PKE8720DF-C13-F10 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 PKE8720DF-C13-F10 development board is designed by Realsil for the PKM8720DF-C13-F10 module. All the module's GPIOs are pin out for the developers to develop and debug the module conveniently. Standard pin headers on both sides can also make operation easier when using bread boards for development and commissioning.

The PKM8720DF-C13-F10 is a multi-radio MCU Module. With the open CPU architecture, customers can develop advanced applications running on the dual-core 32-bit MCU. The radio provides support for Wi-Fi 802.11 a/b/g/n in the 2.4GHz/5GHz band and BLE 5.0 communications. The rich set of peripherals and high performance make it an ideal choice for smart homes, industrial automation, consumer electronics, etc.

The block diagram of PKM8720DF-C13-F10 module is illustrated in Figure 1.

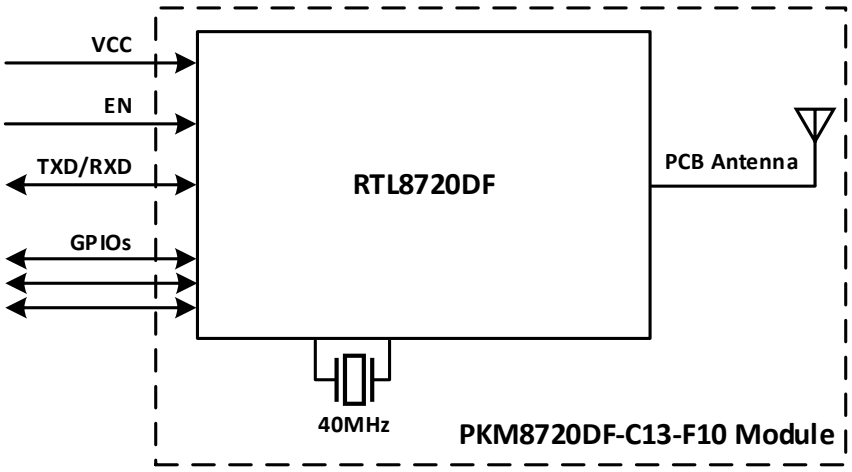


Figure 1. PKM8720DF-C13-F10 Module Block Diagram

1.2 Characteristics

- Support 802.11 a/b/g/n 1x1, 2.4GHz & 5GHz
- Support 20MHz/40MHz bandwidth, up to the data rate of MCS7
- Support low power beacons listen mode, low power Rx mode, and low power suspends mode(DLPS)
- Built-in AES/DES/SHA hardware engine
- Support Arm TrustZone-M and secure boot
- Support SWD debug port access protection and prohibition modes
- Support BLE 5.0, both central and peripheral modes
- Support Bluetooth high-power mode (maximum 10dBm)
- Internal co-existence mechanism between Wi-Fi and BT to share the same antenna
- KM4 and KM0 both have a GDMA controller, each with 6 channels

1.3 Application Solution

- Smart Homes
- Health and Fitness
- Portable Devices
- Medical
- Industrial

1.4 Main Parameters

Table 1. PKM8720DF-C13-F10 Module Main Parameters

Parameter	Description
Module Name	PKM8720DF-C13-F10
Module Package	SMD-22
Module Size	24 ± 0.2mm (L) x 16 ± 0.2mm (W) x 2.3 ± 0.1mm (H)
Antenna	On-board PCB antenna
Wi-Fi Frequency Range	● 2412MHz ~ 2484MHz (2.4GHz ISM Band) ● 5180MHz ~ 5825MHz (5GHz)
Bluetooth	BLE 5.0
Bluetooth Frequency Range	2402MHz ~ 2480MHz
Operating Temperature	-40°C to 105°C
Storage temperature range	-65°C to 150°C, < 90% RH
Power supply Range	(3.3 ± 10%)V, current > 450mA
Interface	UART/GPIO/ADC/PWM/I2C/SPI/SWD/USB 2.0 HS/SDIO/DMIC/IR/I2S
Module Certification	FCC/CE/SRRC

