<GSUB-0003>

UWB SiP Module

Pb-free, halogen-free and RoHS compliant

Restricted

1. Security Warning

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2. Publication History

Version	Date	Description	Author	Approved
0.1	2022.04.12	First release		

Content

1. Introduction

1.1 Functional Description

GSUB-0003 module is based on System-in-Package (SiP) technology which consists of a NXP SR100T UWB transceiver, a crystal, a SPDT, a DPDT, four filters. All these components are integrated in a tiny package via 72-pins 7.6 x 4.9 x 1.08mm³ LGA with sputter technology to achieve EMI shielding. GSUB-0003 can be used to scheme location application for smart phone and mobile devices.

The SR100T is a single die UWB controller that provides common Ultra-Wideband (UWB) ranging technologies like Single-Sided (SS) and Double-Sided (DS) Two-Way-Ranging (TWR), Beacon reception and Beacon transmission for Time Differential of Arrival (TDoA) Ranging. It incorporates an ARM® Cortex-M33 embedded processor capable of running a secure execution and normal execution environment. The SR100T includes NXP Firewall technology which enhances the security and separation of the ARM® Cortex-M33 execution environments. SR100T includes NXP's state of the art secure cryptographic hardware accelerators used for data encryption and generation of the Scrambled Timing Sequence (STS) needed for IEEE802.15.4z enhanced and secure ranging. The SR100T is capable of secure ranging achieving an accuracy of <±10cm. Further the SR100T is able to perform measurement of the angle of arrival with an accuracy of down to ±3° in one measurement cycle using the on-chip dual receiver architecture.

1.2 Hardware Features

- IEEE802.15.4z HRP PHY compliant
- Supports channels 5&6&8&9 (6.24GHz to 8.24GHz)
- Support 64 MHz and 128 MHz PRF mode to optimize FCC TX spectrum efficiency
- Optimized for short frame mode operation at maximum FCC TX limits
- Programmable transmitter output power of up to 10 dBm
- Narrow Band Interference Rejection for superior co-channel interference rejection
- Data rates of 850 kbps, 6.8 Mbps, 7.8 Mbps, 27 Mbps, and 31.2 Mbps
- Supports 2-way ranging and one-way ranging (TDOA)
- Supports Angle of Arrival Measurement
- Support connection to Secure Element (SN110x)
- ARM® Cortex-M33 32 Bit processor @ 125 MHz
  – 128 kB CODE RAM

