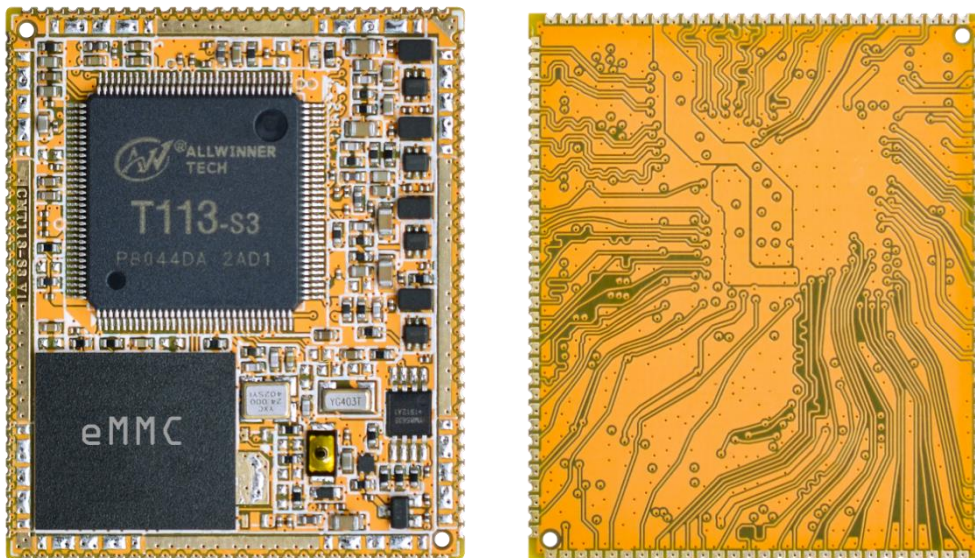


# *CMT113 Reference User Manual*

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**V1. 202410**



**Boardcon Embedded Design**

[www.armdesigner.com](http://www.armdesigner.com)

## **1. Introduction**

### **1.1. About this Manual**

This manual is intended to provide the user with an overview of the board and benefits, complete features specifications, and set up procedures. It contains important safety information as well.

### **1.2. Feedback and Update to this Manual**

To help our customers make the most of our products, we are continually making additional and updated resources available on the Boardcon website ([www.boardcon.com](http://www.boardcon.com) , [www.armdesigner.com](http://www.armdesigner.com)).

These include manuals, application notes, programming examples, and updated software and hardware. Check in periodically to see what's new!

When we are prioritizing work on these updated resources, feedback from customers is the number one influence, If you have questions, comments, or concerns about your product or project, please no hesitate to contact us at [support@armdesigner.com](mailto:support@armdesigner.com).

### **1.3. Limited Warranty**

Boardcon warrants this product to be free of defects in material and workmanship for a period of one year from date of buy. During this warranty period Boardcon will repair or replace the defective unit in accordance with the following process:

A copy of the original invoice must be included when returning the defective unit to Boardcon. This limited warranty does not cover damages resulting from lightning or other power surges, misuse, abuse, abnormal conditions of operation, or attempts to alter or modify the function of the product.

This warranty is limited to the repair or replacement of the defective unit. In no event shall Boardcon be liable or responsible for any loss or damages, including but not limited to any lost profits, incidental or consequential damages, loss of business, or anticipatory profits arising from the use or inability to use this product.

Repairs make after the expiration of the warranty period are subject to a repair charge and the cost of return shipping. Please contact Boardcon to arrange for any repair service and to obtain repair charge information.



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# 1 CMT113 Introduction

## 1.1 Summary

The CMT113 system-on-module is equipped with Allwinner's T113 Dual-core Cortex-A7, HiFi4 DSP and embedded with 128MB DDR3. It is designed specifically for the smart control and display devices such as industrial controller and automotive devices. The low cost and low power solution can help customers to introduce new technologies more quickly and enhance the overall solution efficiency.

In especial, T113 is support 1080p@60bps encode and decode processing.