2 Electrical Characteristics

Table 2. PKM8720DF-C13-F10 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)	-	-	450	mA
3.3V I/O Rating Current	-	-	50	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 PKM8720DF-C13-F10 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 PKM8720DF-C13-F10 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]	1Mbps CCK		20		dBm
	11Mbps CCK		18		dBm
	BPSK rate 1/2, 6Mbps OFDM		20		dBm
	64QAM rate 3/4, 54Mbps OFDM		17		dBm
	HT20-MCS 0, BPSK rate 1/2		19		dBm
	HT20-MCS 7, 64QAM rate 5/6		16		dBm
	HT40-MCS 0, BPSK rate 1/2		19		dBm
	HT40-MCS 7, 64QAM rate 5/6		16		dBm
Tx EVM	BPSK rate 1/2, 6Mbps OFDM		-25	-5	dB
	64QAM rate 3/4, 54Mbps OFDM		-34	-25	dB
	HT20-MCS 0, BPSK rate 1/2		-29	-5	dB
	HT20-MCS 7, 64QAM rate 5/6		-34	-28	dB
	HT40-MCS 0, BPSK rate 1/2		-25	-5	dB
	HT40-MCS 7, 64QAM rate 5/6		-35	-28	dB
Output power variation	After do power trim at FT	-1.5		1.5	dBm
Carrier suppression				-30	dBm
Harmonic output power (IC port)	2nd harmonic		-23	-21.9	dBm
	3rd harmonic		-15	-14	

NOTE

[1] The power level is tested after Digital Pre-Distortion (DPD) enable.

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	1Mbps CCK		-98		dBm
	2Mbps CCK		-96		dBm
	5.5Mbps CCK		-94		dBm
	11Mbps CCK		-91		dBm
802.11g Rx Sensitivity	BPSK rate 1/2, 6Mbps OFDM		-95		dBm
	BPSK rate 3/4, 9Mbps OFDM		-94		dBm
	QPSK rate 1/2, 12Mbps OFDM		-93		dBm
	QPSK rate 3/4, 18Mbps OFDM		-90		dBm
	16QAM rate 1/2, 24Mbps OFDM		-87		dBm
	16QAM rate 3/4, 36Mbps OFDM		-84		dBm
	64QAM rate 1/2, 48Mbps OFDM		-79		dBm
	64QAM rate 3/4, 54Mbps OFDM		-77		dBm
802.11n Rx Sensitivity BW = 20MHz Mixed Mode 800ns Guard Interval Non-STBC	MCS 0, BPSK rate 1/2		-95		dBm
	MCS 1, QPSK rate 1/2		-92		dBm
	MCS 2, QPSK rate 3/4		-89		dBm
	MCS 3, 16QAM rate 1/2		-86		dBm
	MCS 4, 16QAM rate 3/4		-83		dBm
	MCS 5, 64QAM rate 2/3		-78		dBm
	MCS 6, 64QAM rate 3/4		-77		dBm
	MCS 7, 64QAM rate 5/6		-75		dBm
802.11n Rx Sensitivity BW = 40MHz Mixed Mode	MCS 0, BPSK rate 1/2		-93		dBm
	MCS 1, QPSK rate 1/2		-89		dBm
	MCS 2, QPSK rate 3/4		-86		dBm
	MCS 3, 16QAM rate 1/2		-83		dBm

800ns Guard Interval Non-STBC	MCS 4, 16QAM rate 3/4		-80		dBm
	MCS 5, 64QAM rate 2/3		-75		dBm
	MCS 6, 64QAM rate 3/4		-74		dBm
	MCS 7, 64QAM rate 5/6		-72		dBm
Maximum Receive Level	6Mbps OFDM		0		dBm
	54Mbps OFDM		0		dBm
	MCS 0		0		dBm
	MCS 7		0		dBm
Receive Adjacent Channel Rejection	1Mbps CCK		43		dB
	11Mbps CCK		41		dB
	BPSK rate 1/2, 6Mbps OFDM		40		dB
	64QAM rate 3/4, 54Mbps OFDM		22		dB
	HT20, MCS 0, BPSK rate 1/2		39		dB
	HT20, MCS 7, 64QAM rate 5/6		20		dB
	HT40, MCS 0, BPSK rate 1/2		29		dB
	HT40, MCS 7, 64QAM rate 5/6		10		dB

