PKM8721DCM-E10-F32 Module

DATASHEET

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1 Module Overview

1.1 General Description

The PKM8721DCM-E10-F32 is a multi-radio MCU module. With the open CPU architecture, customers can develop advanced applications running on the dual RISC cores. In addition, the embedded 8MB PSRAM can support running basic AI algorithms. It supports Wi-Fi 802.11 a/b/g/n wireless LAN(WLAN) network with 40MHz bandwidth and BLE 5.0 communications. The rich set of peripherals and high performance make it an ideal choice for AI toys, consumer electronics, etc.

1.2 Features

Chipset and Memory:

- RTL8721DCM chipset embedded, dual-core processor: KM4 up to 345MHz, KM0 up to 115MHz
- on-chip memory: 512KB + 160KB SRAM
- 8MB MCM PSRAM
- 16MB Flash

Wi-Fi:

- 802.11 a/b/g/n 1x1, 2.4GHz & 5GHz
- Center frequency range of operating channel: 2412MHz ~ 2484MHz, 5180MHz ~ 5825MHz
- Support 40MHz bandwidth, up to the data rate of MCS7
- Wi-Fi WEP, WPA, WPA2, WPA3, WPS; open, shared key, and pair-wise key authentication services
- Power-saving mechanism
- Channel management and co-existence

Bluetooth Low Energy:

- Bluetooth 5.0 (LE-1M/LE-2M/LE-Coded PHY (long range))
- Supports piconets in a scatter-net (up to 8 master roles and 3 slave roles)
- Supports LE data length extension
- Supports Link Layer privacy
- Supports LE advertising extensions
- Co-existence RF design between Wi-Fi and Bluetooth

Peripherals:

- 2 x I2S interface
- 4 x UART interface, baud rate up to 8Mbps within high-speed mode (40MHz)
- 2 x I2C, three speed modes: standard up to 100Kbps, fast up to 400Kbps, high to 3.4Mbps
- SDIO Device, Default speed mode (25MHz) and high-speed mode (50MHz)
- 2 x SPI, up to 50Mbps in master and slave modes, in half-duplex, full-duplex and simplex modes.
- 8 x PWM with configurable duration and duty cycle from 0 ~ 100%
- Cap touch x 4 channels
- ADC x (7+1) channels
- Programmable GPIOs
- USB 2.0 Device (Full Speed)
- IR

Antenna Option:

- On-board PCB Antenna

Operating Conditions:

- Operating input voltage: (3.3 ± 10%)V
- Operating ambient temperature: -20°C to 85°C

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2 Module Block Diagram

This module includes the chipset, crystal component, R/L/C components for RF matching, decoupling and RF radio antenna.

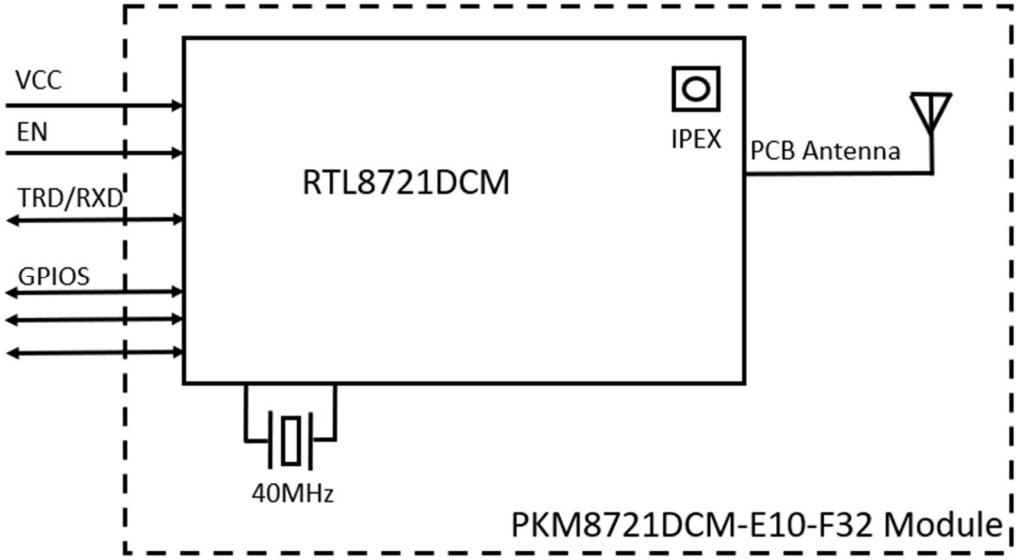

Figure 1. Block Diagram

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3 Module Pin Definition

3.1 Module Pin Layout

This module has 54 pins.

