

Sercomm TPM10 is used to connect to LTE Cat-M1 network, complies with 3GPP Rel-13 LTE Cat-M1 UE specification

TPM10 provides the interconnections between the Cat-M1 networks and terminals. It receives signals sent from the networks, processes, and then sends commands or data to the terminals; and transfers data, commands to networks when receives data, commands from the terminals.

Key Features

- Multiple bands support
- 3GPP Rel.13 LTE Cat-M1 air interfaces and protocols compliant
- Maximum RF output power of 23 dBm
- LTE eDRX and PSM support. Ultra low power consumption for longer battery lifetime
- Integrated temperature sensor

Interfaces

- UART port, Communication port and debug port.
One reserved
- USIM port
- Antenna port
- GPIO
- JTAG

Operating Voltage

- 3.1~4.5V



Power Consumption

- Max through UL+DL (23dBm): 222mA@4.2V
- PSM: 1.00uA@4.2A

Dimension

- LGA 108 pads. 21.35x20.25x1.67mm

Applications

- Smart Metering, smart grid
- Traffic Management and Monitoring
- Asset Tracking
- Environmental Monitoring

Ordering

TPM10	Cat-M1 module
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FCC ID: P27-TPM10

Federal Communication Commission

Interference Statement

This device complies with 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 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:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are 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

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location 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 re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

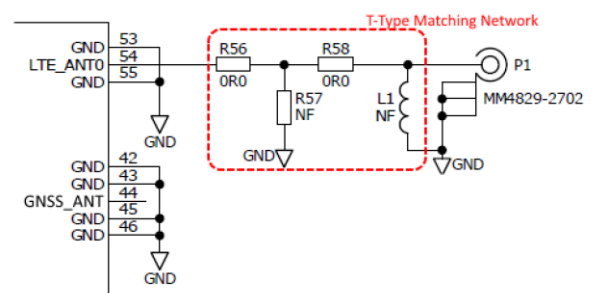
This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains FCC ID: P27-TPM10”. The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

RF typical circuit

The RF inter-connect called P1 is for example purposes only. Depending on the antenna, interfacing system will dictate the RF inter-connect. Below picture is showing RF typical circuit.



LTE-ANT0 is the primary(main) antenna pin and carries TX and RX signals. Connect 50 Ohm transmission lines from this pins to the 50 Ohm Primary Antenna/Antenna connectors. The picture RF typical circuit shows, included in the connection between ANT and the antenna connectors, T-type network for matching.

TPM10 DATASHEET

Specifications are subject to change without notice and should not be construed as a commitment by Sercomm Corporation

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Ver 1.0

Revision History		
Rev	Date	Description
V1.0	04/11/2017	Initial Release V1.0

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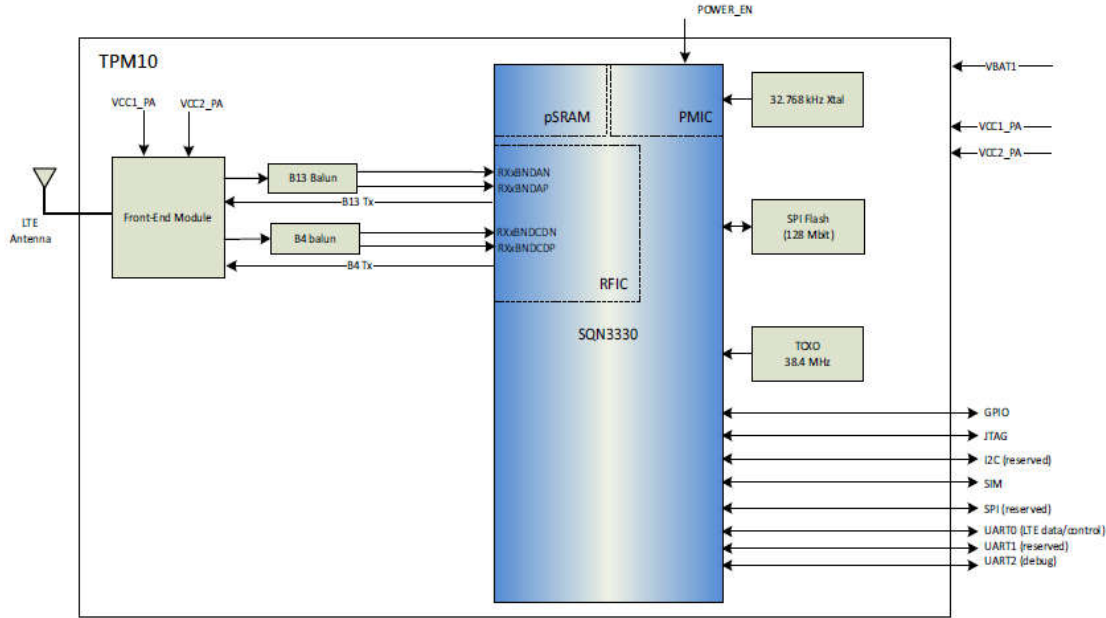
1. Functional Overview

