General Description

RM9000 module is a multiprotocol 2.4 GHz wireless microcontroller (MCU) supporting *Bluetooth*® 5.2 Low Energy, IEEE 802.15.4, IPv6-enabled smart objects (6LoWPAN), proprietary systems, including the TI 15.4-Stack (2.4 GHz), and concurrent multiprotocol through a Dynamic Multiprotocol Manager (DMM) driver. The device is optimized for low-power wireless communication and advanced sensing in building security systems, HVAC, medical, portable electronics, home theater & entertainment, and connected peripherals markets. The highlighted features of this module include:

- Wide flexibility of protocol stack support.
- Enable long-range and low-power applications using integrated +5 dBm high-power amplifier with best-in-class transmit current consumption at 85 mA.
- Coin-cell operation at +5 dBm with transmit current consumption of 22 mA.
- Longer battery life wireless applications with low standby current of 0.94 µA with full RAM retention.
- Industrial temperature ready with lowest standby current of 5 µA at 85°C.
- Advanced sensing with a programmable, autonomous ultra-low power Sensor Controller CPU with fast wake-up capability. As an example, the sensor controller is capable of 1-Hz ADC sampling at 1 µA system current.
- Low SER (Soft Error Rate) FIT (Failure-in-time) for long operation lifetime with no disruption for industrial markets with always-on SRAM parity against corruption due to potential radiation events.
- Dedicated software-controlled radio controller (Arm® Cortex®-M0) providing flexible low-power RF transceiver capability to support multiple physical layers and RF standards.
- Excellent radio sensitivity and robustness (selectivity and blocking) performance for *Bluetooth* ® Low Energy (-105 dBm for 125-kbps LE Coded PHY).

Features

- Microcontroller
  - Powerful 48-MHz Arm® Cortex®-M4F processor
  - EEMBC CoreMark® score: 148
  - 352KB of in-system programmable flash
  - 256KB of ROM for protocols and library functions
  - 8KB of cache SRAM (alternatively available as general-purpose RAM)
  - 80KB of ultra-low leakage SRAM. The SRAM is protected by parity to ensure high reliability of operation.
  - 2-pin cJTAG and JTAG debugging
  - Supports over-the-air (OTA) update
- Ultra-low power sensor controller with 4KB of SRAM
  - Sample, store, and process sensor data
  - Operation independent from system CPU
  - Fast wake-up for low-power operation
- TI-RTOS, drivers, bootloader, *Bluetooth*® 5.2 low energy controller, and IEEE 802.15.4 MAC in ROM for optimized application size
- 7-mm × 7-mm RGZ VQFN48 (26 GPIOs)
  Peripherals
  - Digital peripherals can be routed to any GPIO
  - 4× 32-bit or 8× 16-bit general-purpose timers
  - 12-bit ADC, 200 kSamples/s, 8 channels
  - 2× comparators with internal reference DAC (1× continuous time, 1× ultra-low power)
  - Programmable current source
  - 2× UART

- 2× SSI (SPI, MICROWIRE, TI)
- I^2C and I^2S
- Real-time clock (RTC)
- AES 128- and 256-bit cryptographic accelerator
- ECC and RSA public key hardware accelerator
- SHA2 accelerator (full suite up to SHA-512)
- True random number generator (TRNG)
- Capacitive sensing, up to 8 channels
- Integrated temperature and battery monitor

- External system
  - On-chip buck DC/DC converter
- Low power
  - Active mode RX: 6.9 mA
  - Active mode TX 0 dBm: 7.3 mA
  - Active mode TX 5 dBm: 9.6 mA
  - Active mode MCU 48 MHz (CoreMark): 3.4 mA (71 μA/MHz)
  - Sensor controller, low power-mode, 2 MHz, running infinite loop: 30.1 μA
  - Sensor controller, active mode, 24 MHz, running infinite loop: 808 μA
  - Standby: 0.94 μA (RTC on, 80KB RAM and CPU retention)
  - Shutdown: 150 nA (wakeup on external events)
- Radio section
  - 2.4 GHz RF transceiver compatible with Bluetooth 5.2 Low Energy and earlier LE specifications and IEEE 802.15.4 PHY and MAC
  - 3-wire, 2-wire, 1-wire PTA coexistence mechanisms
  - Excellent receiver sensitivity:
-100 dBm for 802.15.4 (2.4 GHz),
-105 dBm for Bluetooth 125-kbps (LE Coded PHY)
  - Output power up to +5 dBm with temperature compensation
  - Suitable for systems targeting compliance with worldwide radio frequency regulations
    - EN 300 328, (Europe)
    - EN 300 440 Category 2
    - FCC CFR47 Part 15
    - ARIB STD-T66 (Japan)
- Wireless protocols
  - *Bluetooth*® 5.2 Low Energy, IEEE 802.15.4, IPv6-enabled smart objects (6LoWPAN), proprietary systems, SimpleLink™ TI 15.4 stack (2.4 GHz), and dynamic multiprotocol manager (DMM) driver.