## 1.2 Features

- **Microprocessor**

- Dual-core Cortex-A7 up to 1.2G
- 32KB L1 I-cache, 32KB L1 D-cache per Core, 256KB L2 cache
- HiFi4 Audio DSP
- 32KB I-cache, 32KB D-cache, 64KB I-ram, 64KB D-ram

**Memory Organization**

- 128MB DDR3 in chip
- EMMC up to 64GB

- **Boot ROM**

- Supports system code download through USB OTG

- **Security ID**

- 2Kbit OTP e-Fuse

- **Video Decoder/Encoder**

- Supports video decoding up to 1080p@60fps
- Supports H.264/265 decode
- JPEG/MJPEG encoding up to 1080p@60fps

- **Display Subsystem**

- **Video Output**

Supports 4-lane MIPI DSI up to 1920x1200@60fps

Supports LVDS interface Dual link up to 1920x1080@60fps and Single link up to 1366x768@60fps

Supports RGB interface up to 1920x1080@60fps

Supports BT656 interface for PAL/NTSC

Supports Serial RGB interface up to 800x480@60fps

One CVBS out with 10bits DAC

- **Video input**

Supports 8bit parallel input interfaces

Supports BT656/601 interface

Two channel CVBS input with 10bits ADC

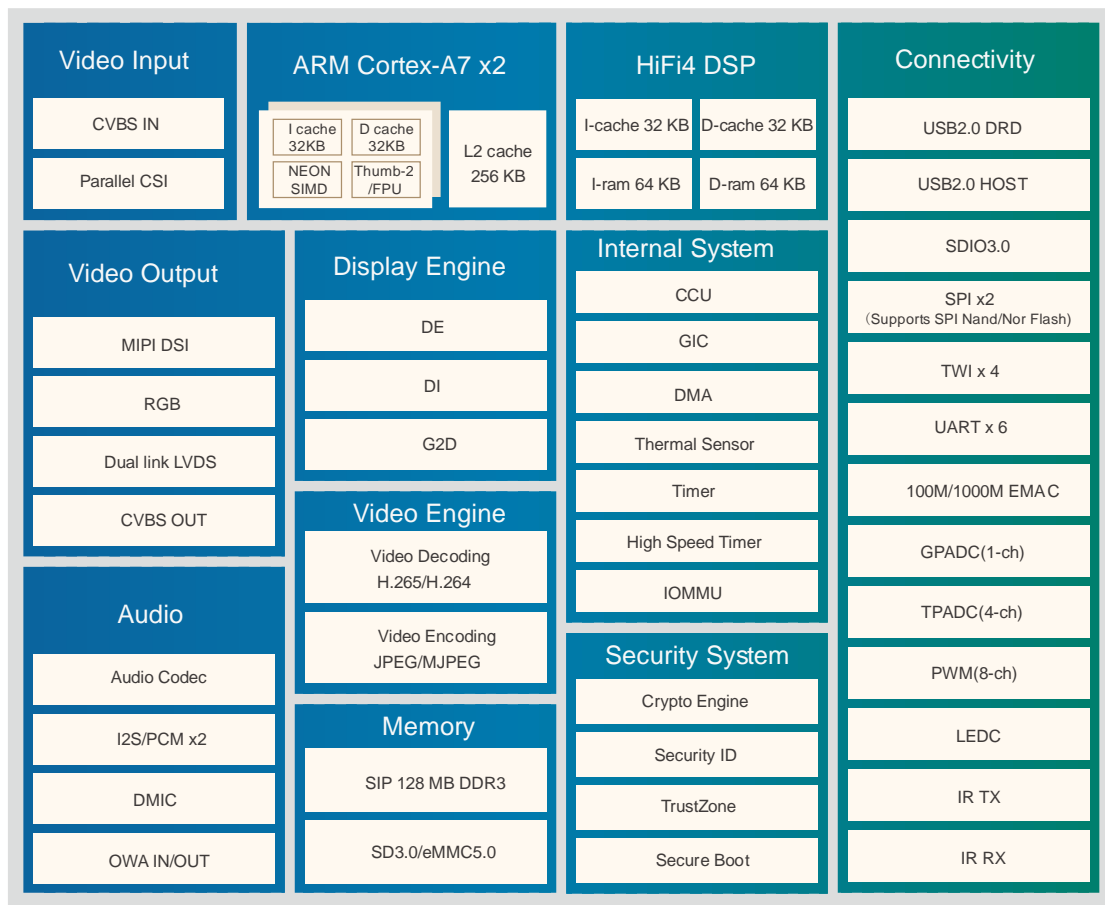


- **Analog audio**
  - One stereo headphone output
  - Two stereo Line input
  - One differential or single-end MIC input
- **I2S/PCM/ AC97**
  - Support 2-ch I2S/PCM interface
  - Support up to 8-CH DMIC
  - Support 1-ch SPDIF input and 1-ch SPDIF output
- **USB**
  - Two USB 2.0 interfaces
  - One USB DRD and One USB host interface
- **Ethernet**
  - One Ethernet interface
