

Datasheet

TS Mini 250

Version 1.2

Revision History

Revision	Date	Change Description
1.0	Jun-2025	Preliminary version
1.1	Jul-2025	Updated the external Radar antenna option etc
1.2	Nov-2025	Updated with FCC Statement

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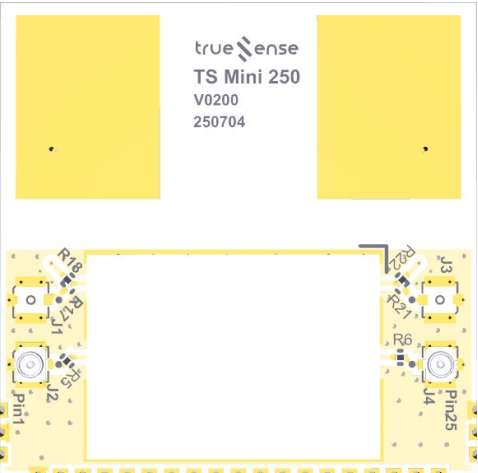
1. Introduction

TS Mini 250 is based on NXP Trimension™ SR250, with 2 embedded PCB Antennas, power management, clock control, BPF filter and peripheral components.

TS Mini 250 module is a 2D AoA solution without extra-antenna overhead, no phase/amplitude skew, no SPST insertion loss and low-cost design.

TS Mini 250 supports Radar processing algorithm enabling Presence Detection & 2D pre-processed CIR streaming allowing advanced ML/AI applications.

1.1. Key Features

	
Name	TS Mini 250
Antenna Type & Number	Onboard PCB Patch Antenna x2; 2 x I-PEX MHF-4L Receptacle Connector for optional external Ranging/Radar Antenna
Size	27.2mm * 27.1mm * 3.3mm
Communication Interface	SPI
Main Chip	SR250
Channel	5, 9
Frequency range	6.24GHz~8.24GHz
Supply Voltage	1.71V ~ 1.89V
Max Output Power (EIRP)	14dBm @ CH5 14.5dBm @CH9

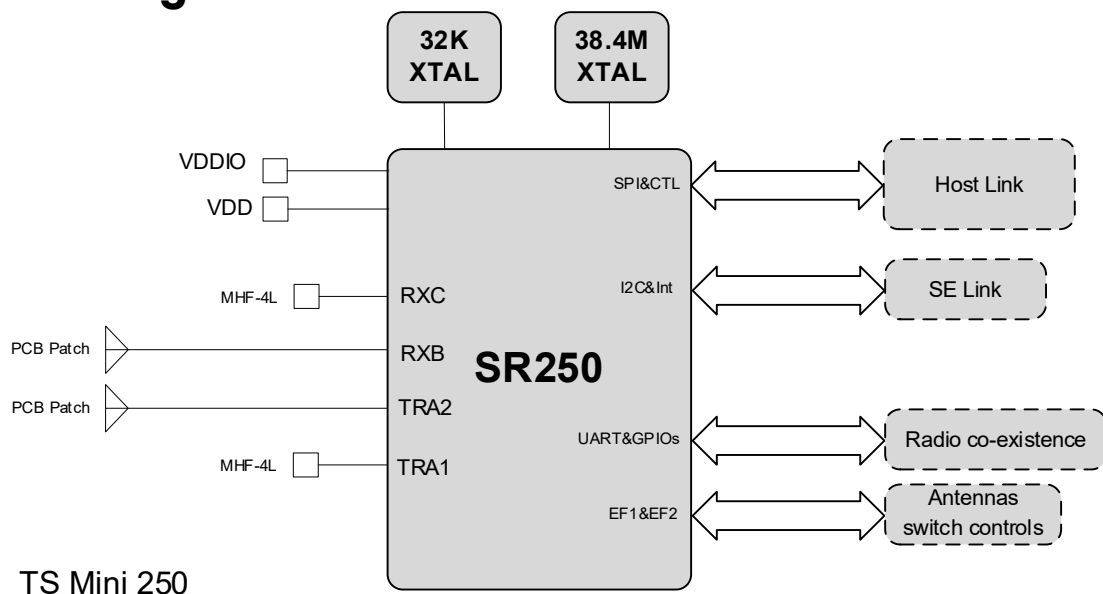
Ranging Mode	ToF, 2D AOA, TDOA, RTLS
RADAR MODE	OCPD,CIRs & Off CRP

1.2. Applications

The perfect ANCHOR for High Precision RTLS (AoA), Industrial, Smart Home & Consumer applications. Smart Home Devices (Point & Trigger), Access Control (Physical and Logical) and Secure payments.

With the additional 2 Radar Antenna, it is possible to have Advanced Radar sensing with ML/AI applications such as: Breathing & Apnea Monitoring, Fall Detection, Behavior Analysis;

1.3. Block Diagram



2. Electrical characteristics

2.1. Recommended operating conditions

When the input voltage of the module is lower than the rated operating voltage, the operation will be unstable. Input voltage higher than the maximum rating will cause permanent damage to the module. At the same time, working under the maximum rating for a long time also affects the stability of the module.

