



Silvair

Bluetooth Smart Radio Modules

Confidentiality Provision

The information contained in this documentation is considered as **confidential**.

Description

The SM4xxx modules are a complete solution that integrates full Bluetooth Smart functionality into one board. All modules are based on TI SoC series CC2541.

Our solution does not require any additional programming to establish a connection and can be used as a network processor that communicates with host microcontroller via UART interface or to run user's application stand-alone. There are integrated RF front-ends in our modules that allowed for a significant increase of TX output power and RX sensitivity; with that our modules achieve best in class communication range of 500 m (over 1500 ft) in open space conditions.

The combination of high performance, low cost and low battery usage that allows run times up to a few years makes our modules an effective solution for development of new products.

Key Features

- *Bluetooth Low Energy v4.0* compatible
- RF Output Power: 8.5 dBm (+/- 0.5)
- RF Receiver Sensitivity: -98 dBm
- Maximum Radio Range: 500 m
- Size: 19.8 mm x 12.3 mm x 2.6 mm
- Operating Voltage: 2.0 V to 3.6 V
- Hardware Version: SLBRM0004
- Software Version: 1.0
- Versions with Three Operating Temperatures:
 - -40 to +85 °C
 - -40 to +105 °C
- Low Current Consumption (1 µA in sleep mode)
- Worldwide Acceptance
- RoHS Compliant
- CE, FCC, IC Compliant

Applications

- Smart Home Appliances
- Wireless Sensors
- Indoor Location Beacons
- Smart Bulb controllers
- Security and Proximity tags



Table of contents

[Description](#)

[Module versions, Ordering code](#)

[2. Block diagram](#)

[3. Pinout and terminal description](#)

[3.1 Pin Description](#)

[4. Electrical characteristics](#)

[4.1 Absolute Maximum Ratings](#)

[4.2 Recommended Operating Voltage](#)

[4.3 DC Characteristics](#)

[4.4 RF Characteristics](#)

[4.5 Current consumption](#)

[5. Physical dimensions](#)

[5.1 Recommended footprint](#)

[5.2 Antenna connector](#)

[6. Design guide](#)

[7. Soldering](#)

[8. FCC and IC information](#)

[9. Contact information](#)



Module versions, Ordering code

Model ID Ordering P/N	Antenna Connector	Operating temperature	SoC type
SM41STNW	<i>Pad + w.FL</i>	-40 to +85 °C	CC2541
SM41ST	<i>Pad + w.FL</i>	-40 to +85 °C	CC2541
SM41HT	<i>Pad + w.FL</i>	-40 to +105 °C	CC2541



2. Block diagram

Silvair Modules are based on Texas Instruments' CC2541 Bluetooth system-on-chip family. This system-on-chip combines the excellent performance of a leading RF transceiver with an industry-standard enhanced 8051 MCU, 256-KB in-system programmable flash memory, 8-KB RAM, and many other powerful supporting features and peripherals.

Apart from the SoCs, the Silvair Modules contain all the necessary passive components, including embedded 32 MHz and 32.678 kHz crystals for clock generation, as well as a RF front-end amplifier with integrated spurious emissions filter, which makes the Modules fully integrated design, requiring only a supply voltage to be provided. The modules interact with environment via GPIO pins, while the Bluetooth radio signal is provided to the integrated w.FL.

