PKE8713ECM-VA4-N43 Board

Specification

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REALSIL MICROELECTRONICS (Suzhou) CO. LTD.

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USING THIS DOCUMENT

This document is intended for the software engineer's reference and provides detailed programming information.

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

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- **Technical support:** iot_support@realsil.com.cn
- **SDK website:** https://github.com/Ameba-AIoT/ameba-rtos

Contents

1 Product Overview

1.1 General Description

The PKE8713ECM-VA4-N43 development board is designed by Realsil for the PKM8713ECM-E10-F43 module. All the module's GPIOs are pin out for the developers to develop and debug the module conveniently. Standard pin headers on the side can also make operation easier when using bread boards for development and commissioning.

The PKM8713ECM-E10-F43 is a multi-radio MCU module that is identical to the official module PKM8713ECM-E10-F33, except for its 32MB flash size. With the open CPU architecture, customers can develop advanced applications running on the dual RISC cores. In addition, the embedded audio codec and digital signal processor (Cadence® Tensilica® HiFi 5 DSP) can run rich AI voice algorithms. The radio provides support for Wi-Fi 802.11 b/g/n/ax in the 2.4GHz band with 20MHz bandwidth and Bluetooth 5.2 communications. The high integration and high performance make it an ideal choice for smart home appliances, AI toys, smart Bluetooth speakers, etc.

The block diagram of PKM8713ECM-E10-F43 module is illustrated in Figure 1.

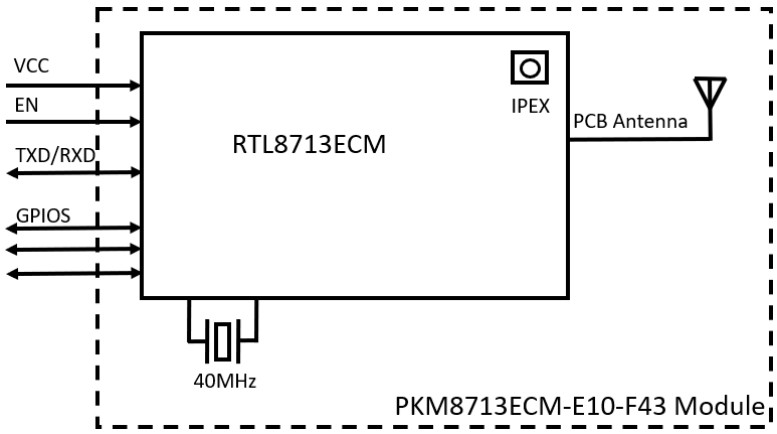


Figure 1. PKM8713ECM-E10-F43 Module Block Diagram

1.2 Characteristics

- Cadence Tensilica HiFi 5 DSP
- 3-channel Audio ADC, SNR > 98dB A-weighted and THD+N < -80dB
- 1-channel Audio DAC, SNR > 98dB A-weighted and THD+N < -85dB
- Supports up to 8-channel I2S transmitter and receiver by TDM or PCM mode
- 4-channel digital microphone interface supported
- Support 802.11 b/g/n/ax 1x1, 2.4GHz and Bluetooth 5.2 (BR/EDR/LE-1M/LE-2M/LE-Coded PHY (long range))
- Support 20MHz bandwidth, up to the data rate of MCS9
- Wi-Fi WPA, WPA2, WPA3, WPS; open, shared key, and pair-wise key authentication services
- Power-saving mechanism
- Supports AP/STA/Concurrent mode (802.11ax AP not supported)
- Frame aggregation for increased MAC efficiency (A-MPDU)
- AoA and AoD (both connection-oriented and connectionless)
- Supports SIG mesh V1.0 and V1.1
- Supports scatter-net (concurrent central and peripheral mode)
- Support Arm TrustZone-M and secure boot
- Internal co-existence mechanism between Wi-Fi and BT to share the same antenna
- Up to 4 serial data outputs/inputs are transmitted within a sample period