Parameter	Min	Type	Max	Unit	Conditions/Notes
Operating Temperature	-30		+85	°C	
Supply Voltage	1.71	1.8	1.89	V	

HIGH level input voltage (V_{IH})	1.26	1.8	2.3	V	
LOW level input voltage (V_{IL})	-0.6	-	0.54	V	
HIGH level output voltage (V_{OH})	1.4	-	1.8	V	
LOW level output voltage (V_{OL})	-	-	0.2	V	

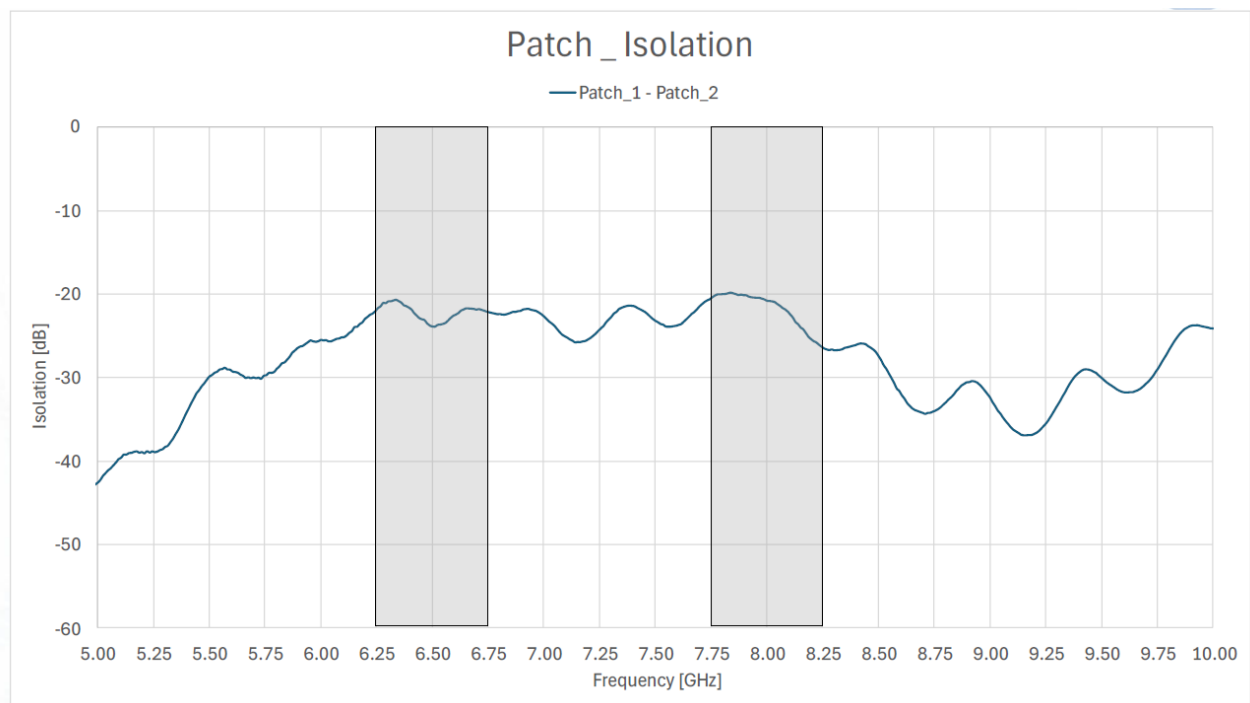
2.2.RF characteristics

Parameter		Min	Type	Max	Unit	Conditions/Notes
Frequency range		6240		8240	MHz	Channel 5 and 9
Channel bandwidth			500		MHz	
Max Power Output TX	Channel 5		14		dBm /500 MHz rms	
	Channel 9		14.5		dBm /500 MHz rms	
Rx Sensitivity (± 10 ppm carrier Offset)	Channel 5			-96.5	dBm	6.8 Mbit/s data rate, Dual RX, SP0 Frame with 20 byte payload, 1 % PER
	Channel 9			-96.5	dBm	6.8 Mbit/s data rate, Dual RX, SP0 Frame with 20 byte payload, 1 % PER

2.3.PCB patch Antenna Information

Antenna Type	PCB Patch
Antenna Polarization	Linear
Return Loss	>10dB
Peak Gain	1.54dBi min @CH5 2.4dBi min @CH9
Efficiency	50%
Antennas Isolation	>20dB
Frequency range	6.25 ~ 8.25GHz



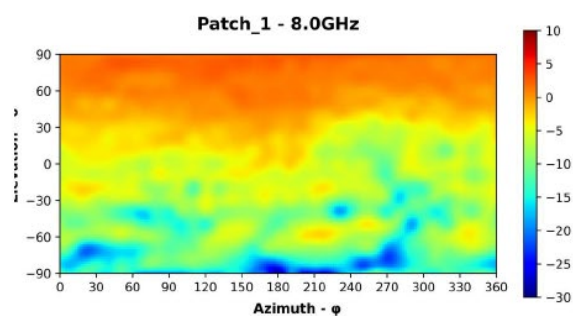
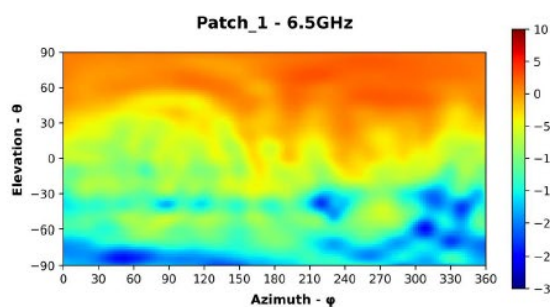


2.3.3 Radiation Pattern

Patch_1

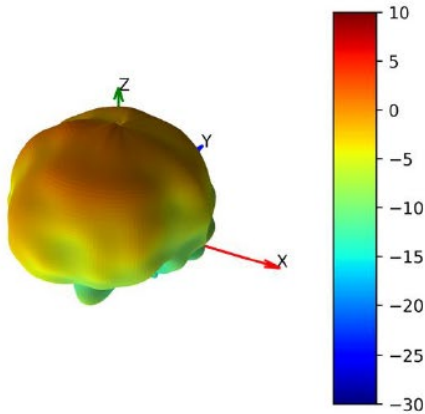
Peak Gain & Efficiency:

Patch_1	CH5	Frequency [GHz]	Peak Gain [dBi]	Tot. Efficiency [%]
		6.25	1.54	50
		6.50	2.83	58
		6.75	2.14	56
	CH9	7.75	2.40	62
		8.00	2.71	62
		8.25	-	-

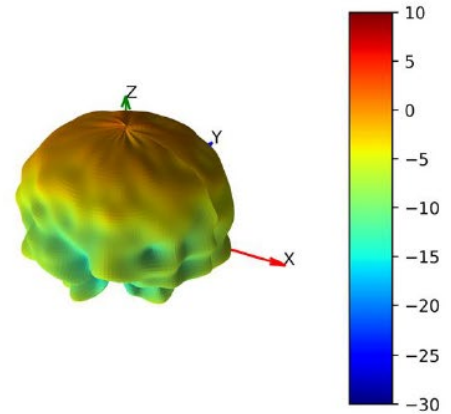


3D Radiation Patterns:

Patch_1 - 6.5GHz

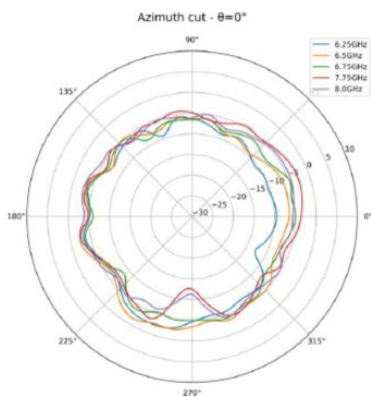


Patch_1 - 8.0GHz

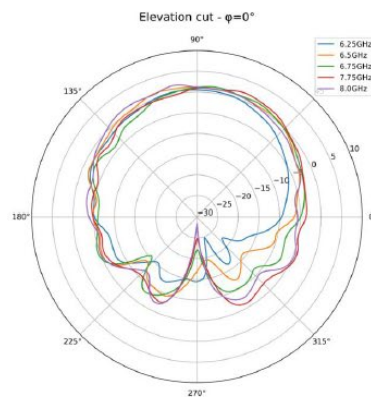


Polar Plots:

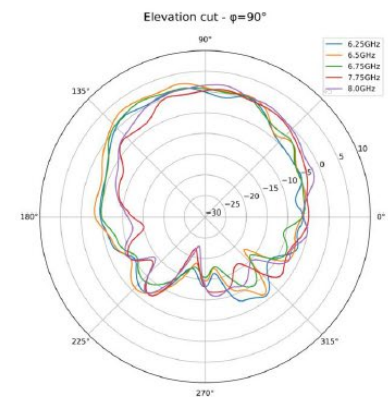
Azimuth $\theta = 0^\circ$



Azimuth $\phi = 0^\circ$



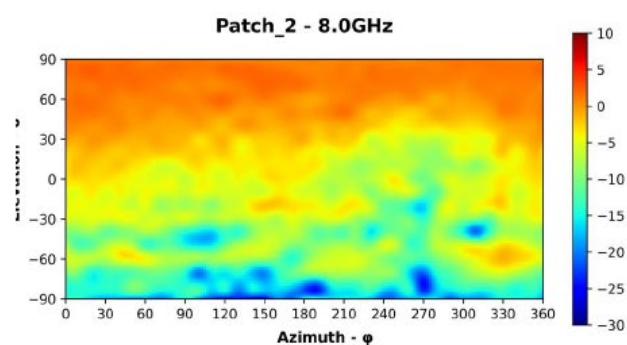
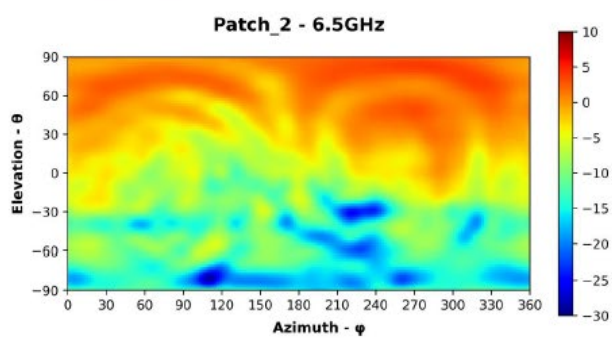
Azimuth $\phi = 90^\circ$



Patch_2

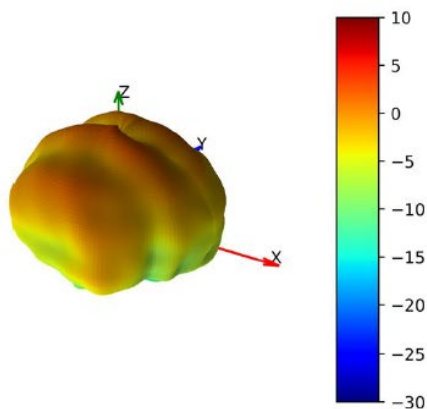
Peak Gain & Efficiency:

		Frequency [GHz]	Peak Gain [dBi]	Tot. Efficiency [%]
Patch_2	CH5	6.25	2.04	50
		6.50	3.63	61
		6.75	2.74	56
	CH9	7.75	3.00	65
		8.00	2.41	62
		8.25	-	-

