RNBD350 Bluetooth® Low Energy Module Data Sheet

RNBD350

Introduction

The RNBD350 module is based on Microchip's PIC32CX-BZ3 Bluetooth® Low Energy System-on-Chip (SoC) that provides a complete solution to implement Bluetooth 5.2 Low Energy connectivity. The module is interfaced with a host MCU or MPU via a Two-Wire or Four-Wire (Flow Control) UART interface with Microchip's simple ASCII command set for easy integration into most of the applications. In addition, it supports an HCI mode for seamless integration with Linux-based host processors. The host can dynamically configure the RNBD350 module with a few simple ASCII commands or switch to a standardized Bluetooth HCI mode. The RNBD350 module, combined with Microchip's Bluetooth Low Energy silicon with necessary GPIO and an on-board PCB antenna, creates an easy-to-use turnkey solution.

Features

- Fully RF-Certified Bluetooth® Low Energy Module
- Compact Form Factor (30-Pin SMD Package, 13.4 mm x 18.7 mm x 2.8 mm)
- On-Board Bluetooth 5.2 Low Energy Stack
- ASCII Command Interface Over UART
- Host Controller Interface (HCI) Mode
- ASCII Commands are Backward Compatible with RN487x Family of Modules
- Beacon Support
- Built-in Microchip Transparent Profile for UART Data Streaming
- Over-The-Air (OTA) Remote Configuration
- 2M Uncoded PHY and Long Range (Coded PHY)
- Extended Advertising
- Data Length Extensions and Secure Connections
- Bluetooth Low Energy Privacy 1.2 with Up to Eight Resolvable and Accept Lists
- UART-Based Device Firmware Update (DFU)
- Built-In Microchip OTA Profile with Server Role for OTA DFU Execution
  - Host MCU OTA firmware update using RNBD350
- Integrated 16 MHz POSC
- Supports UART
- Seven GPIOs that Can Be Controlled by RN Command
- 12-Bit Analog-to-Digital Converters (ADC) Successive Approximation Register (SAR) Module for Analog-to-Digital Conversion
- Add-On Up to Six 16-Bit UUID GATT Services (Public Service), Four 128-Bit UUID GATT Services (Private Service) and Each Service Includes Up to Eight Characteristic Attributes
- Supports Bluetooth Low Energy Advertiser, Observer, Central and Peripheral Roles
- Supports Bluetooth Low Energy GATT Client and Server Roles

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- Supports Up to Six Concurrent Bluetooth Low Energy Connections
- Multi-Link and Multi-Role
- Remote Command Mode in Multi-Link Connection:
  - Client role only supported
- Secured Connection
- DTM Test Mode
- Supports PTA Control

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Operational Conditions

- Operating Voltage:
  - 3.3V typical
  - MLDO mode (Linear Regulator): 1.9V - 3.6V
- Temperature Range: -40°C to +85°C

RF/Analog Features

- Industrial, Scientific and Medical (ISM) Band: 2.402-2.480 GHz Operation
- Channels: 0-39
- Up to +11 dBm Programmable Transmit Output Power
- Typical Receiver Power Sensitivity:
  - -98 dBm for Bluetooth® Low Energy 1 Mbps
  - -95 dBm for Bluetooth Low Energy 2 Mbps
  - -108 dBm for Bluetooth Low Energy 125 Kbps
  - -102 dBm for Bluetooth Low Energy 500 Kbps
- Digital Received Signal Strength Indicator (RSSI)

Applications

- Health/Medical Devices
- Sports Activity/Fitness Meters
- Beacon Applications
- Internet of Things (IoT) Sensor Tag
- Remote Control
- Wearable Smart Devices and Accessories
- Smart Energy/Smart Home
- Industrial Control

Package

- 30-pin SMD Package with Shield CAN
  - Size: 13.4 mm x 18.7 mm x 2.8 mm

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1. Quick References

1.1 Reference Documentation

For more details, refer to the following documents:

- *AN233 Solder Reflow Recommendation Application Note* (DS00233)
- *PIC32CX-BZ3 and WBZ35x Family Data Sheet* (DS70005541)
- *PIC32CX-BZ3 Family Silicon Errata* (DS80001122)
- *RNBD350 Bluetooth® Low Energy Module User's Guide* (DS50003684)

1.2 Acronyms and Abbreviations

Table 1-1. Acronyms and Abbreviations

Acronyms and Abbreviations	Description
ADC	Analog-to-Digital Converters
API	Application Programming Interface
CDM	Charged Device Model
CTS	Clear to Send
DIS	Device Information Service
DFU	Device Firmware Update
HBM	Human Body Model
IoT	Internet of Things
ISM	Industrial, Scientific and Medical
NVM	Nonvolatile Memory
OTA	Over-the-Air
OTAPC	Over-the-Air Profile Client
PDS	Persistent Data Storage
PMU	Power Management Unit
POR	Power-on Reset
RSSI	Received Signal Strength Indicator
RTS	Request to Send
SAR	Successive Approximation Register
SoC	System-on-Chip

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2. Ordering Information

This chapter provides the ordering information of the RNBD350 module.

2.1 RNBD350 Module Ordering Information

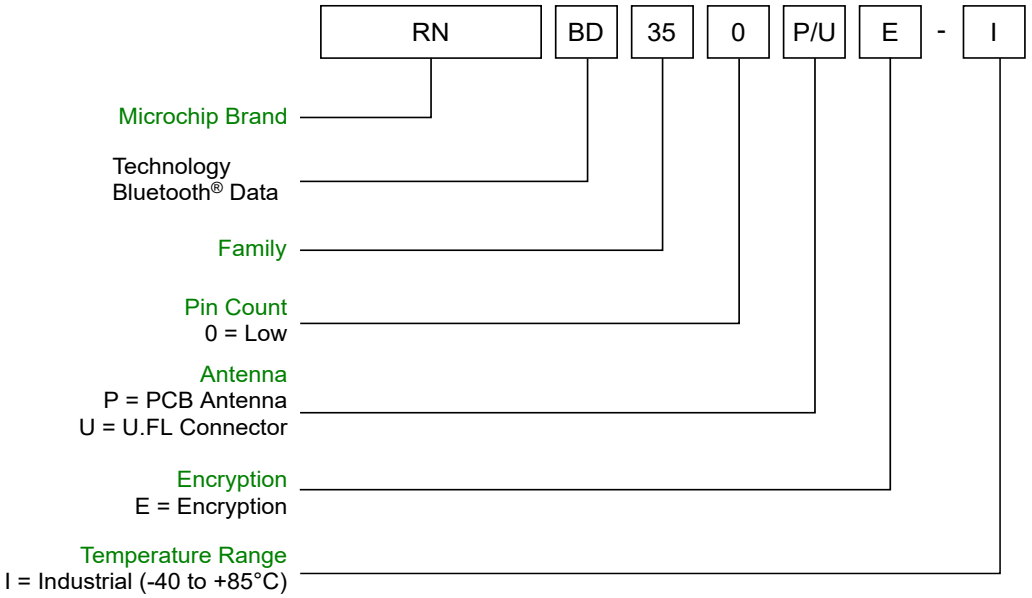
The following table describes the ordering information of the RNBD350 module.

Table 2-1. RNBD350 Module Ordering Details

Model No.	Microchip SoC	Description	Regulatory Certification	Ordering Code
RNBD350PE	PIC32CX5109BZ31032-V/ZWX	RNBD350 module with PCB antenna	FCC, ISED, CE, UKCA, SRRC, KCC, MIC, NCC	RNBD350PE-IXXX
RNBD350UE	PIC32CX5109BZ31032-V/ZWX	RNBD350 module with U.FL for external antenna	FCC, ISED, CE, UKCA, KCC, MIC, NCC	RNBD350UE-IXXX

The following figure illustrates the details of the RNBD350 module ordering information.

Figure 2-1. RNBD350 Module Ordering Information



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3. Device Overview

3.1 Module Overview

The RNBD350 Bluetooth® Low Energy Module integrates the Bluetooth 5.2 baseband controller, Bluetooth stack, digital and analog I/O and RF power amplifier into one solution.

Figure 3-1. RNBD350 Module Block Diagram

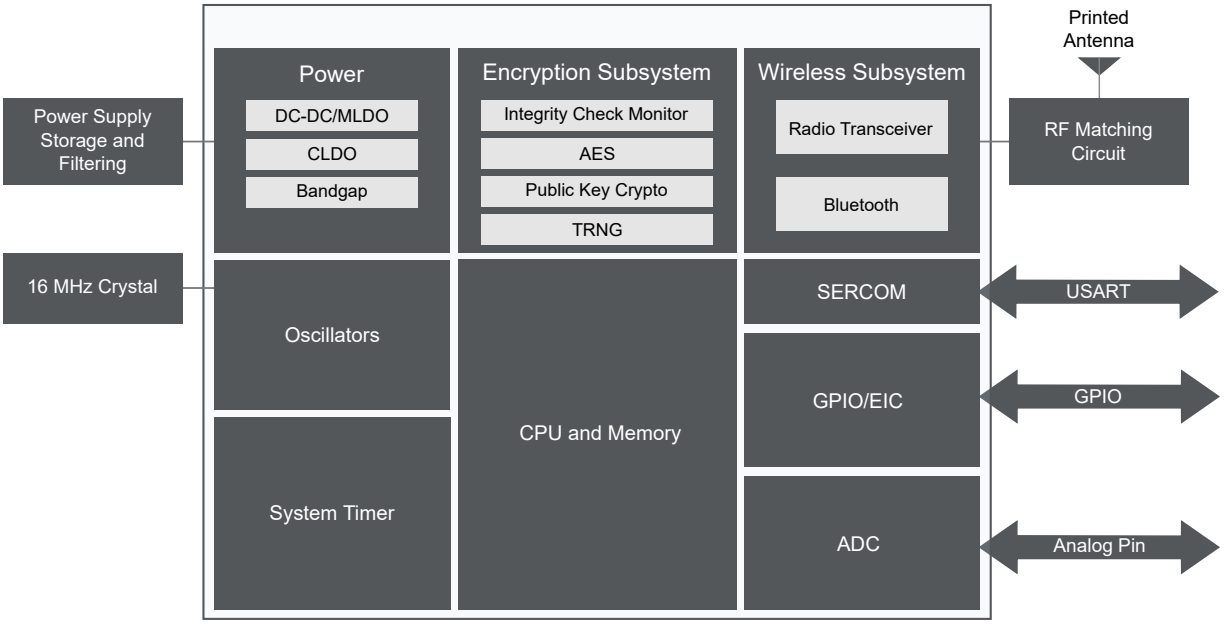

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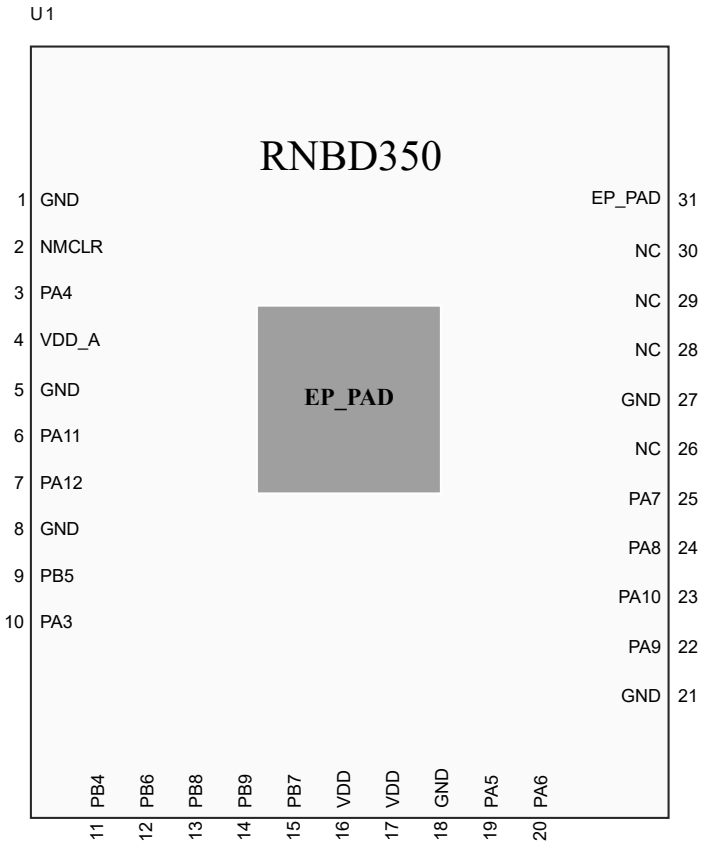
Figure 3-2. Pin Diagram – RNBD350 Module



Note: Ensure the exposed thermal pad (EP_PAD) on the bottom of the module is connected to ground in the PCB.

Table 3-1. Pinout and Signal Descriptions List

Pin#	RNBD350 Module Pin	RNBD350 Pin Definition	Type
1	GND	Ground	—
2	NMCLR	Reset	—
3	PA4	UART Request to Send (RTS)	O
4	VDD_A	AVDD Power Supply Input	—
5	GND	Ground	—
6	PA11/SOSCI	Reserved. No Connect	—
7	PA12/SOSCO	Reserved. No Connect	—
8	Ground	GND	—
9	PB5(1)	Bluetooth® status LED	O
10	PA3(1)	PTA control (BT_ACTIVE)	O
11	PB4(1)	UART transmit indication pin	O
12	PB6	UART receive data	I
13	PB8(1)	Bluetooth Low Energy status indication pin 2/2	O
14	PB9	UART receive indication pin/RNBD350 wake-up pin Low-power mode	I
15	PB7	Dedicated ADC pin for Host MCU to query ADC value	I
16	VDD	VDD power supply input	—
17	VDD	VDD power supply input	—
18	GND	Ground	—

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Pin#	RNBD350 Module Pin	RNBD350 Pin Definition	Type
19	PA5	UART transmit data	O
20	PA6	UART Clear to Send (CTS)	I
21	GND	Ground	—
22	PA9(1)	PTA control (BT_PRIORITY)/UART mode switch	O
23	PA10(2)	Bluetooth Low Energy status indication pin 1/2	O
24	PA8(2)	PTA control (WLAN ACTIVE)	I
25	PA7	Debug UART receive data	O
26	NC	No Connect	—
27	GND	Ground	—
28	NC	No Connect	—
29	NC	No Connect	—
30	NC	No Connect	—
31	EP_PAD	Ground	—

Notes:

1. The priority of the PTA function is higher than that of the mode switch function.
2. The priority of the PTA function is higher than that of the event indicator function.

3.2 Module Configuration

Use the ASCII command interface for configuring the GPIO pins of the RNBD350 module to different functions. The following table provides the details about the various pins and functions in the RNBD350 module that are available for configuration and their default configuration settings.
Note: This configuration is not applicable in the HCI mode.

Table 3-2. Configurable Functions and Descriptions

Pin	Function Name	Description
PB5	Bluetooth® status LED	To indicate the Bluetooth Low Energy connection status by a specific LED flash pattern, see the following pattern description. The function can be enabled or disabled. By default, the function is disabled. • Standby mode – No Bluetooth Low Energy connection. The RNBD350 Module is in Advertisement or Scan state. Flash one time for every three seconds. – ON – 50 ms – OFF – 2950 ms • Linked mode – The Bluetooth Low Energy ACL link is connected regardless of whether it is in the Central or Peripheral role. Flash two times for every 1.5 seconds. – ON – 50 ms – OFF – 150 ms • DFU mode – The RNBD350 module is in the MCU DFU procedure. Flash 4 times for every two seconds. – ON – 100 ms – OFF – 100 ms **Note:** By default, the Bluetooth status LED is turned OFF. The user can enable this feature by using the `SR,<hex16>` command, for example, `SR,0001`. For more details, refer to the *RNBD350 Bluetooth® Low Energy Module User's Guide* (DS50003684).
PB7	ADC	A dedicated ADC input pin where an analog signal can be the input to the RNBD350 module. The RNBD350 module performs the ADC conversion using a fixed reference and provides the digital value that can be read using a command. For more details, refer to the *RNBD350 Bluetooth® Low Energy Module User's Guide* (DS50003684).