  - Support GMAC or EMAC interface
- **I2C**
  - Up to 4-ch I2Cs
  - Support standard mode and fast mode(up to 400kbit/s)
- **SPI**
  - One SPI controllers
  - Full-duplex synchronous serial interface
  - 4 or 6-wire mode
  - Support DBI mode for display bus
- **UART**
  - Up to 6 UART controllers
  - UART0 default for debug
  - Compatible with industry-standard 16450/16550 UARTs
  - Support RS485 mode on 4 wires UARTs
- **CAN**
  - Support CAN2.0A/B protocol
  - Support listen-only mode
- **CIR**
  - One CIR RX controllers
  - Flexible receiver for consumer IR remote control
  - One CIR TX controllers
  - 128 bytes FIFO
- **ADC**
  - One channel ADC input
  - 12-bit resolution
  - Voltage input range between 0V to 1.8V
- **RTP ADC**
  - 12-bit SAR type ADC
  - Voltage input range between 0V to 1.8V
  - Support 4-wire resistive TP
  - Support 4-ch Aux ADC input

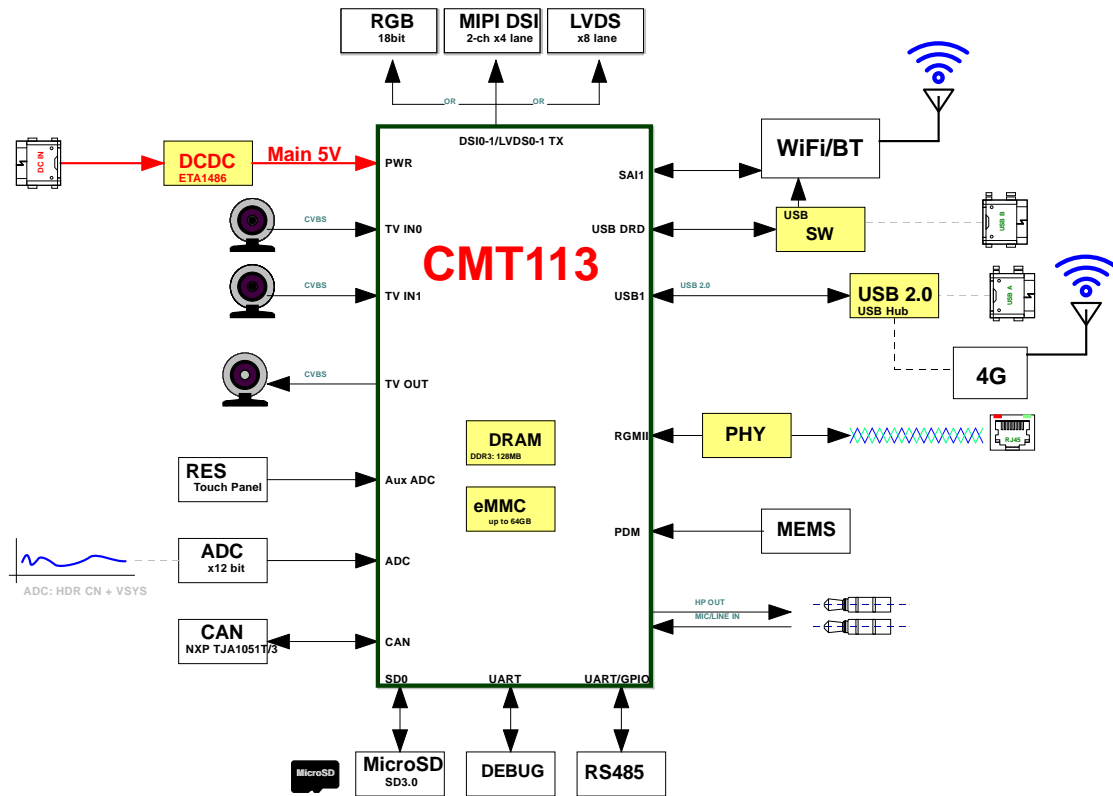
- **PWM**
  - Up 8 PWM channels and 4 PWM controllers
  - up to 24/100MHz output frequency
  - Minimum resolution is 1/65536
- **Interrupt Controller**
  - Support max **23** interrupts
- **Power unit**
  - Discrete Power on board, Single power (5V) input.
  - DCDC 3.3V and 1.8V output(max: 500mA)
  - Audio analog Power standalone input (1V8)
  - Very low RTC consume current, less 5uA at 3V button Cell
- **Temperature**
  - Industrial grade, Operating temperature: -40 ~ 85°C
  - Automotive grade, Operating temperature: -40 ~ 125°C