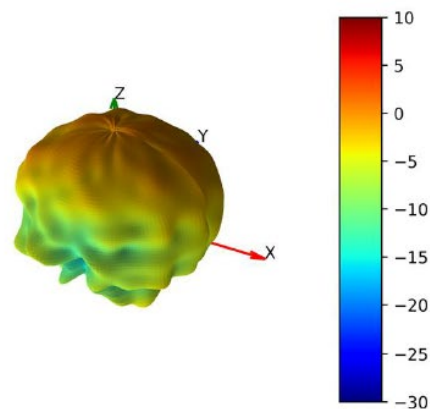


3D Radiation Patterns:

Patch_2 - 6.5GHz

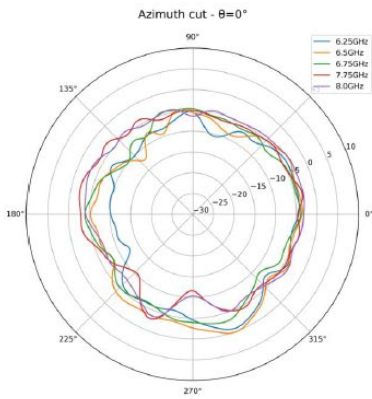


Patch_2 - 8.0GHz

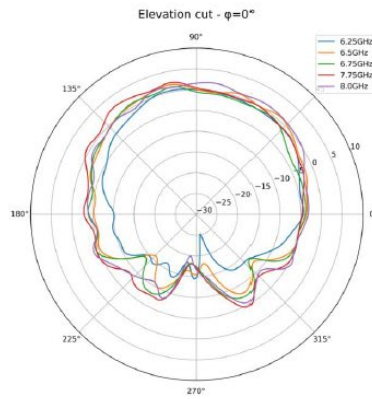


Polar Plots:

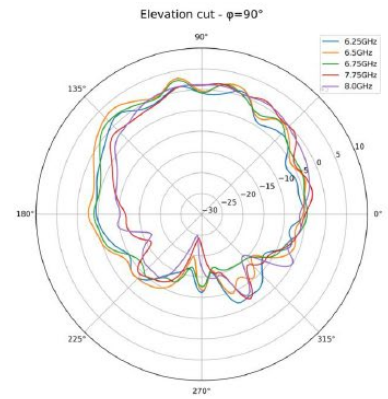
Azimuth $\theta = 0^\circ$



Azimuth $\varphi = 0^\circ$

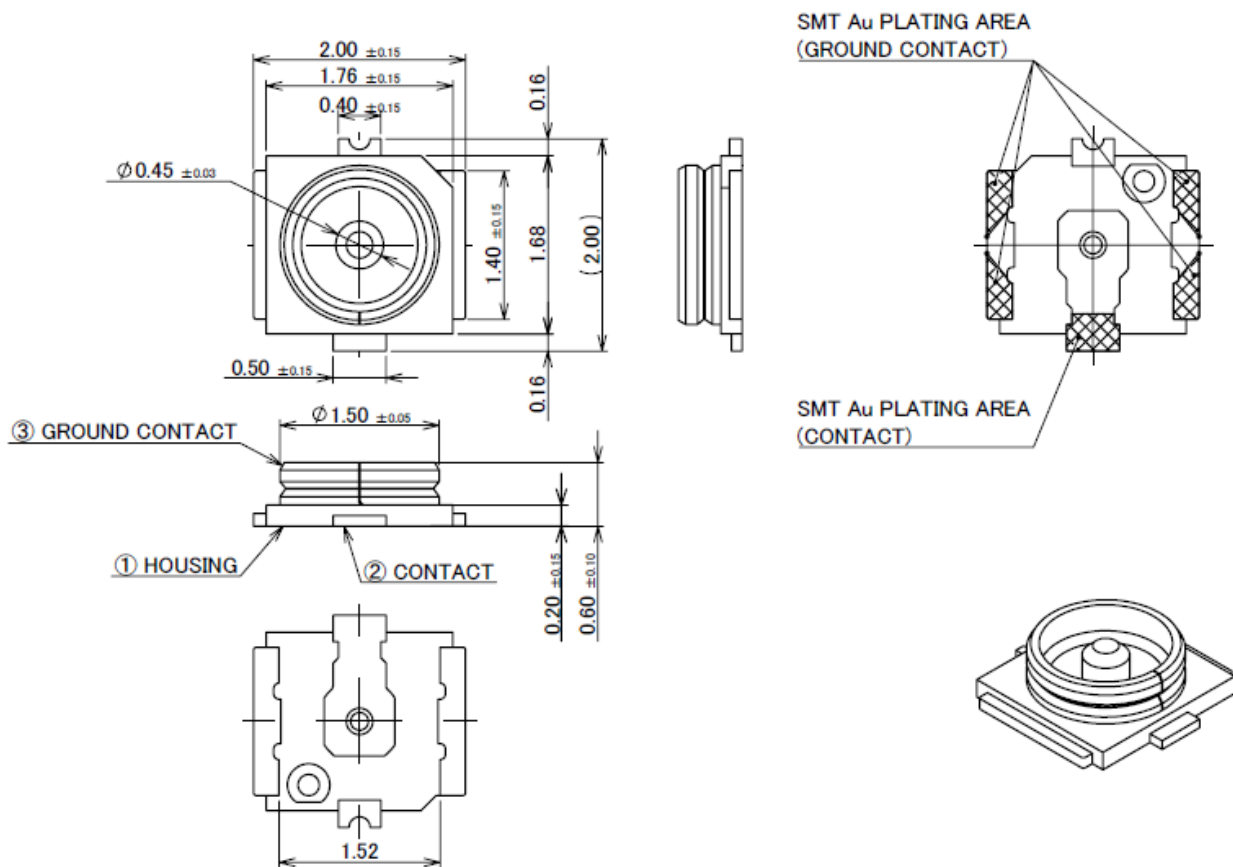


Azimuth $\varphi = 90^\circ$



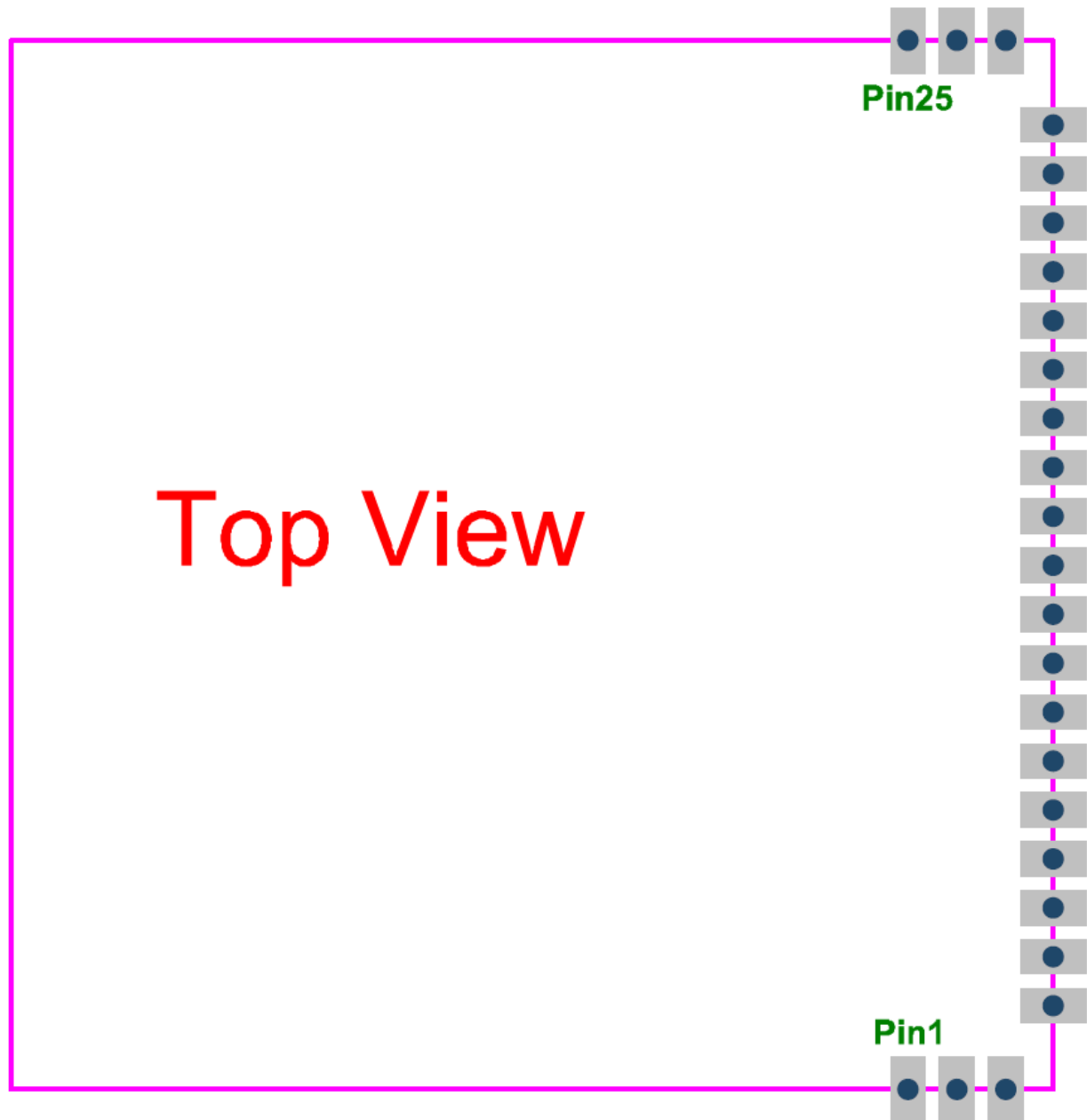
2.4.External Antenna Connector Size information

TS Mini 250 module adopts the fourth-generation external antenna connector shown in below figure, which is compatible with MHF-4 connector of I-PEX.