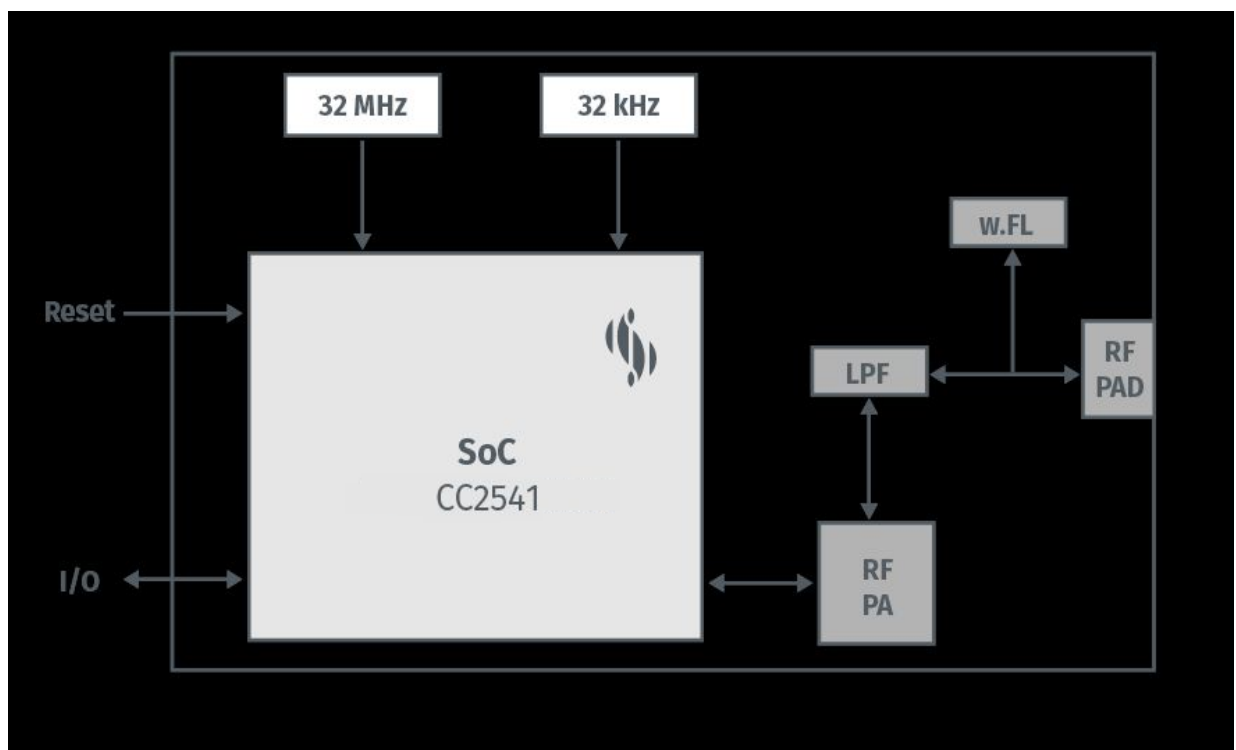


Fig. 1: Simplified block diagram



3. Pinout and terminal description

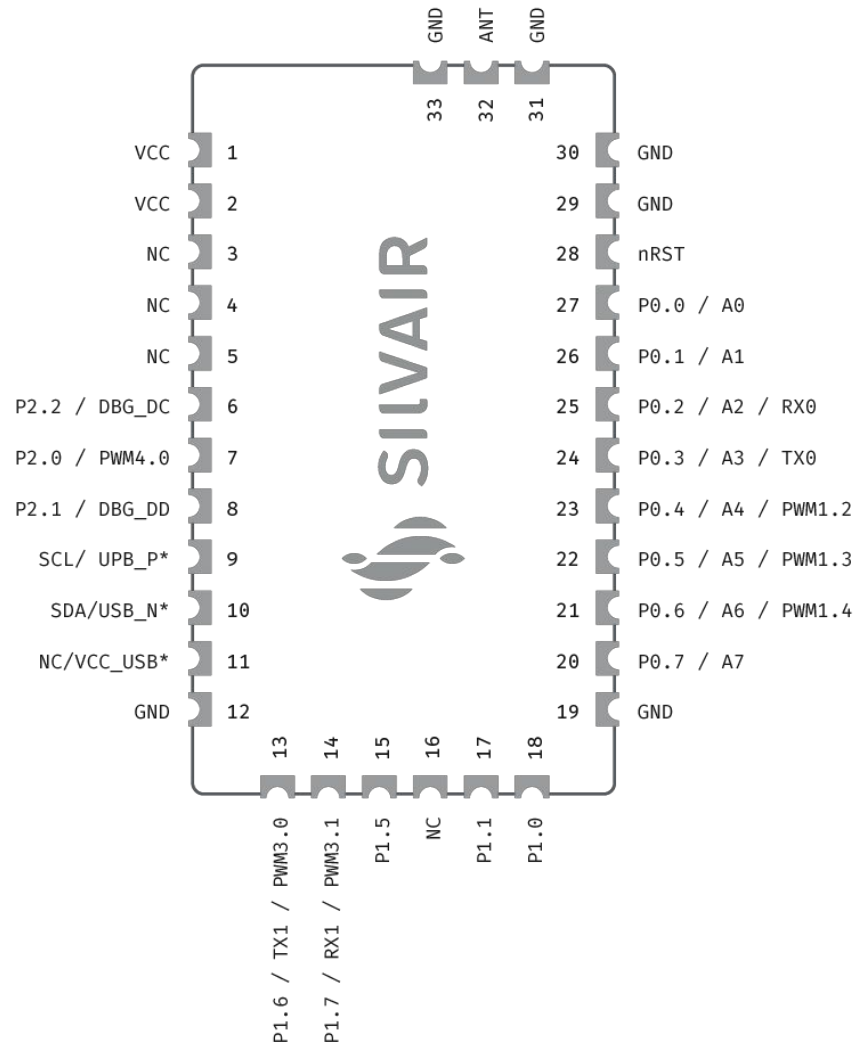


Fig. 2: Module pinout



3.1 Pin Description

Pin Number	Pin Name	Pad Type	Description
12, 19, 29, 30, 31, 33	GND	GND	Power Ground.
1, 2	VCC	Supply Voltage	
28	nRST	Reset	Active low reset.
32	ANT	RF	RF Antenna pad / 50Ω.
27	P0.0/A0	I/O Analog	Configurable Input / Output Pin. ADC Input Channel 0.
26	P0.1/A1	I/O Analog	Configurable Input / Output Pin. ADC Input Channel 1.
25	P0.2/A2/RX0	I/O Analog	Configurable Input / Output Pin. ADC Input Channel 2. UART0 RX Input.
24	P0.3/A3/TX0	I/O Analog	Configurable Input / Output Pin. ADC Input Channel 3. UART0 TX Output.
23	P0.4/A4/PWM1.2	I/O Analog	Configurable Input / Output Pin. ADC Input Channel 4. PWM1 Output 2.
22	P0.5/A5/PWM1.3	I/O Analog	Configurable Input / Output Pin. ADC Input Channel 5. PWM1 Output 3.
21	P0.6/A6/PWM1.4	I/O Analog	Configurable Input / Output Pin. ADC Input Channel 6. PWM1 Output 4.
20	P0.7/A7	I/O Analog	Configurable Input / Output Pin. ADC Input Channel 7, ADC VREF Pin.
18	P1.0	I/O	Configurable Input / Output Pin (20mA max).
17	P1.1	I/O	Configurable Input / Output Pin (20mA max).
15	P1.5	I/O	Configurable Input / Output Pin.