## 1.3 Block Diagram

### 1.3.1 T113 Block Diagram



### 1.3.2 Development board (EMT113) Block Diagram



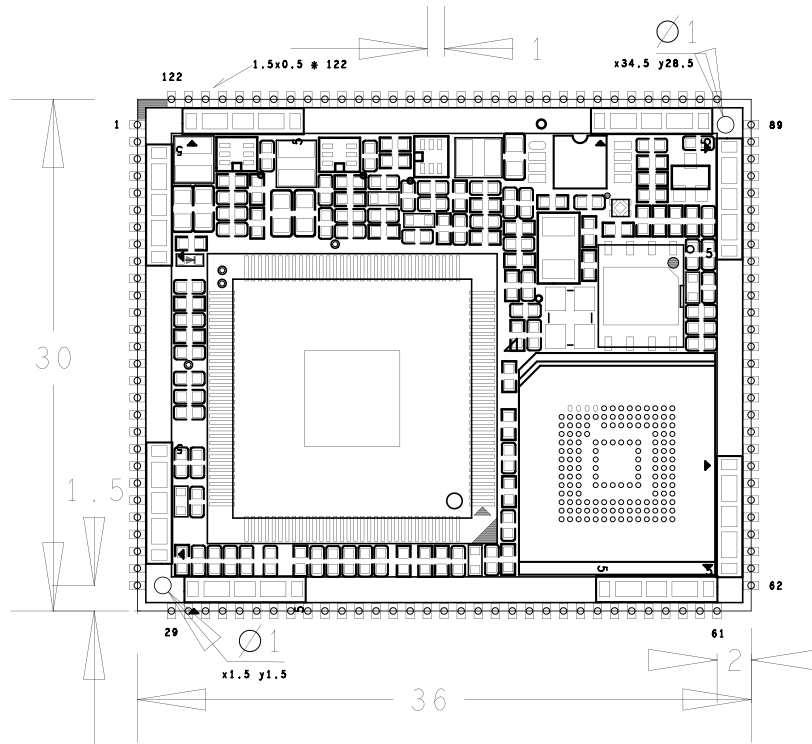
### 1.4 CMT113 specifications

Feature	Specifications
CPU	Dual-core Cortex-A7
DDR	128MB DDR3
eMMC FLASH	8GB (up to 64GB)
Power	DC 5V
LVDS LCD	1CH up to dual LVDS
-DSI LCD	1CH 4-Lane MIPI (option)
-RGB LCD	1CH LCD(24bit) (option)
I2S	2-CH
DVP Camera	1-CH
USB	1-CH Host, 1-CH DRD(OTG 2.0)
Ethernet	1 RGMII/RMII interface
SDMMC/SDIO	2-CH
SPDIF RX/TX	1-CH
I2C	4-CH
SPI	1-CH
CAN	1-CH



Feature	Specifications
UART	5-CH, 1-CH(DEBUG)
PWM	8-CH
ADC IN	1-CH and 4-CH Aux
Board Dimension	36 x 30mm

## 1.5 CMT113 PCB Dimension



--Top View--





## 1.6 CMT113 Pin Definition



Pin	Signal	Description	Alternate functions	IO Voltage
1	VCC_SYS	Main Power input		3.4V-5.5V
2	VCC_SYS	Main Power input		3.4V-5.5V
3	VCC_SYS	Main Power input		3.4V-5.5V
4	PWEN	Power ON/OFF Control		3.4V-5.5V
5	GND	Ground		0V
6	GND	Ground		0V
7	SOC_3V3	3.3V Power output		3.3V
8	SOC_1V8	1.8V Power output		1.8V
9	GND	Ground		0V
Pin	Signal	Description	Alternate functions	IO Voltage
10	PD10/LCD0-D14/LVDS1-V0P/SPI1-CS&DBI-CSX	LVDS1 out or PWM6	PD-EINT10	0.6V/3.3V
11	PD11/LCD0-D15/LVDS1-V0N/SPI1-CLK&DBI-SCLK	LVDS1 out or UART3_TX	PD-EINT11	0.6V/3.3V
12	PD12/LCD0-D18/LVDS1-V1P/SPI1-MOSI&DBI-SDO	LVDS1 out or UART3_RX	PD-EINT12	0.6V/3.3V
13	PD13/LCD0-D19/LVDS1-V1N/SPI1-MISO&DBI-SDI&DBI-TE&DBI-DCX	LVDS1 out or TWI0_SDA	PD-EINT13	0.6V/3.3V
14	PD14/LCD0-D20/LVDS1-V2P/SPI1-HOLD&DBI-DCX&DBI-WRX	LVDS1 out or UART3_CTS	PD-EINT14	0.6V/3.3V
15	PD15/LCD0-D21/LVDS1-V2N/SPI1-WP&DBI-TE	LVDS1 out or IR_RX	PD-EINT15	0.6V/3.3V
16	PD16/LCD0-D22/LVDS1-CKP/DMIC-DATA3/PWM0	LVDS1 out or GPIO	PD-EINT16	0.6V/3.3V