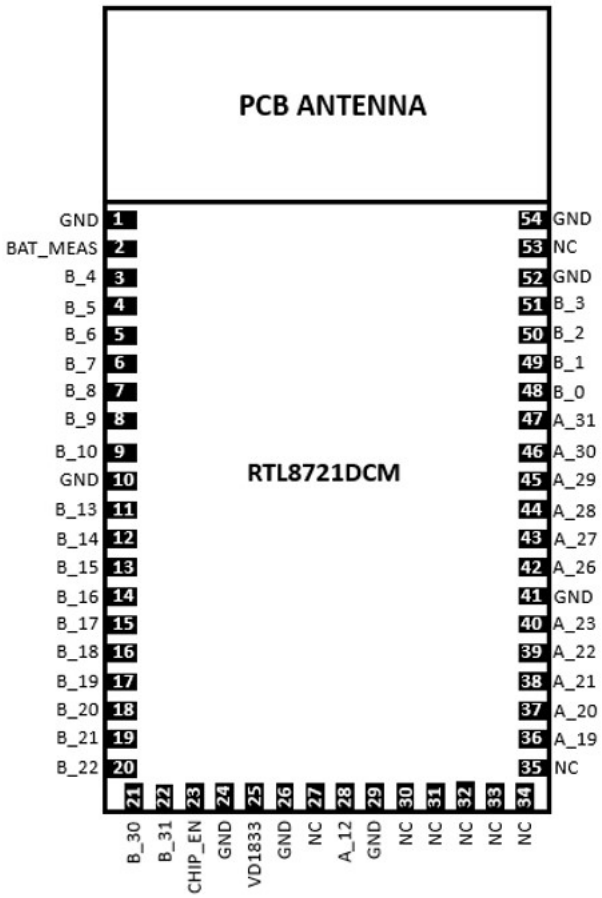

Figure 2. Module Pin Layout (Top View)

3.2 Module Pin Description

3.2.1 Pin Description

Table 1. Pin Description

Pin Name	Pin No.	Type	Description	UART is available	I2C is available	PWM is available
GND	1	P	Ground	NA	NA	NA
BAT_MEAS	2	I/O	BAT_MEAS	NA	NA	NA
B_4	3	I/O	UART_LOG_RXD	NA	NA	NA
B_5	4	I/O	UART_LOG_TXD	NA	NA	NA
B_6	5	I/O	GPIOB_6	√	√	√
B_7	6	I/O	GPIOB_7	√	√	√
B_8	7	I/O	GPIOB_8	√	√	√
B_9	8	I/O	GPIOB_9	√	√	√
B_10	9	I/O	GPIOB_10	√	√	√
GND	10	P	Ground	NA	NA	NA
B_13	11	I/O	GPIOB_13	√	√	√

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B_14	12	I/O	GPIOB_14	√	√	√
B_15	13	I/O	GPIOB_15	√	√	√
B_16	14	I/O	GPIOB_16	√	√	√
B_17	15	I/O	GPIOB_17 / SPI1_CS	√	√	√
B_18	16	I/O	GPIOB_18 / SPI1_CLK	√	√	√
B_19	17	I/O	GPIOB_19 / SPI1_MOSI	√	√	√
B_20	18	I/O	GPIOB_20 / SPI1_MISO	√	√	√
B_21	19	I/O	GPIOB_21	√	√	√
B_22	20	I/O	GPIOB_22	√	√	√
B_30	21	I/O	GPIOB_30	√	√	√
B_31	22	I/O	GPIOB_31	√	√	√
EN	23	I	● High: Enable the chip. ● Low: Module power off.	NA	NA	NA
GND	24	P	Ground	NA	NA	NA
VCC	25	P	Power Supply	NA	NA	NA
GND	26	P	Ground	NA	NA	NA
NC	27	NC	NC	NA	NA	NA
A_12	28	I/O	GPIOA_12	√	√	√
GND	29	P	Ground	NA	NA	NA
NC	30	NC	NC	NA	NA	NA
NC	31	NC	NC	NA	NA	NA
NC	32	NC	NC	NA	NA	NA
NC	33	NC	NC	NA	NA	NA
NC	34	NC	NC	NA	NA	NA
NC	35	NC	NC	NA	NA	NA
A_19	36	I/O	GPIOA_19	√	√	√
A_20	37	I/O	GPIOA_20	√	√	√
A_21	38	I/O	GPIOA_21	√	√	√
A_22	39	I/O	GPIOA_22	√	√	√
A_23	40	I/O	GPIOA_23	√	√	√
GND	41	P	Ground	NA	NA	NA
A_26	42	I/O	GPIOA_26 / D2	√	√	√
A_27	43	I/O	GPIOA_27 / D3	√	√	√
A_28	44	I/O	GPIOA_28 / CMD / DM	√	√	√
A_29	45	I/O	GPIOA_29 / CLK / DP	√	√	√
A_30	46	I/O	GPIOA_30 / D0	√	√	√
A_31	47	I/O	GPIOA_31 / D1	√	√	√
B_0	48	I/O	GPIOB_0	√	√	√
B_1	49	I/O	GPIOB_1	√	√	√
B_2	50	I/O	GPIOB_2	√	√	√
B_3	51	I/O	GPIOB_3	√	√	√
GND	52	P	Ground	NA	NA	NA
NC	53	NC	NC	NA	NA	NA
GND	54	P	Ground	NA	NA	NA