13	P1.6/TX1/PWM3.0	I/O	Configurable Input / Output Pin. UART1 TX Output. PWM3 Output 0.



Pin Number	Pin Name	Pad Type	Description
14	P1.7/RX1/PWM3.1	I/O	Configurable Input / Output Pin. UART1 RX Input. PWM3 Output 1.
7	P2.0/PWM4.0	I/O	Configurable Input / Output Pin. PWM4 Output 0.
8	P2.1/DBG_DD	I/O	Configurable Input / Output Pin. Debug Data Port.
6	P2.2/DBG_DC	I/O	Configurable Input / Output Pin. Debug Clock Port.
9	SCL	I/O	I2C Serial Clock Port.
10	SDA	I/O	I2C Serial Data Port.
3, 4, 5, 11, 16	NC		Do not connect.



4. Electrical characteristics

4.1 Absolute Maximum Ratings

Symbol	Description	Min	Max	Unit
VCC	Supply Voltage	-0.3	3.9	V
VDIO	Voltage on any digital pin	-0.3	VCC + 0.3 3.9 max	V
VAIO	Voltage on any analog pin	-0.3	VCC + 0.3 3.9 max	V
T _{OP}	Operating Temperature ST series	-40	+85	°C
	Operating Temperature HT series		+105	
	Operating Temperature XT series			
ANT RF Input Power	When RX is 'ON'		5	dBm

4.2 Recommended Operating Voltage

Symbol	Min	Typ	Max	Unit
VCC	2.0	3.3	3.6	V



4.3 DC Characteristics

Parameter	Test Conditions	Min	Typ	Max	Unit
Logic-0 input voltage				0.5	V
Logic-1 input voltage	VCC = 3.0 V	2.5			V
Logic-0 output voltage				0.5	V
Logic-1 output voltage					V
Logic-0 input current	Input @ 0 V	-50		50	nA
Logic-1 input current	Input @ VCC			50	nA
I/O pin pullup and pulldown resistors			0		kΩ