TPM10 module provides the interconnection between Cat-M1 networks and terminals.

- Interconnection with Cat-M1
 - TPM10 module receives and processes signals sent from Cat-M1 networks, and then sends commands or data to terminals for performing the operation and maintenance (O&M).
 - The module receives data and commands from terminals, transferring those data and commands to Cat-M1 networks, and then delivers them to application servers (ASs).
- Interconnection with terminals
 - TPM10 module reads and uploads terminal data to the Cat-M1 networks.
 - The module receives commands from the Cat-M1 networks and performs O&M for terminals.

1.1. Block Circuit Diagram

TPM10 module is based on the SQN3330 Cat-M1 baseband and developed for 3GPP E-UTRA and Wireless LTE Cat-M1 UE specification. The image below shows the module block diagram:



1.2. Main Module Components

The TPM10 includes the following components.

A. SQN3330

This module includes SQN3330 Cat-1 baseband, a complete dual band RF front end, memory and required circuitry to meet 3GPP E-UTRA (Long Term Evolution - LTE, Release 13 set of specifications) and Wireless LTE Cat-M1 UE specifications.

SQN3330 is a single-chip LTE Cat M1 solution, which is designed specifically for narrowband IoT applications, including sensors, wearables, and other low data, low power M2M and IoT devices.

B. RF

The RF matching circuit.

C. Power system

The main power supply is “VBAT1” and its range is 3.1~4.5V while the “VSIM” power supply (3.0V) is for external SIM circuit.

D. Clock in system

TPM10 is using 32KHz clock in the module system.

1.3. LTE Low Power Modes

This module will automatically enter in low-power mode. It can be woken from low power mode by the following external sources:

- SIM_DETECT input signal to cope with SIM card insertion into a SIM card connector with built-in hardware detection. The default configuration to wake-up the module is a low-to-high transition.
- The RTS0 input signal whenever data traffic is initiated by the host connected to the module UART0 with hardware flow control; The default configuration to wake-up the module is a high-to-low transition.
- Two dedicated input signal WAKE0 and WAKE1; The default configuration to wake-up the module is on a high-to-low transition. This can be modified by software. As example, these signals can be used to detect an alarm from an external IC such as a sensor. Software can disable the wake-up functionality on these signals.
- A subset of GPIO input signals: GPIO2, GPIO3, GPIO25, GPIO27, GPIO42; they are not configured by default as wake-up source but software can configure them for future use.

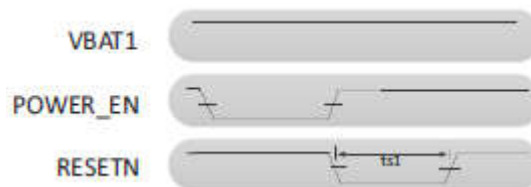
2. Electrical Characteristics

2.1. Power-up Sequence

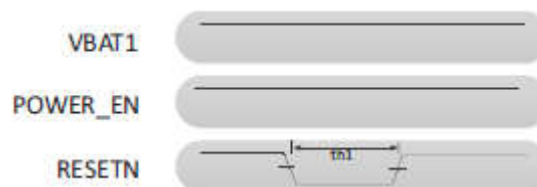
Cold Start



Warm Start



2.2. Reset Cycle



2.3. Power supply

The main power supply is “VBAT1” and its range is 3.1~4.5V while the “VSIM” power supply (3.0V) is for external SIM circuit.