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.....continued		
Pin	**Function Name**	**Description**
PB5, PA3, PB4, PB8, PA9, PA8, PA10	I/O level control	The host MCU can assert the RN command to set some GPIO pins as output pins to set their level or input pins to read their level.
PA9	UART mode switch	• When the host MCU pulls the UART mode switch pin from low to high (rising edge), the RNBD350 module switches to the Data mode. • When the host MCU pulls the UART mode switch pin from high to low (falling edge), the RNBD350 module switches to the Command mode. • When the host MCU uses the RN command to switch the mode, the host MCU keeps the UART mode switch pin to the original setting. **Note:** By default, the UART mode switch functionality is not assigned on to the PB2 pin. The user can enable this feature using the `SR,<hex16>` command, for example, `SR,0002`. For more details, refer to the *RNBD350 Bluetooth® Low Energy Module User's Guide* (DS50003684).
PB9	UART RX indication	• If the RNBD350 module's low power is enabled, the host MCU must wake up the RNBD350 module before sending the UART data out. • Pull the UART RX indication pin low to wake up the system.
PA3	RSSI indication	• Use this indication pin to indicate the quality of the link based on the RSSI level. • If the RSSI level is lower than the specified threshold value, the RSSI indication pin goes low.
PB4	UART TX indication	• The UART TX indication is an output pin. Provides indication if the RNBD350 module is transmitting to host the MCU over UART. • Pulled low before the UART TX begins and pulled high after the UART TX is over.
PA10, PB8	Status indication	The status indication pins identify the device status for connection, and data transmission

Table 3-3. Status Indication Pins

BT_Status_Ind1 (PB5)	BT_Status_Ind2 (PB7)	RNBD350 Module Status
Low	Low	Bluetooth® Low Energy is disconnected
		Data transmission channel is closed
High	Low	Bluetooth Low Energy is connected
		Data transmission channel is closed
High	High	Bluetooth Low Energy is connected
		The data transmission channel is opened
Low	High	DFU mode

Note: By default, the Bluetooth status indication feature is disabled in the firmware. The user can enable this feature via the SR,<hex16> command, for example, SR,1000. For more details, refer to the *RNBD350 Bluetooth® Low Energy Module User's Guide* (DS50003684).

3.3 Device Programming

The RNBD350 device is available for purchase with a pre-programmed firmware. Microchip periodically releases the firmware for fixing previously-reported issues or to implement the latest feature support. There are two ways to perform a regular firmware update:

1. Serial DFU command-based update over UART
2. Advanced programming

For an advanced programming option (SWD), go to support.microchip.com.

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Note: For the serial DFU and OTA programming guidance, refer to the *RNBD350 Bluetooth® Low Energy Module User's Guide* (DS50003684).

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4. Electrical Characteristics

4.1 Absolute Maximum Ratings

Exposure to these maximum rating conditions for extended periods may affect device reliability. Functional operation of the device at these or any other conditions above the parameters indicated in the operation listings of this specification is not implied.

Table 4-1. Absolute Maximum Ratings

Parameter	Value
Ambient temperature under bias (PIC32CX-BZ3)(1)	-40°C to +125°C
Ambient temperature under bias (RNBD350)(1)	-40°C to +85°C
Storage temperature	-65°C to +150°C
Voltage on V_{DD}/V_{DDIO} with respect to GND	-0.3V to +4.0V
Voltage on any digital I/O pin, with respect to GND(3)	-0.3V to (V_{DDIO} + 0.3V)
Maximum current out of GND pins	200 mA
Maximum current into V_{DD} pins(2)	200 mA
Maximum output current sunk by any I/O pin	10 mA
Maximum output current sourced by any I/O pin	15 mA
Maximum current sunk by all ports	120 mA
Maximum current sourced by all ports(2)	120 mA
ESD Qualification	
Human Body Model (HBM) per JESD22-A114	±2000V
Charged Device Model (CDM) (ANSI/ESD STM 5.3.1)...(All pins/Corner pins)	±500V

Notes:

1. Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.
2. Maximum allowable current is a function of the device's maximum power dissipation.

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4.2 DC Electrical Characteristics

Table 4-2. Operating Frequency VS. Voltage

Param. No.	V_{DDIO}, VDD_A Range	Temp. Range (in °C)	Max. MCU Frequency	Comments
DC_5	1.9V to 3.6V	-40°C to +85°C	64 MHz	Industrial
Note: The same voltage must be applied to V_{DD} and VDD_A.				

4.3 Active Current Consumption DC Electrical Specifications

Table 4-3. Active Current Consumption DC Electrical Specifications

DC Characteristics				Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp			
Param. No.	Symbol	Characteristics	Clock/Freq	Typ.	Max.	Units	Conditions
APWR_1	IDD_ACTIVE	MCU I_{DD} in Active mode w/LDO mode selected	PLL 64 MHz	3.5	—	mA	V_{DD} = 3.3V, T_A = 25°C

4.4 Sleep Current Consumption DC Electrical Specifications

Table 4-4. Sleep Current Consumption DC Electrical Specifications

DC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	V_{DDIO}	Typ.	Max.	Units	Conditions
SPWR_5	I_{DD_SLEEP}	MCU I_{DD} in Sleep mode w/LDO mode selected	3.3V	0.8	—	mA	—

4.5 Deep Sleep Current Consumption DC Electrical Specifications

Table 4-5. Deep Sleep Current Consumption DC Electrical Specifications

DC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	V_{DDIO}	Typ.	Max.	Units	Conditions
BPWR_9	I_{DD_BACKUP}	MCU I_{DD} in Deep Sleep mode powered from V_{DDIO}	3.6V	1.9	—	µA	—

4.6 XDS (Extreme Deep Sleep) Current Consumption DC Electrical Specifications

Table 4-6. XDS (Extreme Deep Sleep) Current Consumption DC Electrical Specifications

DC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	V_{DDIO}	Typ.	Max.	Units	Conditions
OPWR_1	I_{DD_OFF}	MCU I_{DD} in XDS mode powered from V_{DDIO}	3.3V	0.09	—	µA	—

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4.7 Power Supply DC Module Electrical Specifications

Table 4-7. Power Supply DC Electrical Specifications

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
REG_20	V_{DD}	Voltage range of V_{DD} (main power supply)	1.9	3.3	3.6	V	Operating range of 1.9-3.6V
REG_39	VDD_A	Analog V_{DD} supply input voltage range	V_{DD}-0.3	—	V_{DD}+0.3	V	Operating range
REG_21	GND	Analog V_{SS} supply	V_{SS}-0.3	—	V_{SS}+0.3	V	GND

Notes:

- These parameters are characterized but not tested in manufacturing.
- V_{DD} and VDD_A must be at the same voltage level.
- For more details on power supply pins filtering, refer to the Design Package available on the product page.

Table 4-8. POR Electrical Characteristics

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
DC16	VPOR	V_{DD} Start voltage to ensure internal Power-on Reset signal	1.52	—	1.58	V	V_{DD} voltage must remain at V_{SS} for a minimum of 200 µs to ensure POR. V_{DDIO} Power-up/Power-down (See V_{DDIO} Ramp Rate)
DC17	SVDD_R	V_{DDIO} Rise ramp rate to ensure internal Power-on Reset signal	0.03	—	0.115	V/ms	Failure to meet this specification may lead to start-up or unexpected behaviors
DC18	SVDD_F	VDDIO Falling ramp rate to ensure internal Power-on Reset signal	—	1.39	—	V/ms	Failure to meet this specification may cause the device to not detect Reset

Note: These parameters are characterized but not tested in manufacturing.

Table 4-9. BOR Electrical Characteristics

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
B011	V_{BHYS}	Brown-out hysteresis	51	53.4	54	mV	—
B012	VZPBOR	Zero-power BOR	—	1.9	—	V	—

Note: These parameters are characterized but not tested in manufacturing.

Table 4-10. Reset Timing Characteristics

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
SY00	T_{PU}	Power-up period	—	400	600	µs	—
SY02	T_{SYSDLY}	System delay period before first instruction is fetched	—	1 µs + 8 SYSCLK cycles	—	—	—

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AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
SY20	$T_{\overline{MCLR}}$	$\overline{MCLR}$ pulse width (low)	2	—	—	µs	Minimum reset active time to guarantee MCU reset
SY30	T_{BOR}	BOR pulse width (low)	—	1	—	µs	CRU combines BOR12 and BOR33

Note: These parameters are characterized but not tested in manufacturing.

4.8 I/O PIN AC/DC Electrical Specifications

Table 4-11. I/O PIN AC/DC Electrical Specifications

AC - DC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
DI_1	V_{IL}	Input low voltage I/O pins (Drive strength, 8x)	V_{SS}	—	0.2*V_{DD}	V	—
		Input low voltage I/O pins (Drive strength, 4x)		—	0.2*V_{DD}		—
DI_3	V_{IH}	Input high voltage, I/O pins (Drive strength, 8x)	—	—	V_{DD}	V	—
		Input high voltage, I/O pins (Drive strength, 4x)	—	—	V_{DD}	V	—
DI_5	V_{OL}	4x Drive strength I/O pins (Output low)	—	—	0.4	V	V_{DDIO} = 3.3V at I_{OL} = 15 mA
		8x Drive strength I/O pins (Output low)	—	—	0.4		
		12x Drive strength I/O pins (Output low)	—	—	0.4		
DI_9	V_{OH}	4x Drive strength I/O pins (Output high)	2.4	—	—	V	V_{DDIO} = 3.3V at I_{OH} = 15 mA
		8x Drive strength I/O pins (Output high)	2.4	—	—		
		12x Drive strength I/O pins (Output high)	2.4	—	—		
DI_13	I_{IL}	Input pin leakage current	-1	—	+1	µA	GND ≤ V_{PIN} ≤ $V_{DDIO(max)}$ (V_{PIN} = Voltage present on pin)
DI_15	R_{PDWN}	Internal pull-down resistance	—	13	—	kΩ	$V_{DDIO(min)}$ to $V_{DDIO(max)}$
DI_17	R_{PUP}	Internal pull-up resistance	—	13	—	kΩ	
DI_19	I_{ICL}	Input low injection current	0	—	-5	mA	This parameter applies to all I/O pins except VDD, VSS, VDD_A, GND, $\overline{MCLR}$(1,3,4)

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AC - DC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
DI_21	I_{ICH}	Input high injection current	0	—	+5	mA	This parameter applies to all pins, except V_{DD}, V_{SS}, VDD_A, GND, $\overline{MCLR}$
DI_25	T_{RISE}	I/O pin rise time (Drive strength, 4x)	—	—	9.5	ns	V_{DDIO} = 3.3V, C_{LOAD} = 50 pf
		I/O pin rise time (Drive strength, 4x)	—	—	6	ns	V_{DDIO} = 3.3V, C_{LOAD} = 20 pf
		I/O pin rise time (Drive strength, 8x)	—	—	8	ns	V_{DDIO} = 3.3V, C_{LOAD} = 50 pf
		I/O pin rise time (Drive strength, 8x)	—	—	6	ns	V_{DDIO} = 3.3V, C_{LOAD} = 20 pf
		I/O pin rise time (Drive strength, 12x)	—	—	3.5	ns	V_{DDIO} = 3.3V, C_{LOAD} = 50 pf
		I/O pin rise time (Drive strength, 12x)	—	—	2	ns	V_{DDIO} = 3.3V, C_{LOAD} = 20 pf
DI_27	T_{FALL}	I/O pin fall time (Drive strength, 4x)	—	—	9.5	ns	V_{DDIO} = 3.3V, C_{LOAD} = 50 pf
		I/O pin fall time (Drive strength, 4x)	—	—	7.5	ns	V_{DDIO} = 3.3V, C_{LOAD} = 20 pf
		I/O pin fall time (Drive strength, 8x)	—	—	8	ns	V_{DDIO} = 3.3V, C_{LOAD} = 50 pf
		I/O pin fall time (Drive strength, 8x)	—	—	7.5	ns	V_{DDIO} = 3.3V, C_{LOAD} = 20 pf
		I/O pin fall time (Drive strength, 12x)	—	—	4	ns	V_{DDIO} = 3.3V, C_{LOAD} = 50 pf
		I/O pin fall time (Drive strength, 12x)	—	—	3.1	ns	V_{DDIO} = 3.3V, C_{LOAD} = 20 pf

Notes:

1. V_{IL} source < (GND – 0.3). Characterized but not tested in manufacturing.
2. V_{IH} source > (V_{DDIO} + 0.3). Characterized but not tested in manufacturing.
3. If the sum of all injection currents are > | ∑IICT |, it can affect the ADC results by approximately 4 to 6 counts (in other words, V_{IH} Source > (V_{DDIO} + 0.3) or V_{IL} source < (GND – 0.3)).
4. Any number and the combination of I/O pins not excluded under IICL or IICH conditions are permitted provided the absolute instantaneous sum of the input injection currents from all pins do not exceed the specified ∑IICT limit. To limit the injection current, the user must insert a resistor in series RSERIES (RS), between the input source voltage and device pin. The resistor value is calculated according to:
   - For negative input voltages less than (GND – 0.3): RS ≥ absolute value of | ((V_{IL} source – (GND – 0.3))/IICL) |
   - For positive input voltages greater than (V_{DDIO} + 0.3): RS ≥ ((V_{IH} source – (V_{DDIO} +0.3))/IICH)
   - For V_{PIN} voltages greater than V_{DDIO} + 0.3 and less than GND – 0.3: RS = the larger of the values calculated above

4.9 ADC Electrical Specifications

Table 4-12. ADC AC Electrical Specifications

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
Device Supply							
ADC_1	VDD_A	ADC module supply	$VDD\_A_{(min)}$	—	$VDD\_A_{(max)}$	V	—

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.....continued

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
Reference Inputs							
ADC_2	V_{REF}(4)	Absolute reference voltage (V_{REFH}-V_{REFL}) (4)	GND-0.3	—	VDD_A+0.3	V	—
ADC_3	V_{REF}	Reference voltage high (external reference buffers)	GND+1.8	—	VDD_A	V	—
ADC_4	V_{REFL}	Reference voltage low (external reference buffers)	GND	—	VDD_A-1.8	V	—
ADC_4a	R_{REF}	Suggested V_{REF} impedance	—	—	25	Ω	Resistance from source to the V_{REFP}/V_{REFM} input, including RSource, PCB trace, pads and on-chip routing
ADC_4b	V_{CM}	Analog input Common mode voltage	GND + V_{REF}/2	—	VDD_A - V_{REF}/2	V	—
ADC_4c	V_{DIFF}	Differential analog input voltage (seldiff = 1)	2*(V_{REFH} - V_{REFL})			V	—
ADC_4d	VSING	Single-ended analog input voltage (seldiff = 0)	V_{REFL}	—	V_{REFH}	—	—
ADC_4e	RIN_INT	ADC internal resistance	—	—	200	Ω	Internal sampling switch resistance
ADC_4f	RIN_SYS	External input resistance to meet the maximum speed	—	—	125	Ω	Resistance from VINP/ VINM to signal source. Include RSource + RPad + RPCB + Rroute
ADC_4g	RSRC	Maximum source impedance to meet 2 MSPS at 12-bit	—	—	500	Ω	—
		Maximum source impedance to meet 1 MSPS at 12-bit	—	—	1400	Ω	—
Analog Input Range							
ADC_7	A_{FS}	Full-scale analog input signal range (Single-ended)	GND	—	V_{REF}	V	V_{REF} = $VDD\_A_{(max)}$
ADC_11	$T_{SETTLING}$	ADC stabilization time	—	10	—	µs	—