3.2 Wi-Fi 5GHz Band RF Specification

Table 5. Wi-Fi 5GHz Transmitter Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	5180		5825	MHz
Output power with spectral mask and EVM compliance[1]	BPSK rate 1/2, 6Mbps OFDM		18		dBm
	64QAM rate 3/4, 54Mbps OFDM		14		dBm
	HT20-MCS 0, BPSK rate 1/2		17		dBm
	HT20-MCS 7, 64QAM rate 5/6		13		dBm
	HT40-MCS 0, BPSK rate 1/2		17		dBm
	HT40-MCS 7, 64QAM rate 5/6		13		dBm
Tx EVM	BPSK rate 1/2, 6Mbps OFDM		-24	-5	dB
	64QAM rate 3/4, 54Mbps OFDM		-29	-25	dB
	HT20-MCS 0, BPSK rate 1/2		-26	-5	dB
	HT20-MCS 7, 64QAM rate 5/6		-31	-28	dB
	HT40-MCS 0, BPSK rate 1/2		-23	-5	dB
	HT40-MCS 7, 64QAM rate 5/6		-31	-28	dB
Output power variation	After doing power trim at FT	-1.5		1.5	dBm
Carrier suppression				-30	dBm

NOTE

[1] The power level is tested after Digital Pre-Distortion (DPD) enable.

Table 6. Wi-Fi 5GHz Receiver Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	5180		5825	MHz
802.11g Rx Sensitivity	BPSK rate 1/2, 6Mbps OFDM		-93		dBm
	BPSK rate 3/4, 9Mbps OFDM		-93		dBm
	QPSK rate 1/2, 12Mbps OFDM		-92		dBm
	QPSK rate 3/4, 18Mbps OFDM		-89		dBm
	16QAM rate 1/2, 24Mbps OFDM		-86		dBm
	16QAM rate 3/4, 36Mbps OFDM		-83		dBm
	64QAM rate 1/2, 48Mbps OFDM		-78		dBm
	64QAM rate 3/4, 54Mbps OFDM		-76		dBm
802.11n Rx Sensitivity BW = 20MHz Mixed Mode 800ns Guard Interval Non-STBC	MCS 0, BPSK rate 1/2		-93		dBm
	MCS 1, QPSK rate 1/2		-91		dBm
	MCS 2, QPSK rate 3/4		-88		dBm
	MCS 3, 16QAM rate 1/2		-85		dBm
	MCS 4, 16QAM rate 3/4		-82		dBm
	MCS 5, 64QAM rate 2/3		-77		dBm
	MCS 6, 64QAM rate 3/4		-75		dBm

	MCS 7, 64QAM rate 5/6		-74		dBm
802.11n Rx Sensitivity BW = 40MHz Mixed Mode 800ns Guard Interval Non-STBC	MCS 0, BPSK rate 1/2		-91		dBm
	MCS 1, QPSK rate 1/2		-88		dBm
	MCS 2, QPSK rate 3/4		-85		dBm
	MCS 3, 16QAM rate 1/2		-82		dBm
	MCS 4, 16QAM rate 3/4		-79		dBm
	MCS 5, 64QAM rate 2/3		-74		dBm
	MCS 6, 64QAM rate 3/4		-73		dBm
	MCS 7, 64QAM rate 5/6		-71		dBm
Maximum Receive Level	6Mbps OFDM		0		dBm
	54Mbps OFDM		0		dBm
	MCS 0		0		dBm
	MCS 7		0		dBm
Receive Adjacent Channel Rejection	BPSK rate 1/2, 6Mbps OFDM		21		dB
	64QAM rate 3/4, 54Mbps OFDM		11		dB
	HT20, MCS 0, BPSK rate 1/2		19		dB
	HT20, MCS 7, 64QAM rate 5/6		7		dB
	HT40, MCS 0, BPSK rate 1/2		30		dB
	HT40, MCS 7, 64QAM rate 5/6		13		dB

