



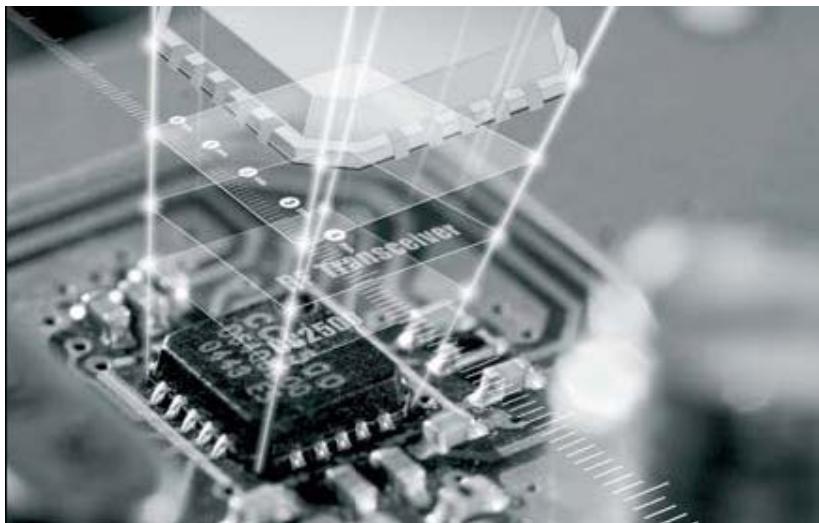
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# SPECIFICATION SPECIFICATION

## 2.4-GHz Wireless System-on-Module



Bluetooth®



Model : **2.4GHz RF Module**  
Part No : TC2640R2-F128-02-XX  
Version : V1.3  
Date : 2019.09.18

## ■ Applications

- Home and Building Automation
  - Connected Appliances
  - Lighting
  - Locks
  - Gateways
  - Security Systems
- Industrial
  - Logistics
  - Production and Manufacturing
  - Automation
  - Asset Tracking and Management
  - Remote Display
  - Cable Replacement
  - HMI
  - Access Control
- Retail
  - Beacons
  - Advertising
  - ESL / Price Tags
  - Point of Sales / Payment Systems
- Health and Medical
  - Thermometers
  - SpO2
  - Blood Glucose and Pressure Meters
  - Weight-scales
  - Vitals Monitoring
  - Hearing Aids
- Sports and Fitness
  - Activity Monitors and Fitness Trackers
  - Heart Rate Monitors
  - Running Sensors
  - Biking Sensors
  - Sports Watches
  - Gym Equipment
  - Team Sports Equipment
- HID
  - Remote Controls
  - Keyboards and Mice
  - Gaming
- Accessories
  - Toys
  - Trackers
  - Luggage-tags
  - Wearables

## ■ Selection Guide

**Denomination** : 2.4GHz Bluetooth RF Module

**Part No.** :

TC2640R2-F128-02-XX



- **S: Shielding case**
- **O: without Shielding case**
- **A: internal antenna**
- **E: external antenna**

## ■ Absolute Maximum Ratings

		MIN	MAX	UNIT
Supply voltage, VDD <sup>(3)</sup>	VDDR supplied by internal DC/DC regulator or internal GLDO	-0.3	4.1	V
Supply voltage, VDD <sup>(3)</sup> and VDDR	External regulator mode (VDD <sup>(3)</sup> and VDDR pins connected on PCB)	-0.3	2.25	V
Voltage on any digital pin <sup>(4)</sup>		-0.3	VDD <sup>(3)</sup> +0.3, max 4.1	V
Voltage on crystal oscillator pins, X32K_Q1, X32K_Q2, X24M_N and X24M_P		-0.3	VDDR+0.3, max 2.25	V
Voltage on ADC input (V <sub>in</sub> )	Internal fixed or relative reference, voltage scaling enabled	-0.3	VDD <sup>(3)</sup>	V
	Internal fixed reference, voltage scaling disabled	-0.3	1.49	
	Internal relative reference, voltage scaling disabled	-0.3	VDD <sup>(3)</sup> / 2.9	
	External reference, voltage scaling enabled	-0.3	min (V <sub>ref</sub> × 2.9, VDD <sup>(3)</sup> )	
	External reference, voltage scaling disabled	-0.3	V <sub>ref</sub>	
Voltage on external ADC reference (V <sub>ref</sub> )		-0.3	1.6	V
Input RF level			+5	dBm
T <sub>stg</sub>	Storage temperature	-40	150	°C

- (1) All voltage values are with respect to VDD<sup>(3)</sup>, unless otherwise noted.
- (2) 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.
- (3) VDD<sub>S2</sub> and VDD<sub>S3</sub> needs to be at the same potential as VDD<sup>(3)</sup>.
- (4) Including analog capable DIO.