Pad Name	Pad #	Comment
GND	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22, T23, T24, T25, T26, T27, T28, T29, T30	T1 to T30 pads are used as both GND and thermal drops
GND	1, 20, 22, 24, 26, 28, 30, 31, 32, 33, 34, 42, 43, 45, 46, 53, 55, 62, 63, 64, 65, 66, 68, 69, 70, 71, 72, 73, 74, 86, 87	All GND pads shall be connected to the same copper.

Pad Name	Pad #	Comment
VBAT1	107, 108	Power supply for Baseband, voltage level 3.1V to 4.5V

2.4. Performance

- The Max output power of TPM10 is 23dBm +2/-2.7dBm
- The typical sensitivity level of TPM10 is -103 dBm

3. Pin out and Definitions

3.1. I/O Parameters Definition

Type	Description
DI	Digital input
DO	Digital output
I/O	Bidirectional input/output
AI	Analog input
AO	Analog output
PO	Power output
PI	Power input
OD	Open drain

3.2. Module Pin Definition

Pad Name	Pad No.	I/O Type	Description
GND	1, 20, 22, 24, 26, 28, 30, 31, 32, 33, 34, 42, 43, 45, 46, 53, 55, 62, 63, 64, 65, 66, 68, 69, 70, 71, 72, 73, 74, 86, 87	N/A	All GND pads shall be connected to the same copper.
GPIO3/STATUS_LED	2	IN	GPIO or status LED (STATUS_LED, OUT) in option with 3 modes: <ul style="list-style-type: none"> - Activity based on LTE connectivity status (typically: ON when attached to LTE network) - Periodic pulse (Sign of life signal) - LED switch off

1V8	3	O (power)	1.8V reference voltage for IOs
GNSS_VINB	4	N/A	Reserved
RESERVED/FFF_FFH	5	I/O	Reserved pad
GPIO2/POWER_MON	6	I/O	GPIO or Power monitor (POWER_MON, OUT) in option
GPIO19/CLK0	7	I/O	GPIO, USART0/CLK in option
GPIO27/CTS2	8	I/O	GPIO (I/O), USART2/CTS (OUT) in option
3V0	9, 11	O (power)	3.0V power supply
GPIO28/RTS2	10	I/O	GPIO (I/O), USART2/RTS (IN) in option
SIM_RESETN	12	O	SIM card interface: reset output pin for the SIM card
DNC	13, 15	Do not connect	Do not connect
SIM_CLK	14	O	SIM card interface: clock output pin for the SIM card
SIM_DETECT	16	I/O	SIM card presence indication (input)

SIM_IO	17	I/O	SIM card bidirectional data input/output
SIM_VCC	18	O (power)	SIM card supply voltage
GNSS_TXD3	19	N/A	Reserved
GNSS_RXD3	21	N/A	Reserved
GNSS_BOOT0	23	N/A	Reserved
GNSS_RSTN	25	N/A	Reserved
GNSS_STDBY_OUT	27	N/A	Reserved
GNSS_WAKEUP	29	N/A	Reserved
GNSS_STDBYN	35	N/A	Reserved
GNSS_GPIO28	36	N/A	Reserved
GNSS_GPIO1_PPSOUT	37	N/A	Reserved
GNSS_GPIO0/BLANKING	38	N/A	Reserved
RFDATA12	39	I/O	RF Control, reserved for future use
RFDATA16	40	I/O	RF Control, reserved for future use
RFDATA17	41	I/O	RF Control, reserved for future use
GNSS_ANT1	44	N/A	Reserved

RESETN	47	I	Module HW reset signal
JTAG_TDO	48	O	Used for JTAG interface
JTAG_TRSTN	49	I	Used for JTAG interface
JTAG_TMS	50	I	Used for JTAG interface
JTAG_TDI	51	I	Used for JTAG interface
JTAG_TCK	52	I	Used for JTAG interface
LTE_ANT	54	Analog	LTE antenna
RXD2	56	O	UART2/RXD (OUT)
ADC	57	Analog	Analog Digital Converter
TXD2	58	I	UART2/TXD (IN)
SPI_SDI	59	I/O	SPI interface, reserved for future use
SPI_CSN	60	I/O	SPI interface, reserved for future use
SPI_CLK	61	I/O	SPI interface, reserved for future use
SPI_SDO	67	I/O	SPI interface, reserved for future use
RTS0	75	I	UART0/RTS (IN)