3.3 Bluetooth LE RF Specification

Table 7. Bluetooth LE Transmitter Performance Specification

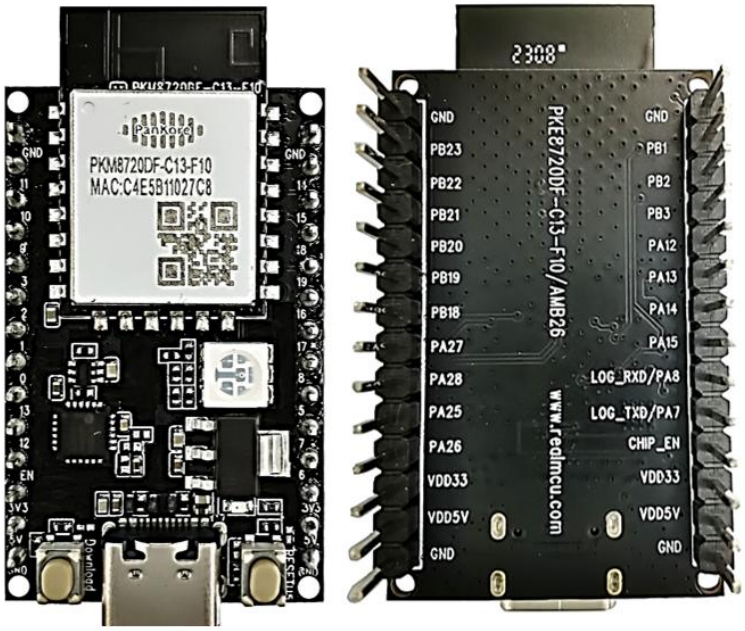
Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	2402		2480	MHz
Tx Output Power	LE1M	-10	4.5	10	dBm
	LE2M				
Modulation Characteristics (LE1M)	ΔF1 Avg.	225		275	kHz
	ΔF2 Max.	285			kHz
	Modulation Index (ΔF2 Avg./ΔF1 Avg.)	0.8			
Modulation Characteristics (LE2M)	ΔF1 Avg.	450		550	kHz
	ΔF2 Max.	370			kHz
	Modulation Index (ΔF2 Avg./ΔF1 Avg.)	0.8			
Modulation Characteristics Stable Modulation (LE1M)	ΔF1 Avg.	247.5		252.5	kHz
	ΔF2 Max.	185			kHz
	Modulation Index (ΔF2 Avg./ΔF1 Avg.)	0.8			
Modulation Characteristics Stable Modulation (LE2M)	ΔF1 Avg.	495		505	kHz
	ΔF2 Max.	370			kHz
	Modulation Index (ΔF2 Avg./ΔF1 Avg.)	0.8			

Table 8. Bluetooth LE Receiver Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Center channel frequency	2402		2480	MHz
Rx Sensitivity @30.8% PER	LE1M		-100.9		dBm
	LE2M		-96.8		

4 Appearance Dimensions

Board dimension: 46.6 ± 0.2mm (L) x 25.4 ± 0.2mm (W) x 3.3 ± 0.2mm (H)