## ■ Recommended Operation Condition

		MIN	MAX	UNIT
Ambient temperature range		-40	85	°C
Operating supply voltage (VDD <sup>(3)</sup> and VDDR), external regulator mode	For operation in 1.8 V systems (VDD <sup>(3)</sup> and VDDR pins connected on PCB, internal DC/DC cannot be used)	1.7	1.95	V
Operating supply voltage (VDD <sup>(3)</sup> )	For operation in battery-powered and 3.3 V systems (internal DC/DC can be used to minimize power consumption)	1.8	3.8	V

## ■ Electrical Specifications

### ● Current Consumption

TA = 25°C and VDD = 3 V

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_{core}$	Reset. RESET_N pin asserted		100		nA
	Shutdown. No clocks running, no retention		150		
	Standby. With RTC, CPU, RAM and (partial) register retention. RCOSC_LF		1		
	Standby. With RTC, CPU, RAM and (partial) register retention. XOSC_LF		1.2		
	Standby. With Cache, RTC, CPU, RAM and (partial) register retention. RCOSC_LF		2.5		
	Standby. With Cache, RTC, CPU, RAM and (partial) register retention. XOSC_LF		2.7		
	Idle. Supply Systems and RAM powered.		550		
	Active. Core running CoreMark	1.45 mA + 31 μA/MHz			
	Radio RX <sup>(1)</sup>	5.9			mA
	Radio RX <sup>(2)</sup>	6.1			
	Radio TX, 0 dBm output power <sup>(1)</sup>	6.1			
	Radio TX, 5 dBm output power <sup>(2)</sup>	9.1			
$I_{peri}$	Peripheral Current Consumption (Adds to core current $I_{core}$ for each peripheral unit activated) <sup>(3)</sup>				
	Peripheral power domain	Delta current with domain enabled	20		μA
	Serial power domain	Delta current with domain enabled	13		μA
	RF Core	Delta current with power domain enabled, clock enabled, RF Core Idle	237		μA
	μDMA	Delta current with clock enabled, module idle	130		μA
	Timers	Delta current with clock enabled, module idle	113		μA
	I <sup>2</sup> C	Delta current with clock enabled, module idle	12		μA
	I2S	Delta current with clock enabled, module idle	36		μA
	SSI	Delta current with clock enabled, module idle	93		μA
	UART	Delta current with clock enabled, module idle	164		μA

## ■ General Characteristics

TA = 25°C and VDD = 3 V, unless otherwise noted.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Wake-up and Timing</b>					
Idle -> Active		14			μs
Standby -> Active		151			μs
Shutdown -> Active		1015			μs
<b>Flash Memory</b>					
Supported flash erase cycles before failure		100			k Cycles
Flash page/sector erase current	Average delta current	12.6			mA
Flash page/sector erase time <sup>(1)</sup>		8			ms
Flash page/sector size		4			KB
Flash write current	Average delta current, 4 bytes at a time	8.15			mA
Flash write time <sup>(1)</sup>	4 bytes at a time	8			μs

## ■ RF Characteristics

### RX Sensitivity

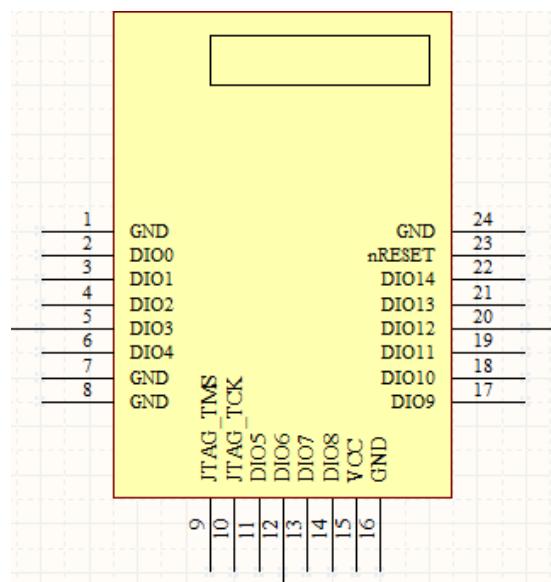
1Mbps, GFSK, 250-KHz deviation, Bluetooth low energy mode and 1%BER

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Receiver sensitivity	Differential mode. Measured at the SMA	-97			dBm

### TX output Power

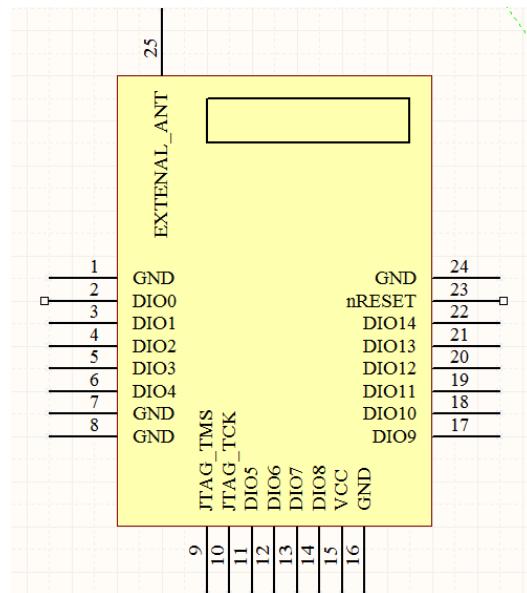
Output power, highest setting	Measured on 50-Ω load, delivered to a single-ended	+2	dBm
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## ■ TC2640R2-F128-02-XA RF Module (internal antenna) Pin Configuration