Applications

- 2400 to 2480 MHz ISM and SRD systems 1 with down to 4 kHz of receive bandwidth
- Building automation
  - Building security systems – motion detector, electronic smart lock, door and window sensor, garage door system, gateway
  - HVAC – thermostat, wireless environmental sensor, HVAC system controller, gateway
  - Fire safety system – smoke and heat detector, fire alarm control panel (FACP)
  - Video surveillance – IP network camera
  - Elevators and escalators – elevator main control panel for elevators and escalators
- Grid infrastructure
  - Smart meters – water meter, gas meter, electricity meter, and heat cost allocators
  - Grid communications – wireless communications – Long-range sensor applications
  - Other alternative energy – energy harvesting
- Industrial transport – asset tracking
- Factory automation and control
- Medical
- Electronic point of sale (EPOS) – Electronic Shelf Label (ESL)
- Communication equipment
  - Wired networking – wireless LAN or Wi-Fi access points, edge router , small business router
- Personal electronics
  - Portable electronics – RF smart remote control
  - Home theater & entertainment – smart speakers, smart display, set-top box
  - Connected peripherals – consumer wireless module, pointing devices, keyboards and keypads
  - Gaming – electronic and robotic toys
  - Wearables (non-medical) – smart trackers, smart clothing

Contents

1. References

[1] CC2652P resources: https://www.ti.com/product/CC2652

2. Block Diagram

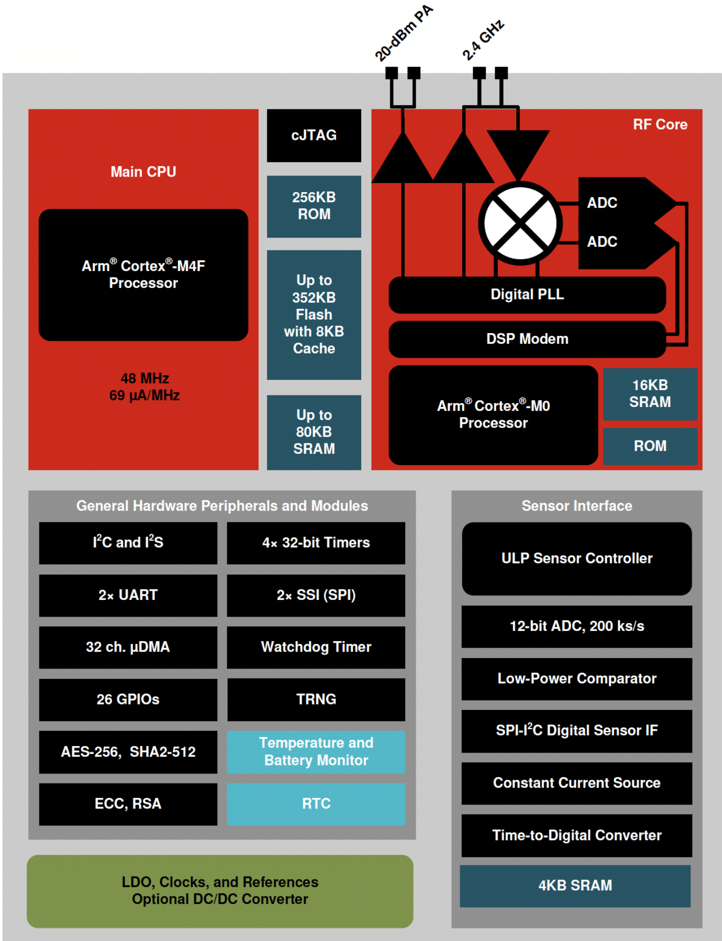

Figure 2-1. RM9000 Block Diagram

3. Terminal Configuration and Functions

3.1 Pin Diagram

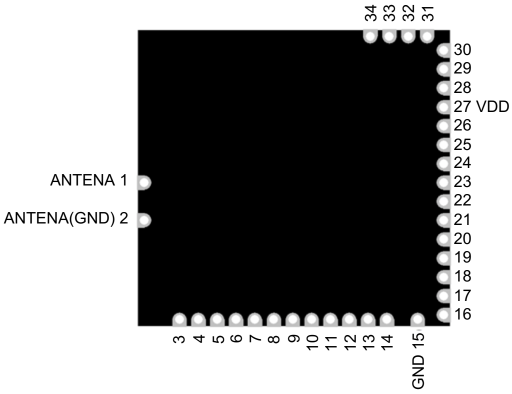

Figure 3-1. Pin Diagram (Top View)

3.2 Pin Attributes and Pin Multiplexing

Table 3-1. Pin Description

Pin #	Pin Name	Description
1	ANTENNA	Antenna
2	ANTENNA(GND)	Antenna Ground
15	GND	Power Ground
27	VDD	1.8-V to 3.8-V main chip supply
OTHERS	NC	GPIO

4. Specifications

4.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1] [2]

			MIN	MAX	UNIT
VDDS[3]	Supply voltage		–0.3	4.1	V