Top View Bottom View

Figure 2. PKE8720DF-C13-F10 Board Appearance

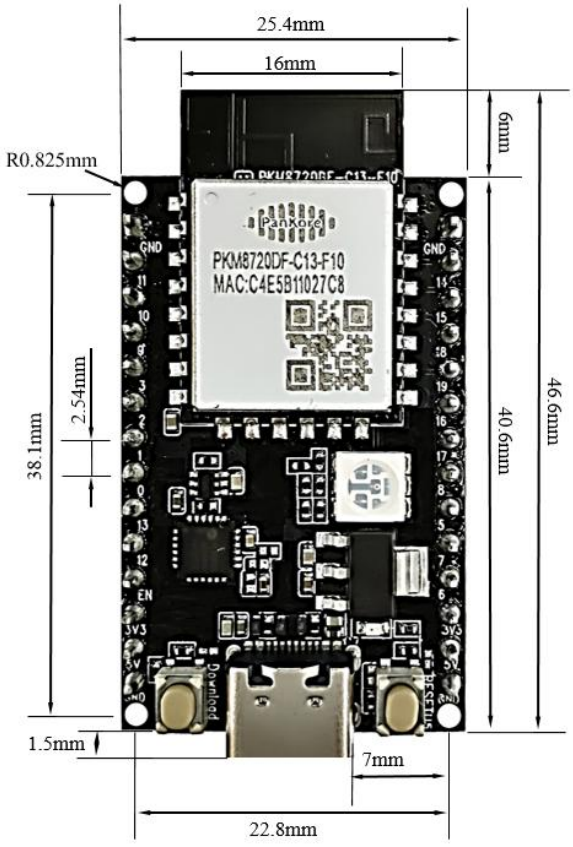


Figure 3. PKE8720DF-C13-F10 Board Dimensions

5 LED and Keys

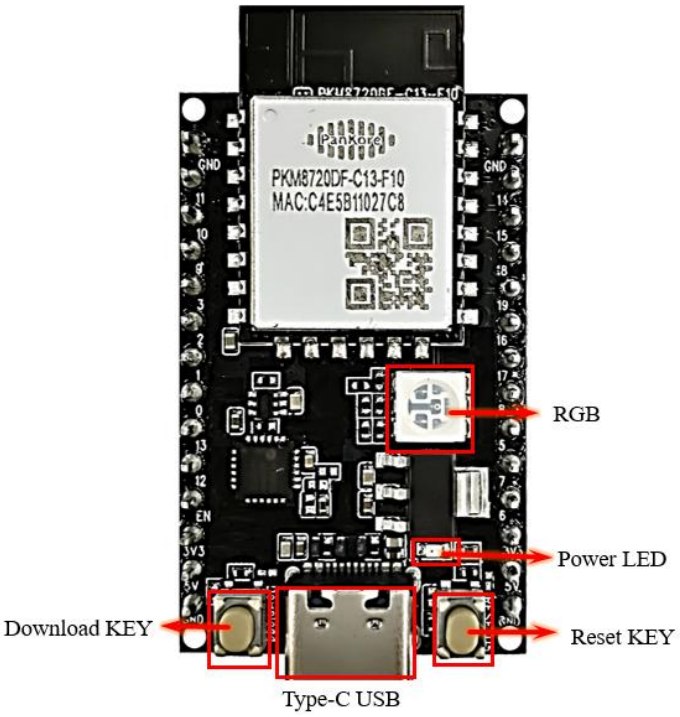


Figure 4. LED and Keys

Table 9. Information of LED and Keys

LED & Keys	Function	Note
Power LED	3.3 V power light	LED lights up when 3.3V is available.
RGB	RGB light	The red, blue and green colors are controlled by PA12, PA13 and PA14
Reset KEY	Reset button	-
Download KEY	Set the module to download mode	Follow these steps to enter the download mode: (1) Press and hold the Download KEY (2) Press the Reset KEY and release it (3) Release the Download KEY

6 Pin Definition

The PKE8720DF-C13-F10 development board leads out 19 I/O interfaces. Figure 5 describes the board interfaces, and the pin function definition table is also layout to list the interface definition.