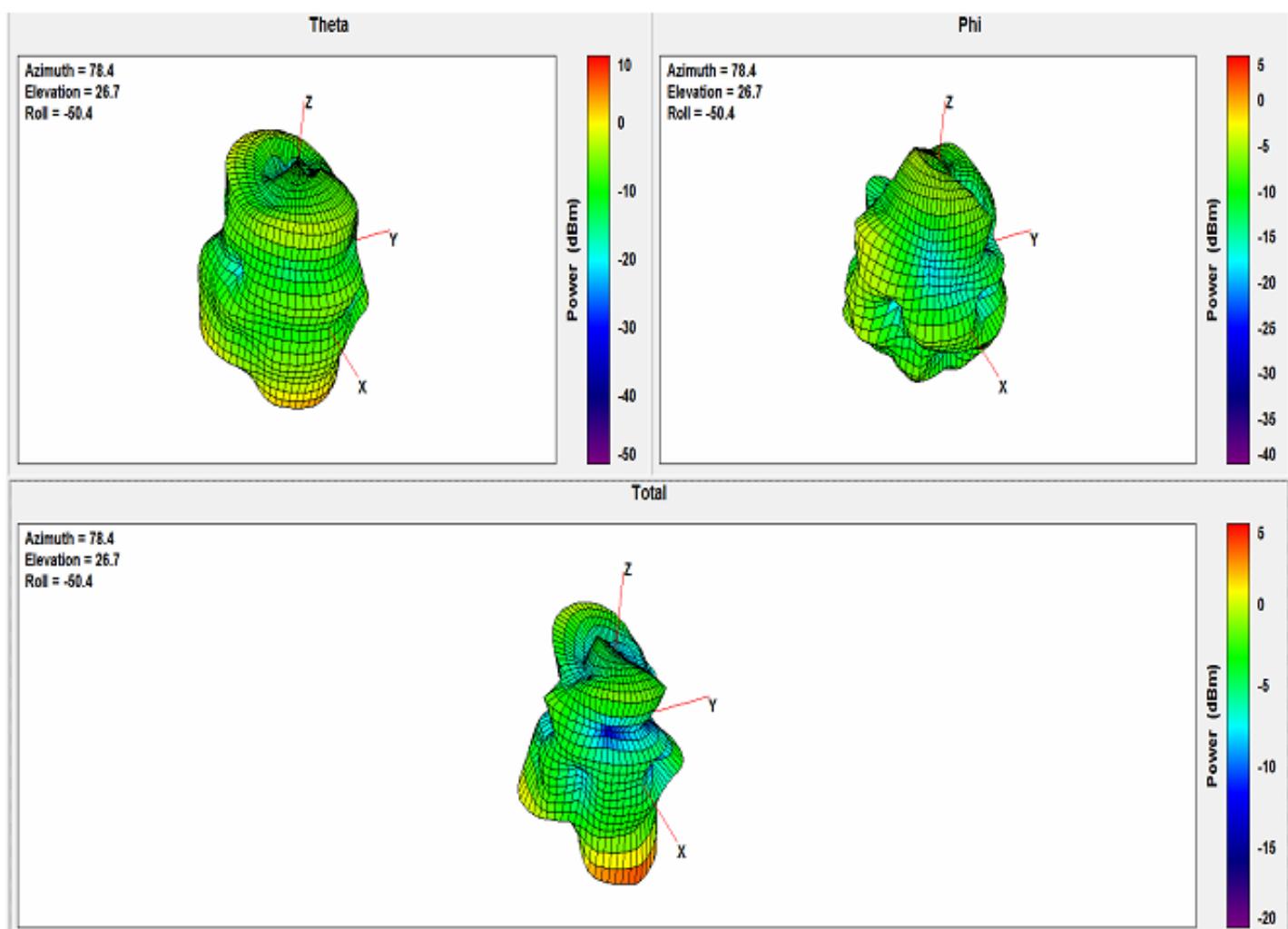
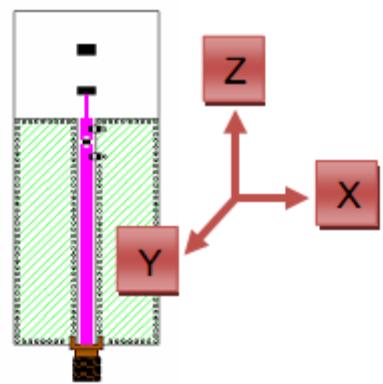
Pin#	Pin Define	Pin Type	Description
1	GND	GND	Ground
2	DIO_0	Digital I/O	
3	DIO_1	Digital I/O	
4	DIO_2	Digital I/O	
5	DIO_3	Digital I/O	
6	DIO_4	Digital I/O	
7	GND	Digital I/O	
8	GND	Digital I/O	
9	TMS	Digital I/O	JTAG TMSC
10	TCK	Digital I/O	JTAG TCKC
11	DIO_5	Digital I/O	
12	DIO_6	Digital I/O	
13	DIO_7	Digital/Analog I/O	
14	DIO_8	Digital/Analog I/O	
15	VDD	POWER	2~3.6V power supply
16	GND	GND	Ground
17	DIO_9	Digital/Analog I/O	
18	DIO_10	Digital/Analog I/O	
19	DIO_11	Digital/Analog I/O	
20	DIO_12	Digital/Analog I/O	
21	DIO_13	Digital/Analog I/O	
22	DIO_14	Digital/Analog I/O	
23	nRESET	RESET	RESET
24	GND	GND	Ground