NOTE

- ***P**: power supply*
- ***I**: input*
- *I/**O**: input / output*
- *Detail Available pin refer to "pin_mux" table*

3.2.2 Strapping Pins

This module has 2 strapping pins.

Table 2. Strapping Pin

Pin Name	Pin No.	Default State	Description
B_5	4	Pull up	1: Normal mode (default)

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			0: Flash download mode
B_31	22	Pull up	1: Normal mode (default) 0: Test mode

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4 RF Characteristic

4.1 Wi-Fi Radio Standard

Table 3. Wi-Fi Radio Standard

Wi-Fi Wireless Standard	Description
Wi-Fi frequency range	● 2412MHz ~ 2484MHz (2.4GHz ISM Band) ● 5180MHz ~ 5825MHz (5GHz)
Wi-Fi wireless standard	IEEE 802.11 a/b/g/n
Wi-Fi wireless standard Modulation	DSSS, DBPSK, DQPSK, CCK and OFDM (BPSK/QPSK/16-QAM/64-QAM)
Wi-Fi wireless data rate	● 802.11a: 6/9/12/18/24/36/48/54 Mbps ● 802.11b: 1/2/5.5/11 Mbps ● 802.11g: 6/9/12/18/24/36/48/54 Mbps ● 802.11n: HT20 MCS0-7, HT40 MCS0-7

4.1.1 Wi-Fi 2.4GHz Band RF Transmitter Specification

Table 4. Wi-Fi 2.4GHz Transmitter Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	-	2412	-	2484	MHz
Output power with spectral mask and EVM compliance[1]	1 Mbps DSSS	-	20	-	dBm
	11 Mbps DSSS	-	10	-	dBm
	6 Mbps OFDM	-	19	-	dBm
	54 Mbps OFDM	-	19	-	dBm
	HT20 MCS0	-	19	-	dBm
	HT20 MCS7	-	19	-	dBm
	HT40 MCS0	-	19	-	dBm
	HT40 MCS7	-	18	-	dBm
Tx EVM	6 Mbps OFDM	-		-5	dB
	54 Mbps OFDM	-		-25	dB
	HT20 MCS0	-		-5	dB
	HT20 MCS7	-		-27	dB
	HT40 MCS0	-		-5	dB
	HT40 MCS7	-		-27	dB
Output power variation		-1.5		1.5	dB
Carrier Suppression		-	-40	-30	dBc
Harmonic Output Power[2]	2nd Harmonic	-	-18	-	dBm/MHz
	3rd Harmonic	-	-22	-	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. The output power is measured at RF connector on the Realtek EVB with an approximate 2.4GHz trace loss of 0.8dB. The actual Tx power may differ from the suggested power level due to PCB losses and national regulatory restrictions. Note that the mass production (MP) power may be lower than the values mentioned above. For further details, refer to the MP flow documentation.*
- *[2] Harmonic output power is tested at IC port.*
- *[3] Harmonic output power is measured at RF connector with diplexer (RFDIP1606LB598D1T) and appropriate matching.*

4.1.2 Wi-Fi 2.4GHz Band RF Receiver Specification

Table 5. Wi-Fi 2.4GHz Receiver Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit

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Frequency Range	-	2412	-	2484	MHz
802.11b Rx Sensitivity	1 Mbps DSSS	-	-100	-	dBm
	2 Mbps DSSS	-	-97	-	dBm
	5.5 Mbps DSSS	-	-94	-	dBm
	11 Mbps DSSS	-	-90.5	-	dBm
802.11g Rx Sensitivity	6 Mbps OFDM	-	-95	-	dBm
	9 Mbps OFDM	-	-93.5	-	dBm
	12 Mbps OFDM	-	-92.5	-	dBm
	18 Mbps OFDM	-	-90.5	-	dBm
	24 Mbps OFDM	-	-87	-	dBm
	36 Mbps OFDM	-	-84	-	dBm
	48 Mbps OFDM	-	-79.5	-	dBm
	54 Mbps OFDM	-	-78	-	dBm
802.11n Rx Sensitivity	HT20 MCS0	-	-95	-	dBm
	HT20 MCS1	-	-92	-	dBm
	HT20 MCS2	-	-90	-	dBm
	HT20 MCS3	-	-87	-	dBm
	HT20 MCS4	-	-83.5	-	dBm
	HT20 MCS5	-	-79	-	dBm
	HT20 MCS6	-	-77.5	-	dBm
	HT20 MCS7	-	-76	-	dBm
	HT40 MCS0	-	-92	-	dBm
	HT40 MCS1	-	-89	-	dBm
	HT40 MCS2	-	-87	-	dBm
	HT40 MCS3	-	-83.5	-	dBm
	HT40 MCS4	-	-80.5	-	dBm
	HT40 MCS5	-	-75.5	-	dBm
	HT40 MCS6	-	-74	-	dBm
	HT40 MCS7	-	-73	-	dBm
Maximum Receive Level	6Mbps OFDM	-	0	-	dBm
	54Mbps OFDM	-	0	-	dBm
	HT20 MCS 0	-	0	-	dBm
	HT20 MCS 7	-	0	-	dBm
	HT40 MCS 0	-	0	-	dBm
	HT40 MCS 7	-	0	-	dBm
Adjacent Channel Rejection	11Mbps DSSS	-	43	-	dB
	6 Mbps OFDM	-	44	-	dB
	54Mbps OFDM	-	26	-	dB
	HT20 MCS 0	-	43	-	dB
	HT20 MCS 7	-	23	-	dB
	HT40 MCS 0	-	32	-	dB
	HT40 MCS 7	-	14	-	dB

4.1.3 Wi-Fi 5GHz Band RF Transmitter Specification

Table 6. Wi-Fi 5GHz Transmitter Performance Specification

Parameter	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Frequency Range	-	5180	-	5885	MHz
Output power with spectral mask and EVM compliance[1]	6 Mbps OFDM	-	18	-	dBm
	54 Mbps OFDM	-	18	-	dBm
	HT20 MCS0	-	18	-	dBm
	HT20 MCS7	-	17	-	dBm
	HT40 MCS0	-	18	-	dBm
	HT40 MCS7	-	16	-	dBm
Tx EVM	6 Mbps OFDM	-		-5	dB
	54 Mbps OFDM	-		-25	dB
	HT20 MCS0	-		-5	dB

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	HT20 MCS7	-		-27	dB
	HT40 MCS0	-		-5	dB
	HT40 MCS7	-		-27	dB
Output power variation		-1.5		1.5	dB
Carrier Suppression		-	-40	-30	dBc
Harmonic output power[2]	2nd Harmonic		-28		dBm/MHz
	3rd Harmonic		-30		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. The output power is measured at RF connector on the Realtek EVB with an approximate 5GHz trace loss of 1.5dB. The actual Tx power may differ from the suggested power level due to PCB losses and national regulatory restrictions. Note that the mass production (MP) power may be lower than the values mentioned above. For further details, refer to the MP flow documentation.*
- *[2] Harmonic output power is tested at IC port.*
- *[3] Harmonic output power is measured at RF connector with diplexer (RFDIP1606LB598D1T) and appropriate matching.*