Table 4-13. ADC Single-Ended Mode AC Electrical Specifications

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typical	Max.	Units	Conditions
Single-Ended Mode ADC Accuracy							
SADC_11	Res	Resolution	6	—	12	bits	Selectable 8-, 10-, 12-bit resolution ranges
SADC_13	EN0B(3)	Effective number of bits	6.3	—	—	bits	2 Msps, Internal V_{REF}, VDD_A = V_{DDIO} = 3.3V
SADC_19	INL(3)	Integral non linearity	-13.737	—	2.869	LSb	2 Msps, Internal V_{REF}, VDD_A = V_{DDIO} = 3.3V
SADC_25	DNL(3)	Differential non linearity	-1.628	—	1.736	LSb	2 Msps, Internal V_{REF}, VDD_A = V_{DDIO} = 3.3V

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AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typical	Max.	Units	Conditions
SADC_31	GERR(3)	Gain error	-8.198	—	-4.697	LSb	2 Msps, Internal V_{REF}, VDD_A = V_{DDIO} = 3.3V
SADC_37	E0FF(3)	Offset error	4.905	—	25.094	LSb	2 Msps, Internal V_{REF}, VDD_A = V_{DDIO} = 3.3V
Single-Ended Mode ADC Dynamic Performance							
SADC_49	SINAD(1,2,3)	Signal to noise and distortion	39.728	—	—	dB	V_{REF} = VDD_A = V_{DDIO} = 3.3V at 12-bit resolution, max sampling rate(1,2)
SADC_51	SNR(1,2,3)	Signal to noise ratio	39.747	—	—		
SADC_53	SFDR(1,2,3)	Spurious free dynamic range	61.32	—	—		
SADC_55	THD(1,2,3)	Total harmonic distortion	—	—	-59.346		

Notes:

1. Characterized with an analog input sine wave = (FTP(max)/100). Example: FTP(max) = 1 Msps/100 = 10 kHz sine wave.
2. Sine wave peak amplitude = 96% ADC_ Full Scale amplitude input with 12-bit resolution.
3. Spec values collected under the following additional conditions:
   a. At least (3) SERCOM, (2) TCC and (2) TC peripheral clocks active but the same peripherals disabled, not running.
   b. At least (6) I/O pins toggling simultaneously at > 6 MHz, not adjacent to analog input pin; (3) with external 2 ma pull-up loads & (3) with external 2 ma pull-down loads on the side of the package shared by V_{DDANA}.
   c. 12-bit resolution mode.
4. ADC functional device operation with either internal or external V_{REF} < 2.4V is functional but not characterized. ADC will function but with degraded accuracy of approximately ~((0.06 * 2n)/V_{REF}) LSBs over full scale range, where n=#bits. ADC accuracy is limited by internal VREF accuracy + drift, MCU generated noise plus user's application noise/accuracy on V_{DDANA}, GNDANA.
5. Value taken over 7 harmonics.

Table 4-14. ADC Conversion AC Electrical Requirements

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
ADC_ Clock Requirements							
ADC_57	TAD	ADC clock period	—	20.8	—	ns	V_{REF} = VDD_A = 3.3V
ADC Single-Ended Throughput Rates							
ADC_59	FTPR (Single-ended mode)	Throughput rate(4) (Single-ended)	0.01	—	2	Msps	12-bit resolution, DIV_SHR = 2

Notes:

1. ADC_ Sample time = ((SAMPCTRL.SAMPLEN + 1) * TAD) and SAMPCTRL.OFFCOMP = 0.
2. ADC_ HDW forces sample time to 4*TAD when SAMPCTRL.OFFCOMP = 1; user SAMPCTRL.SAMPLEN is ignored.
3. ADC Throughput Rate FTP = ((1/((TSAMP + TCNV) * TAD))/(# of user active analog inputs in use on specific target ADC module)).
   Note: Specification values assume only one AINx channel in use.
4. SAMPCTRL.R2R = 1. (Must be set to '1' in ADC differential mode).

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Table 4-15. ADC Sample AC Electrical Requirements

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions
ADC_63	TSAMP	ADC sample time (1,2,3,5)	1(1,5)	—	—	TAD	12-bit TAD(min), Ext Analog Input Rsource ≤ 147Ω
							10-bit TAD(min), Ext Analog Input Rsource ≤ 504Ω
							8-bit TAD(min), Ext Analog Input Rsource ≤ 1,000Ω
			2(1,5)	—	—		12-bit TAD(min), Ext Analog Input Rsource ≤ 2,272Ω
							10-bit TAD(min), Ext Analog Input Rsource ≤ 3,008Ω
							8-bit TAD(min), Ext Analog Input Rsource ≤ 4,000Ω
			3(1,5)	—	—		12-bit TAD(min), Ext Analog Input Rsource ≤ 4,416Ω
							10-bit TAD(min), Ext Analog Input Rsource ≤ 5,504Ω
							8-bit TAD(min), Ext Analog Input Rsource ≤ 6,976Ω
			4(1,2,5)	—	—		12-bit TAD(min), Ext Analog Input Rsource ≤ 6,560Ω
							10-bit TAD(min), Ext Analog Input Rsource ≤ 8,000Ω
							8-bit TAD(min), Ext Analog Input Rsource ≤ 9,984Ω
			5(1,5)	—	—		12-bit TAD(min), Ext Analog Input Rsource ≤ 8,704 Ω
							10-bit TAD(min), Ext Analog Input Rsource ≤ 10,496Ω
							8-bit TAD(min), Ext Analog Input Rsource ≤ 12,992Ω
			6(1,5,6)	—	—		12-bit TAD(min), Ext Analog Input Rsource ≤ 10,880Ω
							10-bit TAD(min), Ext Analog Input Rsource ≤ 12,992Ω
							8-bit TAD(min), Ext Analog Input Rsource ≤ 16,000Ω
			—	—	—	ns	With DAC as input
			—	—	—		With temperature sensor as input
ADC_65	TCNV	Conversion time (3) (Single-Ended mode)	12			TAD	12-bit resolution
			11				10-bit resolution
			9				8-bit resolution

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AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.	Max.	Units	Conditions

Notes:

1. When SAMPCTRL.OFFCOMP = 0:
   - TSAMP = (((RSAMPLE + RSOURCE) * CSAMPLE * (#Bits Resolution + 2) * ln(2))/TAD)+1 rounded down to nearest whole integer
   - User SAMPCTRL.SAMPLEN = (TSAMP – 1)
2. When SAMPCTRL.OFFCOMP = 1:
   - TSAMP = 4 (Forced by HDW)
   - User SAMPCTRL.SAMPLEN = (n/a, Ignored by HDW)
3. ADC Throughput Rate FTP = ((1/((TSAMP + TCNV) * TAD))/(# of user active analog inputs in use on specific target ADC module)).
   Note: Specification values assume only one AINx channel in use.
4. SAMPCTRL.R2R = 1. (Must be set to '1' in ADC differential mode).
5. TSAMP ≥ (INT[(RSAMPLE + RSOURCE) * CSAMPLE * (#Bits Resolution+2) * ln(2))/TAD]+1).
6. For RSOURCE values exceeding TSAMP = 6 sample time condition, use the formula in Note 5 to calculate.

4.10 Bluetooth® Low Energy RF Characteristics

Table 4-16. Bluetooth Low Energy RF Characteristics

AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.(1)	Max.	Units	Conditions(2)
BTG1	FREQ	Frequency range of operation	2402	—	2480	MHz	—
BTTX1	TXPWR:PA	Bluetooth® transmit power PA	—	11	—	dBm	—
BTX2	TXIB:1MBPS	In-band emission for FTX ± -2 MHz	—	-40	—	dBm	—
		In-band emission for FTX ± -(3+N) MHz	—	-46	—	dBm	—
BTX3	TXIB:2MBPS	In-band emission for FTX ± -4 MHz	—	-41	—	dBm	—
		In-band emission for FTX ± -5 MHz	—	-52	—	dBm	—
		In-band emission for FTX ± -(6+N) MHz	—	-53	—	dBm	—
BTRX1	RXSENSE	Receiver sensitivity at 1 Mbps	—	-98	—	dBm	—
		Receiver sensitivity at 2 Mbps	—	-95	—	dBm	—
		Receiver sensitivity at S=8	—	-108	—	dBm	—
		Receiver sensitivity at S=2	—	-102	—	dBm	—

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AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.(1)	Max.	Units	Conditions(2)
BTRX2	MAXINSIG	Maximum input signal level at 1 Mbps	—	-2	—	dBm	—
		Maximum input signal level at 2 Mbps	—	-2	—	dBm	—
		Maximum input signal level at S=2	—	-2	—	dBm	—
		Maximum input signal level at S=8	—	-2	—	dBm	—
BTRX3	CI1M:COCH	C/I Co channel rejection	—	14	—	dB	—
	CI1M: ± -1 MHz	C/I adjacent channel rejection	—	16	—	dB	—
	CI1M: ± -2 MHz	C/I adjacent channel rejection	—	7	—	dB	—
	CI1M:ADJ(3+n)	C/I alternate channel rejection	—	8	—	dB	—
	CI1M:IMG	C/I image frequency rejection	—	12	—	dB	—
	CI1M:IMG ± -1 MHz	C/I adjacent channel to image freq rejection	—	11	—	dB	—
BTRX4	CIS2:COCH	C/I Co channel rejection	—	9	—	dB	—
	CIS2: ± -1 MHz	C/I adjacent channel rejection	—	20	—	dB	—
	CIS2: ± -2 MHz	C/I adjacent channel rejection	—	15	—	dB	—
	CIS2:ADJ(3+n)	C/I alternate channel rejection	—	7	—	dB	—
	CIS2:IMG	C/I image frequency rejection	—	15	—	dB	—
	CIS2:IMG ± -1 MHz	C/I adjacent channel to image freq rejection	—	13	—	dB	—
BTRX5	CIS8:COCH	C/I Co channel rejection	—	5	—	dB	—
	CIS8: ± -1 MHz	C/I adjacent channel rejection	—	20	—	dB	—
	CIS8: ± -2 MHz	C/I adjacent channel rejection	—	11	—	dB	—
	CIS8:ADJ(3+n)	C/I alternate channel rejection	—	3	—	dB	—
	CIS8:IMG	C/I image frequency rejection	—	11	—	dB	—
	CIS2:IMG ± -1 MHz	C/I adjacent channel to image freq rejection	—	15	—	dB	—

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AC Characteristics			Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	Min.	Typ.(1)	Max.	Units	Conditions(2)
BTRX6	CI2M:COCH	C/I Co channel rejection	—	13	—	dB	—
	CI2M: ± -2 MHz	C/I adjacent channel rejection	—	14	—	dB	—
	CI2M: ± -4 MHz	C/I adjacent channel rejection	—	12	—	dB	—
	CI2M:ADJ(6+2n)	C/I alternate channel rejection	—	15	—	dB	—
	CI2M:IMG	C/I image frequency rejection	—	14	—	dB	—
	CI2M:IMG ± -2 MHz	C/I adjacent channel to image freq rejection	—	13	—	dB	—
BTRX7	BLOCK1M:<2 GHZ	Blocking performance from 30-2 GHz	—	20	—	dB	—
	BLOCK1M:2 GHZ<SIG<2399 MHz	Blocking performance from 2003-2399 MHz	—	19	—	dB	—
	BLOCK1M:2484 MHZ<SIG<2977 MHz	Blocking performance between 2484-2997 MHz	—	20	—	dB	—
	BLOCK1M:3 GHZ<SIG<12.75 GHz	Blocking performance between 3-12.5 GHz	—	20	—	dB	—
BTRX8	BLE1M:INTERMOD	Inter modulation performance for BLEM	—	10.5	—	dB	—
	BLE2M:INTERMOD	Inter modulation performance for BLEM	—	11.5	—	dB	—

Notes:

1. Data in the Typ column is at T_A = 25°C.
2. This parameter is characterized but not tested in manufacturing.

Table 4-17. Bluetooth Low Energy RF Current Characteristics

AC Characteristics(3)					Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	RF Power	CPU Frequency	Min.	Typ.(1)	Max.	Units	Conditions(2)
IBLETX1	IDDTXPA1M	Current Consumption with TX in MLDO mode 1 Mbps	+11 dBm	64 MHz	—	49	—	mA	—
IBLETX2			+11 dBm	32 MHz	—	45.5	—	mA	—
IBLETX3			10 dBm	64 MHz	—	44	—	mA	—
IBLETX4			10 dBm	32 MHz	—	40	—	mA	—
IBLETX5			0 dBm	64 MHz	—	26	—	mA	—
IBLETX6			0 dBm	32 MHz	—	22	—	mA	—
IBLERX1	IDDRXBLE1M	Current consumption at RX signal MLDO mode	-90 dBm	64 MHz	—	20	—	mA	—
IBLERX2		Current consumption at RX signal MLDO mode	-90 dBm	32 MHz	—	16	—	mA	—

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AC Characteristics[3]					Standard Operating Conditions: V_{DD} = 1.9V to 3.6V (unless otherwise stated) Operating Temperature: -40°C ≤ T_A ≤ +85°C for Industrial Temp				
Param. No.	Symbol	Characteristics	RF Power	CPU Frequency	Min.	Typ.[1]	Max.	Units	Conditions[2]

Notes:

1. Data in the Typ column is at V_{DD} = 3.3V, T_A = 25°C.
2. This parameter is characterized but not tested in manufacturing.
3. The current number includes the FW default operation current consumption.