## ■ TC2640R2-F128-02-XE RF Module (External antenna) Pin Configuration



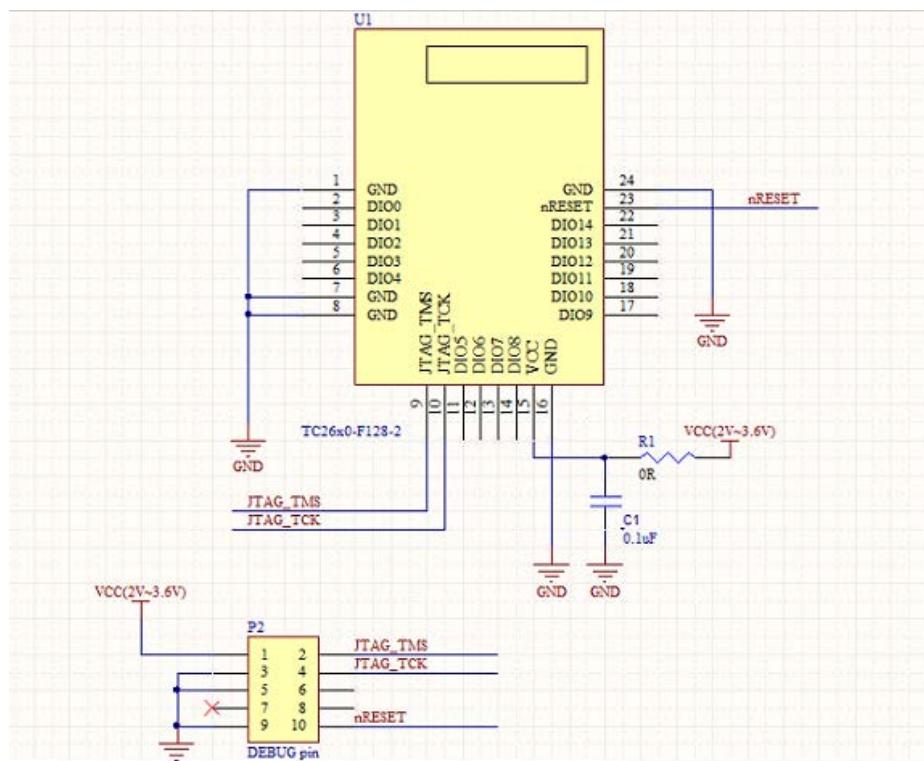
Pin#	Pin Define	Pin Type	Description
1	GND	GND	Ground
2	DIO_0	Digital I/O	
3	DIO_1	Digital I/O	
4	DIO_2	Digital I/O	
5	DIO_3	Digital I/O	
6	DIO_4	Digital I/O	
7	GND	Digital I/O	
8	GND	Digital I/O	
9	TMS	Digital I/O	JTAG TMSC
10	TCK	Digital I/O	JTAG TCKC
11	DIO_5	Digital I/O	
12	DIO_6	Digital I/O	
13	DIO_7	Digital/Analog I/O	
14	DIO_8	Digital/Analog I/O	
15	VDD	POWER	2~3.6V power supply
16	GND	GND	Ground
17	DIO_9	Digital/Analog I/O	
18	DIO_10	Digital/Analog I/O	
19	DIO_11	Digital/Analog I/O	
20	DIO_12	Digital/Analog I/O	
21	DIO_13	Digital/Analog I/O	
22	DIO_14	Digital/Analog I/O	
23	nRESET	RESET	RESET
24	GND	GND	Ground
25	ANT	Analog	Antenna feed point