1.3 Application Solution

- Smart home appliance
- AI toys
- smart Bluetooth speaker
- …

1.4 Main Parameters

Table 1. PKM8713ECM-E10-F43 Module Main Parameters

Parameter	Description
Module Name	PKM8713ECM-E10-F43
Module Package	SMD-54
Module Size	29 ± 0.2mm (L) x 16 ± 0.2mm (W) x 0.8 ± 0.1mm (H)
Antenna	On-board PCB antenna
Wi-Fi Frequency Range	● 2412MHz ~ 2484MHz (2.4GHz ISM Band)
Bluetooth	Bluetooth 5.2
Bluetooth Frequency Range	2402MHz ~ 2480MHz
Operating Temperature	-20°C to 85°C
Storage temperature range	-65°C to 150°C, < 90% RH
Power supply Range[1]	(3.3 ± 10%)V, current >800mA
Interface	UART/GPIO/ADC/Cap touch/PWM/I2C/SPI/SWD/LEDC//DMIC/I2S/PDM
Module Certification	FCC/CE/SRRC

NOTE

[1] When using an external single power supply, the output current needs to reach more than 0.8A, which does not include the power consumption on peripherals and GPIOs.

2 Electrical Characteristics

Table 2. PKM8713ECM-E10-F43 Module Electrical Characteristics

Parameter condition	Min.	Typ.	Max.	Unit
DC 3.3V Supply Voltage	3.0	3.3	3.6	V
Digital I/O Supply Voltage	1.76	1.8~3..3	3.6	V
DC 3.3 Rating Current (with internal regulator and integrated CMOS PA)			800	mA
ESD HBM Condition (TA=25°C, conforming to JESD22-A114F)			Class 2	
ESD CDM Condition (TA=25°C, conforming to JESD22-C101F)			Class C2	

NOTE

The PKM8713ECM-E10-F43 module is electrostatic sensitive devices (ESD) and requires special ESD precautions typically applied to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling, transportation and operation of any application that incorporates the PKM8713ECM-E10-F43 module. Do not touch the module by hand or solder with non-anti-static soldering iron to avoid damage to the module.

3 RF Performance

3.1 Wi-Fi 2.4GHz Band RF Specification

Table 3. Wi-Fi 2.4GHz Transmitter Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	2412		2484	MHz
Output power with spectral mask and EVM compliance[1] (25°C)	1Mbps CCK		20		dBm
	11Mbps CCK		20		dBm
	BPSK rate 1/2, 6Mbps OFDM		20		dBm
	64-QAM rate 3/4, 54Mbps OFDM		19		dBm
	HT20,MCS 0, BPSK rate 1/2		20		dBm
	HT20, MCS 7, 64-QAM rate 5/6		18		dBm
	HE20, MCS 8, 256-QAM rate 3/4		17		dBm
	HE20, MCS 9, 256-QAM rate 5/6		16		dBm
Tx EVM	BPSK rate 1/2, 6Mbps OFDM		-32	-5	dB
	64-QAM rate 3/4, 54Mbps OFDM		-34	-25	dB
	HT20, MCS 0, BPSK rate 1/2		-32	-5	dB
	HT20, MCS 7, 64-QAM rate 5/6		-35	-27	dB
	HE20, MCS 8, 256-QAM rate 3/4		-36	-30	dB
	HE20, MCS 9, 256-QAM rate 5/6		-36	-32	dB
Output power variation	TSSI on across operating temperature range, all channels and VSWR≤1.5:1 at RFIO port	-1.5		1.5	dB
Carrier Suppression				-32	dBc
Harmonic output power[2]	2nd Harmonic		-21		dBm/MHz
	3rd Harmonic		-20		dBm/MHz
Harmonic output power[3]	2nd Harmonic			-50	dBm/MHz
	3rd Harmonic			-50	dBm/MHz

NOTE

- *[1] Power level is tested after Digital Pre-Distortion (DPD) enable.*
- *[2] Harmonic output power is tested at IC port.*
- *[3] Harmonic output power is measured at RF connector with pi-shape LC low pass filter.*