3. Module package

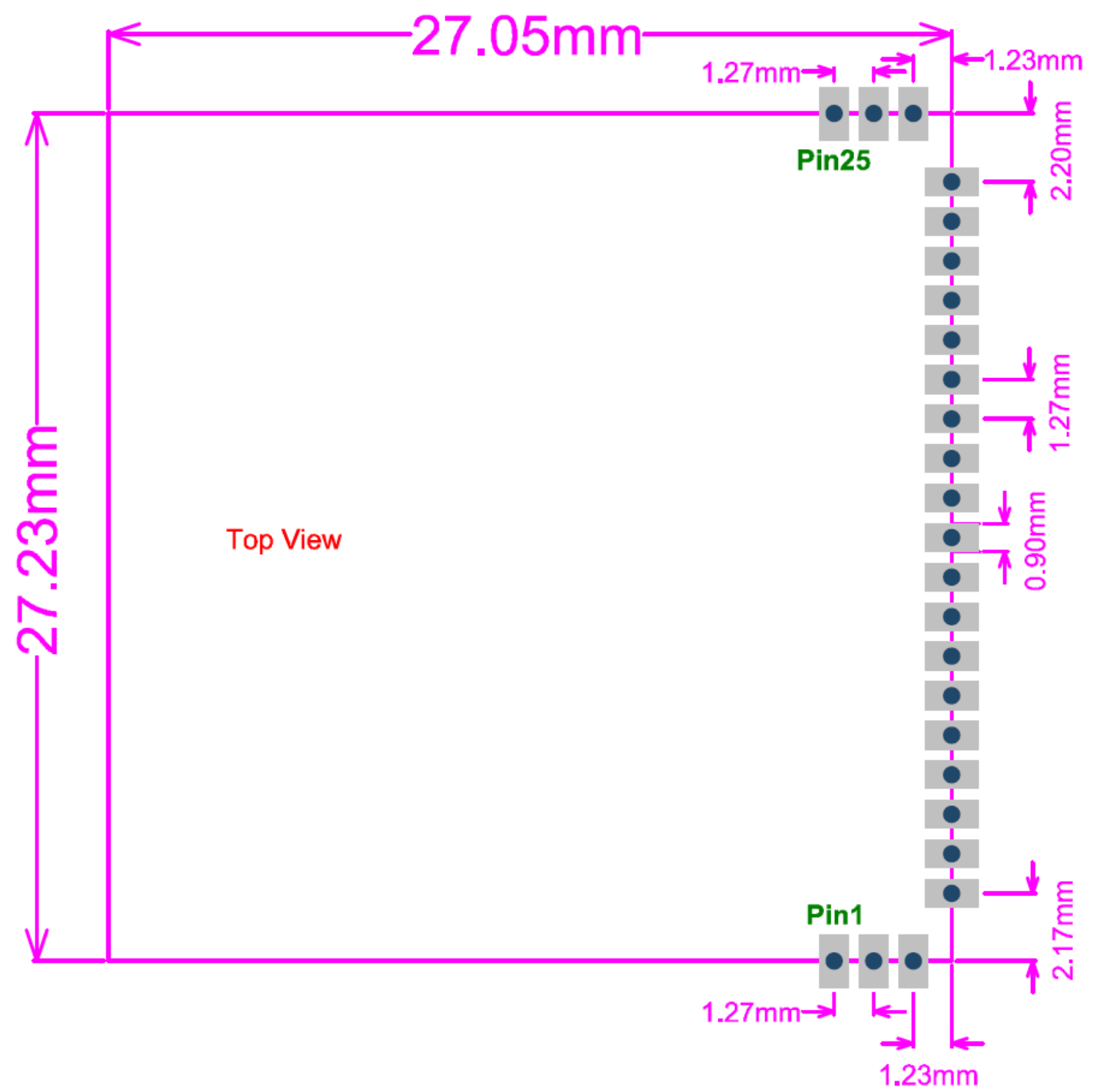
3.1. Pinout Description



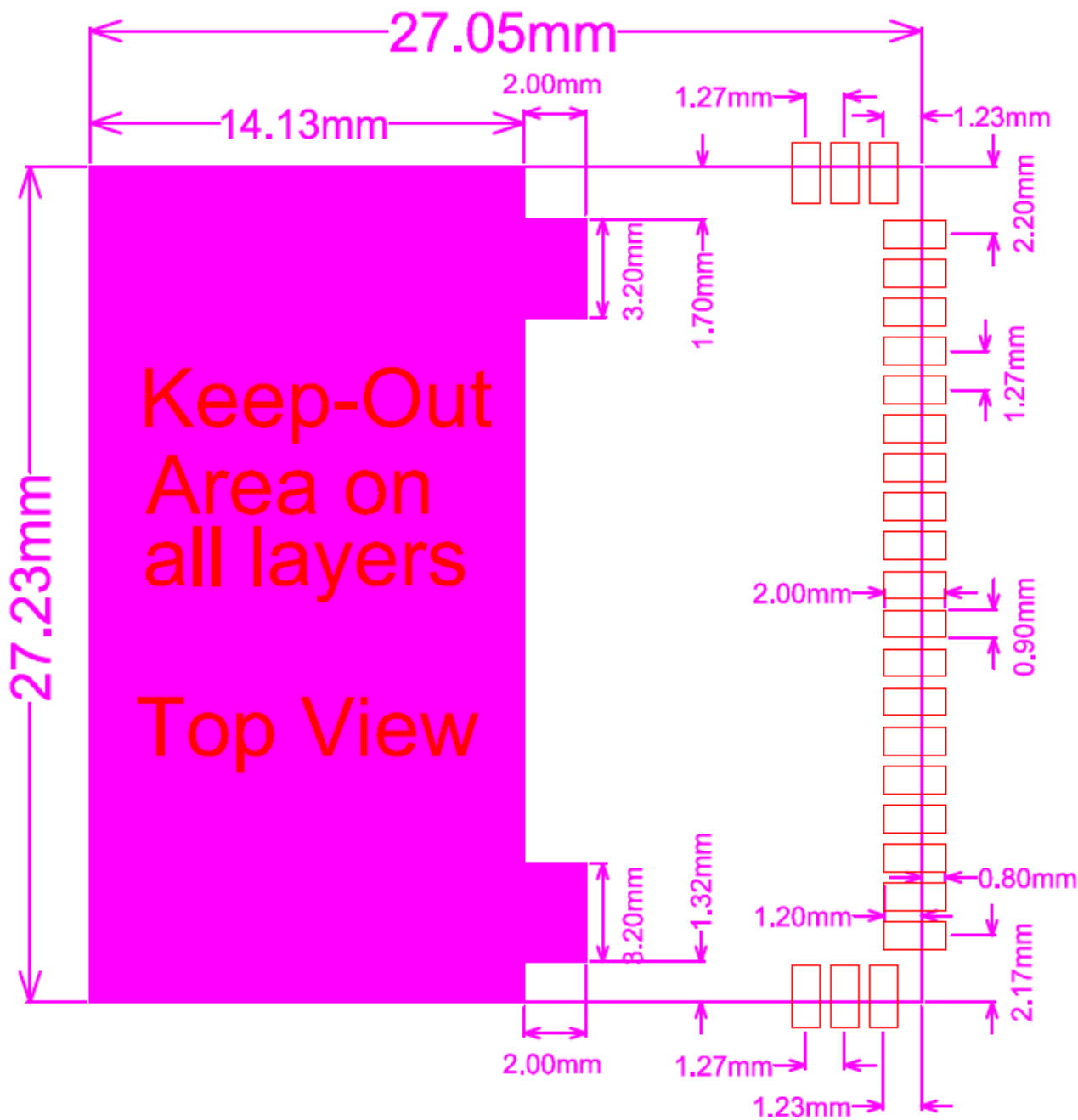
3.2.Pin Description Box

Pin	Pin Name	Pin Type	Description
1	NC		
2	GND	G	Ground
3	VDD_UWB	P	VDD Supply (1.8V, Legacy power supply mode)
4	GND	G	Ground
5	VDD_MCU_UWB	P	VDD Supply (1.8V, Legacy power supply mode)
6	VDDIO_UWB	P	Power Supply input for the Host Interface
7	NC		
8	UWB_RSTN	I	Reset pin
9	UWB_SPI_MISO	I/O	Host interface line 3 as SPI IO0 connection
10	UWB_SPI_SCK	I/O	Host interface line 1 as SPI clock (SCK) line
11	UWB_SPI_MOSI	I/O	Host interface line 4 as SPI IO1 connection
12	UWB_SPI_CS	I/O	Host interface line 2 as SPI Target Select (SS) connection
13	EF1	I/O	High switching speed general purpose I/O used for antenna external switches
14	SE_INT	I	Host Secure Element interrupt (IRQ flag to indicate that data are ready to be shared via I2C)
15	EF2	I/O	High switching speed general purpose I/O used for antenna external switches
16	GPIO00	I/O	General-Purpose I/O
17	GPIO01	I/O	General-Purpose I/O