CTS0	76	O	UART0/CTS (OUT)
TXD0	77	I	UART0/TXD (IN)
GPIO14/TXD1	78	I/O	GPIO (I/O), UART1/TXD (IN) in option
RXD0	79	O	UART0/RXD (OUT)
GPIO15/RXD1	80	I/O	GPIO (I/O), UART1/RXD (OUT) in option
GPIO17/CTS1	81	I/O	GPIO (I/O), UART1/CTS (OUT) in option
GPIO38/CLK1	82	I/O	GPIO, UART1/CLK in option
GPIO16/RTS1	83	I/O	GPIO (I/O), UART1/RTS (IN) in option
GPIO41/DTR0	84	I/O	GPIO (I/O), UART0/DTR (IN) in option
GPIO39/DSR0	85	I/O	GPIO (I/O), UART0/DSR (OUT) in option
GPIO24/DCD0	88	I/O	GPIO (I/O), UART0/DCD (OUT) in option
GPIO25/RING0	89	I/O	GPIO (I/O), UART0/RING (OUT) in option
GPIO40/EMGC Y_SHDN	90	I/O	GPIO, emergency power shutdown signal (EMGCY_SHDN, IN) in option

GPIO26/CLK2	91	I/O	GPIO, USART2/CLK in option
I2C_SDA	92	I/O	I2C/SDA interface. GPIO in option
GPIO23	93	I/O	GPIO
I2C_SCL	94	I/O	I2C/SCL interface. GPIO in option
GPIO21	95	I/O	GPIO
WAKE1	96	I/O	Wake input (WAKE1). Module is wake-up on WAKE1 high to low signal transition
VCC1_PA	97	I (power)	Power supply for LTE RF front end
VCC2_PA	98, 99	I (power)	Power supply for LTE RF front end
GNSS_VCC1	100	N/A	Reserved
GNSS_VCC2	101	N/A	Reserved
GNSS_VCC3	102	N/A	Reserved
GPIO29/32KHZ_CLK_OUT	103	O	32KHz (OUT), GPIO (I/O) in option
WAKE0	104	I	Wake input (WAKE0). Module is wake-up on WAKE0 high to low signal transition
GPIO42/SAR_DET ETECT	105	I/O	GPIO, SAR detection signal (SAR_DETECT, IN, active low) in option

POWER_EN	106	I (power)	See IO Characteristics for VDD_PWR_EN
VBAT1	107, 108	I	Power supply for Baseband, voltage level 3.1V to 4.5V
GND	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22, T23, T24, T25, T26, T27, T28, T29, T30	N/A	T1 to T30 pads are used as both GND and thermal drops

3.3. DC Characteristics

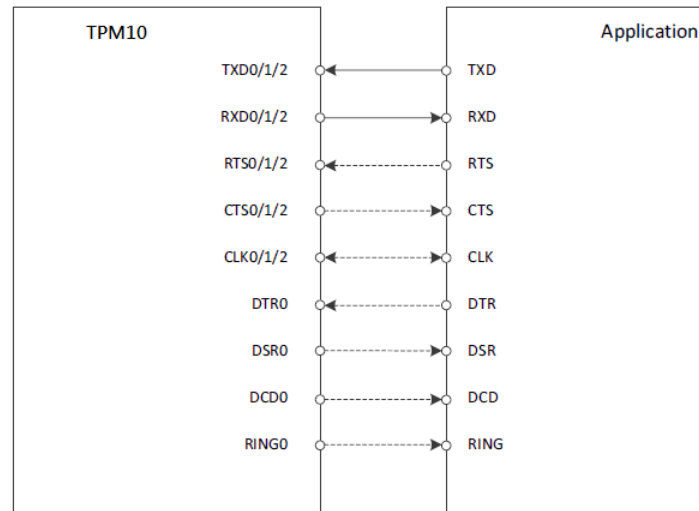
The following table displays the DC characteristics for digital IOs and voltage 1.8 V:

Parameter	Drive Strength	Min.	Nom.	Max.	Unit
V_{IL} Input Low Voltage		-0.3		0.63	V
V_{IH} Input High Voltage		1.17		3.6	V
V_T Threshold Point		0.79	0.87	0.94	V
V_{T+} Schmitt Trigger Low to High Threshold Point		1	1.12	1.22	V
V_{T-} Schmitt Trigger High to Low Threshold Point		0.61	0.71	0.8	V
$V_{T\text{FU}}$ Threshold Point with Pull-up Resistor Enabled		0.79	0.86	0.93	V
$V_{T\text{FD}}$ Threshold Point with Pull-down Resistor Enabled		0.8	0.87	0.95	V
$V_{T+\text{FU}}$ Schmitt Trigger Low to High Threshold Point with Pull-up Resistor Enabled		1	1.12	1.21	V
$V_{T-\text{FU}}$ Schmitt Trigger High to Low Threshold Point with Pull-up Resistor Enabled		0.61	0.7	0.8	V
$V_{T+\text{FD}}$ Schmitt Trigger Low to High Threshold Point with Pull-down Resistor Enabled		1.01	1.13	1.23	V
$V_{T-\text{FD}}$ Schmitt Trigger High to Low Threshold Point with Pull-down Resistor Enabled		0.62	0.72	0.81	V
I_I Input Leakage Current @ $V_I=1.8\text{V}$ or 0V				± 10	μA
I_{OZ} Tri-state Output Leakage Current @ $V_O=1.8\text{V}$ or 0V				± 10	μA
Input Capacitance			3		pF

Parameter	Drive Strength	Min.	Nom.	Max.	Unit
R_{PU} Pull-up Resistor		56	89	148	kOhm
R_{PD} Pull-down Resistor		52	90	167	kOhm
V_{OL} Output Low Voltage				0.45	V
V_{OH} Output High Voltage		1.35			V
I_{OL} Low Level Output Current at $V_{OL(max)}$	2 mA	1.2	2.2	3.6	mA
	4 mA	2.3	4.3	7.1	mA
	8 mA	4.6	8.6	14.3	mA
I_{OH} High Level Output Current at $V_{OH(max)}$	2 mA	1.0	2.4	4.6	mA
	4 mA	2.0	4.7	9.2	mA
	8 mA	4.0	9.4	18.4	mA

3.4. UART Port

The following image represents the typical implementation for the hardware flow control for UART0, UART1 and UART2. TDX and RDX signals are mandatory. RTS and CTS are strongly recommended. The other signals are optional.



UART pin definition:

Pad Name	Pad No.	I/O Type	Description
RXD2	56	O	UART2/RXD (OUT)
TXD2	58	I	UART2/TXD (IN)
RTS0	75	I	UART0/RTS (IN)
CTS0	76	O	UART0/CTS (OUT).
TXD0	77	I	UART0/TXD (IN)
RXD0	79	O	UART0/RXD (OUT)

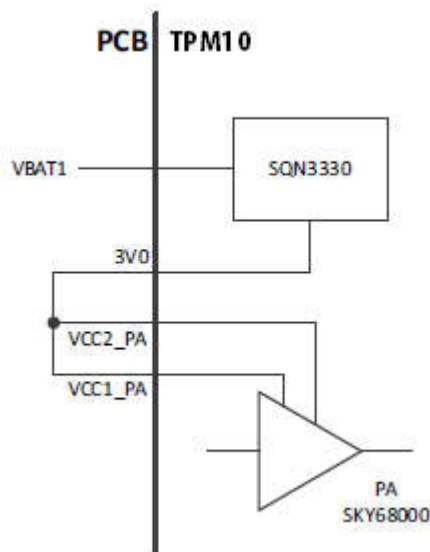
3.5. SIM Port

Pin definition:

Pad Name	Pad No.	I/O Type	Description
SIM_RESETN	12	O	SIM card interface: reset output pin for the SIM card
SIM_CLK	14	O	SIM card interface: clock output pin for the SIM card
SIM_DETECT	16	I/O	SIM card presence indication (input)
SIM_IO	17	I/O	SIM card bidirectional data input/output
SIM_VCC	18	O	SIM card supply voltage

3.6. Antenna Port

TPM10 LTE RF front-end power supplies diagram:



Pin definition:

Pad Name	Pad No.	I/O Type	Description
LTE_ANT	54	Analog	LTE antenna

4. ESD

The module has no electro-static discharge (ESD) protection measures, and its sensitive pins need external ESD protection. Appropriate ESD measures need to be added during the manufacturing/transporting/operation stages.