4.1.4 Wi-Fi 5GHz Band RF Receiver Specification

Table 7. Wi-Fi 5GHz Receiver Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	-	5180	-	5885	MHz
802.11a Rx Sensitivity	6 Mbps OFDM	-	-94.5	-	dBm
	9 Mbps OFDM	-	-92.5	-	dBm
	12 Mbps OFDM	-	-91.5	-	dBm
	18 Mbps OFDM	-	-89.5	-	dBm
	24 Mbps OFDM	-	-86.5	-	dBm
	36 Mbps OFDM	-	-83	-	dBm
	48 Mbps OFDM	-	-78.5	-	dBm
	54 Mbps OFDM	-	-77	-	dBm
802.11n Rx Sensitivity	HT20 MCS0	-	-94	-	dBm
	HT20 MCS1	-	-91.5	-	dBm
	HT20 MCS2	-	-89	-	dBm
	HT20 MCS3	-	-86	-	dBm
	HT20 MCS4	-	-82.5	-	dBm
	HT20 MCS5	-	-78	-	dBm
	HT20 MCS6	-	-76.5	-	dBm
	HT20 MCS7	-	-75	-	dBm
	HT40 MCS0	-	-91	-	dBm
	HT40 MCS1	-	-88.5	-	dBm
	HT40 MCS2	-	-85.5	-	dBm
	HT40 MCS3	-	-82.5	-	dBm
	HT40 MCS4	-	-79	-	dBm
	HT40 MCS5	-	-74.5	-	dBm
	HT40 MCS6	-	-73	-	dBm
	HT40 MCS7	-	-71.5	-	dBm
Maximum Receive Level	6Mbps OFDM	-	0	0	dBm
	54Mbps OFDM	-	0	0	dBm
	HT20 MCS0	-	0	0	dBm
	HT20 MCS7		0	0	dBm
	HT40 MCS0		0	0	dBm
	HT40 MCS7	-	0	0	dBm
Adjacent Channel Rejection	6Mbps OFDM		33		dB
	54Mbps OFDM		10		dB
	HT20 MCS0		29		dB
	HT20 MCS7		10		dB
	HT40 MCS0		29		dB

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	HT40 MCS7		11		dB

4.2 Bluetooth LE Radio Standard

4.2.1 Bluetooth LE RF Transmitter Specification

Table 8. Bluetooth LE Transmitter Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	-	2402	-	2480	MHz
Tx Output Power	LE1M	-	8	-	dBm
	LE2M				
Modulation Characteristics (LE1M)	ΔF1 Avg.	-	250	-	kHz
	ΔF2 Max.	185	-	-	kHz
	Modulation Index (ΔF2 Avg./ΔF1 Avg.)	-	0.92	-	
Modulation Characteristics (LE2M)	ΔF1 Avg.	-	500	-	kHz
	ΔF2 Max.	370	-	-	kHz
	Modulation Index (ΔF2 Avg./ΔF1 Avg.)	-	0.93	-	
Modulation Characteristics (LR8)	ΔF1 Avg.	-	250	-	kHz
	ΔF1 99.9%.	185	-	-	kHz
In-Band Spurious Emission (LE1M)	±2MHz offset		-46		dBm
	>±3MHz offset		-49		dBm
In-Band Spurious Emission (LE2M)	±4MHz offset		-48		dBm
	±5MHz offset		-50		dBm
	>±6MHz offset		-50		dBm

4.2.2 Bluetooth LE RF Receiver Specification

Table 9. Bluetooth LE Receiver Performance Specification

Parameter	Condition	Min.	Typ.	Max.	Unit
Frequency Range	-	2402	-	2480	MHz
Rx Sensitivity @30.8% PER	LE1M	-	-99	-	dBm
	LE2M	-	-95	-	
	LR8		-106		

5 Module Electrical Characteristics

5.1 Module Operating Conditions

Table 10. Module Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Units
VCC	Power supply voltage	3.0	3.3	3.6	V
Ta	Ambient operating temperature	-20	-	85	°C
Ts	Storage temperature	-40	-	125	°C

5.2 Module DC Characteristics

Table 11. DC Characteristic (3.3V, 25°C)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
VIH	Input-High Voltage	LVTTL	2.0	-	-	V
VIL	Input-Low Voltage	LVTTL	-	-	0.8	V

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HIFOUVOH	Output-High Voltage	LVTTL	2.4	-	-	V
VOL	Output-Low Voltage	LVTTL	-	-	0.4	V
VT+	Schmitt-trigger High Level	-	1.78	1.87	1.97	V
VT-	Schmitt-trigger Low Level	-	1.36	1.45	1.56	V
IIL	Input-Leakage Current	VIN=3.3V or 0	-10	±1	10	μA