18	SE_I2C_SDA	I/O	SDA (I2C Data) with 2.2K pull-up to VDDIO
19	SE_I2C_SCL	I/O	SCL (I2C clock) with 2.2K pull-up to VDDIO
20	CX_UART_RX	I	RX connection of the UART for external radio interface
21	UWB_WAKEUP	I	HOST interface wakeup input
22	UWB_HOST_IRQ	O	Host IRQ pin
23	CX_UART_TX	O	TX connection of the UART for external radio interface
24	NC		
25	GND	G	Ground

3.3.Package outline



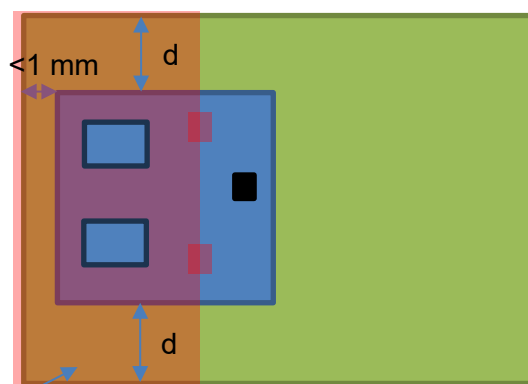
3.4.Recommended PCB Footprint



3.5.Host Board mounting

TS Mini 250 is designed to be mounted onto a host board and it is preferably mounted close to the host board edge, as shown next. Maximum distance from top to the edge should be up to 1mm.

It's also recommended to reserve a 10mm(d) spacing without metal(copper on PCB or components) at the left & right side of the module antenna area.



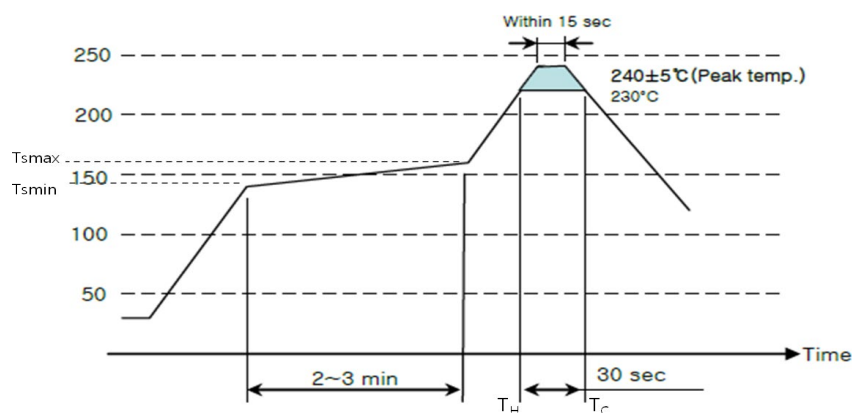
Copper free area (all layers)

4. Soldering Condition

4.1.Manual Soldering – Pb Free

Soldering Temperature: $360^{\circ}\text{C} \pm 5^{\circ}\text{C}$, 5sec max.