4.4 RF Characteristics

Parameter	Test Conditions	Min	Typ	Max	Unit
Output Power		8.0	8.5	9.0	dBm
Receiver Sensitivity	0.1% BER		98		dBm
TX Spurious Emissions			-40		dBm
Maximum RX Signal Level	0.1% BER		-8		dBm
Co-channel rejection	Wanted signal -67 dBm, 0.1% BER		6		dBc
In-band blocking rejection	±1 MHz offset, 0.1% BER, wanted signal -67 dBm		2		dBc



	±2 MHz offset, 0.1% BER, wanted signal –67 dBm		26		
	±3 MHz offset, 0.1% BER, wanted signal –67 dBm		34		
	>6 MHz offset, 0.1% BER, wanted signal –67 dBm		33		
Out-of-band blocking rejection	Minimum interferer level, interferer frequency < 2 GHz (Wanted signal –67 dBm)		24		dBm
	Minimum interferer level, interferer frequency [2 GHz, 3 GHz] (Wanted signal –67 dBm)		-33		
	Minimum interferer level, interferer frequency >3GHz (Wanted signal –67 dBm)		2		
Load S11 for Ruggedness	No Damage		0		dB

4.5 Current consumption

Typical operating conditions while advertising:

Parameter	Value	Unit
TX Power	8.5 (+/-0.5)	dBm
Temp.	25	°C



Current consumption for **VCC = 2.4V**.

Power mode	Typ	Max	Unit
Transmit	49	53	mA
Receive	33	34	mA
Processing	8	-	mA
Sleep	1	-	μA

Current consumption for **VCC = 3V**.

Power mode	Typ	Max	Unit
Transmit	56	60	mA
Receive	34	35	mA
Processing	8	-	mA
Sleep	1	-	μA