Table 4. Wi-Fi 2.4GHz Receiver Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	2412		2484	MHz
802.11b Rx Sensitivity (8% PER)	1 Mbps CCK		-100		dBm
	2 Mbps CCK		-97		dBm
	5.5 Mbps CCK		-94		dBm
	11 Mbps CCK		-91		dBm
802.11g Rx Sensitivity (10% PER)	BPSK rate 1/2, 6Mbps OFDM		-95		dBm
	BPSK rate 3/4, 9Mbps OFDM		-94		dBm
	QPSK rate 1/2, 12Mbps OFDM		-92.5		dBm
	QPSK rate 3/4, 18Mbps OFDM		-90		dBm
	16-QAM rate 1/2, 24Mbps OFDM		-87		dBm
	16-QAM rate 3/4, 36Mbps OFDM		-83.5		dBm
	64-QAM rate 1/2, 48Mbps OFDM		-79.5		dBm
	64-QAM rate 3/4, 54Mbps OFDM		-78		dBm
802.11n Rx Sensitivity (10% PER) BW=20MHz	MCS 0, BPSK rate 1/2		-95		dBm
	MCS 1, QPSK rate 1/2		-92.5		dBm
	MCS 2, QPSK rate 3/4		-90		dBm
	MCS 3, 16-QAM rate 1/2		-86.5		dBm
	MCS 4, 16-QAM rate 3/4		-83.5		dBm
	MCS 5, 64-QAM rate 2/3		-79.5		dBm
	MCS 6, 64-QAM rate 3/4		-78		dBm

	MCS 7, 64-QAM rate 5/6		-76.5		dBm
802.11ax Rx Sensitivity (10% PER) BW=20MHz	MCS 0, BPSK rate 1/2		-95		dBm
	MCS 1, QPSK rate 1/2		-92		dBm
	MCS 2, QPSK rate 3/4		-89.5		dBm
	MCS 3, 16-QAM rate 1/2		-86.5		dBm
	MCS 4, 16-QAM rate 3/4		-83		dBm
	MCS 5, 64-QAM rate 2/3		-79		dBm
	MCS 6, 64-QAM rate 3/4		-78		dBm
	MCS 7, 64-QAM rate 5/6		-76.5		dBm
	MCS 8, 256-QAM rate 3/4		-72.5		dBm
	MCS 9, 256-QAM rate 5/6		-70.5		dBm
Maximum Receive Level	6Mbps OFDM		0		dBm
	54Mbps OFDM		0		dBm
	11n MCS 0 HT20		0		dBm
	11n MCS 7 HT20		0		dBm
	11ax MCS 0 HE20		0		dBm
	11ax MCS 9 HE20		0		dBm
Adjacent Channel Rejection	11Mbps CCK		46		dBm
	BPSK rate 1/2, 6Mbps OFDM		45		dBm
	64-QAM rate 3/4, 54Mbps OFDM		25		dBm
	HT20, MCS 0, BPSK rate 1/2		42		dBm
	HT20, MCS 7, 64-QAM rate 5/6		24		dBm
	HE20, MCS 0, BPSK rate 1/2		42		dBm
	HE20, MCS 8, 256-QAM rate 3/4		20		dBm
	HE20, MCS 9, 256-QAM rate 5/6		17		dBm

3.2 Bluetooth RF Specification

Table 5. Bluetooth BR Transmitter Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	2402	2440	2480	MHz
Max. Transmit Power	At max. power output level		8		dBm
Gain step			4		dB
Modulation Characteristics	ΔF1 Avg.		165		kHz
	ΔF2 Max. (for at least 99.9% of all ΔF2 max.)	115		-	kHz
	ΔF2 Avg./ΔF1 Avg		0.93		
ICFT	Initial carrier frequency tolerance		±15		kHz
Carrier Frequency Drift	One slot packet (DH1)		±10		kHz
	Two slot packet (DH3)		±10		kHz
	Five slot packet (DH5)		±10		kHz
	Max. drift rate		±10		kHz
Tx Output Spectrum	20dB bandwidth			1000	kHz
Adjacent Channel Power	±2MHz offset		-55		dBm
	±3MHz offset		-57		dBm
	>±3MHz offset		-59		dBm