6 Module Schematics

6.1 Module Internal Schematics

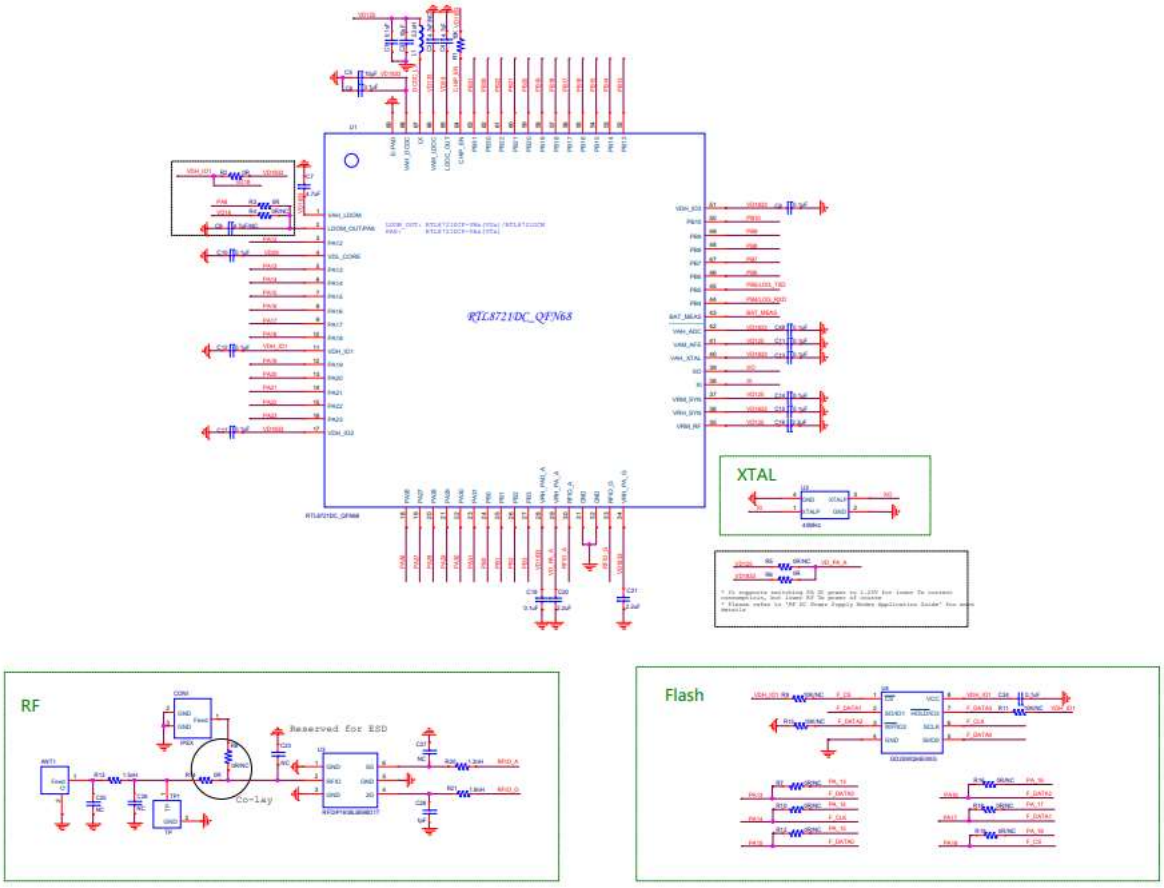

Figure 3. Module internal schematics

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6.2 Module Reference Schematics