Figure 4-1. Bluetooth Low Energy Transmit Power vs. Frequency

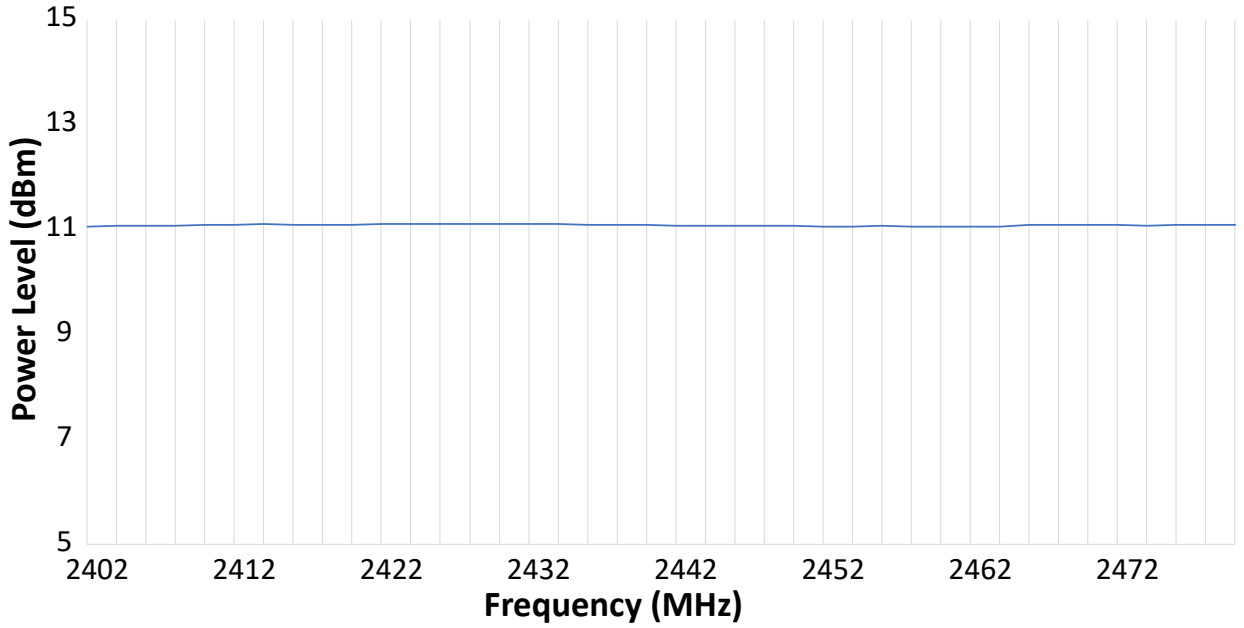

Figure 4-2. Bluetooth Low Energy Transmit Power vs. Temperature

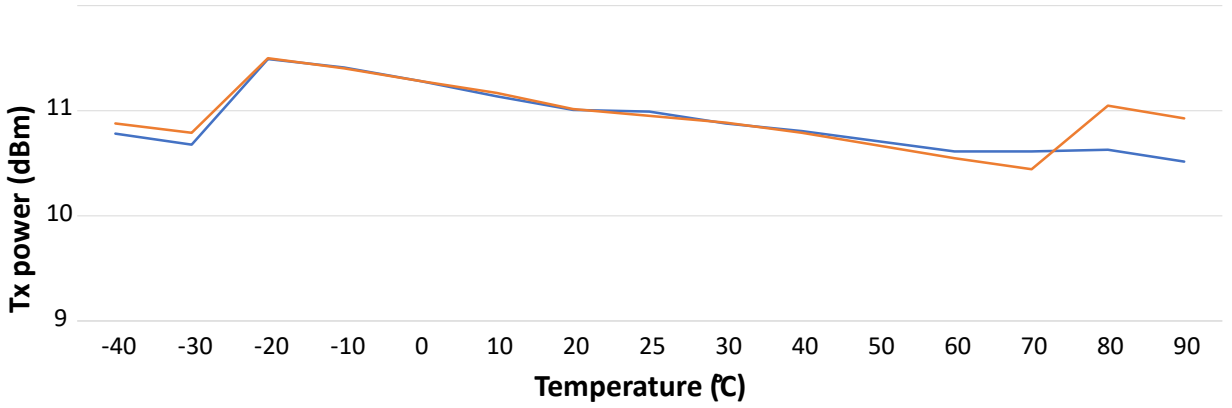

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Figure 4-3. Bluetooth Low Energy Transmit Power vs. Transmit Power Level

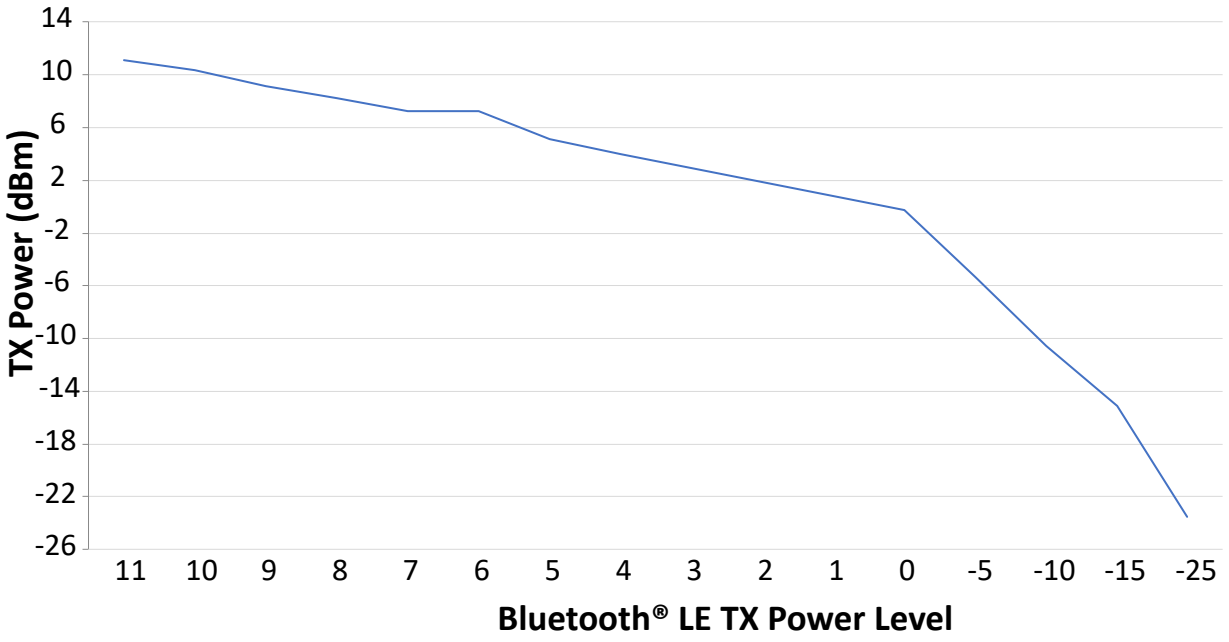

Figure 4-4. Bluetooth Low Energy Receive Sensitivity vs. Temperature

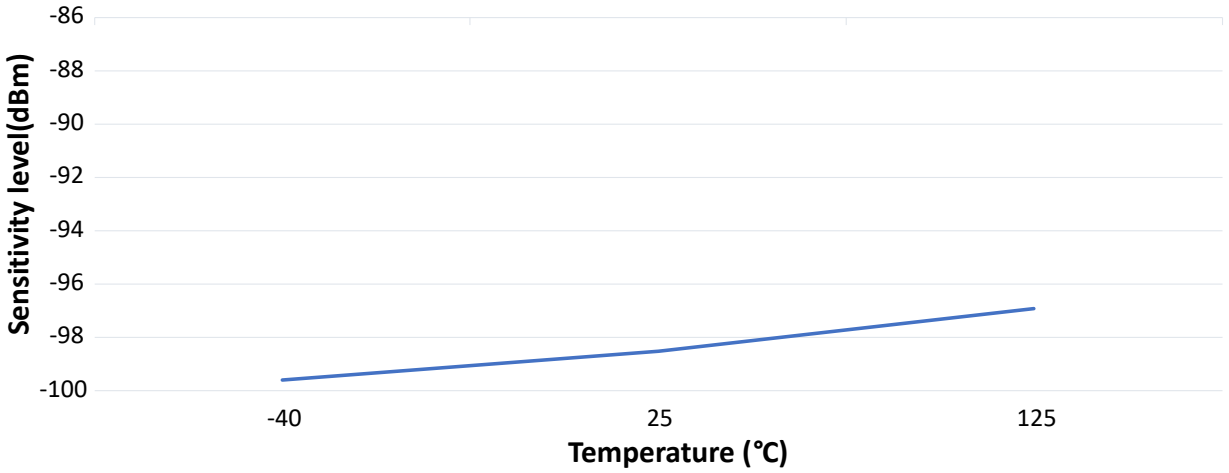

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Figure 4-5. RNBD350 Module Bluetooth Low Energy Receive Sensitivity vs. Temperature

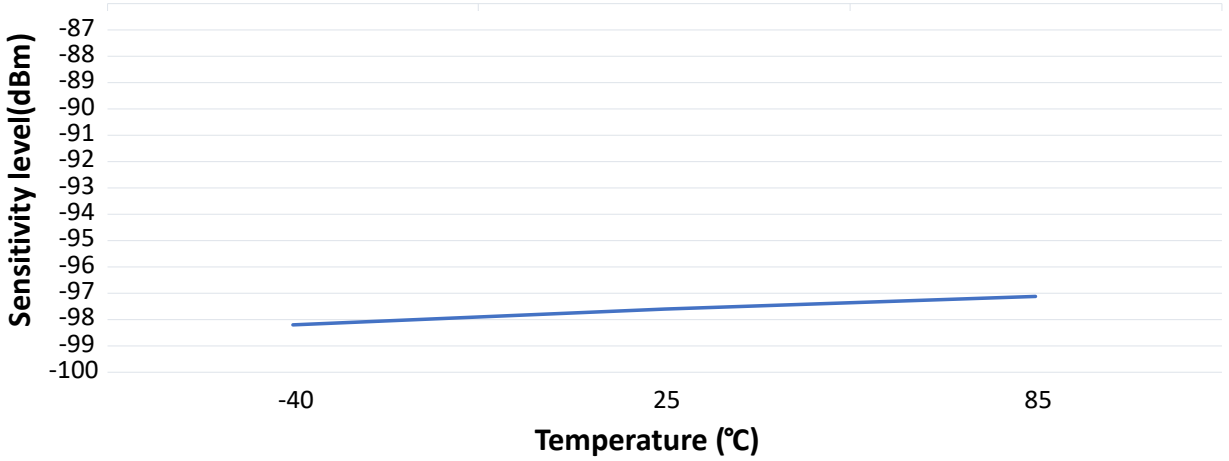

Figure 4-6. Bluetooth Low Energy Receive Sensitivity vs. Frequency

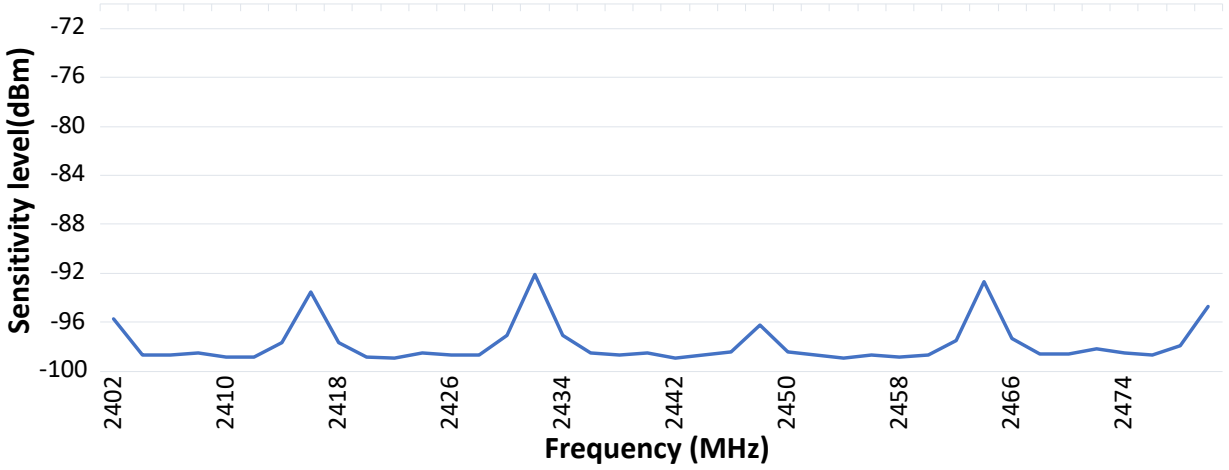

Figure 4-7. RNBD350 Module Bluetooth Low Energy Receive Sensitivity vs. Frequency

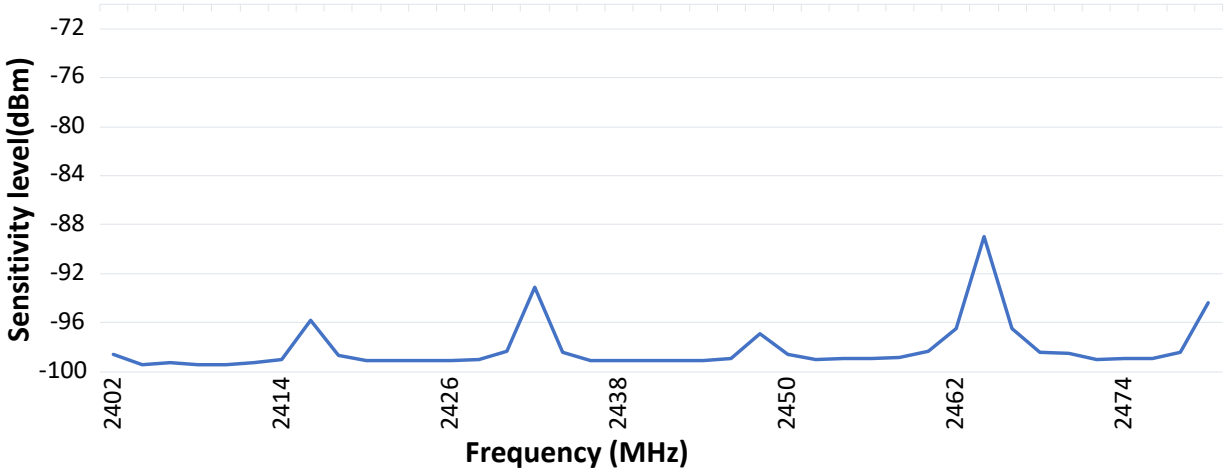

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Figure 4-8. Bluetooth Low Energy Transmit Power vs. VDD Supply Voltage

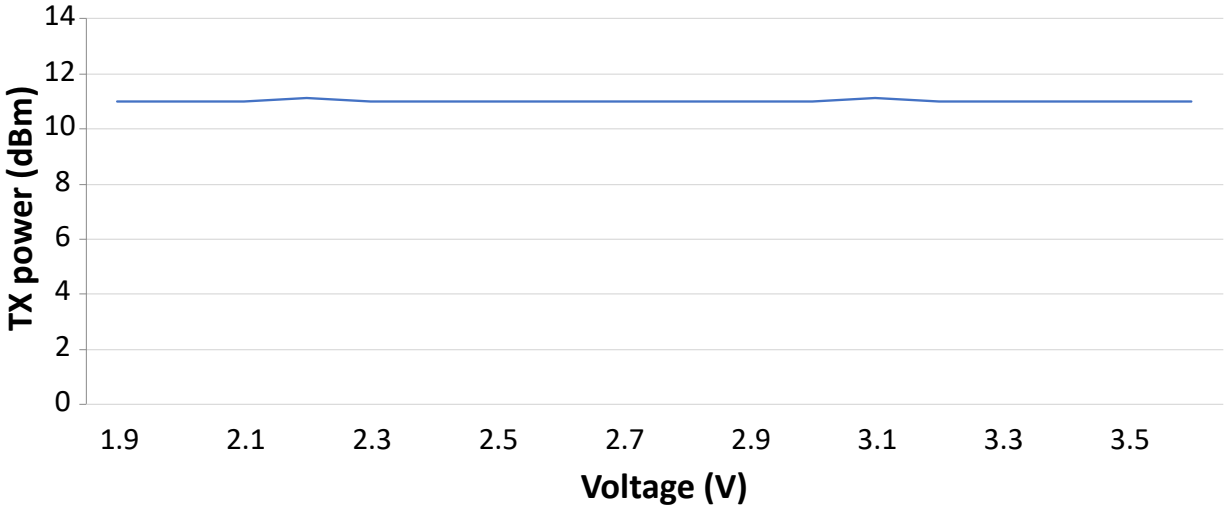

Figure 4-9. Bluetooth Low Energy Receive Sensitivity vs. VDD Supply Voltage

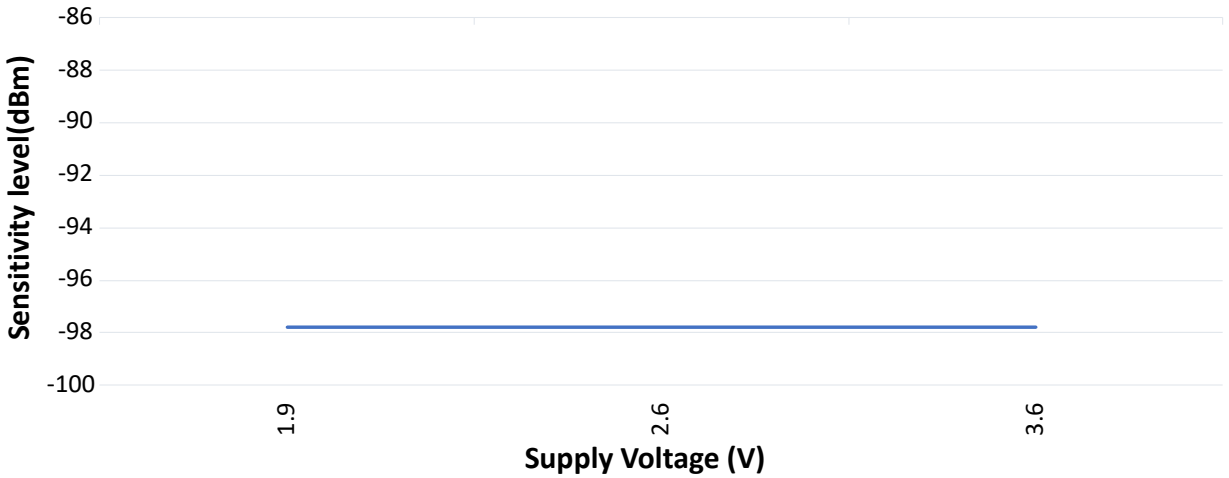

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Figure 4-10. Bluetooth Low Energy RX CI Margin