Table 6. Bluetooth BR Receiver Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	2402	2440	2480	MHz
Receiver Sensitivity	BER<0.1%		-94.5		dBm
Max. Usable Signal	BER<0.1%		0		dBm
C/I co-channel (BER<0.1%)	Co-channel sensitivity		9		dB
C/I 1MHz (BER<0.1%)	Adjacent channel selectivity		-17		dB
C/I 2MHz (BER<0.1%)	2nd adjacent channel selectivity		-46		dB
C/I 3MHz (BER<0.1%)	3rd adjacent channel selectivity		-53		dB
C/I Image Channel (BER<0.1%)	Image channel selectivity		-22		dB

C/I Image 1MHz (BER<0.1%)	1MHz adjacent to image channel selectivity		-31		dB
Inter-modulation			-33		dBm
Out-of-band blocking	30MHz to 2000MHz	-10			dBm
	2000MHz to 2400MHz	-27			dBm
	2500MHz to 3000MHz	-27			dBm
	3000MHz to 12.75GHz	-10			dBm

Table 7. Bluetooth EDR Transmitter Performance Specification

Parameter	Condition		Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency		2402	2440	2480	MHz
Max. Transmit Power	π/4 DQPSK				10	dBm
	8PSK				10	dBm
Relative Transmit Power	π/4 DQPSK			8		dBm
	8PSK			8		dBm
Frequency Stability	Max. carrier frequency stability, ωo	π/4 DQPSK		0		kHz
		8PSK		0		kHz
	Max. carrier frequency stability, ωi	π/4 DQPSK		±10		kHz
		8PSK		±10		kHz
	Max. carrier frequency stability, |ωo + ωi|	π/4 DQPSK		±10		kHz
		8PSK		±10		kHz
Modulation Accuracy	RMS DEVM	π/4 DQPSK			20	%
		8PSK			13	%
	99% DEVM	π/4 DQPSK			30	%
		8PSK			20	%
	Peak DEVM	π/4 DQPSK			35	%
		8PSK			25	%
In-Band	±1MHz offset	π/4 DQPSK		-42		dB
	±1MHz offset	8PSK		-42		dB
Spurious Emissions	±2MHz offset	π/4 DQPSK		-46		dBm
	±2MHz offset	8PSK		-46		dBm
	±3MHz offset	π/4 DQPSK		-48		dBm
	±3MHz offset	8PSK		-48		dBm

Table 8. Bluetooth EDR Receiver Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	2402	2440	2480	MHz
Receiver Sensitivity (BER < 0.007% after 1600000 bits/BER < 0.01% after 16000000 bits)	π/4 DQPSK		-94.4		dBm
	8PSK		-88.1		dBm
Max. Usable Signal (BER<0.1%)	π/4 DQPSK		0		dBm
	8PSK		0		dBm
C/I co-channel (BER<0.1%)	π/4 DQPSK		8		dB
	8PSK		15		dB
C/I 1MHz (BER<0.1%)	π/4 DQPSK		-15		dB
	8PSK		-8		dB
C/I 2MHz (BER<0.1%)	π/4 DQPSK		-47		dB
	8PSK		-41		dB
C/I 3MHz (BER<0.1%)	π/4 DQPSK		-54		dB
	8PSK		-48		dB
C/I Image Channel (BER<0.1%)	π/4 DQPSK		-23		dB
	8PSK		-21		dB
C/I Image 1MHz (BER<0.1%)	π/4 DQPSK		-31		dB
	8PSK		-28		dB

Table 9. Bluetooth LE Transmitter Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	2402	2440	2480	MHz

