	A4
73	RGMII2_TXD0	RGMII Transmit Data Bit0	3.3V	E7
75	RGMII2_RXCLK	RGMII Receive Clock	3.3V	F6
77	RGMII2_RXD2	RGMII Receive Data Bit2	3.3V	B4
79	RGMII2_RXD0	RGMII Receive Data Bit0	3.3V	D8
81	MMC2_CMD/ CAM1_DATA3	MMC/SD/SDIO Command/ Camera data	3.3V	AE22
83	MMC2_DAT1/ CAM1_DATA5	MMC/SD/SDIO Data Bus/ Camera data	3.3V	AE23
85	MMC2_DAT3/ CAM1_DATA7	MMC/SD/SDIO Data Bus/ Camera data	3.3V	AE24
87	CAM1_VD	CCD Data Vertical Detect	3.3V	AC23
89	GND	Ground	0	--

Table 2-2 J1

Pin No.	Net Name	Description	Voltage	Pin Out
2	PORZn	Power on Reset	3.3V	Y23
4	SYS_RESETn	Warm Reset Input/Output	3.3V	G22
6	MCASP0_ACLKX	McASP Transmit Bit Clock	3.3V	N24
8	MCASP0_ACLKR	McASP Receive Bit Clock	3.3V	L23
10	MCASP0_AXR0	McASP Serial Data	3.3V	H23
12	MCASP0_AXR1	McASP Serial Data	3.3V	M25
14	ADC0_AIN1	Analog Input/Output	1.8V	Y12
16	ADC0_AIN3	Analog Input/Output	1.8V	AA13
18	ADC0_AIN4	Analog Input/Output	1.8V	AB13
20	ADC0_AIN6	Analog Input/Output	1.8V	AD13
22	ADC0_AIN7	Analog Input/Output	1.8V	AE13
24	GND	Ground	0	--
26	CLKOUT2	Clock out2	3.3V	C24
28	CLKOUT1	Clock out1	3.3V	D24
30	GND	Ground	0	--
32	LCD_DATA11	LCD Data Bus	3.3V	B18
34	LCD_DATA12	LCD Data Bus	3.3V	C19
36	LCD_DATA13	LCD Data Bus	3.3V	D19
38	LCD_DATA14	LCD Data Bus	3.3V	C17
40	LCD_DATA15	LCD Data Bus	3.3V	D17
42	GND	Ground	0	--
44	LCD_DE	LCD AC Bias Enable Chip Select	3.3V	A24
46	LCD_DATA16	LCD Data Bus	3.3V	A11
48	LCD_DATA17	LCD Data Bus	3.3V	B11
50	LCD_DATA18	LCD Data Bus	3.3V	C11
52	LCD_DATA19	LCD Data Bus	3.3V	E11
54	LCD_DATA20	LCD Data Bus	3.3V	D11
56	LCD_DATA21	LCD Data Bus	3.3V	F11
58	LCD_DATA22	LCD Data Bus	3.3V	A10
60	LCD_DATA23	LCD Data Bus	3.3V	B10
62	CAN1_RX	DCAN1 Receive Data	3.3V	J25
64	CAN1_TX	DCAN1 Transmit Data	3.3V	L25
66	I2C2_SCL	I2C2 Clock	3.3V	T22
68	I2C2_SDA	I2C2 Data	3.3V	P23
70	RGMII2_TXD3	RGMII Transmit Data Bit3	3.3V	C6
72	RGMII2_TXD1	RGMII Transmit Data Bit1	3.3V	D7
74	RGMII2_TXCLK	RGMII Transmit Clock	3.3V	E8
76	RGMII2_RXD3	RGMII Receive Data Bit3	3.3V	F7
78	RGMII2_RXD1	RGMII Receive Data Bit1	3.3V	G8

80	MMC2_CLK/ CAM1_DATA2	MMC/SD/SDIO Clock/ Camera data	3.3V	AD21
82	MMC2_DAT0/ CAM1_DATA4	MMC/SD/SDIO Data Bus/ Camera data	3.3V	AD22
84	MMC2_DAT2/ CAM1_DATA6	MMC/SD/SDIO Data Bus/ Camera data	3.3V	AD23
86	CAM1_HD	CCD Data Horizontal Detect	3.3V	AD25
88	CAM1_PCLK	CCD Data Pixel Clock	3.3V	AE21
90	GND	Ground	0	--