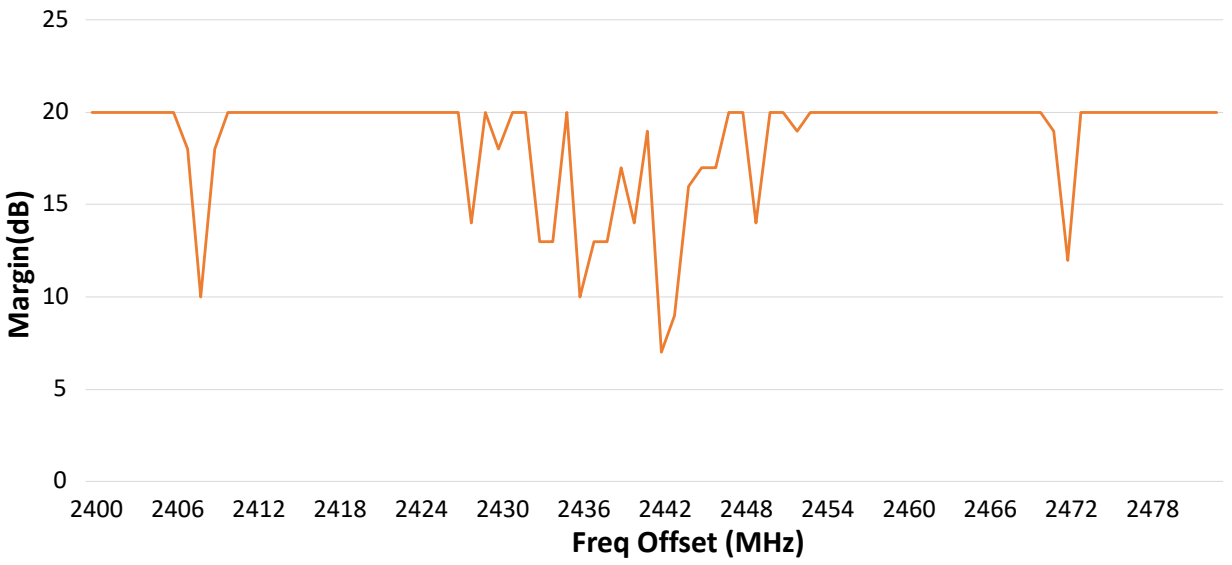


Figure 4-11. Bluetooth Low Energy Transmit Current vs. Temperature

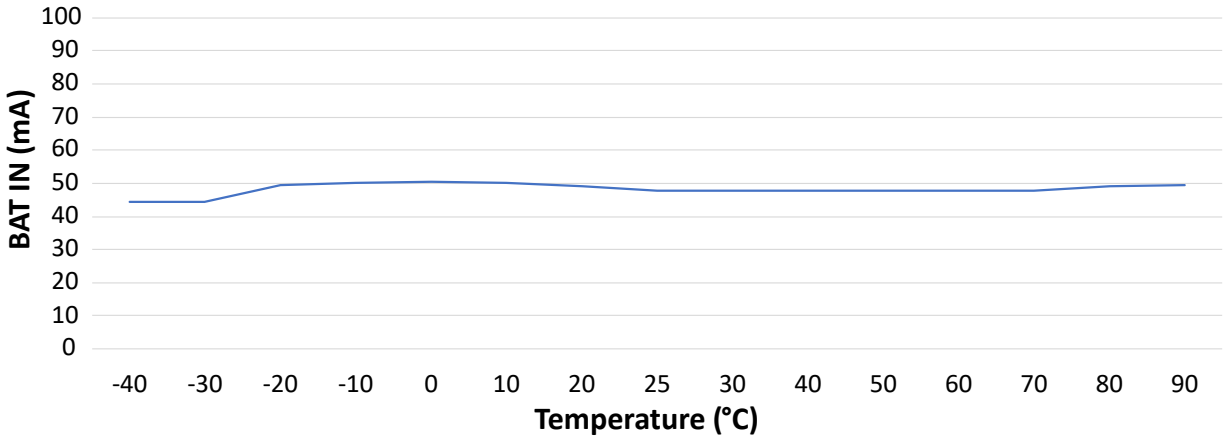
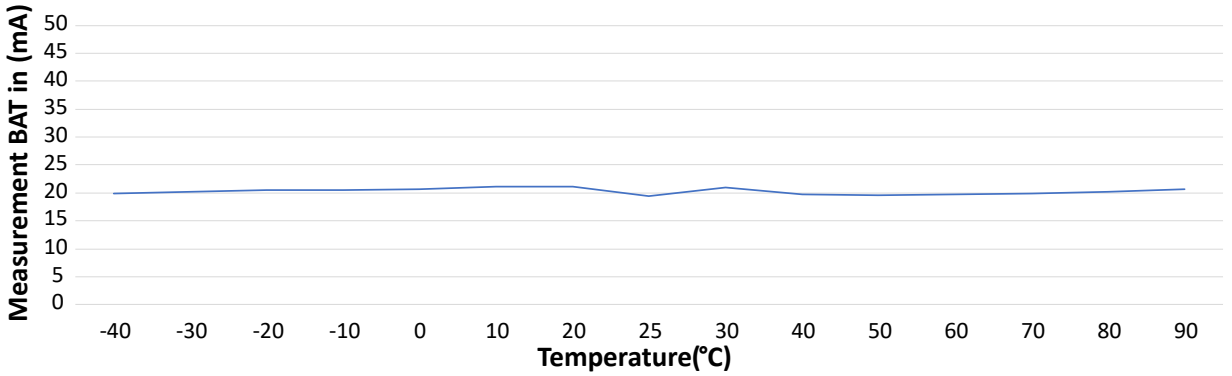


Figure 4-12. Bluetooth Low Energy Receive Current vs. Temperature



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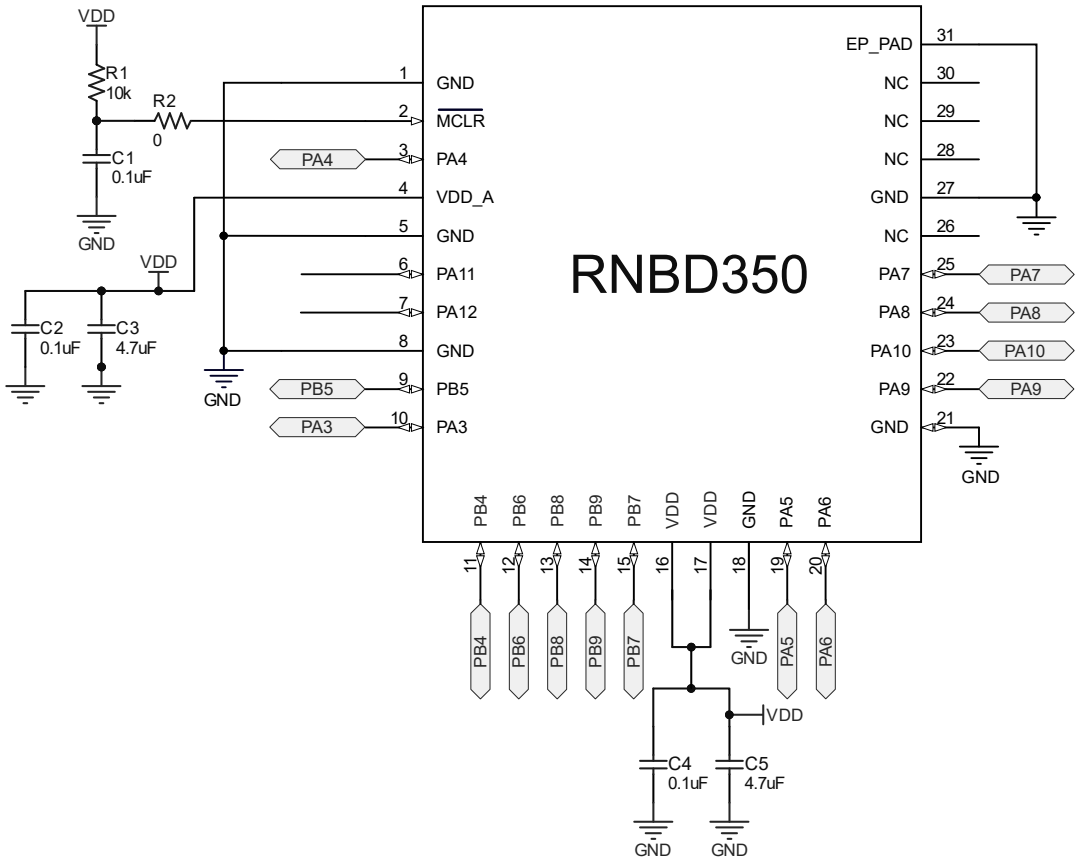
5. Basic Connection Requirement

The RNBD350 module requires attention to a minimal set of device pin connections before proceeding with development.

Figure 5-1. Module Basic Connection and Interface Diagram for RNBD350 Module



5.1 Power Pins

It is recommended that a bulk and a decoupling capacitor be added at the input supply pin (V_{DD}, VDD_A and GND pins) of the RNBD350 Module.

- The recommendation is to have a 4.7 µF on the VDD_A pin, 4.7 µF and a 0.1 µF on the V_{DD} pin.
- The value of the capacitors are based on typical application requirements and are the minimum recommended values. Depending on the application requirement (in other words, a noisy power line or other known noise sources), the user can adjust the values of the capacitor to provide a clean supply to the module.
- Place all the capacitors close to the module power supply pins.

5.2 Master Clear ($\overline{MCLR}$) Pin

Pulling the $\overline{MCLR}$ pin low generates a device Reset. For more details on the typical $\overline{MCLR}$ circuit, see Figure 5-1.

The RNBD350 module has sufficient filtering (0.1 µF) and pull-up (10k) on the Reset line. On a typical application, there is no need for extra filtering on this pin.

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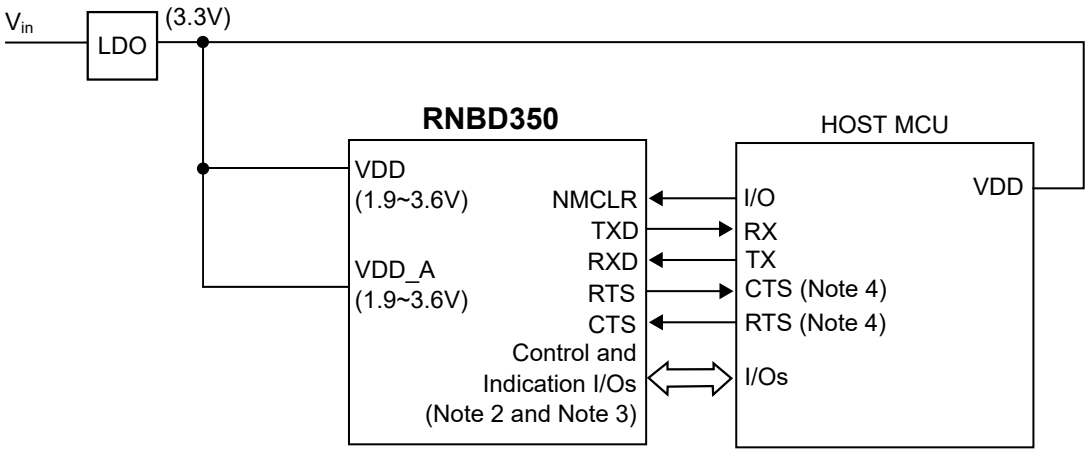
5.3 Unused I/O Pins

The recommendation is not to allow the unused I/O pins to float as inputs. The user can configure them as inputs and pulled up. Alternatively, depending on the application, they can be pulled down as well.

5.4 Interface Pins

The following illustrates the power scheme using a 3.3V low-dropout regulator to the RNBD350 module and a host MCU. This scheme ensures the same voltage is used for both the module and the MCU.

Figure 5-2. Power Scheme



Notes:

1. Ensure VDD_IO and MCU VDD voltages are compatible.
2. Control and indication ports are configurable.
3. To implement low-power operation, enable the UART RX indication pin and connect to host MCU and control.
4. These connectivities are optional and needed only when there is a need for UART flow control.

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6. Physical Dimensions and Attributes

6.1 RNBD350 Module Placement Guidelines

- For any Bluetooth Low Energy/Zigbee product, the antenna placement affects the performance of the whole system. The antenna requires free space to radiate RF signals and ensure it is not surrounded by the ground plane. Thus, for the best PCB antenna performance, the RNBD350 Module must be placed at the edge of the host board.
- The RNBD350 Module ground outline edge must be aligned with the edge of the host board ground plane (see the following figure).
- A low-impedance ground plane for the RNBD350 Module ensures the best radio performance (best range and lowest noise). The ground plane can be extended beyond the minimum recommendation as required for the host board EMC and noise reduction.
- For best performance, keep metal structures and components (such as mechanical spacers, bump-on and so on) at least 31.75 mm away from the PCB trace antenna (see the following figure).
- Do not place the antenna on the RNBD350 Module in direct contact with or close proximity to plastic casing or objects. Be sure to keep a clearance of 10 mm in all directions around the PCB antenna (see the following figure). Keeping metallic and plastic objects close to the antenna can detune the antenna and reduce the performance of the device.
- Exposed GND pads on the bottom of the RNBD350 Module must be soldered to the host board (see *Example of Host Board on Top Layer* figure in the *RNBD350 Module Routing Guidelines* from Related Links).
- A PCB cutout or a copper keepout is required under RF test point. See *RNBD350 Module Packaging Information* from Related Links.
- Copper keepout areas are required on the top layer under voltage test points. See *RNBD350 Module Packaging Information* from Related Links.
- On the other hand, the entire region except the exposed ground paddle can be solder-masked.

The following figure illustrates the examples of the RNBD350 Module placement on a host board with a ground plane. Refer to the following figure for placement-specific guidance.