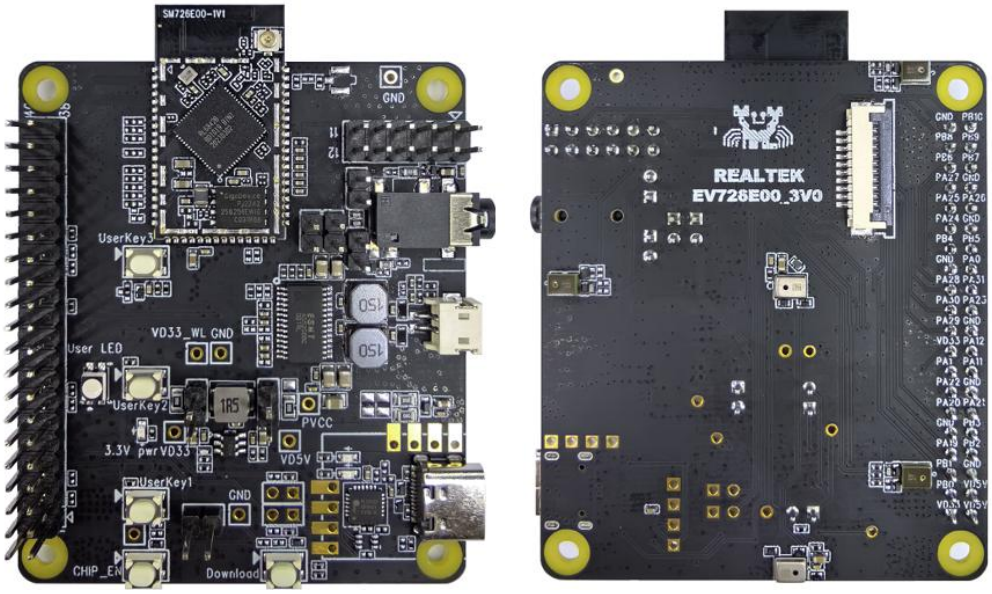
Output Power Carrier Frequency Offset and Drift	At max. power output level		8	10	dBm
	Frequency offset		±10		kHz
	Frequency drift		±10	-	kHz
	Max. drift rate		±10	-	kHz
Modulation Characteristics	ΔF1 Avg.		250		kHz
	ΔF2 Max.	185	-	-	kHz
	ΔF2 Avg./ΔF1 Avg		0.93	-	
In-Band Emissions	±2MHz offset		-51	-	dBm
	≥ ±3MHz offset		-53	-	dBm

Table 10. Bluetooth LE Receiver Performance Specification

Parameter	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Frequency Range	Center channel frequency	2402	2440	2480	MHz
Receiver Sensitivity	PER<30.8%		-99		dBm
Max. Usable Signal	PER<30.8%		0		dBm
C/I co-channel (PER<30.8%)	Co-channel sensitivity		5		dB
C/I 1MHz (PER<30.8%)	Adjacent channel selectivity		-7		dB
C/I 2MHz (PER<30.8%)	2nd adjacent channel selectivity		-48		dB
C/I >= 3MHz (PER<30.8%)	3rd adjacent channel selectivity		-56		dB
C/I Image Channel (PER<30.8%)	Image channel selectivity		-25		dB
C/I Image 1MHz (PER<30.8%)	1MHz adjacent to image channel selectivity		-29		dB
Inter-modulation			-27		dBm
Out-of-band blocking	30MHz to 2000MHz	-30		-	dBm
	2003MHz to 2399MHz	-35			dBm
	2484MHz to 2997MHz	-35			dBm
	3000MHz to 12.75GHz	-30		-	dBm

4 Appearance Dimensions

Board dimension: 72± 0.2mm (L) x 56 ± 0.2mm (W) x 11.5 ± 0.2mm (H)