Table 2-3 J2

Pin No.	Net Name	Description	Voltage	Pin Out
1	EXT_VRTC	3V Power for RTC	3V	TPS65218
3	MMC0_DAT0	MMC/SD/SDIO Data Bus Bit0	3.3V	C1
5	MMC0_DAT1	MMC/SD/SDIO Data Bus Bit1	3.3V	C2
7	MMC0_DAT2	MMC/SD/SDIO Data Bus Bit2	3.3V	B2
9	MMC0_DAT3	MMC/SD/SDIO Data Bus Bit3	3.3V	B1
11	GND	Ground	0	--
13	SPI2_SCLK	SPI Clock	3.3V	N20
15	SPI2_D0	SPI Data	3.3V	P22
17	UART0_RXD	UART Receive Data	3.3V	K25
19	UART0_TXD	UART Transmit Data	3.3V	J24
21	UART1_RXD	UART Receive Data	3.3V	K21
23	UART1_TXD	UART Transmit Data	3.3V	L21
25	CAN0_RX	DCAN0 Receive Data	3.3V	L22
27	CAN0_TX	DCAN0 Transmit Data	3.3V	K22
29	I2C1_SDA	I2C1 Data	3.3V	T21
31	I2C1_SCL	I2C1 Clock	3.3V	T20
33	GND	Ground	0	--
35	CAM0_DATA0	Camera data	3.3V	AE18
37	CAM0_DATA2	Camera data	3.3V	Y18
39	CAM0_DATA4	Camera data	3.3V	AE19
41	CAM0_DATA6	Camera data	3.3V	AE20
43	CAM0_DATA8	Camera data	3.3V	AB19
45	GND	Ground	0	--
47	CAM0_FIELD	CCD Data Field Indicator	3.3V	AC18
49	CAM0_WEN	CCD Data Write Enable	3.3V	AD17
51	GBE1_LED_LINK	GBE Link Indicator	3.3V	KSZ9031
53	GBE1_LED_ACT	GBE ACT Indicator	3.3V	KSZ9031
55	GND	Ground	0	--

57	GBE1_TRP2	GBE Data Plus	--	KSZ9031
59	GBE1_TRN2	GBE Data Minus	--	KSZ9031
61	GBE1_TRP3	GBE Data Plus	--	KSZ9031
63	GBE1_TRN3	GBE Data Minus	--	KSZ9031
65	GND	Ground	0	--
67	USB0_DM	USB0 Data Minus	--	W24
69	USB0_DP	USB0 Data Plus	--	W25
71	GND	Ground	0	--
73	USB1_DM	USB1 Data Minus	--	V25
75	USB1_DP	USB0 Data Plus	--	V24
77	GND	Ground	0	--
79	SPI4_SCLK	SPI Clock	3.3V	P25
81	SPI4_D0	SPI Data	3.3V	R24
83	SPI4_D1	SPI Data	3.3V	P24
85	SPI4_CS0	SPI Chip Select	3.3V	N25
87	GND	Ground	0	--
89	VDD_5V	5V Power Supply	5V	--

Table 2-4 J2

Pin No.	Net Name	Description	Voltage	Pin Out
2	PB_PWRON	Push-Button Monitor Input	3.3V	TPS65218
4	WARM_RESETn	CPU Reset Signal Input and output	3.3V	G22
6	MMC0_CMD	MMC/SD/SDIO Command	3.3V	D2
8	MMC0_SDCD	SD Card Detect	3.3V	R25
10	MMC0_CLK	MMC/SD/SDIO Clock	3.3V	D1
12	SPI2_CS0	SPI Chip Select	3.3V	T23
14	SPI2_D1	SPI Data	3.3V	P20
16	UART3_RXD	UART Receive Data	3.3V	H25
18	UART3_TXD	UART Transmit Data	3.3V	H24
20	UART3_RTS	UART Request to Send	3.3V	K24
22	UART3_CTS	UART Clear to Send	3.3V	H22
24	UART5_RXD	UART Receive Data	3.3V	D16
26	UART5_TXD	UART Transmit Data	3.3V	A16
28	UART5_RTS	UART Request to Send	3.3V	B13
30	UART5_CTS	UART Clear to Send	3.3V	B14
32	GND	Ground	0	--
34	CAM0_DATA1	Camera data	3.3V	AB18
36	CAM0_DATA3	Camera data	3.3V	AA18
38	CAM0_DATA5	Camera data	3.3V	AD19