17	PD17/LCD0-D23/LVDS1-CKN/DMIC-DATA2/PWM1	LVDS1 out or GPIO	PD-EINT17	0.6V/3.3V
18	PD18/LCD0-CLK/LVDS1-V3P/DMIC-DATA1/PWM2	LVDS1 out or GPIO	PD-EINT18	0.6V/3.3V
19	PD19/LCD0-DE/LVDS1-V3N/DMIC-DATA0/PWM3	LVDS1 out or GPIO	PD-EINT19	0.6V/3.3V
20	PD20/LCD0-HSYNC/TWI2-SCK/DMIC-CLK/PWM4		PD-EINT20	3.3V
21	PD21/LCD0-VSYNC/TWI2-SDA/UART1-TX/PWM5		PD-EINT21	3.3V
22	GND	Ground		0V
23	TVOUT0	CVBS OUT		0.8V
24	AVCC_1.8V	Audio Power input		1.8V
25	MICN3P	Microphone positive input		0.8V
26	MICN3N	Microphone negative input		0.8V
<b>Pin</b>	<b>Signal</b>	<b>Description</b>	<b>Alternate functions</b>	<b>IO Voltage</b>
27	AGND	Audio Ground		0V
28	GND	Ground		0V
29	FMINR	FM right Line in		0.8V
30	FMINL	FM left Line in		0.8V
31	LINEINR	Right Line in		0.8V
32	LINEINL	Left Line in		0.8V
33	GND	Ground		0V
34	HPOUTR	Headphone right channel output		0.8V
35	HPOUTL	Headphone left channel output		0.8V
36	HPOUTFB	Headphone Feedback		0V
37	GND	Ground		0V
38	GPADC0	ADC input		1.8V
39	TP-X1	Aux ADC in		1.8V
40	TP-X2	Aux ADC in		1.8V
41	TP-Y1	Aux ADC in		1.8V
42	TP-Y2	Aux ADC in		1.8V
43	GND	Ground		0V



44	TVIN0	CVBS0 input		0.8V
45	TVIN1	CVBS1 input		0.8V
46	GND	Ground		0V
47	USB1-DP			3.3V
48	USB1-DM			3.3V
49	USB0-DP			3.3V
50	USB0-DM			3.3V
51	GND	Ground		0V
52	PG0/SDC1-CLK	RGMII_RXCTRL/RMII_CRS_DV /UART3_TX/PWM7	PG-EINT0	3.3V(Note1)
53	PG1/SDC1-CMD	RGMII_RXD0/RMII_RXD0/UAR T3_RX/PWM6	PG-EINT1	3.3V
54	PG2/SDC1-D0	RGMII_RXD1/RMII_RXD1/UAR T3_RTS/UART4_TX	PG-EINT2	3.3V
55	PG3/SDC1-D1	RGMII_TXCK /RMII_TXCK/UART3_CTS/UAR T4_RX	PG-EINT3	3.3V
56	PG5/SDC1-D3	RGMII_TXD1/RMII_TXD1/UART 5_RX/PWM4	PG-EINT5	3.3V
57	PG4/SDC1-D2	RGMII_TXD0/RMII_TXD0/UART 5_TX/PWM5	PG-EINT4	3.3V
58	PG12/I2S1-LRCK	RGMII_TXCTRL/RMII_TXEN/T WI0_SCK /UART1_TX/CLK_FANOUT2/P WM0	PG-EINT12	3.3V
Pin	Signal	Description	Alternate functions	IO Voltage
59	PG13/I2S1-BCLK	RGMII_CLKIN/RMII_RXER/TWI 0_SDA/UART1_RX/LEDC_DO/ PWM2	PG-EINT13	3.3V
60	PG14/I2S1-DIN0	MDC/TWI2_SCK/UART1_RTS/I 2S1_DOUT1	PG-EINT14	3.3V
61	PG15/I2S1-DOUT0	MDIO/TWI2_SDA/UART1_CTS/I 2S1_DIN1	PG-EINT15	3.3V
62	PG6/UART1-TX	RGMII_TXD2/TWI2_SCK/PWM 1	PG-EINT6	3.3V
63	PG7/UART1-RX	RGMII_TXD3/TWI2_SDA/OWA_ IN	PG-EINT7	3.3V
64	PG8/UART1-RTS	RGMII_RXD2/TWI1_SCK/UART 3_TX	PG-EINT8	3.3V
65	PG9/UART1-CTS	RGMII_RXD3/TWI1_SDA/UART 3_RX	PG-EINT9	3.3V
66	PG10/PWM3	RGMII_RXCK/TWI3_SCK/IR_R X/CLK_FANOUT0	PG-EINT10	3.3V