Top View Bottom View

Figure 2. PKE8713ECM-VA4-N43 Board Appearance

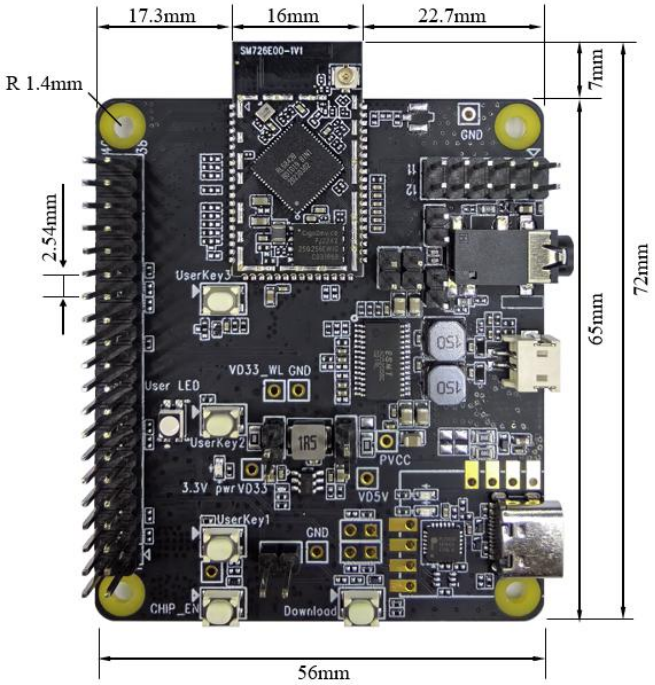


Figure 3. PKE8713ECM-VA4-N43 Board Dimensions

5 Component Distribution

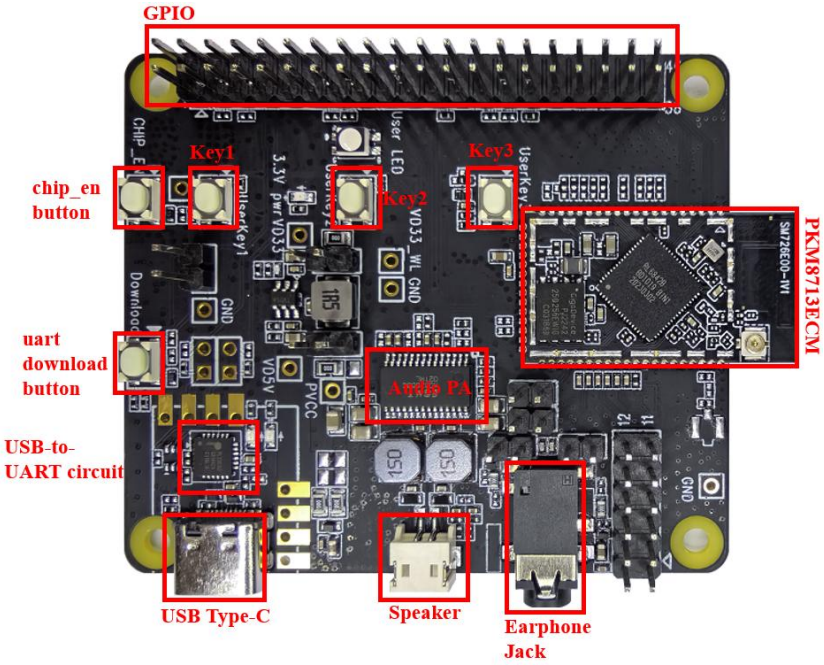


Figure 4. Top Layer

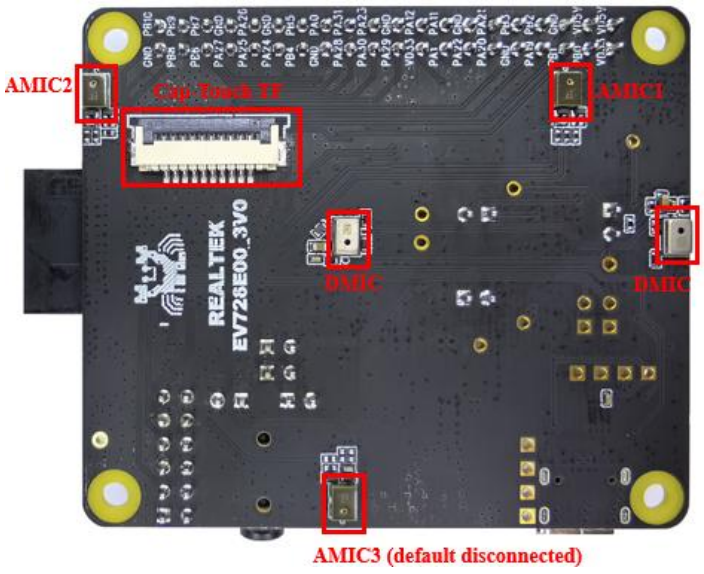


Figure 5. Bottom Layer

Table 11. Information of LED and Keys

LED & Keys	Function	Note
Chip_en	Reset button	Reset the system.
UART Download	Set the module to download mode	Follow these steps to enter the download mode: (1) Press and hold the Download button (2) Press the chip_en button and release it (3) Release the Download button

6 Pin Definition

The PKE8713ECM-VA4-N43 development board leads out 36 I/O interfaces. Figure describes the board interfaces, and the pin function definition table is also layout to list the interface definition.