5. Physical dimensions

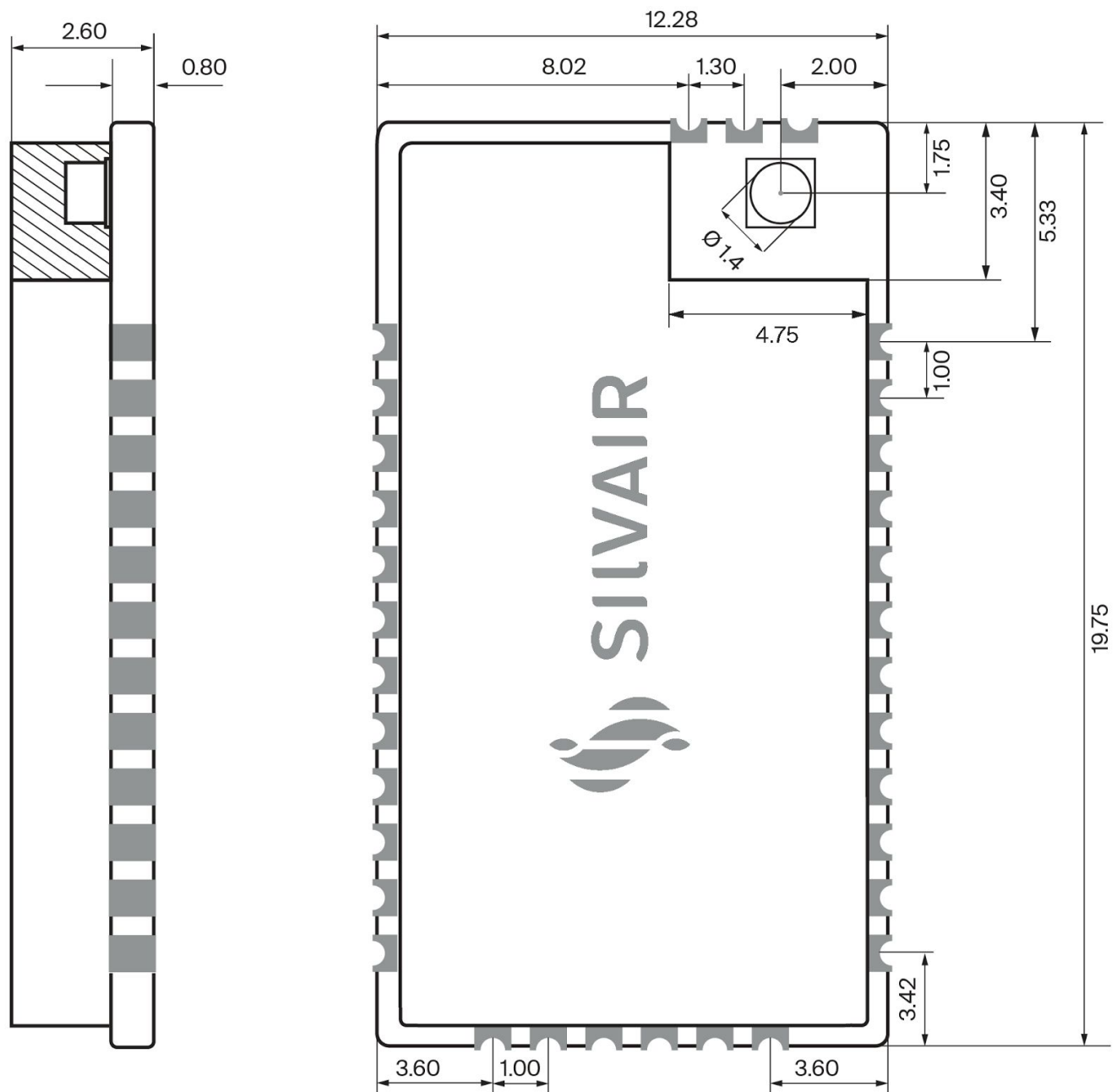


Fig. 3: physical dimensions.



5.1 Recommended footprint

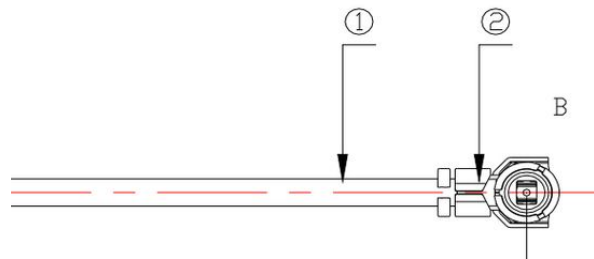
Layout recommendations:

Use controlled impedance track (50Ω) as a connection to external antenna.

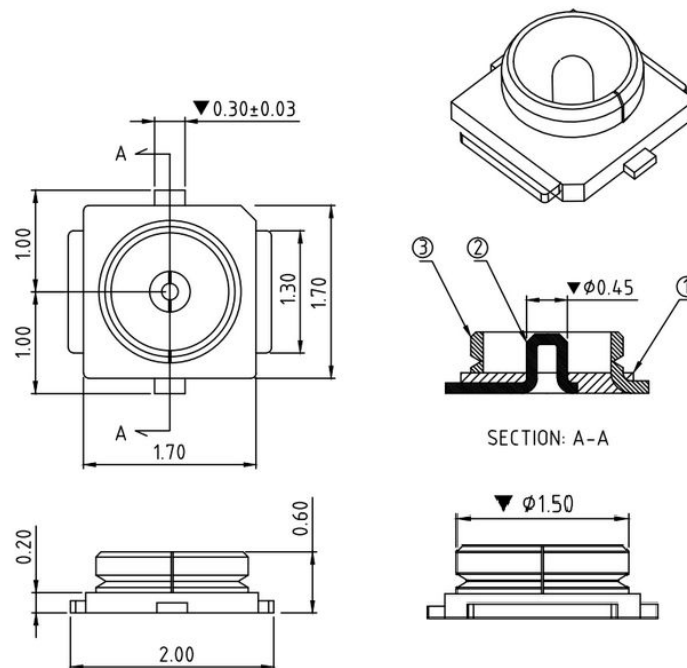
5.2 Antenna connector

Modules have w.FL RF connector for external antennas.