	Voltage on any digital pin[4]		–0.3	VDDS + 0.3, max 4.1	V
	Voltage on crystal oscillator pins, X32K_Q1, X32K_Q2, X48M_N and X48M_P		–0.3	VDDR + 0.3, max 2.25	V
V_{in}	Voltage on ADC input	Voltage scaling enabled	–0.3	VDDS	V
		Voltage scaling disabled, internal reference	–0.3	1.49	
		Voltage scaling disabled, VDDS as reference	–0.3	VDDS / 2.9	
	Input level, RF pins			5	dBm
T_{stg}	Storage temperature		–40	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values are with respect to ground, unless otherwise noted.
(3) VDDS_DCDC, VDDS2 and VDDS3 must be at the same potential as VDDS.
(4) Including analog capable DIOs.

4.2 ESD Ratings

				VALUE	UNIT
V_{ESD}	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS001[1]	All pins	±2000	V
		Charged device model (CDM), per JESD22-C101[2]	All pins	±500	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

4.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

	MIN	MAX	UNIT
Operating ambient temperature	–40	85	°C
Operating supply voltage (VDDS)	1.8	3.8	V
Rising supply voltage slew rate	0	100	mV/µs
Falling supply voltage slew rate[1]	0	20	mV/µs

(1) For small coin-cell batteries, with high worst-case end-of-life equivalent source resistance, a 22-µF VDDS input capacitor must be used to ensure compliance with this slew rate.

4.4 Power Supply and Modules

over operating free-air temperature range (unless otherwise noted)

PARAMETER		MIN	TYP	MAX	UNIT
VDDS Power-on-Reset (POR) threshold			1.1 - 1.55		V
VDDS Brown-out Detector (BOD) [1]	Rising threshold		1.77		V
VDDS Brown-out Detector (BOD), before initial boot [2]	Rising threshold		1.70		V
VDDS Brown-out Detector (BOD) [1]	Falling threshold		1.75		V

(1) For boost mode (VDDR =1.95 V), TI drivers software initialization will trim VDDS BOD limits to maximum (approximately 2.0 V)
(2) Brown-out Detector is trimmed at initial boot, value is kept until device is reset by a POR reset or the RESET_N pin

4.5 Power Consumption - Power Modes

When measured on the CC1352PEM-XD7793-XD24-PA24 reference design with T_c = 25 °C, V_{DDS} = 3.0 V with DC/DC enabled unless otherwise noted.