- – 128 kB Data RAM
- – 128 kB ROM
- – ARM® TrustZone technology and S-DMA for security
- Modem DSP
    - – Programmable DSP (BSP32 CoolFlux subsystem)
    - – 32 kB RAM for Code
    - – 2x16 kB RAM for Data
- Real Time Clock
    - – 32 kHz in Deep Power Down mode
    - – 125 MHz in Active Mode
    - – 125 us resolution in DPD mode and 1us resolution in Active mode
    - – Can be used to synchronize systems with an accuracy of 0.5 µs
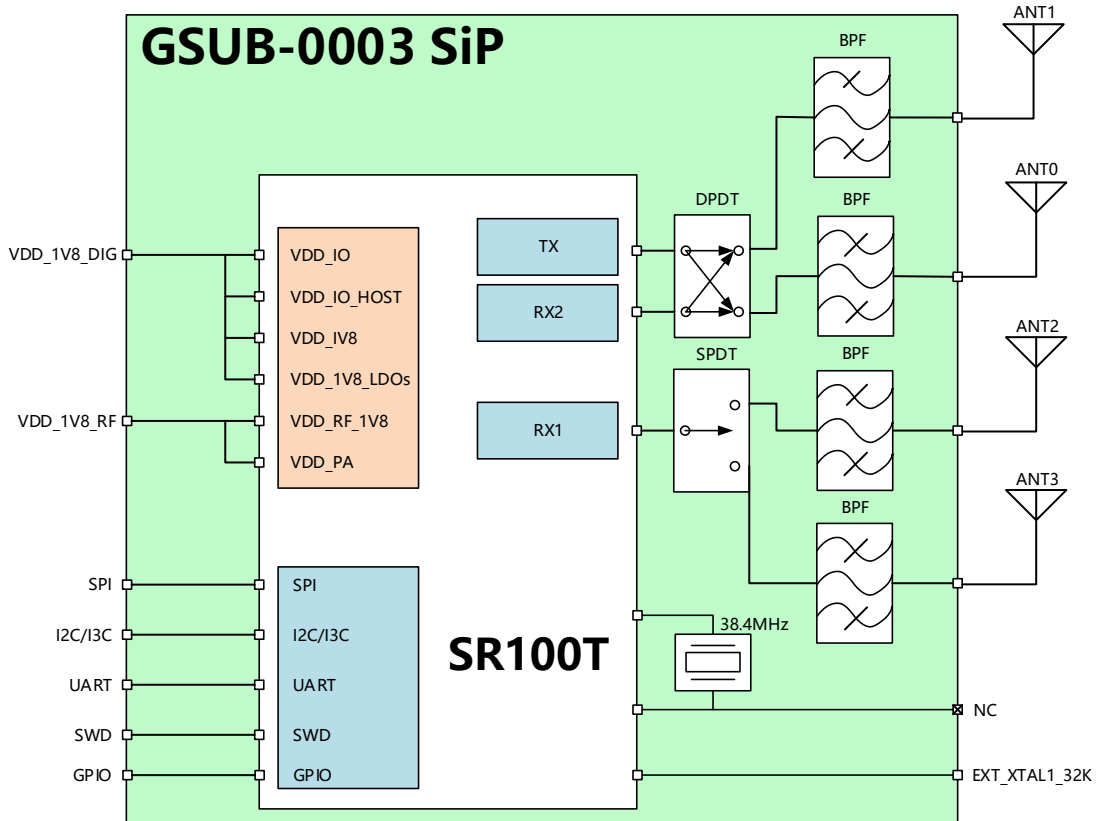
1.3 Applications

- Mobile devices
    - – Mobile smart car access
    - – Mobile smart access for residential and enterprise
    - – Device to device positioning
    - – Location-based services
- Portable equipment (Personal Digital Assistants, tablets, notebooks)
- Wearable devices
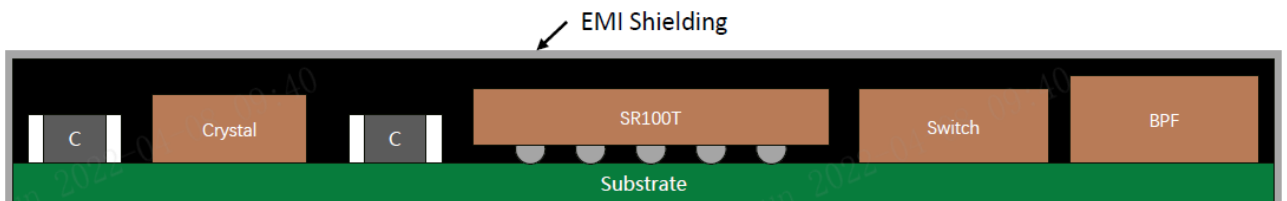
2. Part Number
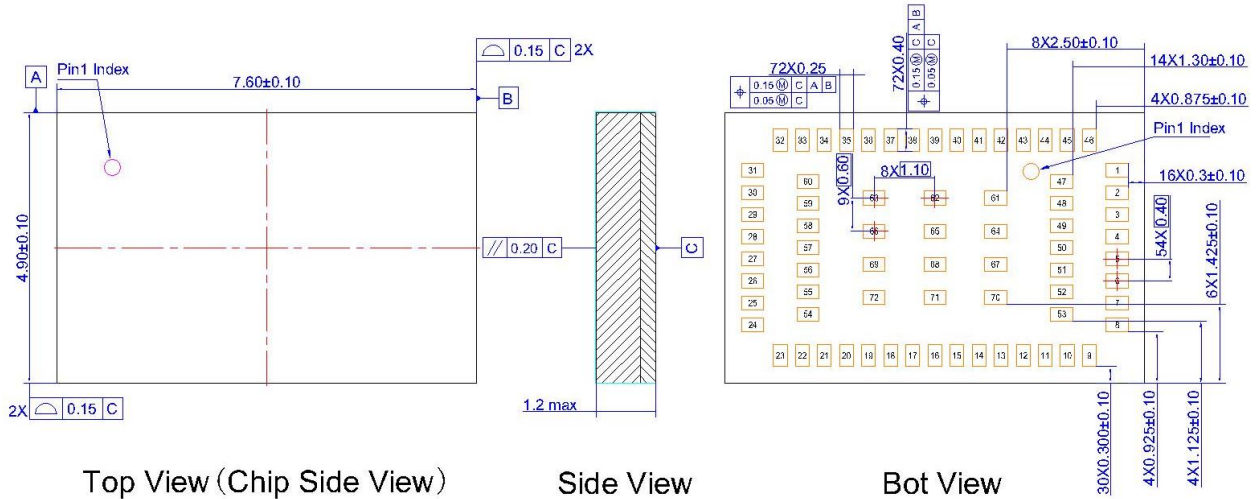
Part Number	GSUB-0003