Manufacturer: SmartCon, P/N: TA-RF03-001-03-811



w.FL Connector drawing:



6. Design guide

When powering the module from a coin battery, we recommend that an additional TPS62730 step-down converter be used. It provides a fixed 2.1 V at the output and reduces the current consumption drawn from the battery during normal radio operation. When the module is in low-power mode (i.e. sleeping), bypassing the converter (ON/BYP pin low) is recommended in order to reduce the supply current of the TPS62730 from 35 μ A to 30 nA.

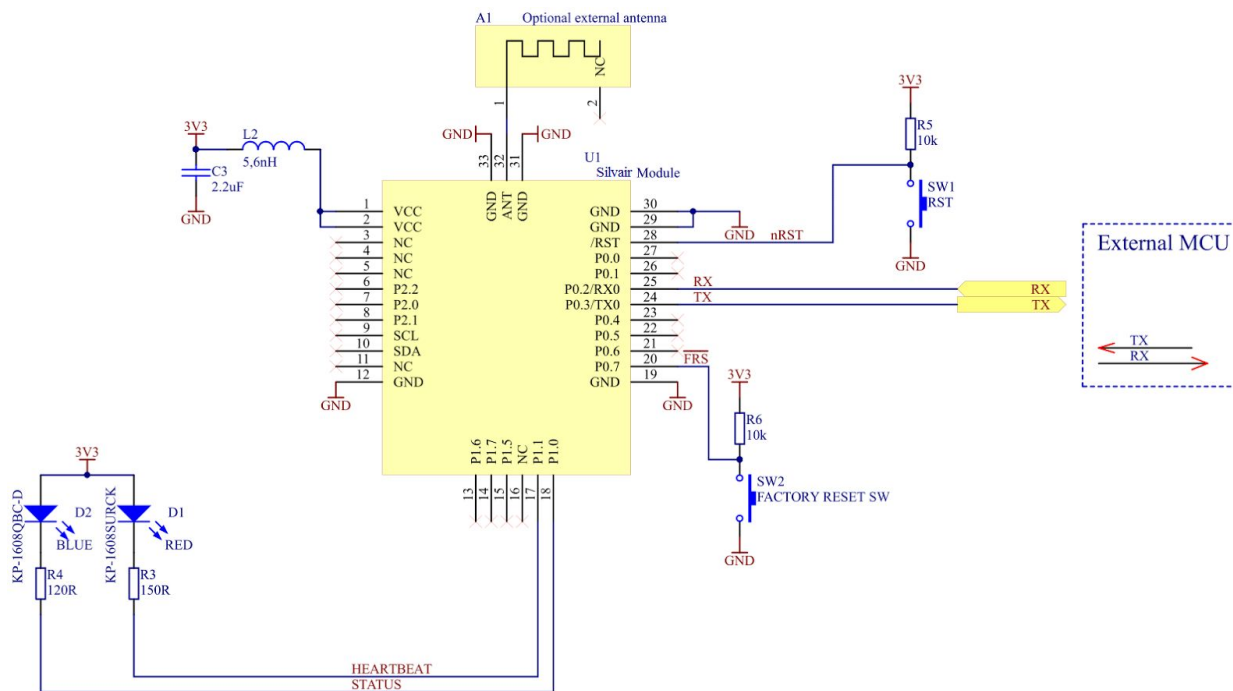


Fig. 4: Example schematic with an external MCU.