PARAMETER		TEST CONDITIONS	TYP	UNIT
Core Current Consumption				
I_{core}	Reset and Shutdown	Reset. RESET_N pin asserted or VDDS below power-on-reset threshold	150	nA
		Shutdown. No clocks running, no retention	150	
	Standby without cache retention	RTC running, CPU, 80KB RAM and (partial) register retention. RCOSC_LF	0.94	µA
		RTC running, CPU, 80KB RAM and (partial) register retention XOSC_LF	1.09	µA
	Standby with cache retention	RTC running, CPU, 80KB RAM and (partial) register retention. RCOSC_LF	3.2	µA
		RTC running, CPU, 80KB RAM and (partial) register retention. XOSC_LF	3.3	µA
	Idle	Supply Systems and RAM powered RCOSC_HF	675	µA
	Active	MCU running CoreMark at 48 MHz RCOSC_HF	3.39	mA
Peripheral Current Consumption(1) (2)				
I_{peri}	Peripheral power domain	Delta current with domain enabled	97.7	µA
	Serial power domain	Delta current with domain enabled	7.2	
	RF Core	Delta current with power domain enabled, clock enabled, RF core idle	210.9	
	µDMA	Delta current with clock enabled, module is idle	63.9	
	Timers	Delta current with clock enabled, module is idle(5)	81.0	
	I2C	Delta current with clock enabled, module is idle	10.1	
	I2S	Delta current with clock enabled, module is idle	26.3	
	SSI	Delta current with clock enabled, module is idle	82.9	
	UART	Delta current with clock enabled, module is idle(3)	167.5	
	CRYPTO (AES)	Delta current with clock enabled, module is idle(4)	25.6	
	PKA	Delta current with clock enabled, module is idle	84.7	
	TRNG	Delta current with clock enabled, module is idle	35.6	
Sensor Controller Engine Consumption				
I_{SCE}	Active mode	24 MHz, infinite loop	808.5	µA
	Low-power mode	2 MHz, infinite loop	30.1	

(1) Adds to core current I_{core} for each peripheral unit activated.
(2) I_{peri} is not supported in Standby or Shutdown modes.
(3) Only one UART running
(4) Only one SSI running
(5) Only one GPTimer running

4.6 Power Consumption - Radio Modes

When measured on the CC1352PEM-XD7793-XD24-PA24 reference design with T_c = 25 °C, V_{DDS} = 3.0 V with DC/DC enabled unless otherwise noted.
High-power PA connected to V_{DDS} unless otherwise noted.

PARAMETER	TEST CONDITIONS	TYP	UNIT
Radio receive current	2440 MHz	6.9	mA
Radio transmit current 2.4 GHz PA (BLE)	0 dBm output power setting 2440 MHz	7.3	mA
	+5 dBm output power setting 2440 MHz	9.6	mA

(1) Measured on evaluation board as described in Optimizing the CC1352P and CC2652P for Coin Cell Operation at 10 dBm Output Power.

4.7 Nonvolatile (Flash) Memory Characteristics

Over operating free-air temperature range and V_{DDS} = 3.0 V (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Flash sector size			8		KB
Supported flash erase cycles before failure, full bank[(1)] [(5)]		30			k Cycles
Supported flash erase cycles before failure, single sector[(2)]		60			k Cycles
Maximum number of write operations per row before sector erase[(3)]				83	Write Operations
Flash retention	85 °C		11.4		Years at 85 °C
Flash sector erase current	Average delta current		10.7		mA
Flash sector erase time[(4)]	Zero cycles		10. 0		ms
Flash write current	Average delta current, 4 bytes at a time		6.2		mA
Flash write time[(4)]	4 bytes at a time		21.6		µs

(1) A full bank erase is counted as a single erase cycle on each sector
(2) Up to 4 customer-designated sectors can be individually erased an additional 30k times beyond the baseline bank limitation of 30k cycles
(3) Each wordline is 2048 bits (or 256 bytes) wide. This limitation corresponds to sequential memory writes of 4 (3.1) bytes minimum per write over a whole wordline. If additional writes to the same wordline are required, a sector erase is required once the maximum number of write operations per row is reached.
(4) This number is dependent on Flash aging and increases over time and erase cycles
(5) Aborting flash during erase or program modes is not a safe operation.

4.8 Thermal Resistance Characteristics

THERMAL METRIC[(1)]		PACKAGE RGZ (VQFN) 48 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	23.4	°C/W[(2)]
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	13.3	°C/W[(2)]
$R_{\theta JB}$	Junction-to-board thermal resistance	8.0	°C/W[(2)]
Ψ_{JT}	Junction-to-top characterization parameter	0.1	°C/W[(2)]
Ψ_{JB}	Junction-to-board characterization parameter	7.9	°C/W[(2)]
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	1.7	°C/W[(2)]

(1) For more information about traditional and new thermal metrics, see Semiconductor and IC Package Thermal Metrics.
(2) °C/W = degrees Celsius per watt.

4.9 RF Frequency Bands

Over operating free-air temperature range (unless otherwise noted).