## ■ Antenna Radiation Pattern

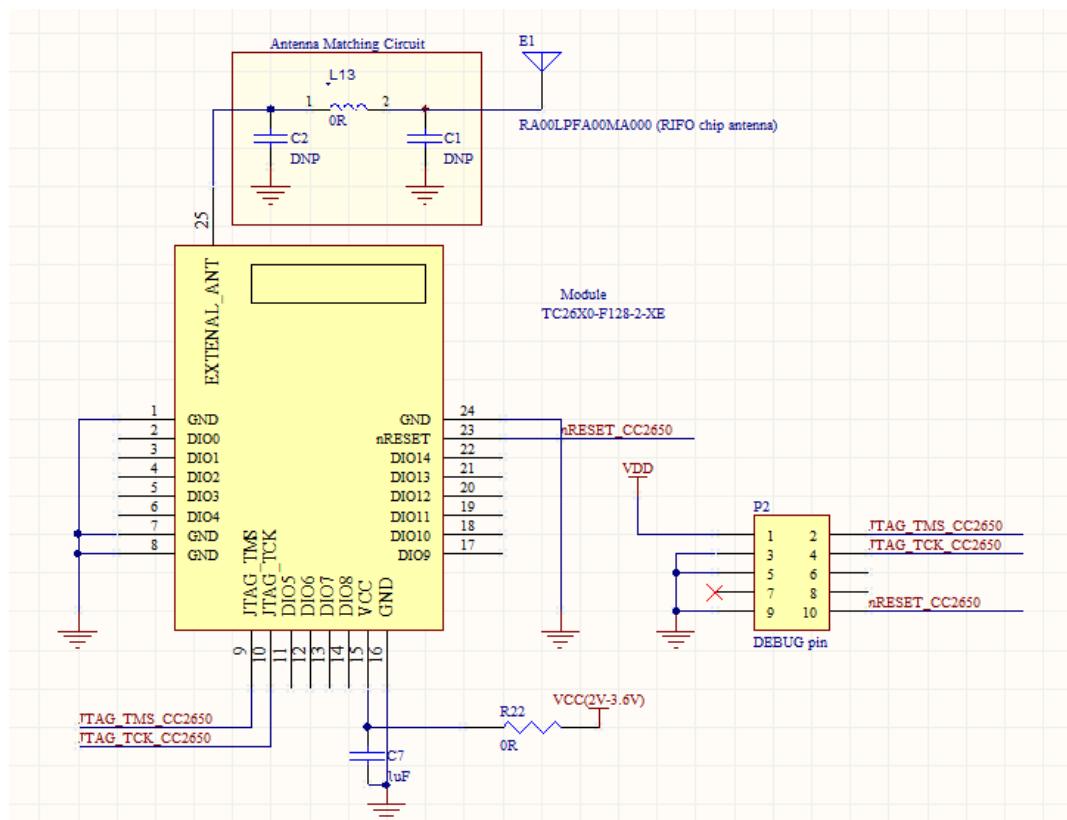


## ■ TC2640R2-F128-02-XX RF Module Example Design schematic

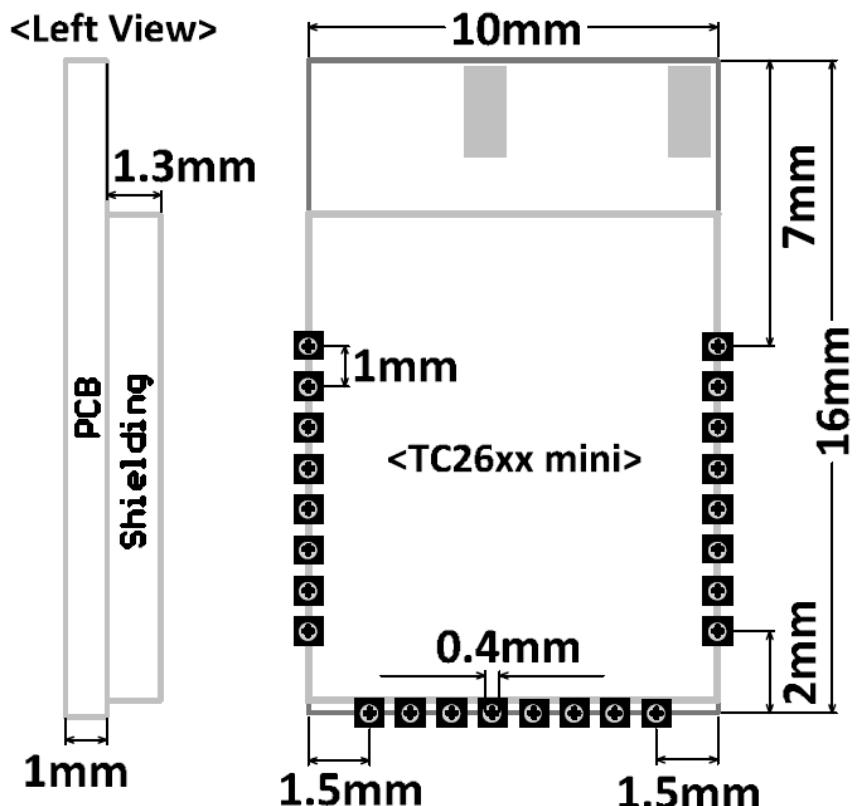
### Example schematic:



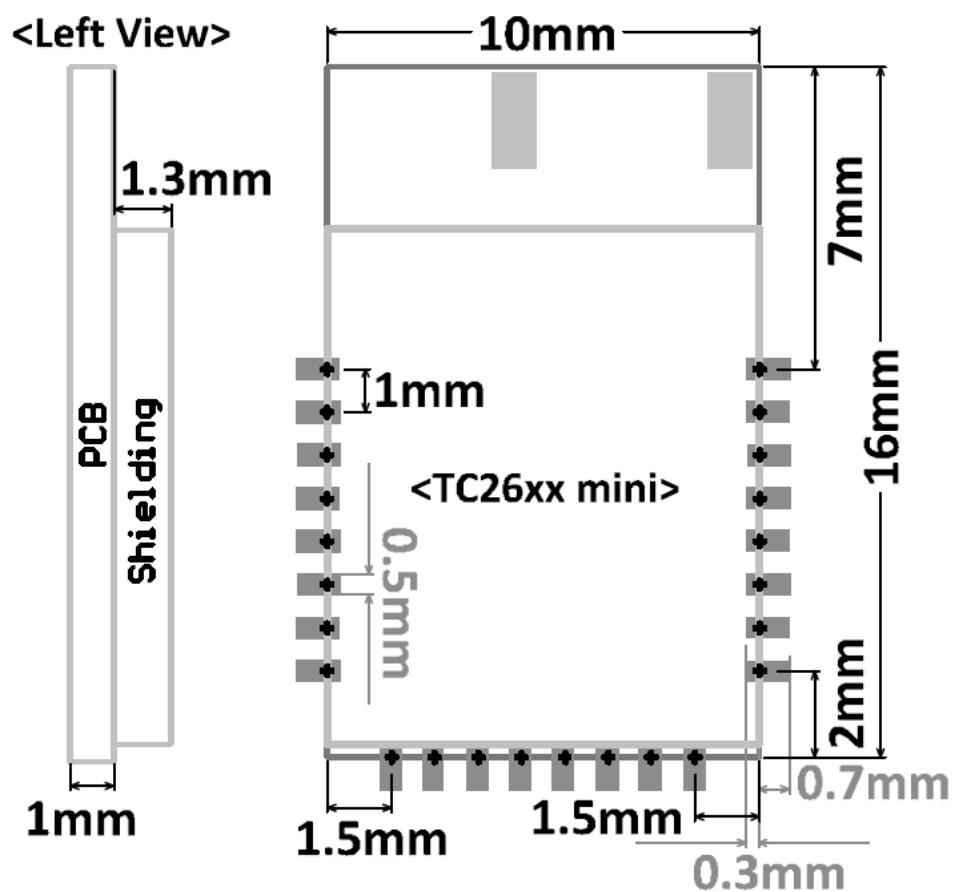
### Example schematic (external antenna):