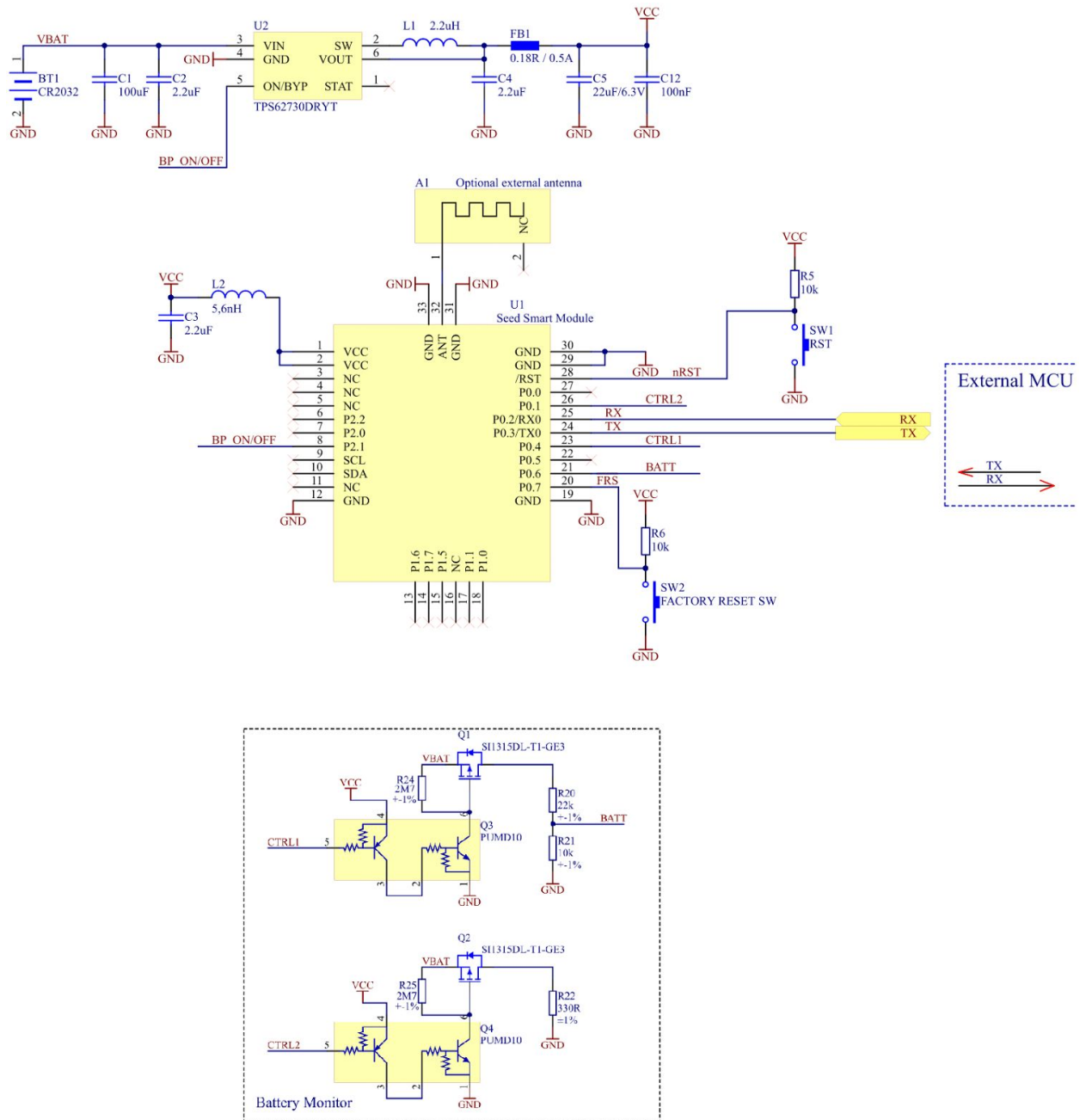


Fig. 5: Example schematic for battery powered with an external MCU.



7. Soldering

Recommended Reflow Profile
Referred to IPC/JEDEC standard.
Peak Temperature : <250°C
Number of Times : ≤2 times