The table below shows the ESD requirements for the module.

Pin	Contact Discharge	Air Discharge	Unit
VBAT	±5	±10	KV
ANT	±4	±8	KV
Other ports	±0.5	±1	KV

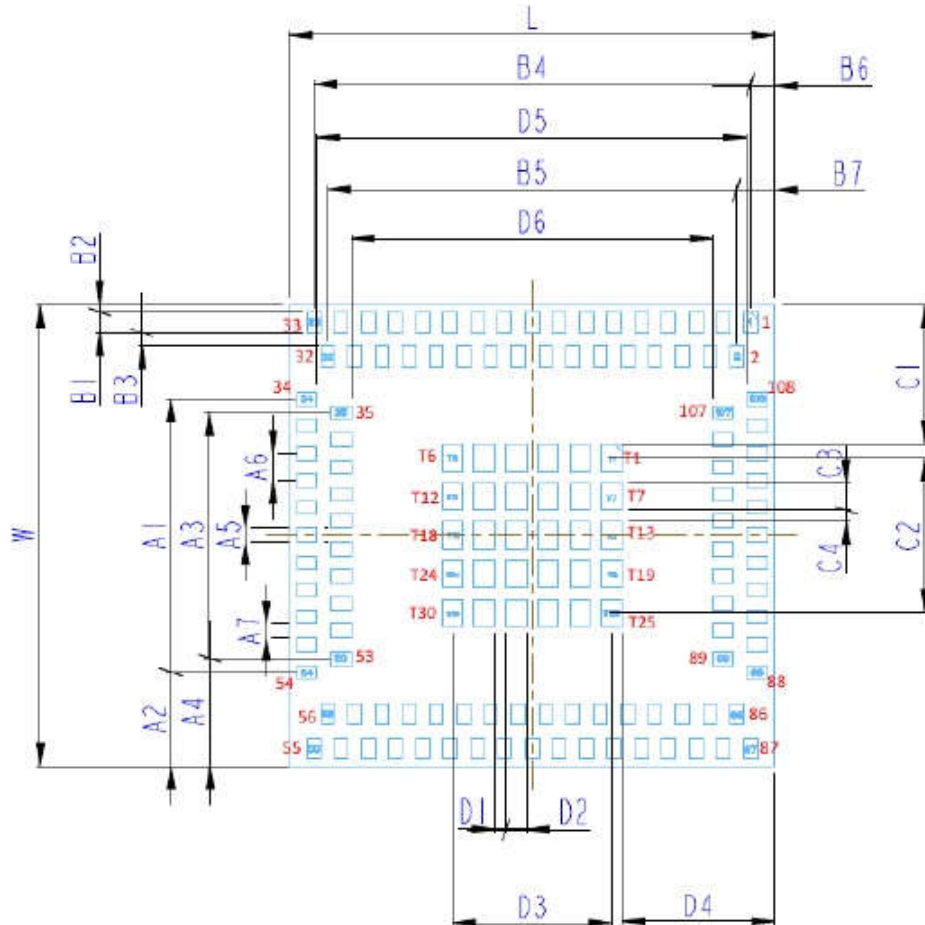
5. EMC

The signal integrity and power integrity issues caused by electromagnetic compatibility (EMC) need to be considered when you use the module to design. Below are some suggestions:

- The coupling of the module and other digital chips must be deployed remotely as far as possible, in order to avoid mutual interference.
- The power supply (CSS), clock, high-speed digital signals, EMI components, and RF simulation parts must be deployed remotely as far as possible.
- The CSS, clock, high-speed digital signals, EMI components, and antennas must be coupled remotely as far as possible in space.
- During cabling routing, RF reference ground, digital and analog areas should be separated, and all cables are routed in compliance with specified requirements to avoid mutual coupling between lines.
- The decoupling capacitor is placed near pins.