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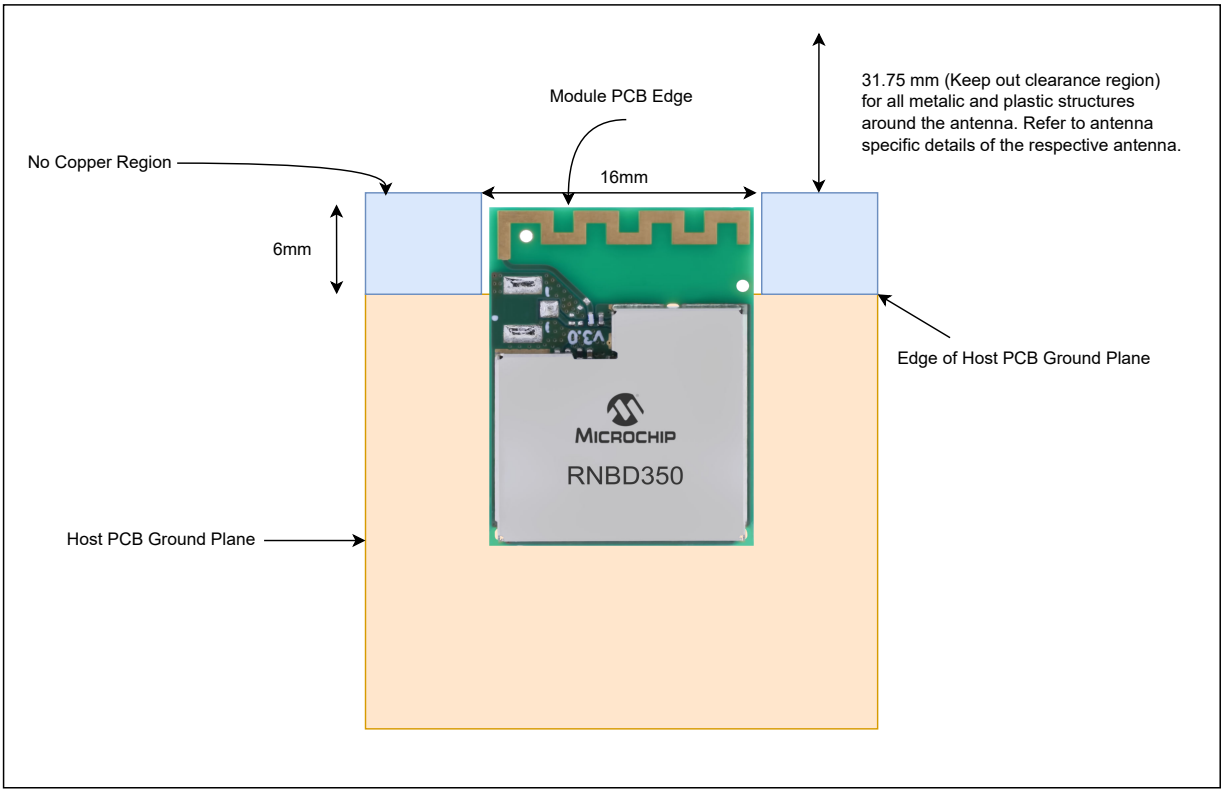
Figure 6-1. Module Placement Guidelines



6.2 RNBD350 Module Routing Guidelines

- Use the multi-layer host board for routing signals on the inner layer and the bottom layer.
- The top layer (underneath the module) of the host board must be ground with as many GND vias as possible, (see the following figure).
- Avoid fan-out of the signals under the module or antenna area. Use a via to fan-out signals to the edge of the RNBD350 Module.
- For a better GND connection to the RNBD350 Module, solder the exposed GND pads of the RNBD350 Module on the host board.
- For the module GND pad, use a GND via of a minimum 10 mil (hole diameter) for good ground to all the layers and thermal conduction path.
- The recommendation is to have a series resistor on the host board for all GPIOs. Place these resistors close to the RNBD350 Module. The following figure illustrates the placement of the series resistor.

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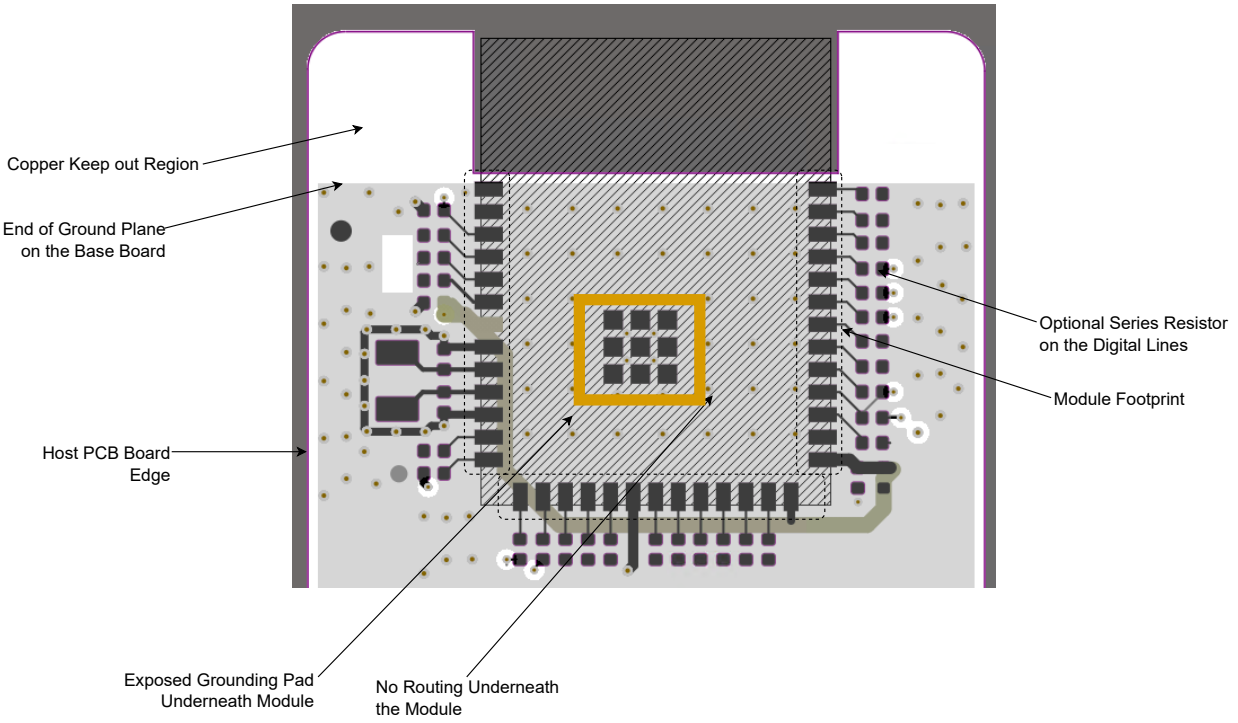
Figure 6-2. Example of Host Board on Top Layer



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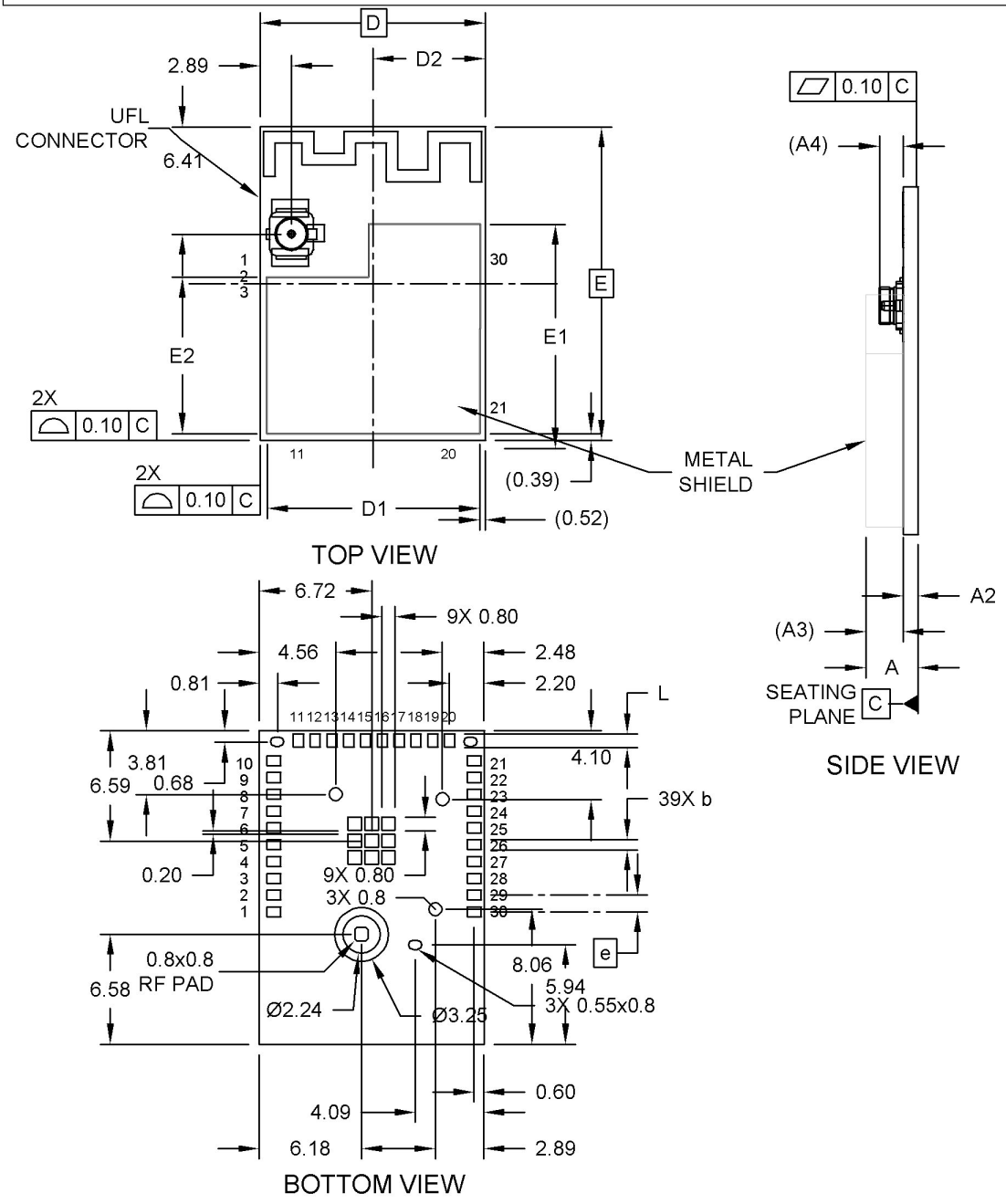
6.3 RNBD350 Module Packaging Information

30-Lead PCB Module (3BW) - 13.4x18.7x2.8mm [MODULE]
With Metal Shield and Coaxial Connector

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-10055 Rev C Sheet 1 of 2

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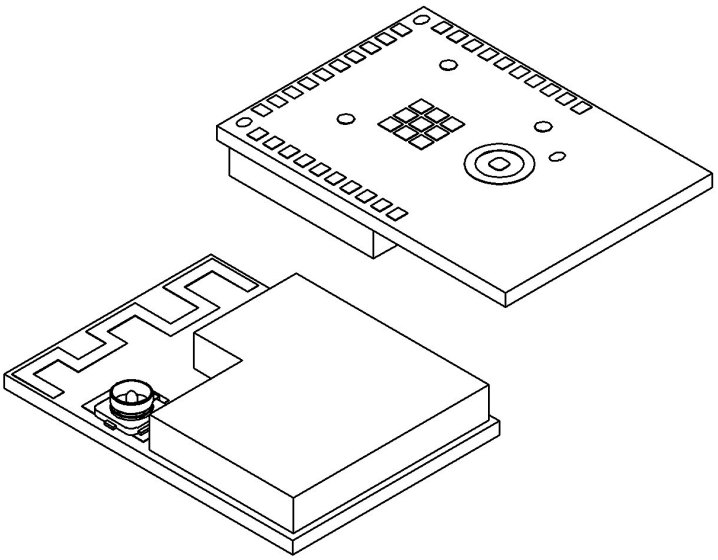
30-Lead PCB Module (3BW) - 13.4x18.7x2.8mm [MODULE] With Metal Shield and Coaxial Connector

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Terminals	N		39	
Terminal Pitch	e		1.00 BSC	
Overall Height	A	2.70	2.80	2.90
PCB Thickness	A2	0.70	0.80	0.90
Shield Height	A3		2.00 REF	
UFL Connector Height	A4		1.25 REF	
Overall Length	D		13.40 BSC	
Overall Width	E		18.70 BSC	
Shield Length	D1	12.14	12.24	12.34
Shield Length	D2	6.60	6.70	6.80
Shield Width	E1	12.14	12.24	12.34
Shield Width	E2	8.92	9.02	9.12
Terminal Width	b	0.50	0.60	0.70
Terminal Length	L	0.70	0.80	0.90

Notes:

1. All Dimensions are in Millimeters
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-10055 Rev C Sheet 2 of 2

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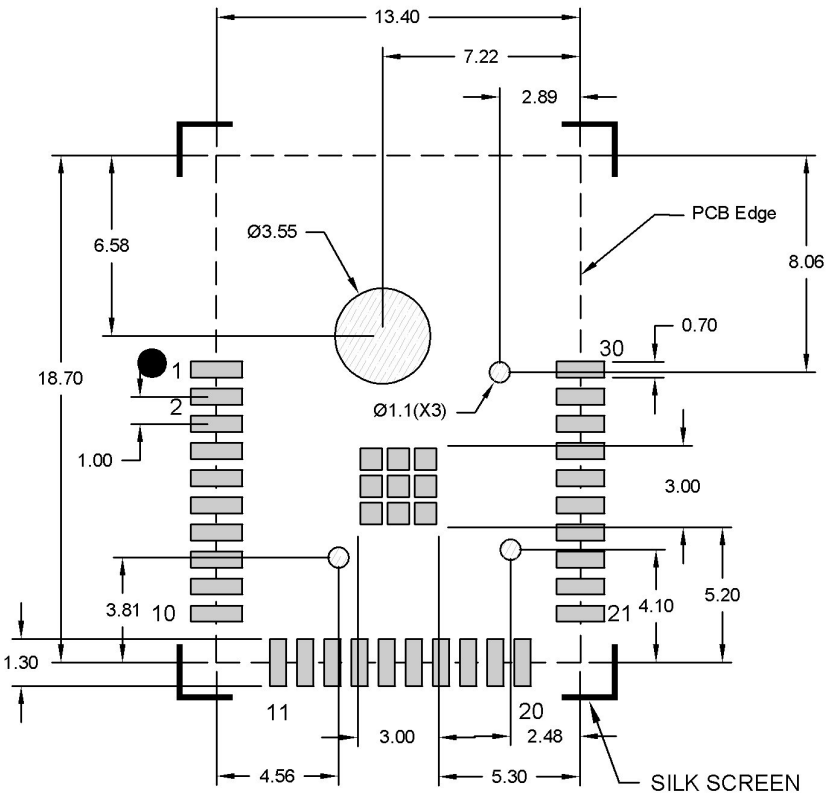
30-Lead PCB Module (3BW) - 13.4x18.7x2.8mm [MODULE]
With Metal Shield and Coaxial Connector

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

COPPER KEEPOUT ZONE

Notes:

1. All dimensions are in millimeters.
2. Keep this area free from all metal, including ground fill.
3. Keep these areas free from routes and exposed copper. Ground fill with solder mask may be placed here.

Microchip Technology Drawing C04-12055 Rev C

6.4 RNBD350 Module RF Considerations

The product design, environment and application significantly affect the overall performance of the system. The product designer must ensure system-level shielding (if required) and verify the performance of the product features and applications.