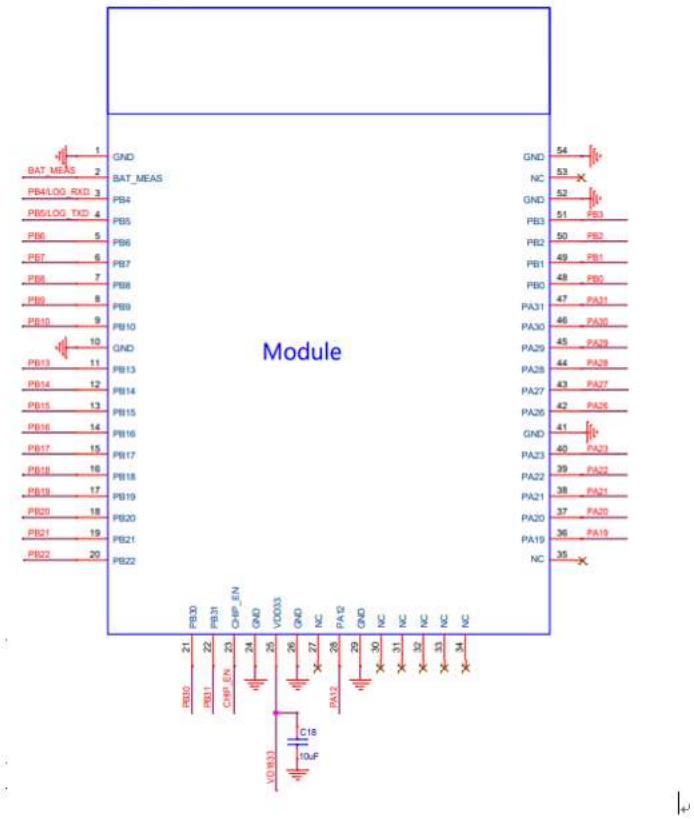

Figure 4. Module Reference schematics

7 Physical Dimensions

Module dimension: 29 ± 0.2mm (L) x 16 ± 0.2mm (W) x 2.8 ± 0.1mm (H)

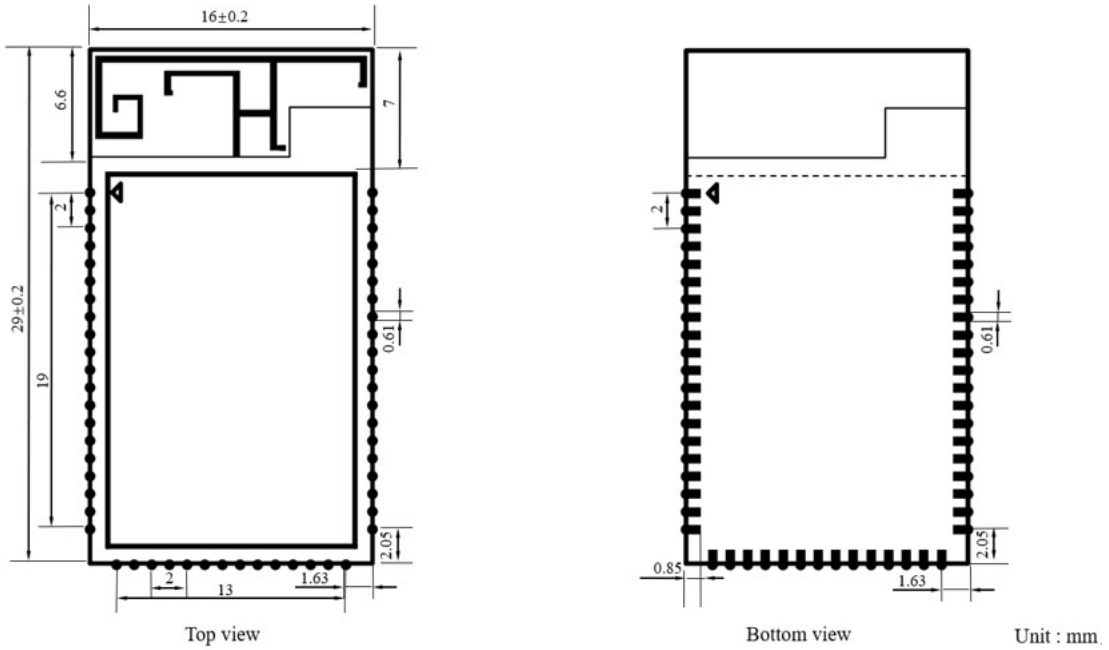

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Figure 5. Module Physical Dimensions

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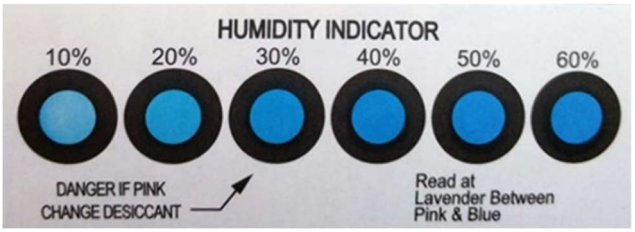
8 Product Handling

8.1 Storage Conditions

The storage conditions for a delivered module:

- Moisture sensitive level (MSL): 3
- Calculated shelf life in sealed bag: 12 months at <40°C and <90% relative humidity (RH)
- Peak package body temperature: 260°C
- A humidity indicator card (HIC) in the packaging bag.