PARAMETER	MIN	TYP	MAX	UNIT
Frequency bands	2360		2500	MHz

4.10 Bluetooth Low Energy - Receive (RX)

Measured on the CC1352PEM-XD7793-XD24-PA24 reference design with T_c = 25 °C, V_{DDS} = 3.0 V, f_{RF}= 2440 MHz with DC/DC enabled and high power PA connected to V_{DDS} unless otherwise noted.
All measurements are performed at the antenna input with a combined RX and TX path, except for high power PA which is measured at a dedicated antenna connection. All measurements are performed conducted.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
125 kbps (LE Coded)					
Receiver sensitivity	Differential mode. BER = 10^{-3}		–105		dBm

Receiver saturation	Differential mode. BER = 10^{-3}	>5	dBm
Frequency error tolerance	Difference between the incoming carrier frequency and the internally generated carrier frequency	> (–300 / 300)	kHz
Data rate error tolerance	Difference between incoming data rate and the internally generated data rate (37-byte packets)	> (–320 / 240)	ppm
Data rate error tolerance	Difference between incoming data rate and the internally generated data rate (255-byte packets)	> (–125 / 125)	ppm
Co-channel rejection[1]	Wanted signal at –79 dBm, modulated interferer in channel, BER = 10^{-3}	–1.5	dB
Selectivity, ±1 MHz[1]	Wanted signal at –79 dBm, modulated interferer at ±1 MHz, BER = 10^{-3}	8 / 4.5[2]	dB
Selectivity, ±2 MHz[1]	Wanted signal at –79 dBm, modulated interferer at ±2 MHz, BER = 10^{-3}	44 / 39 [2]	dB
Selectivity, ±3 MHz[1]	Wanted signal at –79 dBm, modulated interferer at ±3 MHz, BER = 10^{-3}	46 / 44[2]	dB
Selectivity, ±4 MHz[1]	Wanted signal at –79 dBm, modulated interferer at ±4 MHz, BER = 10^{-3}	44 / 46[2]	dB
Selectivity, ±6 MHz[1]	Wanted signal at –79 dBm, modulated interferer at ≥ ±6 MHz, BER = 10^{-3}	48 / 44[2]	dB
Selectivity, ±7 MHz	Wanted signal at –79 dBm, modulated interferer at ≥ ±7 MHz, BER = 10^{-3}	51 / 45[2]	dB
Selectivity, Image frequency[1]	Wanted signal at –79 dBm, modulated interferer at image frequency, BER = 10^{-3}		dB
Selectivity, Image frequency ±1 MHz[1]	Note that Image frequency + 1 MHz is the Co-channel –1 MHz. Wanted signal at –79 dBm, modulated interferer at ±1 MHz from image frequency, BER = 10^{-3}	4.5 / 44 [2]	dB
500 kbps (LE Coded)			
Receiver sensitivity	Differential mode. BER = 10^{-3}	–100	dBm
Receiver saturation	Differential mode. BER = 10^{-3}	> 5	dBm
Frequency error tolerance	Difference between the incoming carrier frequency and the internally generated carrier frequency	> (–300 / 300)	kHz
Data rate error tolerance	Difference between incoming data rate and the internally generated data rate (37-byte packets)	> (–450 / 450)	ppm
Data rate error tolerance	Difference between incoming data rate and the internally generated data rate (255-byte packets)	> (–175 / 175)	ppm
Co-channel rejection[1]	Wanted signal at –72 dBm, modulated interferer in channel, BER = 10^{-3}	–3.5	dB
Selectivity, ±1 MHz[1]	Wanted signal at –72 dBm, modulated interferer at ±1 MHz, BER = 10^{-3}	8 / 4[2]	dB
Selectivity, ±2 MHz[1]	Wanted signal at –72 dBm, modulated interferer at ±2 MHz, BER = 10^{-3}	44 / 37 [2]	dB
Selectivity, ±3 MHz[1]	Wanted signal at –72 dBm, modulated interferer at ±3 MHz, BER = 10^{-3}	46 / 46[2]	dB