The following are the guidelines to consider for optimal RF performance:

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- Position the RNBD350 Module in a noise-free RF environment, keep it far away from high-frequency clock signals and any other sources of RF energy.
- Do not shield the antenna by any metal objects.
- The power supply must be clean and noise-free.
- Ensure that the width of the traces routed to GND, VDD rails are sufficiently large for handling peak TX current consumption.
  Note: The RNBD350 Module includes RF shielding on top of the board as a standard feature.

6.5 RNBD350 Module Antenna Considerations

6.5.1 PCB Antenna

For the RNBD350 module, the PCB antenna is fabricated on the top copper layer and covered in a solder mask. The layers below the antenna do not have copper trace. It is recommended that the module be mounted on the edge of the host board and to have no PCB material below the antenna structure of the module and no copper traces or planes on the host board in that area.

The following table lists the technical specification of the PCB antenna when tested with the RNBD350 module mounted on an Evaluation Board.

Table 6-1. PCB Antenna Specification for RNBD350 Module

Parameter	Specification
Operating frequency	2400 to 2500 MHz
Peak gain	2.9 dBi at 2430 MHz
Efficiency	50%

PCB Antenna Radiation Pattern

The following figures illustrate the antenna radiation patterns for RNBD350 module.

Figure 6-3. RNBD350 Antenna Radiation Pattern when Phi = 0°

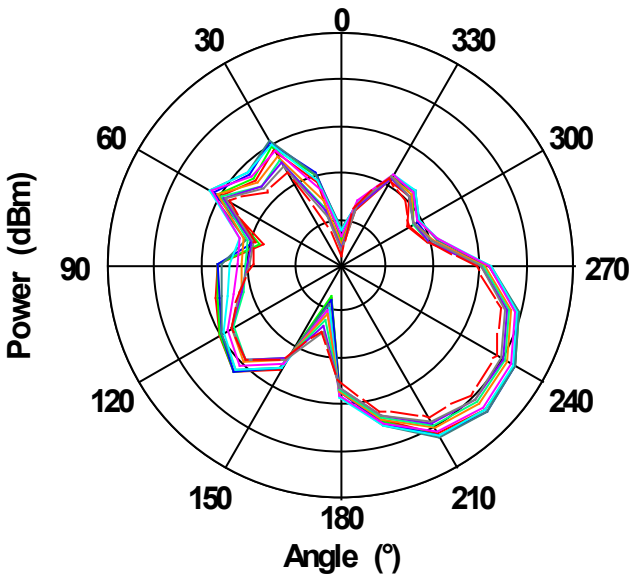

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Figure 6-4. RNBD350 Antenna Radiation Pattern when Phi = 90°

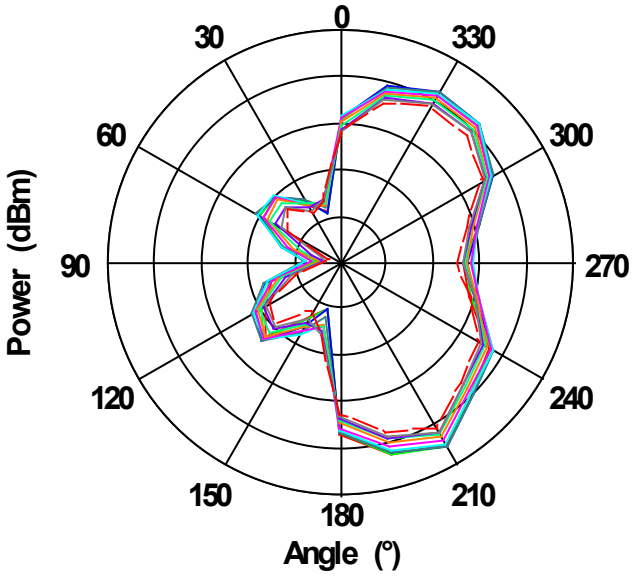

Figure 6-5. RNBD350 Antenna Radiation Pattern when Theta = 90°

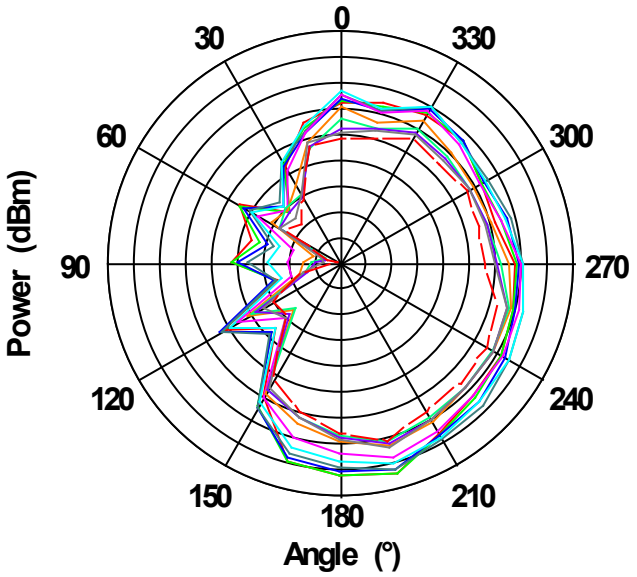

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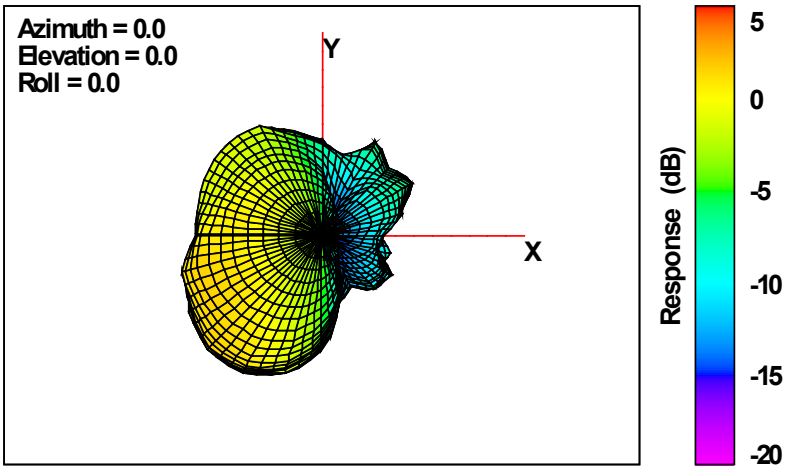
Figure 6-6. RNBD350 Antenna Radiation 3D Pattern



6.5.2 External Antenna Placement Recommendations

The user must apply the following recommendations for the placement of the antenna and its cable:

- Do not route the antenna cable over circuits generating electrical noise on the host board or alongside or underneath the module. The recommendation is to route the cable straight out of the module.
- Do not place the antenna in direct contact with or in close proximity to the plastic casing/objects. (Except when the selected antenna specifically recommends it.)
- Do not enclose the antenna within a metal shield.
- The user must keep any components capable of radiating noise, signals or harmonics in the 2.4-2.5 GHz frequency range away from the antenna, and, if feasible, provide shielding for such components. Any noise radiated from the host board in this frequency band degrades the sensitivity of the module.
- Place the antenna at a distance greater than 5 cm away from the module. The following figure illustrates the antenna keep-out area where the antenna must not be placed.

These recommendations are based on an open-air measurement and do not take into account any metal shielding of the customer end product. When a metal enclosure is used, the antenna can be located closer to the RNBD350 module.

The following figure illustrates an indication on how to route the antenna cable depending on the location of the antenna with respect to the RNBD350 PCB. There are two possible options for the optimum routing of the cable.

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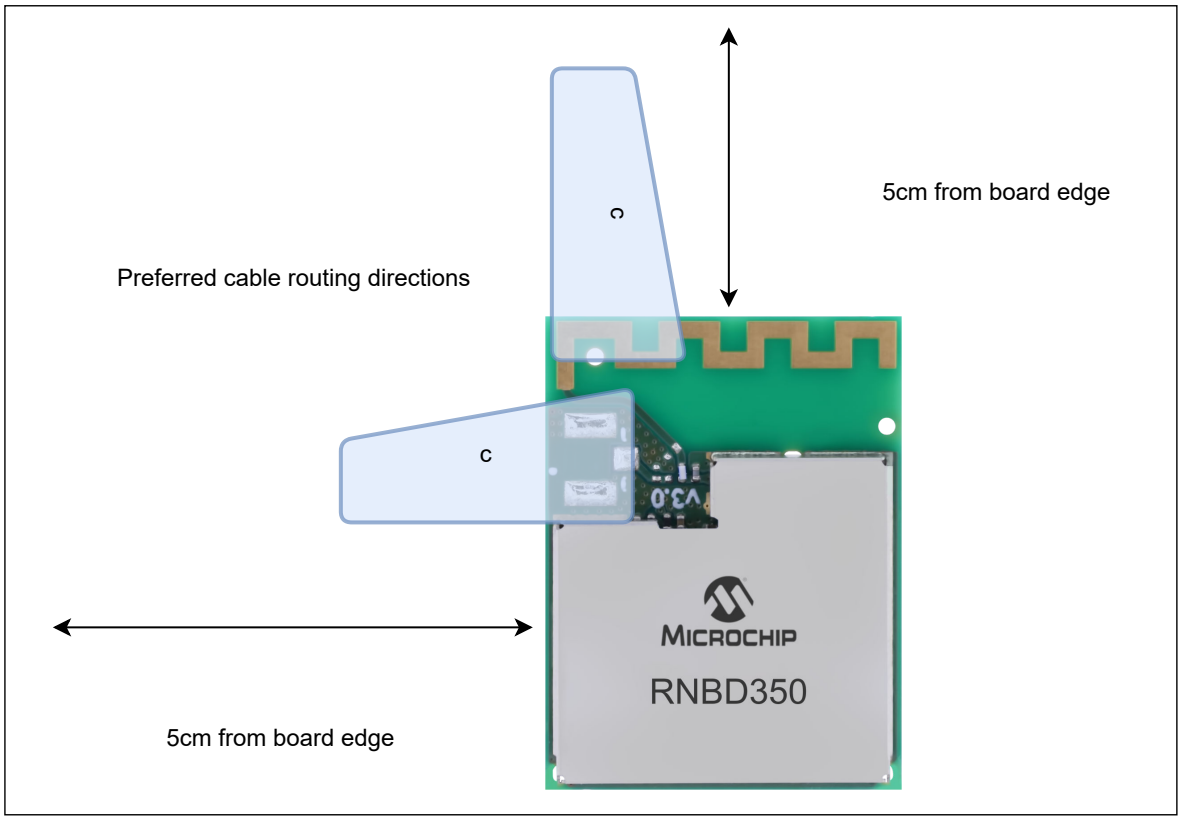
Figure 6-7. RNBD350 Antenna Placement Guidelines



Note: These are generic guidelines, and the recommendation is that the customers can check and fine-tune the antenna positioning in the final host product based on RF performance.

6.5.2.1 External Antennas

The RNBD350UE modules have an ultra-small surface mount U.FL connector for an external antenna connection. The choice of antenna is limited to the antenna types that the module is tested and approved for.

The RNBD350UE modules are approved to use with the antennas listed in the following table. It is permissible to use a different antenna, provided it is the same antenna type, has the same antenna gain (equal or less than) and similar in-band and out-of-band characteristics are present (refer to the antenna specification sheet for cutoff frequencies).

If other antenna types are used, the OEM installer must conduct the necessary assessments and authorize the antenna with the respective regulatory agencies and ensure compliance.

Table 6-2. RNBD350 Module Approved External Antenna List with Antenna Gain

Antenna Number	Part Number	Manufacturer	Antenna Gain (dBi)	Antenna Type	Comment
1	W3525B039	Pulse	2	PCB	Cable length 100 mm
2	RFDPA870915IMAB306	WALSIN	1.82	Dipole	150 mm
3	001-0016	LSR	2.5	PIFA	Flex PCB antenna
4	001-0001	LSR	2	Dipole	RPSMA connector
5	1461530100	Molex	3	PCB	100 mm (Dual Band)
6	ANT-2.4-LPW-125	Linx Technologies	2.8	Dipole	125 mm
7	RFA-02-P05-D034	Alead	2	PCB	150 mm

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.....continued

Antenna Number	Part Number	Manufacturer	Antenna Gain (dBi)	Antenna Type	Comment
8	RFA-02-P33-D034	Alead	2	PCB	150 mm
9	ABAR1504-S2450	ABRACON	2.28	PCB	250 mm
10	WBZ350 LGA	—	2.9	PCB	only for WBZ350 and RNBD350 module

Notes:

1. If the end product using the module is designed to have an antenna port that is accessible to the end user, a unique (non-standard) antenna connector (as permissible by FCC) must be used (for example, RP (Reverse Polarity)-SMA socket).
2. If an RF coaxial cable is used between the module RF output and the enclosure, a unique (non-standard) antenna connector must be used in the enclosure wall to interface with the antenna.
3. Contact the antenna vendor for detailed antenna specifications to review the suitability to the end product operating environment and to identify alternatives.
4. If any external antenna is used other than the recommended antennas in the list, it may need an extra step of post-calibration on the customer's application board.

6.6 RNBD350 Module Reflow Profile Information

The RNBD350 Module was assembled using the IPC/JEDEC J-STD-020 standard lead-free reflow profile. The RNBD350 Module can be soldered to the host board using standard leaded or lead-free solder reflow profiles. To avoid damaging the module, adhere to the following recommendations:

- For solder reflow recommendations, refer to the *AN233 Solder Reflow Recommendation Application Note* (DS00233).
- Do not exceed a peak temperature (TP) of 250°C.
- For specific reflow profile recommendations from the vendor, refer to the *Solder Paste Data Sheet*.
- Use no-clean flux solder paste.
- Do not wash as moisture can be trapped under the shield.
- Use only one flow. If the PCB requires multiple flows, apply the module on the final flow.

6.6.1 Cleaning

The exposed GND pad helps to self-align the module, avoiding pad misalignment. The recommendation is to use the no clean solder pastes. Ensure full drying of no-clean paste fluxes as a result of the reflow process. As per the recommendation by the solder paste vendor, this requires longer reflow profiles and/or peak temperatures toward the high end of the process window. The uncured flux residues can lead to corrosion and/or shorting in accelerated testing and possibly the field.

6.7 RNBD350 Module Assembly Considerations

The RNBD350 module is assembled with an EMI shield to ensure compliance with EMI emission and immunity rules. The EMI shield is made of a tin-plated steel (SPTE) and is not hermetically sealed. Use the solutions such as IPA and similar solvents to clean this module. The user must never use cleaning solutions containing acid on the module.

6.7.1 Conformal Coating

The modules are not intended for use with a conformal coating, and the customer assumes all risks (such as the module reliability, performance degradation and so on) if a conformal coating is applied to the modules.

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7. ASCII Command API

For more details on the RNBD350 module command Application Programming Interfaces (APIs), refer to the *RNBD350 Bluetooth® Low Energy Module User's Guide* (DS50003684).