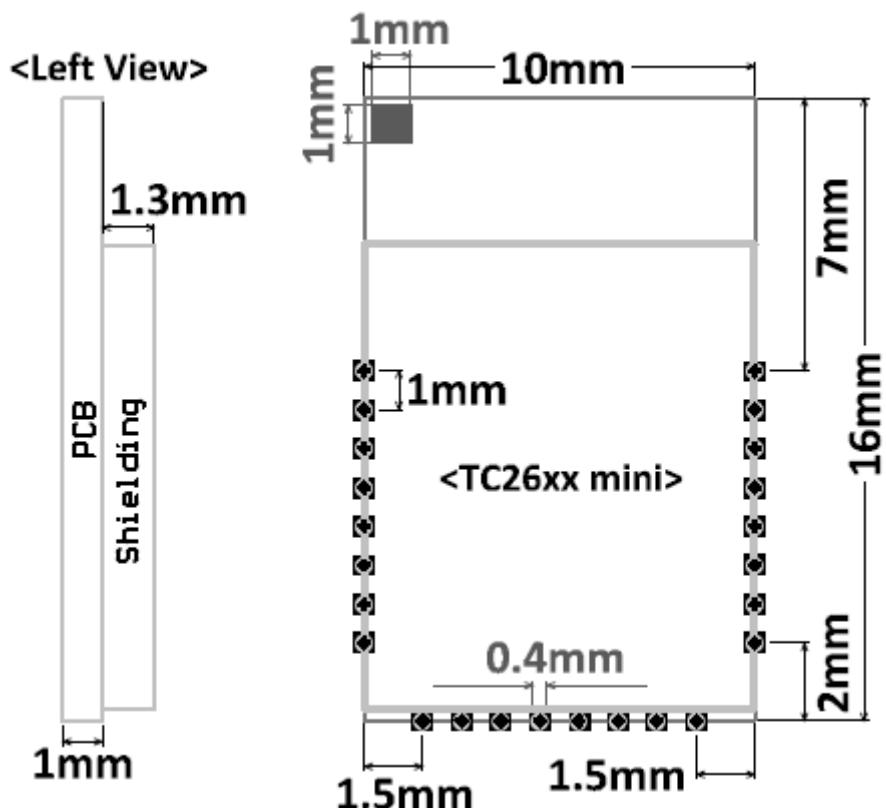
## ■ TC2640R2-F128-02-XA RF Module (internal antenna) Dimension