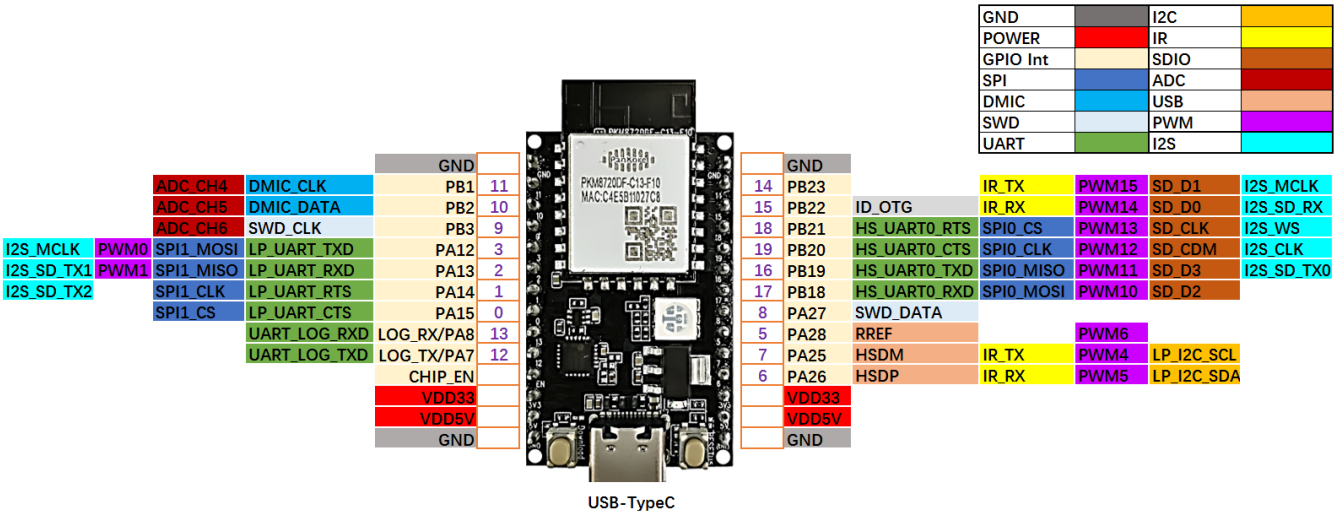


Figure 5. PKE8720DF-C13-F10 Board Interface Description

Table 10. PKE8720DF-C13-F10 Board Pin Definition

Pin No.	Pin Name	Description
0	PA15	LP_UART_CTS/SPI1_CS
1	PA14	LP_UART_RTS/SPI1_CLK/I2S_SD_TX2
2	PA13	LP_UART_RXD/SPI1MISO/PWM1/I2S_SD_TX1
3	PA12	LP_UART_TXD/SPI1_MOSI/PWM0/I2S_MCLK
4	-	-
5	PA28	RREF/PWM6
6	PA26	HSDP/LP_I2C_SDA/PWM5/IR_RX
7	PA25	HSDM/LP_I2C_SCL/PWM4/IR_TX
8	PA27	SWD_DATA
9	PB3	SWD_CLK/ADC_CH6
10	PB2	DMIC_DATA/ADC_CH5
11	PB1	DMIC_CLK/ADC_CH4
12	LOG_TX/PA7	UART_LOG_TXD
13	LOG_RX/PA8	UART_LOG_RXD
14	PB23	IR_TX/PWM15/SD_D1/I2S_MCLK
15	PB22	ID_OTG/IR_RX/ PWM14/S_D0/I2S_SD_RX
16	PB19	HS_UART0_TXD/SPI0_MISO/PWM11/SD_D3/I2S_SD_TX0
17	PB18	HS_UART0_RXD/SPI0_MOSI/PWM10/SD_D2
18	PB21	HS_UART0_RTS/SPI0_CS/PWM13/SD_CLK/I2S_WS
19	PB20	HS_UART0_CTS/SPI0_CLK/PWM12/SD_CDM/I2S_CLK

NOTE

If user wants to use the USB function, RREF needs to be connected to a resistor (12kohm, 1%) in series to the ground.