3. Block Diagram

4. Certification Information（TBD）

5. Structure, Dimensions, Terminal Configurations and Marking

5.1 Structure

Goermicro

5.2 Dimensions

Top View (Chip Side View)   Side View   Bot View

5.3 Terminal Configurations

Top View

Table 1. GSUB-0003 terminal configurations

Pin No.	Name of pin number	Type	Function
1	GPIO01	I/O	General Purpose IO, switching time is 125 ns. Alternative as CLK_REQ_38MHz, use for CLOCK request when using system clock 38.4MHz.
2	GPIO04	I/O	General Purpose IO, switching time is 125 ns.
3	RTC_SYNC	I	Real Time clock synchronization, alternative customer configuration as general-purpose IO, switching time is 125 ns.

Table 1. GSUB-0003 terminal configurations

Pin No.	Name of pin number	Type	Function
4	GPIO11	I/O	GPIO11_ANT_CTRL1. General purpose IO, switching time is dependent on the end control point, 125 ns when controlled by ARM, 33 ns when controlled by the DSP.
5	GPIO08_SE_IRQ	I/O	Secure Element Interrupt I2C_IRQ.
6	GPIO12	I/O	General Purpose IO, alternative customer configuration is secondary SPI bus select line SPI_SS, switching time is 125 ns.
7	COEX_1	I/O	Default customer configuration as secondary I2C-bus clock line I2C_SCL, alternative configuration as secondary UART RX line for the coexistence with Wi-Fi radio, switching time is 125 ns.
8	COEX_2	I/O	Default customer configuration as secondary I2C-bus clock line I2C_SCL, alternative configuration as secondary UART TX line for the coexistence with Wi-Fi radio, switching time is 125 ns.
9	GPIO13	I/O	General Purpose IO, switching time is 125 ns.
10	GPIO07	I/O	General Purpose IO, switching time is 125 ns.
11	UART_RX	I/O	RX connection of the UART interface, switching time is 125 ns.
12	UART_TX	I/O	TX connection of the UART interface, switching time is 125 ns.
13	GPIO05_SENSORINT	I/O	General Purpose IO, switching time is 125 ns. IRQ sent to Host to let it know data are available for read.
14	GPIO06	I/O	General Purpose IO, switching time is 125 ns.
15	EXT_XTAL1_32K	I	Input for the 32 KHz oscillator which is used for the RTC.
16	EXT_XTAL2_32K	I	Second input for the 32 KHz oscillator which is used for the RTC.
17	GND1	G	GND
18	GND2	G	GND
19	GND3	G	GND
20	GND4	G	GND
21	GND5	G	GND
22	GND6	G	GND
23	GND7	G	GND
24	ANT0	I/O	RF Antenna port, TX / RX2 switched by internal DPDT.
25	GND8	G	GND