67	PG11/I2S1-MCLK	EPHY_25M/TWI3_SDA/TCON_TRIG/CLK_FANOUT1	PG-EINT11	3.3V
68	GND	Ground		0V
69	PB3/I2S2-DOUT1/TWI0-SCK/UART4-RX	I2S2_DIN0/CAN0_RX/LCD0_D1/LCD0_D19	PB-EINT3	3.3V
70	PB2/I2S2-DOUT2/TWI0-SDA/UART4-TX	I2S2_DIN2/CAN0_TX/LCD0_D0/LCD0_D18	PB-EINT2	3.3V
71	PB6/I2S2-LRCK/TWI3-SCK/UART3-TX	CPUBIST0/LCD0_D16/LCD0_D22/PWM1	PB-EINT6	3.3V
72	PB7/I2S2-MCLK/TWI3-SDA/UART3-RX	CPUBIST1/LCD0_D17/LCD0_D23/IR_RX	PB-EINT7	3.3V
73	PB5/I2S2-BCLK/PWM0/UART5-RX	LCD0_D9/LCD0_D21	PB-EINT5	3.3V
74	PB4/I2S2-DOUT0/TWI1-SCK/UART5-TX	LCD0_D8/LCD0_D20	PB-EINT4	3.3V
75	GND	Ground		0V
76	PF2/SDC0-CLK	UART0_TX/TWI0_SCK/OWA_IN/LEDC_DO	PF-EINT2	3.3V
77	GND	Ground		0V
78	PF0/SDC0-D1	JTAG_MS/I2S2_DIN0/I2S2_DOUT1	PF-EINT0	3.3V
79	PF1/SDC0-D0	JTAG_DI/I2S2_DIN1/I2S2_DOUT0	PF-EINT1	3.3V
<b>Pin</b>	<b>Signal</b>	<b>Description</b>	<b>Alternate functions</b>	<b>IO Voltage</b>
80	PF3/SDC0-CMD	JTAG_DO/I2S2_BCK	PF-EINT3	3.3V
81	PF4/SDC0-D3	UART0_RX/TWI0_SDA/IR_TX/PWM6	PF-EINT4	3.3V
82	PF5/SDC0-D2	JTAG_CK/I2S2_LRCK	PF-EINT5	3.3V
83	PF6/IR-RX/PWM5	OWA_OUT/I2S2_MCK	PF-EINT6	3.3V
84	GND	Ground		0V
85	REFCLK-OUT			3.3V
86	32.768KHz-OUT	RTC CLKOUT(PU 2K)		3.3V
87	GND	Ground		0V
88	VBUCK	RTC power output		3.3V
89	GND	Ground		0V
90	GND	Ground		0V
91	RESET	RESETN OUT		3.3V