7 Schematic Diagram & Layout

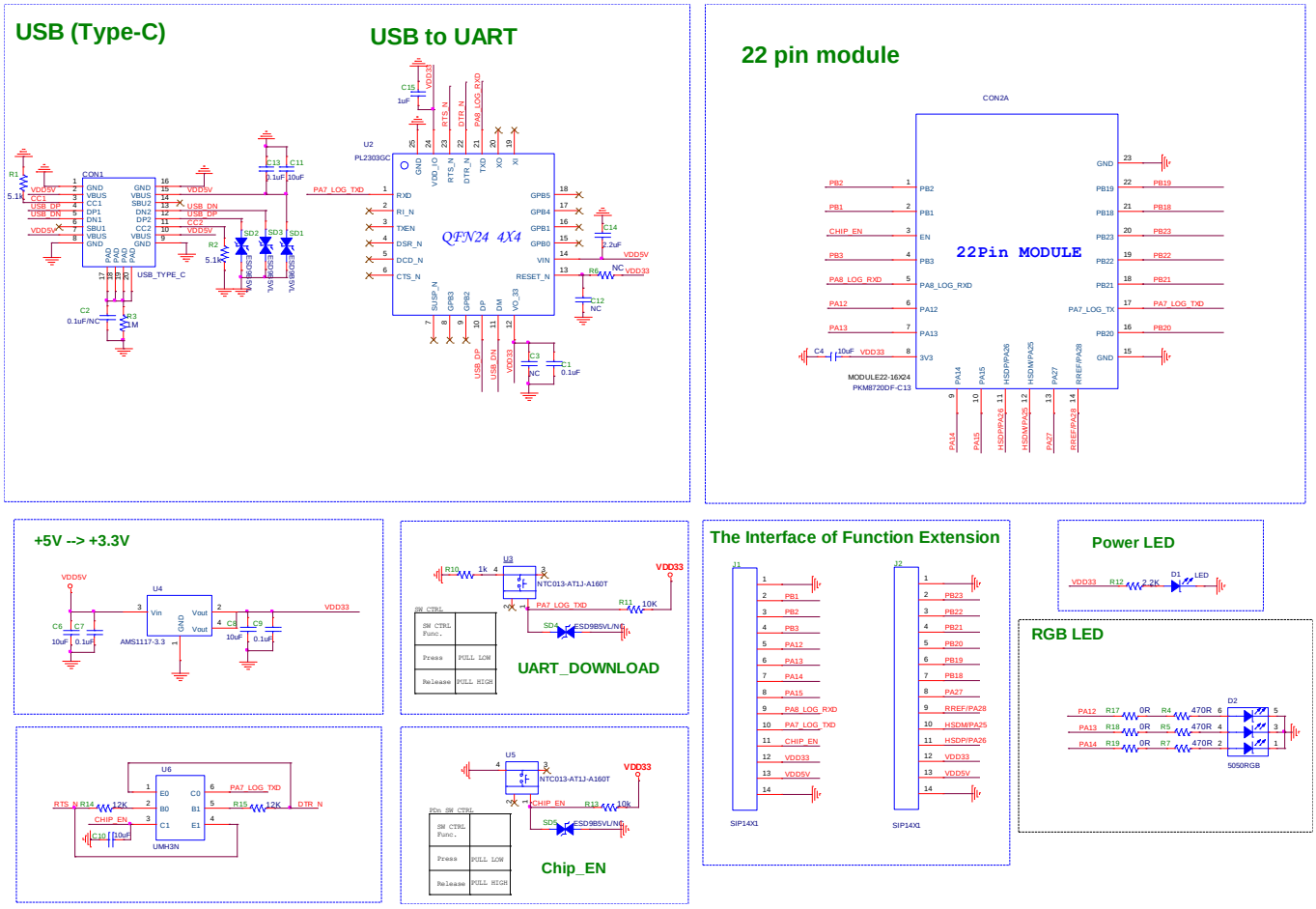


Figure 6. PKE8720DF-C13-F10 Schematic Diagram

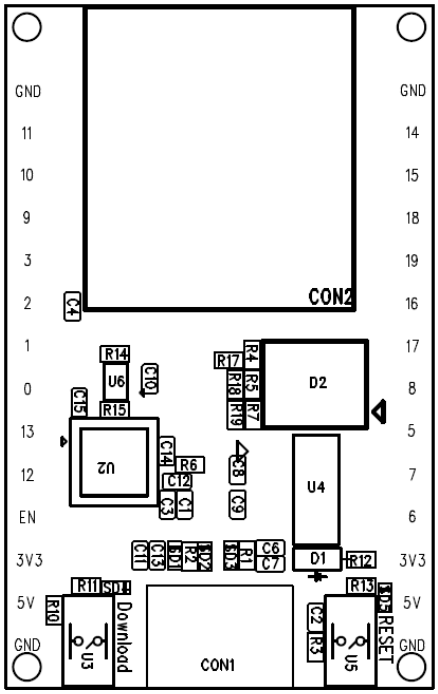


Figure 7. PKE8720DF-C13-F10 Layout

8 Package Information

The PKE8720DF-C13-F10 development board is packaged for inserted pearl cotton with electrostatic bags.

Revision History

Data	Revision	Summary
2023-03-29	1.0	Initial release
2024-08-27	1.1	Change contact email
2025-09-25	1.2	Correct some formats