Table 1. GSUB-0003 terminal configurations

Pin No.	Name of pin number	Type	Function
26	GND9	G	GND
27	ANT1	I/O	RF Antenna port, TX / RX2 switched by internal DPDT.
28	GND10	G	GND
29	ANT3	I	RF Antenna port, RX1 switched by internal SPDT.
30	GND11	G	GND
31	ANT2	I	RF Antenna port, RX1 switched by internal SPDT.
32	GND12	G	GND
33	GND13	G	GND
34	GND14	G	GND
35	CHIPENABLE	I	Connection for disabling/enabling the chip.
36	HOST_1	I	Host interface line 1, default configuration is SPI clock line/alternative configuration is clock for the I3C interface or clock for the I2C host interface, switching time is 125 ns.
37	HOST_4	I/O	Host interface line 4, default configuration is SPI MISO connection alternating configuration I2C address 1, switching time is 125 ns.
38	GND15	G	GND
39	EXT_XTAL1_38M	I	NC. External RF-Interface 38.4 MHz oscillator input pin, a crystal has been integrated into the module.
40	GND16	G	GND
41	HOST_2	I/O	Host interface line 2. Default configuration is SPI Slave select connection, alternating configuration is I2C SDA connection, switching time is 125 ns.
42	HOST_3	I/O	Host interface line 3. Default configuration is SPI MOSI connection, alternative configuration is I2C address 0 or I3C address & data line "I3C_SDA", switching time is 125 ns.
43	GND17	G	GND
44	VDD_1V8_DIG	P	VDD for all Digital LDOs, Host interface and IO pins.
45	GND18	G	GND
46	VDD_1V8_RF	P	VDD supply for PA and Vin input to 1.8V RF.
47	GPIO14	I/O	GPIO14_ANT_CTRL. High switching speed general purpose IO used for antenna external switches, switching time is dependent on the end control point,

| | | | 125 ns when controlled by ARM, 33 ns when controlled by the DSP. |

Table 1. GSUB-0003 terminal configurations

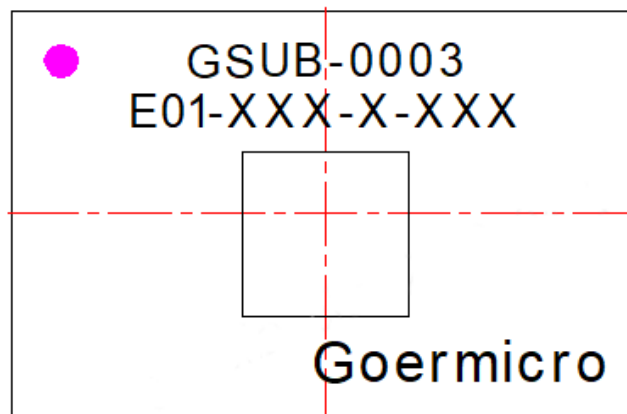| Pin No.	Name of pin number	Type	Function
48	GPIO03_SYNC	I	General Purpose IO, switching time is 125 ns. SPI RX handshake from the Host to the chip when in DPD mode.
49	GPIO09	I/O	General Purpose IO, switching time is 125 ns.
50	GPIO02	I/O	General Purpose IO, switching time is 125 ns. Alternative as CLK_REQ_32KHz, use for CLOCK request when using system clock 32KHz.
51	GPIO10	I/O	General Purpose IO, switching time is 125 ns.
52	SE_4	I/O	General Purpose IO, switching time is 125 ns.
53	SE_3	I/O	General Purpose IO. Alternative customer configuration as secondary SPI bus, MOSI connection, switching time is 125 ns.
54	GND19	G	GND
55	GND20	G	GND
56	GND21	G	GND
57	GND22	G	GND
58	GND23	G	GND
59	GND24	G	GND
60	GND25	G	GND
61	SWD_IO	I/O	Serial Wire Debug interface input/output. Default customer configuration is secondary SPI bus MISO connection, switching time is 125 ns.
62	GND26	G	GND
63	GND27	G	GND
64	SWD_CLK	I/O	Serial Wire Debug interface clock input. Default customer configuration as secondary SPI bus clock interface connection SPI_SCK, switching time is 125ns.
65	GND28	G	GND
66	GND29	G	GND
67	SE1_SCL	I/O	Embedded Secure Element I2C CLK interface, I2C_SCL, switching time is 125 ns. 4K7 pull up to VDDIO_SE to be tuned according to I2C line shape analysis.
68	GND30	G	GND