Measured on the CC1352PEM-XD7793-XD24-PA24 reference design with T_c = 25 °C, V_{DDS} = 3.0 V, f_{RF}= 2440 MHz with DC/DC enabled and high power PA connected to V_{DDS} unless otherwise noted.
All measurements are performed at the antenna input with a combined RX and TX path, except for high power PA which is measured at a dedicated antenna connection. All measurements are performed conducted.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Selectivity, ±4 MHz[1]	Wanted signal at –72 dBm, modulated interferer at ±4 MHz, BER = 10^{-3}		45 / 47[2]		dB
Selectivity, ±6 MHz[1]	Wanted signal at –72 dBm, modulated interferer at ≥ ±6 MHz, BER = 10^{-3}		46 / 45[2]		dB
Selectivity, ±7 MHz	Wanted signal at –72 dBm, modulated interferer at ≥ ±7 MHz, BER = 10^{-3}		49 / 45[2]		dB
Selectivity, Image frequency[1]	Wanted signal at –72 dBm, modulated interferer at image frequency, BER = 10^{-3}				dB

Selectivity, Image frequency ±1 MHz[1]	Note that Image frequency + 1 MHz is the Co-channel –1 MHz. Wanted signal at –72 dBm, modulated interferer at ±1 MHz from image frequency, BER = 10^{-3}		4 / 46[2]		dB
1 Mbps (LE 1M)					
Receiver sensitivity	Differential mode. BER = 10^{-3}		–97		dBm
Receiver saturation	Differential mode. BER = 10^{-3}		> 5		dBm
Frequency error tolerance	Difference between the incoming carrier frequency and the internally generated carrier frequency		> (–350 / 350)		kHz
Data rate error tolerance	Difference between incoming data rate and the internally generated data rate (37-byte packets)		> (–750 / 750)		ppm
Co-channel rejection[1]	Wanted signal at –67 dBm, modulated interferer in channel, BER = 10^{-3}		–6		dB
Selectivity, ±1 MHz[1]	Wanted signal at –67 dBm, modulated interferer at ±1 MHz, BER = 10^{-3}		7 / 4[2]		dB
Selectivity, ±2 MHz[1]	Wanted signal at –67 dBm, modulated interferer at ±2 MHz,BER = 10^{-3}		40 / 33[2]		dB
Selectivity, ±3 MHz[1]	Wanted signal at –67 dBm, modulated interferer at ±3 MHz, BER = 10^{-3}		36 / 41 [2]		dB
Selectivity, ±4 MHz[1]	Wanted signal at –67 dBm, modulated interferer at ±4 MHz, BER = 10^{-3}		36 / 45[2]		dB
Selectivity, ±5 MHz or more[1]	Wanted signal at –67 dBm, modulated interferer at ≥ ±5 MHz, BER = 10^{-3}		40		dB
Selectivity, image frequency[1]	Wanted signal at –67 dBm, modulated interferer at image frequency, BER = 10^{-3}		33		dB
Selectivity, image frequency ±1 MHz[1]	Note that Image frequency + 1 MHz is the Co-channel –1 MHz. Wanted signal at –67 dBm, modulated interferer at ±1 MHz from image frequency, BER = 10^{-3}		4 / 41[2]		dB
Out-of-band blocking[3]	30 MHz to 2000 MHz		–10		dBm
Out-of-band blocking	2003 MHz to 2399 MHz		–18		dBm
Out-of-band blocking	2484 MHz to 2997 MHz		–12		dBm
Out-of-band blocking	3000 MHz to 12.75 GHz		–2		dBm
Intermodulation	Wanted signal at 2402 MHz, –64 dBm. Two interferers at 2405 and 2408 MHz respectively, at the given power level		–42		dBm
Spurious emissions, 30 to 1000 MHz[4]	Measurement in a 50-Ω single-ended load.		< –59		dBm
Spurious emissions, 1 to 12.75 GHz[4]	Measurement in a 50-Ω single-ended load.		< –47		dBm

Measured on the CC1352PEM-XD7793-XD24-PA24 reference design with T_c = 25 °C, V_{DDS} = 3.0 V, f_{RF}= 2440 MHz with DC/DC enabled and high power PA connected to V_{DDS} unless otherwise noted.
All measurements are performed at the antenna input with a combined RX and TX path, except for high power PA which is measured at a dedicated antenna connection. All measurements are performed conducted.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
RSSI dynamic range			70		dB
RSSI accuracy			±4		dB
2 Mbps (LE 2M)					
Receiver sensitivity	Differential mode. Measured at SMA connector, BER = 10^{-3}		–92		dBm
Receiver saturation	Differential mode. Measured at SMA connector, BER = 10^{-3}		> 5		dBm
Frequency error tolerance	Difference between the incoming carrier frequency and the internally generated carrier frequency		> (–500 / 500)		kHz
Data rate error tolerance	Difference between incoming data rate and the internally generated data rate (37-byte packets)		> (–700 / 750)		ppm