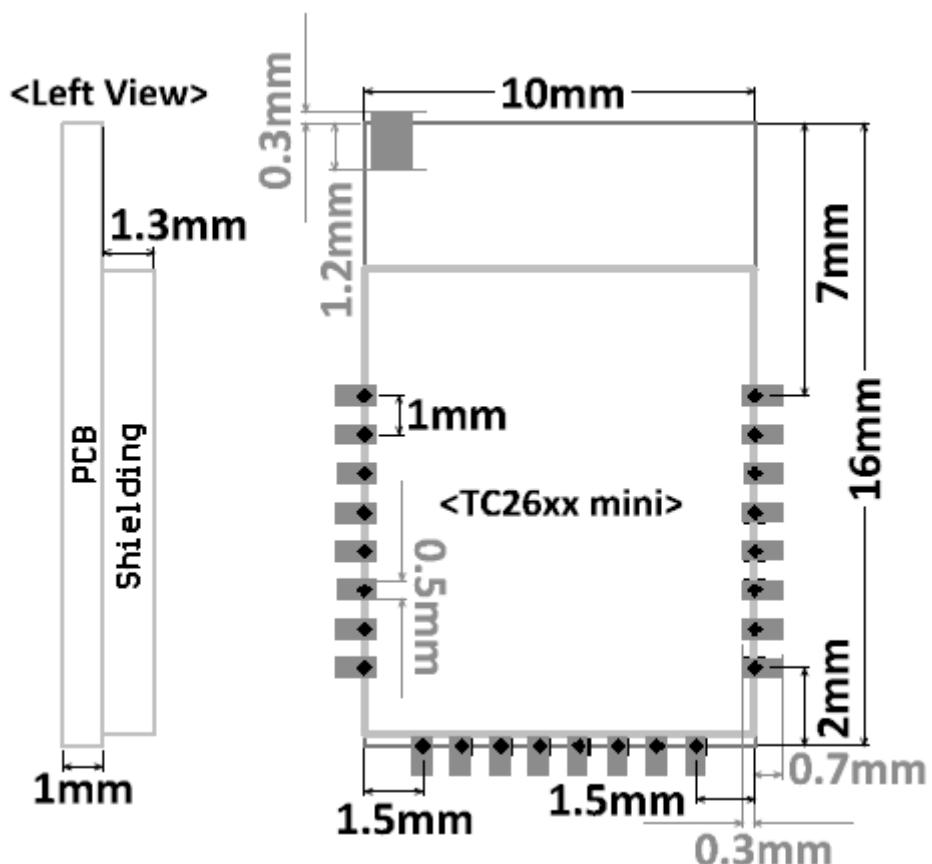
## ■ Recommended PCB layout for Module

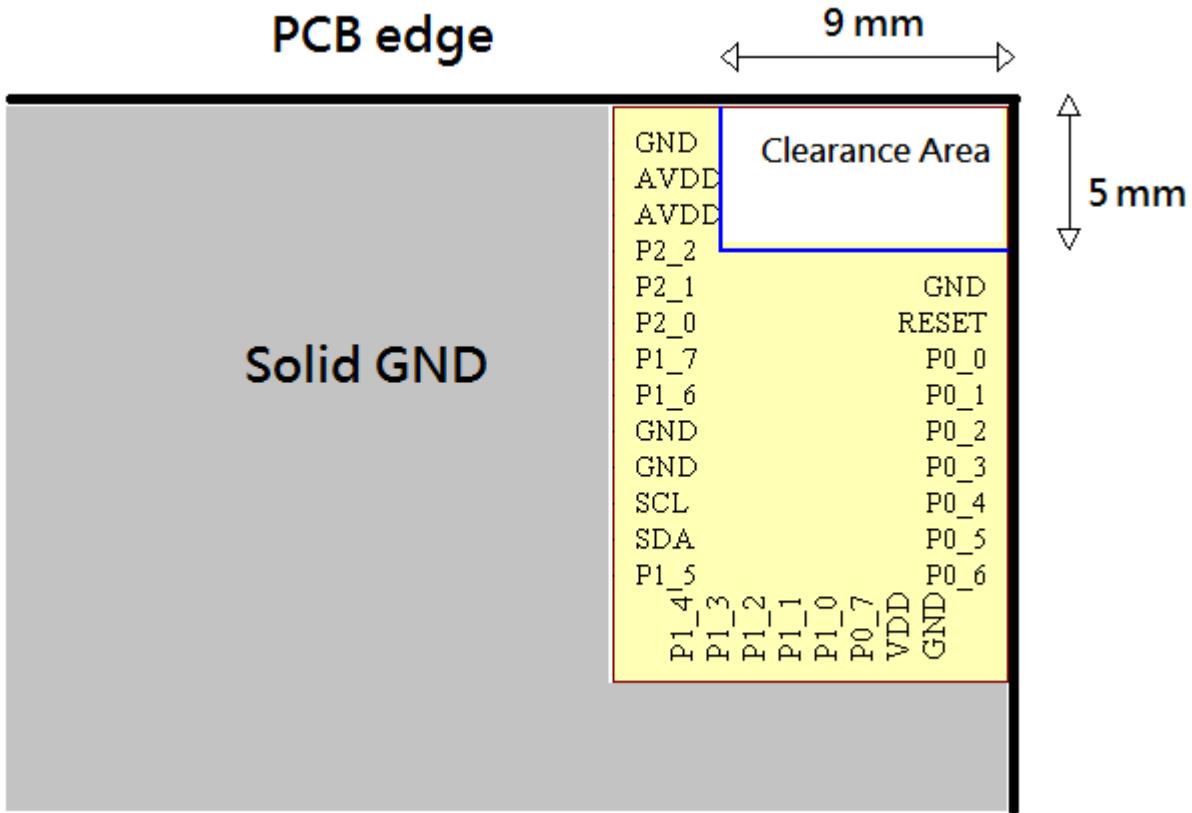


■ TC2640R2-SF128-02-XE RF Module (external antenna) Dimension



■ Recommended PCB layout for Module





## ■ Federal Communication Commission Interference Statement

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 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.

**FCC Caution:** To assure continued compliance, any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. (Example - use only shielded interface cables when connecting to computer or peripheral devices).

## ■ Important FCC notice:

In accordance with FCC Part 15C, this module is listed as a Modular Transmitter device.

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

The antenna of this transmitter must not be co-located or operating in conjunction with any other antenna or transmitters within a host device, except in accordance with FCC multitransmitter product approval procedures.

## ■ FCC Label Instructions

This transmitter module is authorized only for use in devices where the antenna may be installed such that 0.5 cm may be maintained between the antenna and users. The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as the following:

**“Contains Transmitter Module FCC ID: 2AEQ403” or “Contains FCC ID: 2AEQ403”**. Any similar wording that expresses the same meaning may be used.