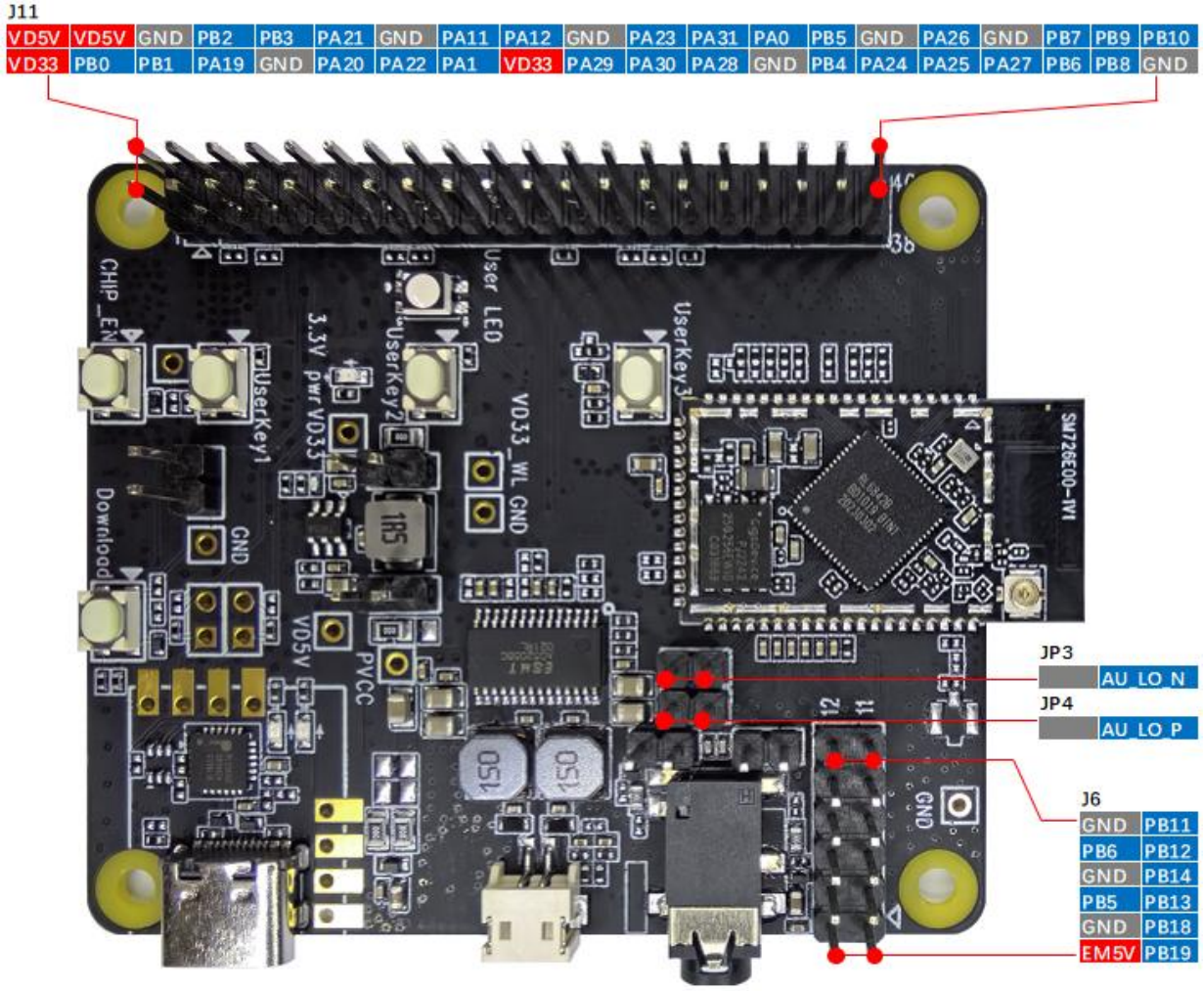


Figure 6. PKE8713ECM-VA4-N43 Board Interface Description

Table 12. PKE8713ECM-VA4-N43 Board Pin Definition

Designator	Pin No.	Symbol	Description
J11	1	VD33	3.3V power supply
	2	VD5V	5V power supply
	3	PB0	Used as GPIO or other functions connected to PB0 of chip directly
	4	VD5V	5V power supply
	5	PB1	Used as GPIO or other functions connected to PB1 of chip directly
	6	GND	Ground
	7	PA19	Used as GPIO or other functions connected to PA19 of chip directly through R54 0 ohm resistor(default NC)
	8	PB2	Used as GPIO or other functions connected to PB2 of chip directly
	9	GND	Ground
	10	PB3	Used as GPIO or other functions connected to PB3 of chip directly
	11	PA20	Used as GPIO or other functions connected to PA19 of chip directly through R55 0 ohm resistor(default NC)
	12	PA21	Used as GPIO or other functions connected to PA21 of chip directly
	13	PA22	Used as GPIO or other functions connected to PA22of chip directly
	14	GND	Ground

	15	PA1	Used as GPIO or other functions connected to PA1 of chip directly
	16	PA11	Used as GPIO or other functions connected to PA11of chip directly
	17	VD33	3.3V power supply
	18	PA12	Used as GPIO or other functions connected to PA12 of chip directly
	19	PA29	Used as GPIO or other functions connected to PA29 of chip directly
	20	GND	Ground
	21	PA30	Used as GPIO or other functions connected to PA30 of chip directly
	22	PA23	Used as GPIO or other functions connected to PA23 of chip directly
	23	PA28	Used as GPIO or other functions connected to PA28 of chip directly
	24	PA31	Used as GPIO or other functions connected to PA31 of chip directly
	25	GND	Ground
	26	PA0	Used as GPIO or other functions connected to PA0 of chip directly
	27	PB4	Used as GPIO or other functions connected to PB4 of chip directly