Co-channel rejection(1)	Wanted signal at –67 dBm, modulated interferer in channel,BER = 10^{-3}	–7	dB
Selectivity, ±2 MHz(1)	Wanted signal at –67 dBm, modulated interferer at ±2 MHz, Image frequency is at –2 MHz, BER = 10^{-3}	8 / 4(2)	dB
Selectivity, ±4 MHz(1)	Wanted signal at –67 dBm, modulated interferer at ±4 MHz, BER = 10^{-3}	36 / 36 (2)	dB
Selectivity, ±6 MHz(1)	Wanted signal at –67 dBm, modulated interferer at ±6 MHz, BER = 10^{-3}	37 / 36(2)	dB
Selectivity, image frequency(1)	Wanted signal at –67 dBm, modulated interferer at image frequency, BER = 10^{-3}	4	dB
Selectivity, image frequency ±2 MHz(1)	Note that Image frequency + 2 MHz is the Co-channel. Wanted signal at –67 dBm, modulated interferer at ±2 MHz from image frequency, BER = 10^{-3}	–7 / 36(2)	dB
Out-of-band blocking(3)	30 MHz to 2000 MHz	–16	dBm
Out-of-band blocking	2003 MHz to 2399 MHz	–21	dBm
Out-of-band blocking	2484 MHz to 2997 MHz	–15	dBm
Out-of-band blocking	3000 MHz to 12.75 GHz	–12	dBm
Intermodulation	Wanted signal at 2402 MHz, –64 dBm. Two interferers at 2408 and 2414 MHz respectively, at the given power level	–38	dBm

(1) Numbers given as I/C dB
(2) X / Y, where X is +N MHz and Y is –N MHz
(3) Excluding one exception at F_{wanted} / 2, per Bluetooth Specification
(4) Suitable for systems targeting compliance with worldwide radio-frequency regulations ETSI EN 300 328 and EN 300 440 Class 2 (Europe), FCC CFR47 Part 15 (US), and ARIB STD-T66 (Japan)

4.11 Bluetooth Low Energy - Transmit (TX)

Measured on the CC1352PEM-XD7793-XD24-PA24 reference design with T_c = 25 °C, V_{DDS} = 3.0 V, f_{RF}= 2440 MHz with DC/DC enabled and high power PA connected to V_{DDS} unless otherwise noted.
All measurements are performed at the antenna input with a combined RX and TX path, except for high power PA which is measured at a dedicated antenna connection. All measurements are performed conducted.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
General Parameters					
Max output power, high power PA	Differential mode, delivered to a single-ended 50 Ω load through a balun		19.5		dBm
Output power programmable range high power PA	Differential mode, delivered to a single-ended 50 Ω load through a balun		6		dB
Max output power, high power PA, 10 dBm configuration(4)	Differential mode, delivered to a single-ended 50 Ω load through a balun		10.5		dBm
Output power programmable range high power PA, 10 dBm configuration(4)	Differential mode, delivered to a single-ended 50 Ω load through a balun		5		dB
Max output power, regular PA	Differential mode, delivered to a single-ended 50 Ω load through a balun		5		dBm
Output power programmable range, regular PA	Differential mode, delivered to a single-ended 50 Ω load through a balun		26		dB

Measured on the CC1352PEM-XD7793-XD24-PA24 reference design with T_c = 25 °C, V_{DDS} = 3.0 V, f_{RF}= 2440 MHz with DC/DC enabled and high power PA connected to V_{DDS} unless otherwise noted.
All measurements are performed at the antenna input with a combined RX and TX path, except for high power PA which is

measured at a dedicated antenna connection. All measurements are performed conducted.