92	GND	Ground		0V
93	PE13/TWI2-SDA/PWM5	RGMII_RXD2/DMIC_DATA3 (PU 2K)(Note2)	PE-EINT13	3.3V
94	PE12/TWI2-SCK/NCSI0-FIELD	RGMII_TXD3/NCSI0_FIFLD (PU 2K)(Note2)	PE-EINT12	3.3V
95	GND	Ground		0V
96	PE3/NCSI0-MCLK/UART2-RX	RGMII_TXCK/RMII_TXCK/UAR T0_RX/TWI0_SDA/CLK_FANO1	PE-EINT3	3.3V
97	GND	Ground		0V
98	PE2/NCSI0-PCLK/UART2-TX	RGMII_RXD1/RMII_RXD1/UAR T0_TX/TWI0_SCK/CLK_FANO0	PE-EINT2	3.3V
99	GND	Ground		0V
100	PE11/NCSI0-D7/UART1-RX	RGMII_TXD2/JTAG_CK	PE-EINT11	3.3V
101	PE10/NCSI0-D6/UART1-TX	EPHY_25M/JTAG_DO/IR_RX/P WM4	PE-EINT10	3.3V
102	PE9/NCSI0-D5/UART1-CTS	MDIO/JTAG_DI/UART3_RX/PW M3	PE-EINT9	3.3V
103	PE8/NCSI0-D4/UART1-RTS	MDC/JTAG_MS/UART3_TX/PW M2	PE-EINT8	3.3V
104	PE7/NCSI0-D3/UART5-RX	RGMII_CLKIN/RMII_RXER/D- JTAG_CK/TWI3_SDA/OWA_OU T	PE-EINT7	3.3V
105	PE6/NCSI0-D2/UART5-TX	RGMII_TXCTRL/RMII_TXEN/D- JTAG_DO/TWI3_SCK/OWA_IN	PE-EINT6	3.3V
106	PE5/NCSI0-D1/UART4-RX	RGMII_TXD1/RMII_TXD1/D- JTAG_DI/TWI2_SDA/LEDC_DO	PE-EINT5	3.3V
107	PE4/NCSI0-D0/UART4-TX	RGMII_TXD0/RMII_TXD0/ D- JTAG_MS/TWI2_SCK/CLK_FAN O2	PE-EINT4	3.3V
Pin	Signal	Description	Alternate functions	IO Voltage
108	GND	Ground		0V
109	PE0/NCSI0-HSYNC/UART2-RTS	RGMII_RXCTRL/RMII_CRS_DV /TWI1_SCK/LCD0_HSYNC	PE-EINT0	3.3V(Note1)
110	PE1/NCSI0-VSYNC/UART2-CTS	RGMII_RXD0/RMII_RXD0/TWI1 _SDA/LCD0_VSYNC	PE-EINT1	3.3V
111	PD22/OWA-OUT/IR-RX/UART1-RX/PWM7	Need NC (Note3)	PD-EINT22	3.3V
112	GND	Ground		0V