40	CAM0_DATA7	Camera data	3.3V	AD20
42	CAM0_DATA9	Camera data	3.3V	AA19
44	CAM0_DATA10	Camera data	3.3V	AC25
46	CAM0_DATA11	Camera data	3.3V	AB25
48	GND	Ground	3.3V	--
50	CAM0_PCLK	CCD Data Pixel Clock	3.3V	AC20
52	GND	Ground	0	--
54	CAM0_HSYNC	CCD Data Horizontal Detect	3.3V	AE17
56	CAM0_VSYNC	CCD Data Vertical Detect	3.3V	AD18
58	GND	Ground	0	--
60	GBE1_TRP0	GBE Data Plus	--	KSZ9031
62	GBE1_TRN0	GBE Data Minus	--	KSZ9031
64	GBE1_TRP1	GBE Data Plus	--	KSZ9031
66	GBE1_TRN1	GBE Data Minus	--	KSZ9031
68	GND	Ground	0	
70	ETH_MDIO_CLK	MDIO Clk	3.3V	B17
72	ETH_MDIO_DATA	MDIO Data	3.3V	A17
74	USB0_ID	USB0 ID	--	U24
76	USB0_VBUS	USB0 VBUS	5V	U23
78	USB1_VBUS	USB1 VBUS	5V	T25
80	LCD_PWM	LCD Backlight PWM Output	3.3V	G24
82	BOOT_SEL	Boot Select Input	3.3V	B21
84	PB_INTERRUPT	External Interrupt to ARM Cortex-A9 core	3.3V	G25
86	USB1_ID	USB1 ID	--	U25
88	GND	Ground	3.3V	--
90	VDD_5V	5V Power Supply	5V	--

Technical Support and Warranty

Technical Support

Embest Technology provides its product with one-year free technical support including:

- Providing software and hardware resources related to the embedded products of Embest Technology;

- Helping customers properly compile and run the source code provided by Embest Technology;

- Providing technical support service if the embedded hardware products do not function properly under the circumstances that customers operate according to the instructions in the documents provided by Embest Technology;

- Helping customers troubleshoot the products.

The following conditions will not be covered by our technical support service. We will take appropriate measures accordingly:

- Customers encounter issues related to software or hardware during their development process;

- Customers encounter issues caused by any unauthorized alter to the embedded operating system;

- Customers encounter issues related to their own applications

- Customers encounter issues caused by any unauthorized alter to the source code provided by Embest Technology.

Warranty Conditions

1） 12-month free warranty on the PCB under normal conditions of use since the sales of the product;

2） The following conditions are not covered by free services; Embest Technology will charge accordingly:

● Customers fail to provide valid purchase vouchers or the product identification tag is damaged, unreadable, altered or inconsistent with the products;

● Not according to the user's manual operation causes damage to the product;

● Products are damaged in appearance or function caused by natural disasters (flood, fire, earthquake, lightning strike or typhoon) or natural aging of components or other force majeure;

● Products are damaged in appearance or function caused by power failure, external forces, water, animals or foreign materials;

● Products malfunction caused by disassembly or alter of components by customers or, products disassembled or repaired by persons or organizations unauthorized by Embest Technology, or altered in factory specifications, or configured or expanded with the components that are not provided or recognized by Embest Technology and the resulted damage in appearance or function;

● Product failures caused by the software or system installed by customers or inappropriate settings of software or computer viruses;;

● Products purchased from unauthorized sales;

● Warranty (including verbal and written) that is not made by Embest Technology and not included in the scope of our warranty should be fulfilled by the party who committed. Embest Technology has no any responsibility;

3） Within the period of warranty, the freight for sending products from customers to Embest Technology should be paid by customers; the freight from Embest to customers should be paid by us. The freight in any direction occurs after warranty period should be paid by customers;

4） Please contact technical support if there is any repair request.

Note：
📖 Embest Technology will not take any responsibility on the products sent back without the permission of the company.

Contact Information

Technical Support
Tel：+86-755-25635626-872/875/897
Email：support@embest-tech.com

Sales Information
Tel：+86-755-25635626-860/861/862
Fax：+86-755-25616057
Email：chinasales@embest-tech.com

Company Information
Wabsite：http://www.embest-tech.cn
Address：Tower B 4/F,Shanshui Building,Nanshan Yungu Innovation Industry Park,Liuxian Ave.No.1183,Nanshan District,Shenzhen,Guangdong,China