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Spurious emissions, regular PA (1)	f < 1 GHz, outside restricted bands	+5 dBm setting		< –36		dBm
	f < 1 GHz, restricted bands ETSI			< –54		dBm
	f < 1 GHz, restricted bands FCC			< –55		dBm
	f > 1 GHz, including harmonics			< –42		dBm
Harmonics, regular PA (1)	Second harmonic			< –42		dBm
	Third harmonic			< –42		dBm

(1) Suitable for systems targeting compliance with worldwide radio-frequency regulations ETSI EN 300 328 and EN 300 440 Class 2 (Europe), FCC CFR47 Part 15 (US), and ARIB STD-T66 (Japan).
(2) To ensure margins for passing FCC band edge requirements at 2483.5 MHz, a lower than maximum output-power setting or less than 100% duty cycle may be used when operating at the upper BLE channel(s).
(3) To ensure margins for passing FCC requirements for harmonic emission, duty cycling may be required. The CC1352P-2 LaunchPad reference design should also be reviewed as the filter provides higher attenuation of harmonics compared to the CC1352PEM-XD7793-XD24-PA24 reference design.
(4) Measured on evaluation board as described in Optimizing the CC1352P and CC2652P for Coin Cell Operation at 5 dBm Output Power.

4.12 Bluetooth Antenna

Key Specifications - Electrical

Operating temperature range	-40 to 85°C
Impedance	50 ohm
Gain	3.03 - 2.6dBi
VSWR	≤1.5.1
Max input power	50W
Voltage and supply current	Passive
Frequency	2400 - 2500MHz
Polarization	Vertical

Gain (Wi-Fi)

2400MHz	1.79dBi
2500MHz	2.74dBi

Key Specifications - Mechanical

Dimensions	115mm x 22mm x 4mm
Cable type	RG174

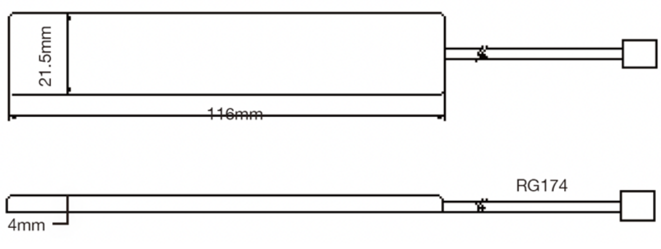

Figure 4-11. Antenna

5. Mechanical Specifications

5.1 Dimensions

Fig 5-1 shows the overall dimensions of RM9000. The module measures 12.5mm long by 13.2mm wide by 1.8mm high with the shield.

Note: All dimensions are in mm.

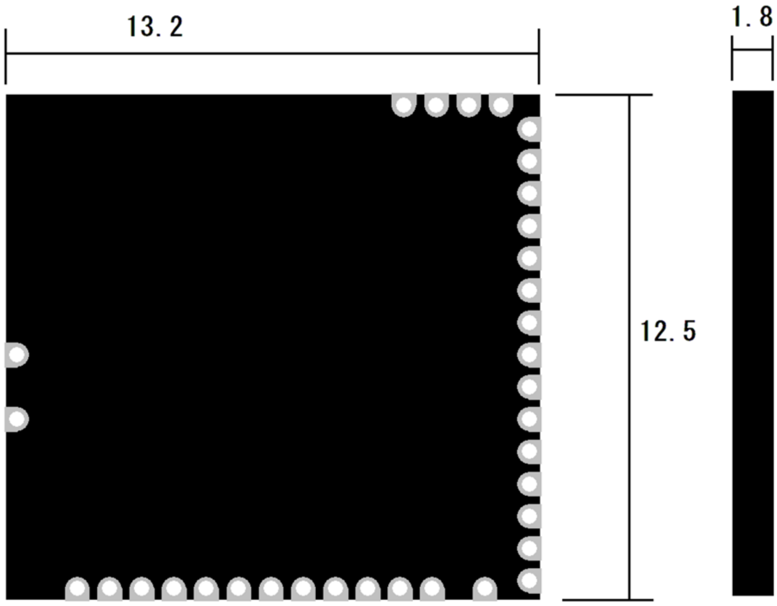

Figure 5-1. Mechanical Drawing

6. FCC Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.
This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and a human body.
If the identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module, Contains FCC ID: 2A3YR-RM9000-001.
Co-location of this module with other transmitters that operate simultaneously are required to be evaluated using the multi-transmitter procedures.
The host integrator must follow the integration instructions provided in this document and ensure that the composite-system end product complies with the requirements by a technical assessment or evaluation to the rules and to KDB Publication 996369.
The host integrator installing this module into their product must ensure that the final composite product complies with the requirements by a technical assessment or evaluation to the rules, including the transmitter operation and should refer to guidance in KDB 996369.

7. Revision History

Revision	Date	Description
V1.0	1-March-2022	Initial Release

Contacts

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