6. Package Description

Module dimensions from the bottom:



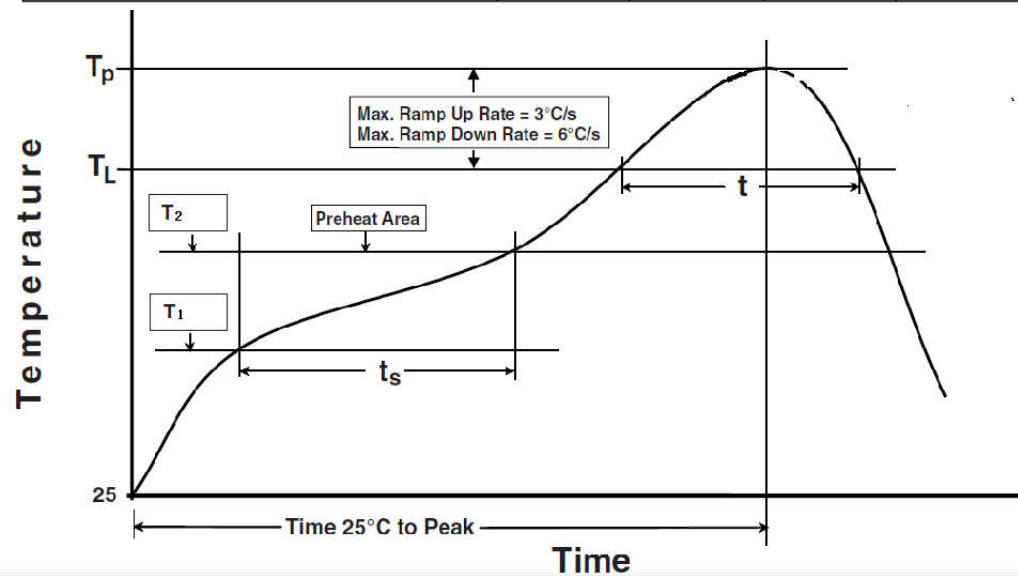
Mark Dimension and tolerance (mm)

Mark	Dimension and tolerance
L	21.35 ± 0.1
W	20.25 ± 0.1
A1	12 ± 1.0
A2	4.125 ± 0.5
A3	10.8 ± 1.0
A4	4.725 ± 0.5
A5	0.6 ± 0.05
A6	1.2 ± 0.1

A7	0.6 ± 0.05
B1	0.9 ± 0.1
B2	0.325 ± 0.05
B3	0.6 ± 0.05
B4	19.2 ± 0.2
B5	18 ± 0.2
B6	1.075 ± 0.1
B7	1.675 ± 0.15
C1	6.125 ± 0.5
C2	6.8 ± 0.5
C3	1.2 ± 0.01
C4	0.5 ± 0.05
D1	0.5 ± 0.05
D2	0.9 ± 0.1
D3	7 ± 0.5
D4	6.725 ± 0.5
D5	18.9 ± 0.2
D6	15.9 ± 0.2

7. Recommend Reflow Profile

TPM10 reflow profile	Min	Typ	Max	Unit
Temperature T_1	150			°C
Temperature T_2			200	°C
Temperature T_i		217		°C
Temperature T_p			260	°C
Time t_s (T_1 to T_2)	60		120	sec
Time t (above T_i)	60		150	sec
Ramp Up Rate T_1 to T_2			3	°C
Ramp Down Rate T_p to T_i			6	°C



8. Package and Storage Condition

Operation and Storage Environment:

Item	Minimum Value	Maximum Value	Unit
Operating temperature	-40	85	°C
Storage temperature	-40	85	°C
Operating Humidity	10	85	%
Storage Humidity	5	85	%

9. Product Information



Model	It displays the model name of the device.
SN	The serial number of the device.
IMEI	The IMEI number is used by a GSM network to identify the device.
D/C	It shows the date code that is used to identify when the device is being manufactured.

10. Ordering Information

Part Number	Description	Package Type	Operation Temp.
TPM10	Cat-M1 Module	Reel	-40~85C