The user manual for end users must include the following information in a prominent location “IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 0.5cm from all persons and must not be colocated or operating in conjunction with any other antenna or transmitter.”

Additionally, there must be the following sentence on the device, unless it is too small to carry it:

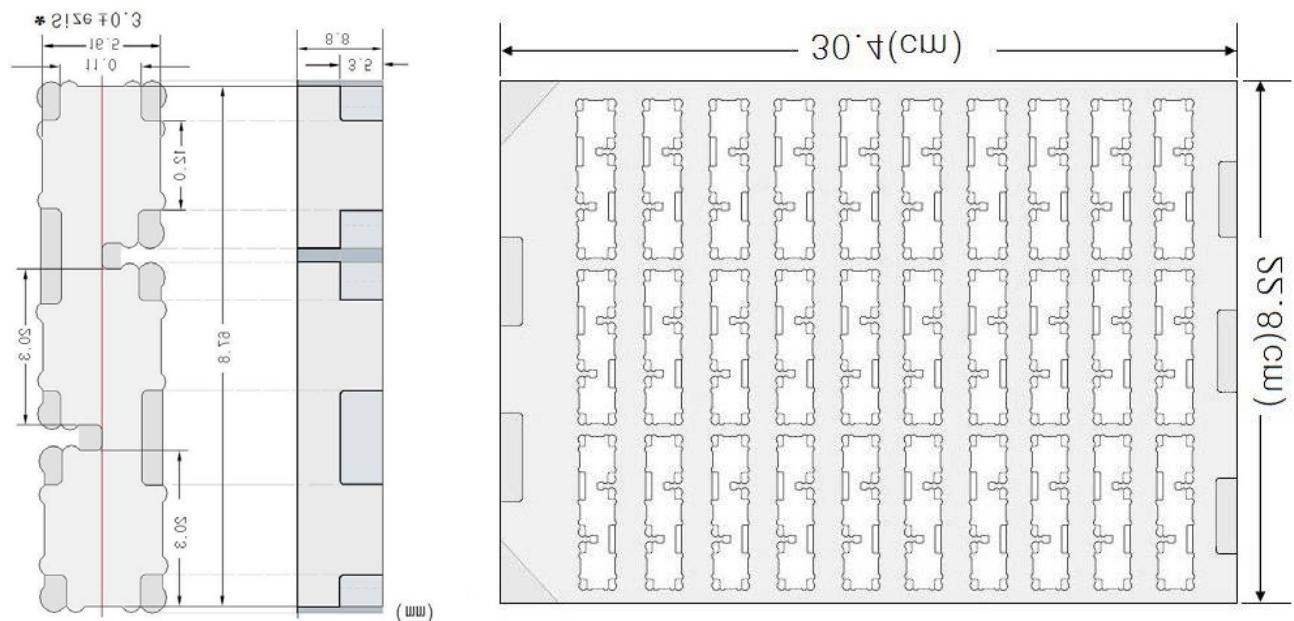
“This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.”

## ■ IMPORTANT NOTE:

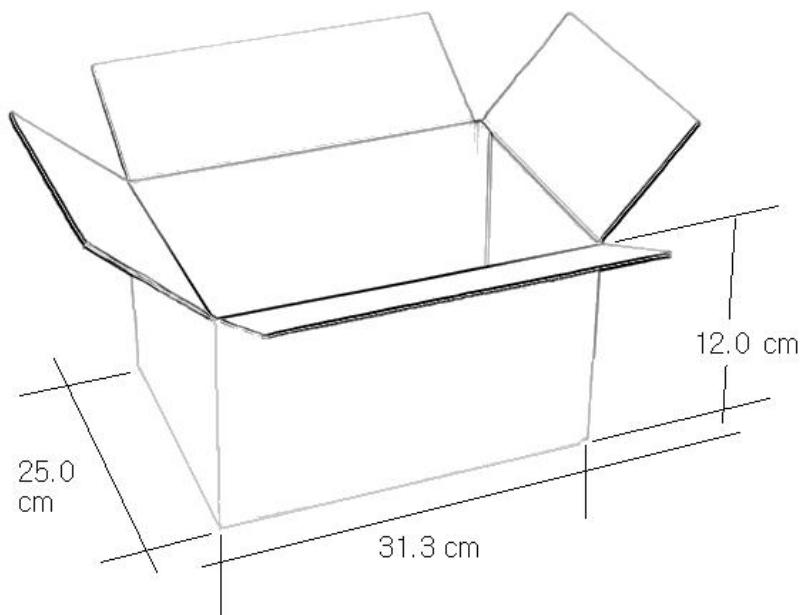
In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization. This device is intended only for OEM integrators under the following conditions: The antenna must be installed such that 0.5 cm is maintained between the antenna and users. As long as a condition above is met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

**FCC Certification only covers the shielded version of the module.**

## ■ Skin packing Information



## ■ Skin packing box Information



Device	Type	SPQ	Length(cm)	Width(cm)	Height(cm)
TC2640R2-F128-02-xx	Module	1080	31.3	25.0	12.0

## ■ Document History

Revision	Date	Description/Changes
1.1	2017.02.21	First release
1.2	2017.06.23	Add packing information
1.3	2019.09.18	Add FCC Important Notice & FCC Label Instruction

## ■ Address Information

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