- After bag is opened, the module that will be subjected to reflow solder or other high temperature process must be
  - Mounted within: 168 hours of factory conditions ≤30°C/60% RH, or
  - Stored per J-STD-033
- The module needs to be baked in the following cases:
  - The packaging bag is damaged before unpacking.
  - There is no humidity indicator card (HIC) in the packaging bag.
  - After unpacking, circles of 10% and above on the HIC become pink.
  - The total exposure time has lasted for over 168 hours since unpacking.
  - More than 12 months have passed since the sealing of the bag.
- If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure.

NOTE

Level and body temperature are defined by IPC/JEDECJ-STD-020.

8.2 Production Instructions

- The PKM8721DCM-E10-F32 module can be packaged with the SMT process according to the customer's PCB designed to be SMT-packaged. After being unpacked, the module must be soldered within 24 hours. Otherwise, it needs to be put into the drying cupboard where the relative humidity is not greater than 10%; or it needs to be packaged again under vacuum and the exposure time needs to be recorded (the total exposure time cannot exceed 168 hours).
  - SMT devices needed:
    - Mounter
    - SPI
    - Reflow soldering machine
    - Thermal profiler
    - Automated optical inspection (AOI) equipment
  - Baking devices needed:
    - Cabinet oven
    - Anti-electrostatic and heat-resistant trays
    - Anti-electrostatic and heat-resistant gloves
- Baking settings:
  - Temperature: 40°C and ≤ 5% RH for reel package and 125°C and ≤5% RH for tray package (use the heat-resistant tray rather than a plastic container)
  - Time: 168 hours for reel package and 12 hours for tray package
  - Alarm temperature: 50°C for reel package and 135°C for tray package
  - Production-ready temperature after natural cooling: < 36°C
  - Re-baking situation: If a module remains unused for over 168 hours after being baked, it needs to be baked again.
  - If a batch of modules is not baked within 168 hours, do not use the wave soldering to solder them. Because these modules are Level-3 moisture-sensitive devices, they are very likely to get damp when exposed beyond the allowable time. In this case, if they are soldered at high temperatures, it may result in device failure or poor soldering.
- In the whole production process, take electrostatic discharge (ESD) protective measures.

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- To guarantee the passing rate, it is recommended to use the SPI and AOI to monitor the quality of solder paste printing and mounting.

8.3 Recommended Oven Temperature Curve

There are some differences between the set temperatures and the actual temperatures. All the temperatures listed in this datasheet are obtained through actual measurements.

For the SMT process, set oven temperatures according to Figure 6.

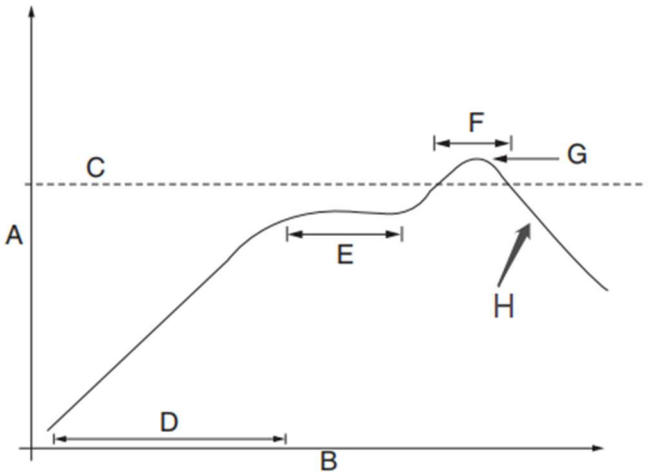

Figure 6. Reflow Soldering Curve Diagram

- D: Rising speed = (1 ~ 3)°C/s, 20°C ~ 150°C, 60s ~ 90s
- E: Average preheating temperature = 150°C ~ 200°C, 60s ~ 120s
- F: Temperature fluctuation > 217°C, 50s to 70s; peak temperature = 235°C ~ 245°C
- H: Drop speed = (1 ~ 4)°C/s

NOTE

Adjust the balance time to ensure the rationalization treatment of gas when tin paste solves. If there are too much gaps on the PCB board, increase the balance time. Considering that the product is long placed in the welding area, to prevent components and bottom plate from damage.

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9 Revision History

Data	Revision	Change Note
2025-07-03	1.0	Initial release
2025-07-18	1.1	Update RF characteristics

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