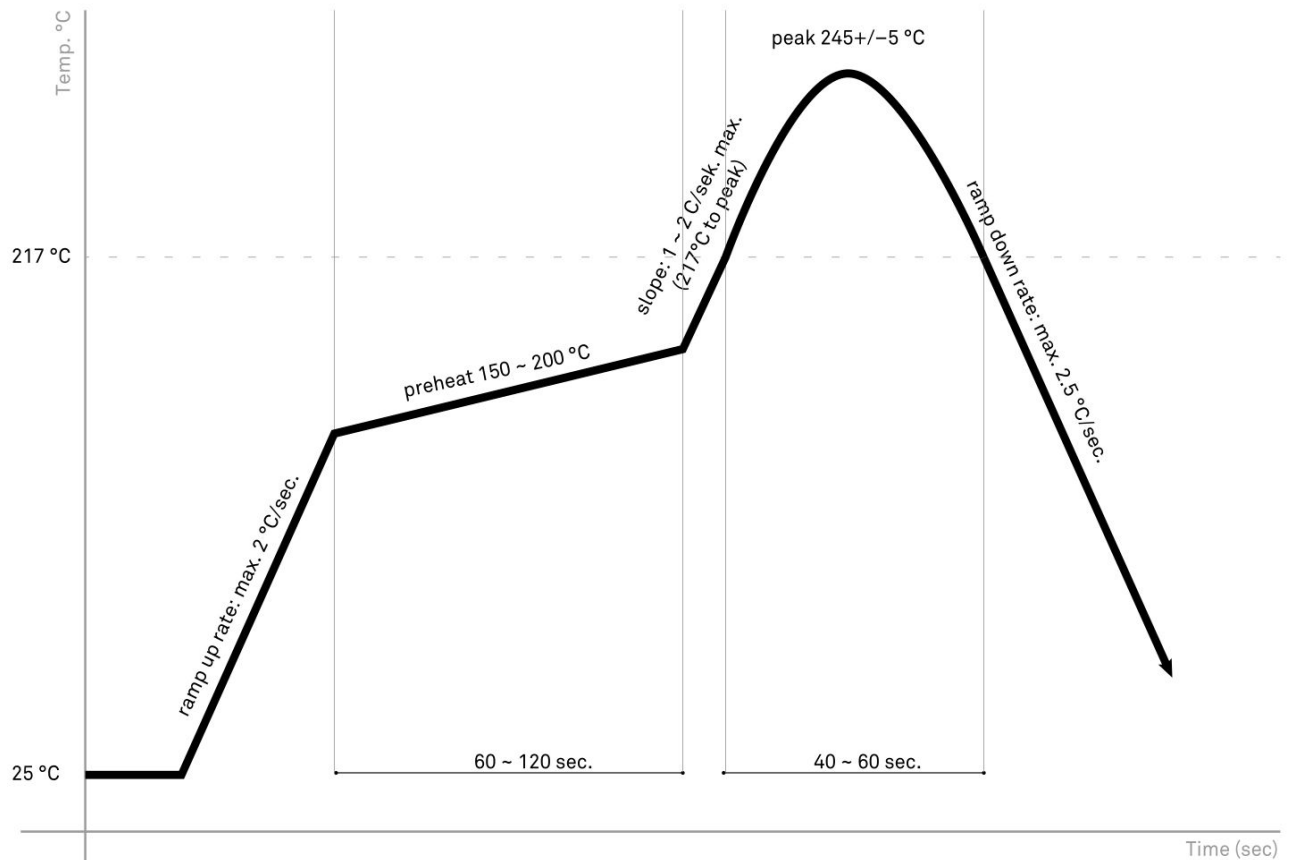


Fig. 6: Soldering chart.



8. FCC and IC information

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.

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. Changes or modifications to this unit not expressly approved by the part responsible for compliance could void the user's authority to operate the equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures. This device has been evaluated and shown compliant with the FCC RF Exposure limit for portable use.

The device is granted a Modular Approval and is intended for integration into host devices by OEM integrators under the following conditions:

- The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product procedures
- The device has been designed to operate with a dipole antenna having maximum gain of 0 dBi. Only this type of antenna may be used

End Product Labeling

The final end product utilizing the approved module must be labeled on the outside in a visible area with the following statement:

Contains FCC ID: 2AC3O-SM41

If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: 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 antenna type shall be dipole antenna, with the antenna maximum gain of 0 dBi.

Important Note

The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module. Appropriate measurements(eg.15B compliance) and if applicable additional equipment authorizations (eg.Verification, DoC) of the host device to be addressed by the integrator/manufacturer.

This RF Module must not be sold to the general public.



IC Notice:

This device complies with Canada Industry licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'industrie Canada applicables aux appareils radioexem pts de licence L'exploitation est autorisée aux deux conditions suivantes: 1) l'appareil ne doit pas produire de brouillage, et 2) l'utilisateur de l'appareil doit accepter brouillage radioélectrique subi même si le brouillage est susceptible d'en compromettre le fonctionnement. mauvais fonctionnement de l'appareil.

This radio transmitter (IC: 20805-SM4) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (IC: 20805-SM4) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous 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, sont strictement interdits pour l'exploitation de l'émetteur

Antenna Information

Type: Dipole

Gain: maximum permissible antenna gain in 0 dBi.



9. Contact information

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