	28	PB5	Used as GPIO or other functions connected to PB5 of chip directly
	29	PA24	Used as GPIO or other functions connected to PA24 of chip directly
	30	GND	Ground
	31	PA25	Used as GPIO or other functions connected to PA25 of chip directly
	32	PA26	Used as GPIO or other functions connected to PA26 of chip directly
	33	PA27	Used as GPIO or other functions connected to PA27 of chip directly
	34	GND	Ground
	35	PB6	Used as GPIO or other functions connected to PB6 of chip directly
	36	PB7	Used as GPIO or other functions connected to PB7 of chip directly
	37	PB8	Used as GPIO or other functions connected to PB8 of chip directly
	38	PB9	Used as GPIO or other functions connected to PB9 of chip directly
	39	GND	Ground
	40	PB10	Used as GPIO or other functions connected to PB0 of chip directly
J6	1	PB19	Extension sub-board signal PB19
	2	EM5V	Extension sub-board 5V power output
	3	PB18	Extension sub-board signal PB18
	4	GND	Ground
	5	PB13	Extension sub-board signal PB13
	6	PB5_CMP	Extension sub-board signal PB5_CMP
	7	PB14	Extension sub-board signal PB14
	8	GND	Ground
	9	PB12	Extension sub-board signal PB12
	10	PB6_PWM	Extension sub-board signal PB6_PWM
	11	PB11	Extension sub-board signal PB11
	12	GND	Ground
JP3	1	AU_LO_N	JP3 need connected when use speaker function(default NC)
JP4	1	AU_LO_P	JP4 need connected when use speaker function(default NC)

NOTE

UART/SPI/LEDC/I2S/I2C/PWM/DMIC is configurable, refer to the excel documentation for details (PKM8713ECM_pin_mux.xls).

7 Schematic Diagram

Please refer to SCH-PKE8713ECM-VA4-N43.pdf

8 Package Information

The PKE8713ECM-VA4-N43 development board is packaged for inserted pearl cotton with electrostatic bags.

Revision History

Data	Revision	Summary
2025-08-12	1.0	Initial release
2025-09-25	1.1	Correct some formats