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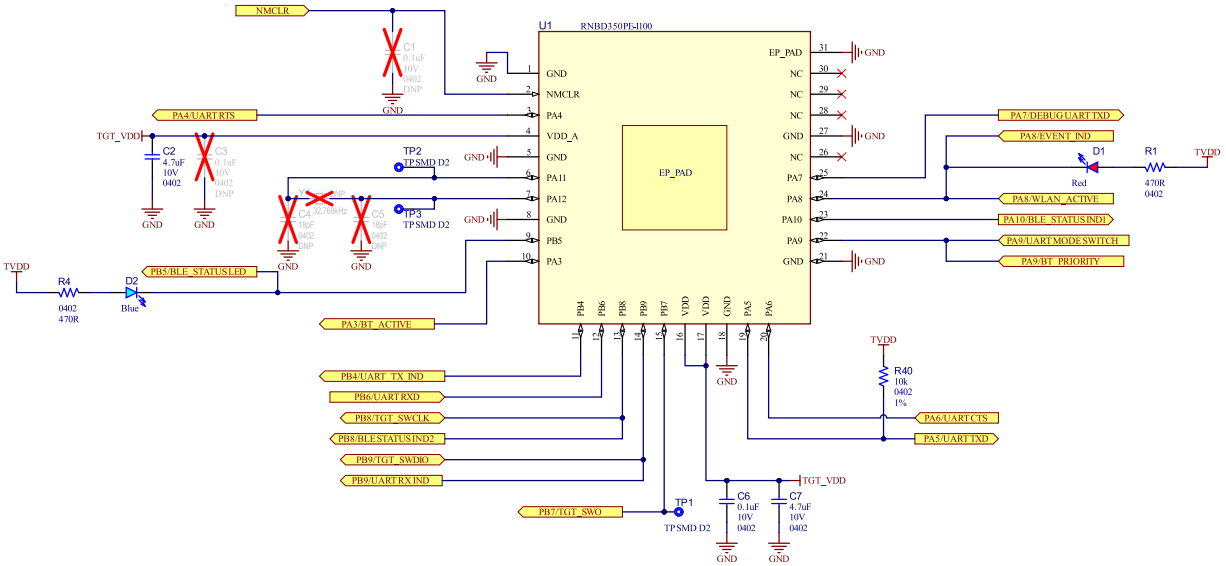
8. Application Reference Schematics

This chapter provides the application reference circuits of the RNBD350 module.

Figure 8-1. RNBD350 Add On Board



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9. Supported Bluetooth® Low Energy Profile and Services

The RNBD350 module supports the following built-in GATT profiles and services:

- Device Information Service (DIS)
- Microchip OTA profile and service handling OTA DFU execution
- Microchip transparent profile and service handling UART data streaming function

In addition to the above built-in profile and service, the RNBD350 module provides the capabilities below to register more GATT services and characteristic attributes by RN command sets. The internal Nonvolatile Memory (NVM), which is also called as Persistent Data Storage (PDS), saves these registered GATT services and characteristics.

- Up to six GATT services with 16-bit UUID and eight characteristic attributes for each GATT service
- Up to four GATT services with 128-bit UUID eight characteristic attributes for each GATT service

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10. Appendix A: Regulatory Approval

The RNBD350 module has received regulatory approval for the following countries:

- Bluetooth Special Interest Group (SIG) QDID:225441
- United States/FCC ID: 2ADHKWBZ350
- Canada/ISED:
  - IC: 20266-WBZ350
  - HVIN: RNBD350PE
- Europe/CE
- Japan/MIC
- Korea/KCC
- Taiwan/NCC
- China/SRRC
- Great Britain/UKCA

10.1 United States

The RNBD350 module has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” single-modular approval in accordance with Part 15.212 Modular Transmitter approval. Single-modular transmitter approval is defined as a complete RF transmission sub-assembly, designed to be incorporated into another device, that must demonstrate compliance with FCC rules and policies independent of any host. A transmitter with a modular grant can be installed in different end-use products (referred to as a host, host product or host device) by the grantee or other equipment manufacturer, then the host product may not require additional testing or equipment authorization for the transmitter function provided by that specific module or limited module device.

The user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

A host product itself is required to comply with all other applicable FCC equipment authorization regulations, requirements, and equipment functions that are not associated with the transmitter module portion. For example, compliance must be demonstrated: to regulations for other transmitter components within a host product; to requirements for unintentional radiators (Part 15 Subpart B), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Suppliers Declaration of Conformity (SDoC) or certification) as appropriate (e.g., Bluetooth and Wi-Fi transmitter modules may also contain digital logic functions).

10.1.1 Labeling and User Information Requirements

The RNBD350 module has been labeled with its own FCC ID number, and if the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must display a label referring to the enclosed module. This exterior label must use the following wording:

Contains Transmitter Module FCC ID: 2ADHKWBZ350 or Contains FCC ID: 2ADHKWBZ350 **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**.

The user's manual for the finished product must include the following statement:

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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

Additional information on labeling and user information requirements for Part 15 devices can be found in KDB Publication 784748, which is available at the FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) apps.fcc.gov/oetcf/kdb/index.cfm.

10.1.2 RF Exposure

All transmitters regulated by FCC must comply with RF exposure requirements. KDB 447498 General RF Exposure Guidance provides guidance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency (RF) fields adopted by the Federal Communications Commission (FCC).

From the FCC Grant: Output power listed is conducted. This grant is valid only when the module is sold to OEM integrators and must be installed by the OEM or OEM integrators. This transmitter is restricted for use with the specific antenna(s) tested in this application for Certification and must not be co-located or operating in conjunction with any other antenna or transmitters within a host device, except in accordance with FCC multi-transmitter product procedures.

RNBD350: These modules are approved for installation into mobile or/and portable host platforms atleast 20cm away from the human body.

10.1.3 Helpful Web Sites

- Federal Communications Commission (FCC): www.fcc.gov.
- FCC Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) apps.fcc.gov/oetcf/kdb/index.cfm.

10.2 Canada

The RNBD350 module has been certified for use in Canada under Innovation, Science and Economic Development Canada (ISED, formerly Industry Canada) Radio Standards Procedure (RSP) RSP-100, Radio Standards Specification (RSS) RSS-Gen and RSS-247. Modular approval permits the installation of a module in a host device without the need to recertify the device.

10.2.1 Labeling and User Information Requirements

Labeling Requirements (from RSP-100 - Issue 12, Section 5): The host product shall be properly labeled to identify the module within the host device.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host device; otherwise, the host product must be labeled to display the Innovation, Science and Economic Development Canada certification number of the module, preceded by the word “Contains” or similar wording expressing the same meaning, as follows:

Contains IC: 20266-WBZ350

User Manual Notice for License-Exempt Radio Apparatus (from Section 8.4 RSS-Gen, Issue 5, February 2021): User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both:

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This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference;

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage;

2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Transmitter Antenna (From Section 6.8 RSS-GEN, Issue 5, February 2021): User manuals, for transmitters shall display the following notice in a conspicuous location:

This radio transmitter [IC: 20266-WBZ350] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio [IC: 20266-WBZ350] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés cidessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi) and required impedance for each.

10.2.2 RF Exposure

All transmitters regulated by Innovation, Science and Economic Development Canada (ISED) must comply with RF exposure requirements listed in RSS-102 - Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands).

This transmitter is restricted for use with a specific antenna tested in this application for certification, and must not be co-located or operating in conjunction with any other antenna or transmitters within a host device, except in accordance with Canada multi-transmitter product procedures.

RNBD350: The device operates at an output power level which is within the ISED SAR test exemption limits at any user distance > 20cm.

10.2.3 Helpful Web Sites

Innovation, Science and Economic Development Canada (ISED): www.ic.gc.ca/.

10.3 Europe

The RNBD350 a Radio Equipment Directive (RED) assessed radio module that is CE marked and has been manufactured and tested with the intention of being integrated into a final product.

The RNBD350 module has been tested to RED 2014/53/EU Essential Requirements mentioned in the following European Compliance table.

Table 10-1. European Compliance Information

Certification	Standard	Article
Safety	EN 62368	3.1a
Health	EN 62311	
EMC	EN 301 489-1	3.1b
	EN 301 489-17	
Radio	EN 300 328	3.2

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The ETSI provides guidance on modular devices in the "*Guide to the application of harmonised standards covering articles 3.1b and 3.2 of the RED 2014/53/EU (RED) to multi-radio and combined radio and non-radio equipment*" document available at http://www.etsi.org/deliver/etsi_eg/203300_203399/20 3367/01.01.01_60/eg_203367v010101p.pdf.

Note: To maintain conformance to the standards listed in the preceding European Compliance table, the module shall be installed in accordance with the installation instructions in this data sheet and shall not be modified. When integrating a radio module into a completed product, the integrator becomes the manufacturer of the final product and is therefore responsible for demonstrating compliance of the final product with the essential requirements against the RED.

10.3.1 Labeling and User Information Requirements

The label on the final product that contains the RNBD350 module must follow CE marking requirements.

10.3.2 Conformity Assessment

From ETSI Guidance Note EG 203367, section 6.1, when non-radio products are combined with a radio product:

If the manufacturer of the combined equipment installs the radio product in a host non-radio product in equivalent assessment conditions (i.e. host equivalent to the one used for the assessment of the radio product) and according to the installation instructions for the radio product, then no additional assessment of the combined equipment against article 3.2 of the RED is required.

10.3.2.1 Simplified EU Declaration of Conformity

Hereby, Microchip Technology Inc. declares that the radio equipment type RNBD350 in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity, for this product, is available at www.microchip.com/design-centers/wireless-connectivity/.

10.3.3 Helpful Websites

A document that can be used as a starting point in understanding the use of Short Range Devices (SRD) in Europe is the European Radio Communications Committee (ERC) Recommendation 70-03 E, which can be downloaded from the European Communications Committee (ECC) at: http://www.ecodocdb.dk/.

Additional helpful web sites are:

- Radio Equipment Directive (2014/53/EU): https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/red_en
- European Conference of Postal and Telecommunications Administrations (CEPT): http://www.cept.org
- European Telecommunications Standards Institute (ETSI): http://www.etsi.org
- The Radio Equipment Directive Compliance Association (REDCA): http://www.redca.eu/

10.4 Japan

The RNBD350 module has received type certification and is required to be labeled with its own technical conformity mark and certification number as required to conform to the technical standards regulated by the Ministry of Internal Affairs and Communications (MIC) of Japan pursuant to the Radio Act of Japan.

Integration of this module into a final product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed. Additional testing may be required:

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- If the host product is subject to electrical appliance safety (for example, powered from an AC mains), the host product may require Product Safety Electrical Appliance and Material (PSE) testing. The integrator should contact their conformance laboratory to determine if this testing is required
- There is an voluntary Electromagnetic Compatibility (EMC) test for the host product administered by VCCI: www.vcci.jp/vcci_e/index.html

10.4.1 Labeling and User Information Requirements

The label on the final product which contains the RNBD350 module(s) must follow Japan marking requirements. The integrator of the module should refer to the labeling requirements for Japan available at the Ministry of Internal Affairs and Communications (MIC) website.

For the RNBD350 module, due to a limited module size, the technical conformity logo and ID is displayed in the data sheet and/or packaging and cannot be displayed on the module label. The final product in which this module is being used must have a label referring to the type certified module inside:

10.4.2 Helpful Web Sites

- Ministry of Internal Affairs and Communications (MIC): www.tele.soumu.go.jp/e/index.htm.
- Association of Radio Industries and Businesses (ARIB): www.arib.or.jp/english/.

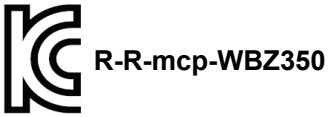
10.5 Korea

The RNBD350 module has received certification of conformity in accordance with the Radio Waves Act. Integration of this module into a final product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed.

10.5.1 Labeling and User Information Requirements

The label on the final product which contains the RNBD350 module(s) must follow KC marking requirements. The integrator of the module should refer to the labeling requirements for Korea available on the Korea Communications Commission (KCC) website.

The RNBD350 module is labeled with its own KC mark. The final product requires the KC mark and certificate number of the module:



10.5.2 Helpful Websites

- Korea Communications Commission (KCC): www.kcc.go.kr.
- National Radio Research Agency (RRA): rra.go.kr.

10.6 Taiwan

The RNBD350 module has received compliance approval in accordance with the Telecommunications Act. Customers seeking to use the compliance approval in their product should contact Microchip Technology sales or distribution partners to obtain a Letter of Authority.

Integration of this module into a final product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed.

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10.6.1 Labeling and User Information Requirements

For the RNBD350 module, due to the limited module size, the NCC mark and ID are displayed in the data sheet only and cannot be displayed on the module label:

The user's manual should contain following warning (for RF device) in traditional Chinese:

根據 NCC LP0002 低功率射頻器材技術規範_章節 3.8.2：

取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

前述合法通信，指依電信管理法規定作業之無線電通信。

低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

此模組於取得認證後將依規定於模組本體標示審驗合格標籤，並要求平台廠商於平台上標示本產品內含發射器模組

10.6.2 Helpful Web Sites

National Communications Commission (NCC): www.ncc.gov.tw

10.7 China

The RNBD350PE has/have received certification of conformity in accordance with the China MIIT Notice 2014-01 of State Radio Regulation Committee (SRRC) certification scheme. Integration of this module into a final product does not require additional radio certification, provided installation instructions are followed and no modifications of the module are allowed. Refer to SRRC certificate available in RNBD350 product page for expiry date.

10.7.1 Labeling and User Information Requirements

The RNBD350PE module is labeled with its own CMIIT ID as follows:

CMIIT ID: 24J999P60002

设备名称：

蓝牙模块

Equipment Name

设备型号：RNBD350PE

Equipment Type

核准代码：24J999P60002

CMIT ID

When Host system is using an approved Full Modular Approval (FMA) radio: The host must bear a label containing the statement “This device contains SRRC approved Radio module CMIIT ID: 24J999P60002”.

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10.8 UKCA (UK Conformity Assessed)

The RNBD350 module is a UK conformity assessed radio module that meets all the essential requirements according to CE RED requirements.

10.8.1 Labeling Requirements for Module and User's Requirements

The label on the final product that contains the RNBD350 module must follow UKCA marking requirements.

The UKCA mark above is printed on the module itself or on the packing label.

Additional details for the label requirement are available at:

https://www.gov.uk/guidance/using-the-ukca-marking#check-whether-you-need-to-use-the-new-ukca-marking.

10.8.2 UKCA Declaration of Conformity

Hereby, Microchip Technology Inc. declares that the radio equipment type the RNBD350 module is in compliance with the Radio Equipment Regulations 2017. The full text of the UKCA declaration of conformity for this product is available (under *Documents* > *Certifications*) at: www.microchip.com/en-us/product/WBZ351PE.

10.8.3 Helpful Websites

For more information on the UKCA regulatory approvals, refer to the www.gov.uk/guidance/placing-manufactured-goods-on-the-market-in-great-britain.

10.9 Other Regulatory Information

- For information about other countries' jurisdictions not covered here, refer to the www.microchip.com/design-centers/wireless-connectivity/certifications.
- Should other regulatory jurisdiction certification be required by the customer, or the customer needs to recertify the module for other reasons, contact Microchip for the required utilities and documentation.

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11. Document Revision History

The document revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Revision	Date	Section	Description
B	11/2024	Features	• Eight GPIOs changed into “seven” • Deleted these features: – Embedded Enhanced Security – OTA device firmware update – OTAPC device firmware update on peer RNBD350 device
		RF/Analog Features	• +10 dBm Programmable Transmit Output Power changed to +11 • -97 Typical Receiver Power Sensitivity changed to -98
		RNBD350 Module Ordering Information	Added new row for UE type
		Module Overview	Updated the thermal pad name into EP_PAD
		Module Configuration	• Added PA10 for “I/O level control” • Added “Status Indication”
		Device Programming	Deleted “Over-the-Air (OTA) update of firmware using Microchip Bluetooth® Data mobile application or module-to-module OTA update (OTAPC mode commands)”
		RNBD350 Module Placement Guidelines	Updated the figure with RNBD350 for module placement guidelines
		PCB Antenna	Updated the specification for “Peak gain” and “Efficiency”
		External Antenna Placement Recommendations	Added new section
		External Antennas	Added new section
		Bluetooth Low Energy RF Characteristics	Updated the temperature plots
		Labeling and User Information Requirements	Added Labeling and User Information in china
A	04/2024	Document	Initial revision

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