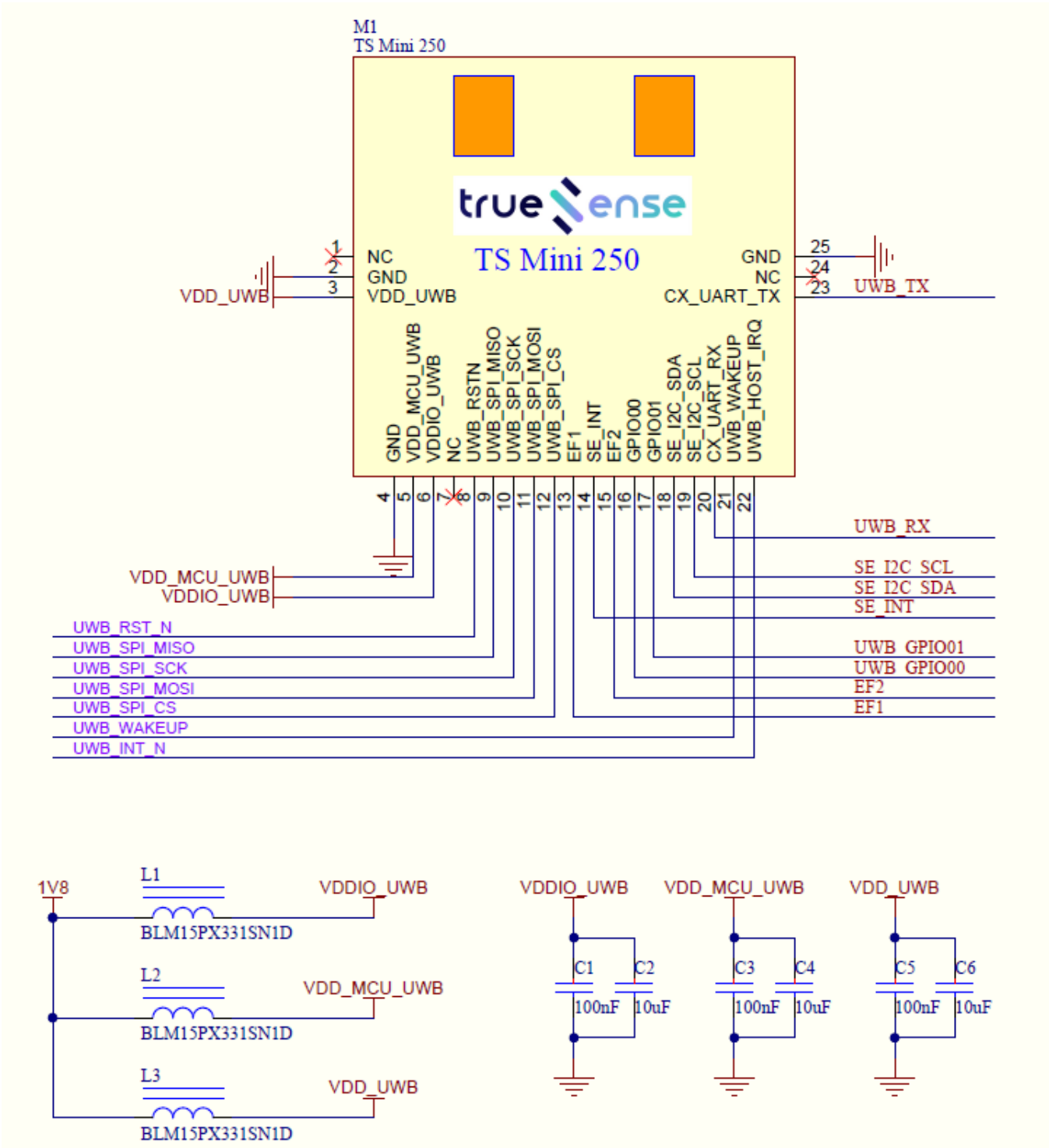
4.2.Recommended Reflow Condition – Pb Free



Profile Feature	Pb-Free Assembly
Preheat	
-Temperature Min (T _{smin})	140°C
-Temperature Typical (T _{stypical})	150°C
-Temperature Max (T _{smax})	160°C
-Time T _{smin} to T _{smax}	2 ~ 3 min
Peak Temperature	240±5°C
Time of actual peak temperature	Max. 15 seconds
Heating to Cool	
-Temperature Heating (T _H)	230°C
-Temperature Cool (T _C)	230°C
-Time T _H to T _C	30 seconds

5. Application design-in information

5.1.Reference schematics for TS Mini 250



6. Regulatory information

FCC STATEMENT :

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Radiation Exposure Statement:

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2BFZA-TSMINI250". Additionally, the following statement should be included on the label and in the final product's user manual: "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 interferences, and
- (2) this device must accept any interference received, including interference that may cause undesired operation."

The module is limited to installation in mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end-use operational conditions, including simultaneous transmission operations.

When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application.

When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers.

Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY.

Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user.

Operations in the 6.24 GHz–8.24 GHz band are restricted to indoor usage only.

UWB devices may not be employed for the operation of toys. Operation onboard an aircraft, a ship or a satellite is prohibited.

1. According to Part 15.517(a), the requirements apply only to ultra-wideband (UWB) transmitters intended for indoor operation:

(1) Indoor UWB equipment, by its design characteristics, must operate only indoors. This is evidenced by the requirement of fixed indoor infrastructure (e.g., transmitters that must be connected to an AC power line).

(2) Equipment operating under this section must not intentionally point its transmission signal outwards from the building where it is located, such as through windows or doors, to perform external functions, such as detecting people about to enter the building.

- (3) Outdoor-mounted antennas are prohibited, such as antennas mounted on the exterior of buildings or utility poles, or any other outdoor infrastructure.
- (4) Field interference sensors installed inside metal or underground storage tanks are considered to be operating indoors as long as their transmission signal is pointed towards the ground.
- (5) Communication systems should only transmit when an intentionally radiating person sends a message to the relevant receiver.