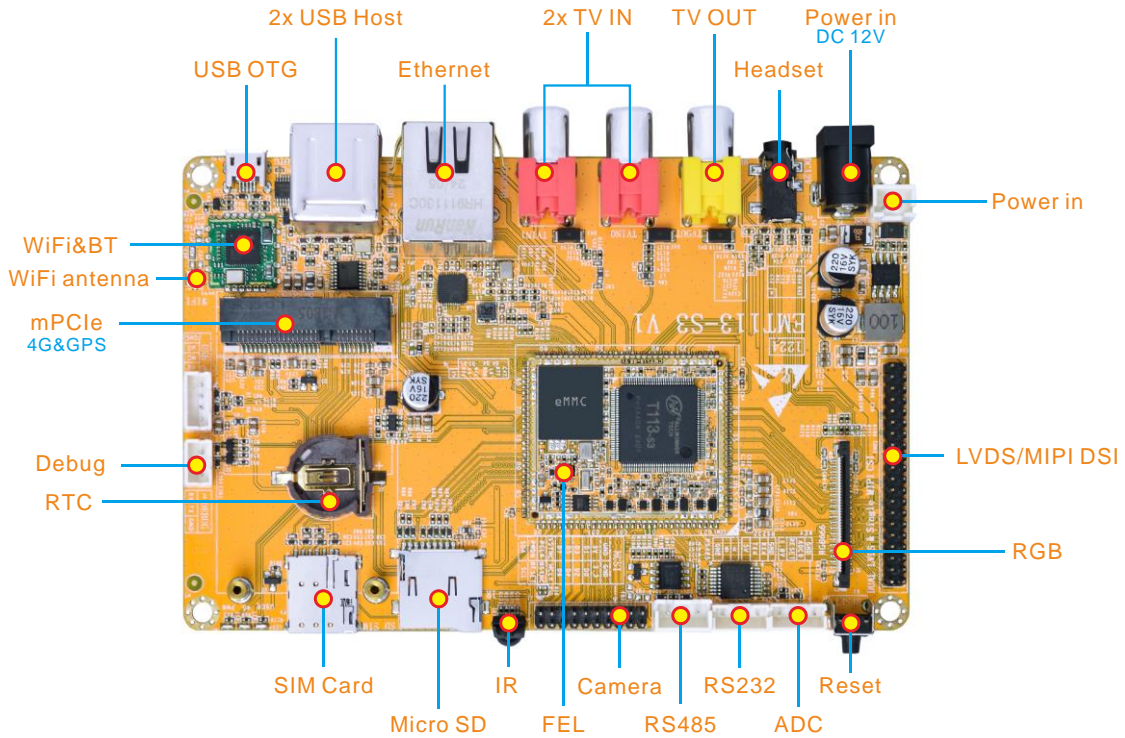


113	PD0/LCD0-D2/LVDS0-V0P/DSI-D0P	LVDS0/DSI or GPIO		0.6V/3.3V
114	PD1/LCD0-D3/LVDS0-V0N/DSI-D0N	LVDS0/DSI or TWI0_SCK	PD-EINT0	0.6V/3.3V (Note1)
115	PD2/LCD0-D4/LVDS0-V1P/DSI-D1P	LVDS0/DSI or UART2_TX	PD-EINT1	0.6V/3.3V
116	PD3/LCD0-D5/LVDS0-V1N/DSI-D1N	LVDS0/DSI or UART2_RX	PD-EINT2	0.6V/3.3V
117	PD4/LCD0-D6/LVDS0-V2P/DSI-CKP	LVDS0/DSI or UART2_RTS	PD-EINT3	0.6V/3.3V
118	PD5/LCD0-D7/LVDS0-V2N/DSI-CKN	LVDS0/DSI or UART2_CTS	PD-EINT4	0.6V/3.3V
119	PD6/LCD0-D10/LVDS0-CKP/DSI-D2P	LVDS0/DSI or UART5_TX	PD-EINT5	0.6V/3.3V
120	PD7/LCD0-D11/LVDS0-CKN/DSI-D2N	LVDS0/DSI or UART5_RX	PD-EINT6	0.6V/3.3V
121	PD8/LCD0-D12/LVDS0-V3P/DSI-D3P	LVDS0/DSI or UART4_TX	PD-EINT7	0.6V/3.3V
122	UPD9/LCD0-D13/LVDS0-V3N/DSI-D3N	LVDS0/DSI or UART4_RX	PD-EINT8	0.6V/3.3V

**Note**

1. PD/PE/PG parts GPIO voltage can change to 1V8.
2. Default used for I2C, can't used for GPIO.
3. Default used for RTC interrupt, NC this Pin please.

## 1.7 Development Kit (EMT113)

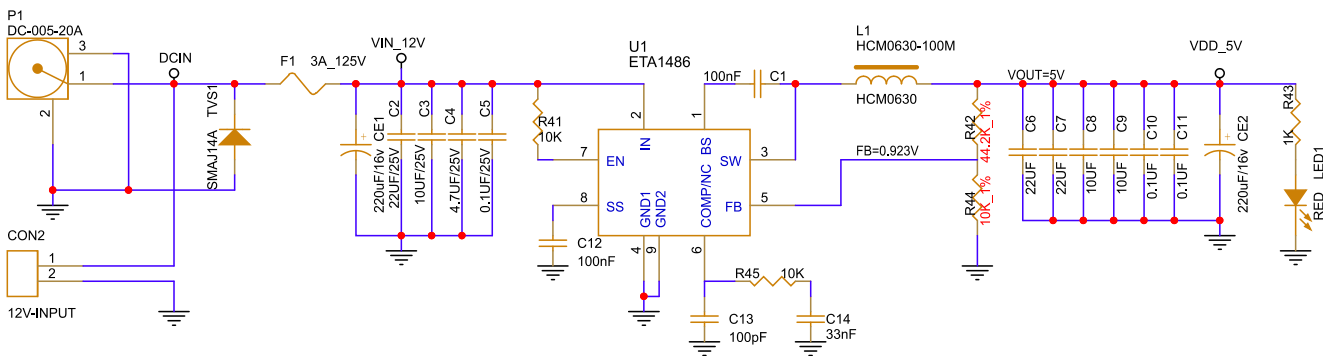


# 2 Hardware Design Guide

## 2.1 Peripheral Circuit Reference

### 2.1.1 External Power

#### MAIN 5V









## 3 Product Electrical Characteristics

### 3.1 Dissipation and Temperature

Symbol	Parameter	Min	Typ	Max	Unit
DCIN	System Voltage	3.4	5	5.5	V
I <sub>dcin</sub>	DCIN input Current		430		mA
AVCC_1.8V	Analog Audio Voltage		1.8		V
I <sub>avcc_in</sub>	AVCCIN input Current		300		mA
SOC_1V8	Peripheral 1.8 Voltage		1.8		V
I <sub>out</sub>	Output Current			500	mA
SOC_3V3	Peripheral 3.3 Voltage		3.3		V
I <sub>out</sub>	Output Current			500	mA
VCC_RTC	RTC Voltage	1.8	3	3.4	V
I <sub>rtc</sub>	RTC input Current		5	8	uA
T <sub>a</sub>	Operating Temperature	-40		85	°C
T <sub>stg</sub>	Storage Temperature	-40		120	°C

### 3.2 Reliability of Test

High Temperature Operating Test		
Contents	Operating 8h in high temperature	55°C±2°C
Result	TDB	

Operating Life Test		
Contents	Operating in room	120h
Result	TDB	