Table 1. GSUB-0003 terminal configurations

Pin No.	Name of pin number	Type	Function
69	GND31	G	GND
70	SE2_SDA	I/O	Embedded Secure Element I2C-bus, I2C_SDA connection, switching time is 125 ns. 4K7 pull up to VDDIO_SE to be tuned according to I2C line shape analysis.
71	GND32	G	GND
72	GND33	G	GND

Note:

1. For more information on standard drive, see GPIO — General purpose input/output in NXP SR100T datasheet.

2. GPIO pins are to be left OPEN if not used.

5.4 Marking

Top View (Chip Side View)

Marking	Content	Height	Font	Type
Logo	Goermicro	0.5		
Projcet Name	GSUB-0003	0.4		
Version	E01	0.4		
Config Name	XXX	0.4		
Strip No.	X （X=1,...9,A,...Z,字母中省略I/O)	0.4		
Unit No.	XXX(XXX=001,..., 448)	0.4		

6. Absolute Maximum Ratings
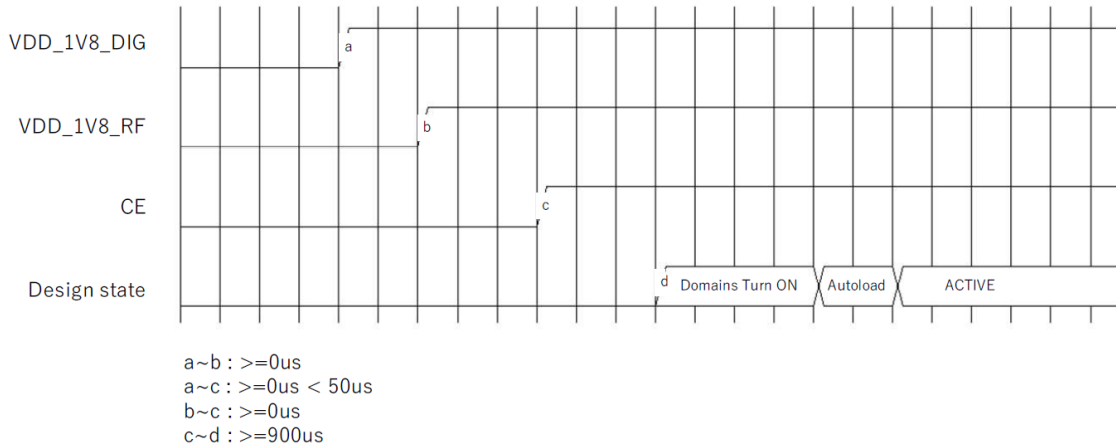
Table 2. Absolute maximus ratings

Parameter		Conditions	Min	Max	Unit
Supply Voltage	VDD_1V8_DIG	-	-	2.5	V
	VDD_1V8_RF	-	-	2.5	V
Supply Current	$I_{VDD\_DIG\_1V8\_MAX}$	Voltage pin @1.8V, 85°C	-	250	mA
	$I_{VDD\_RF\_1V8\_MAX}$	Voltage pin @1.8V, 85°C	-	275	mA
$RX_{CHIP\_OFF\_NODAMAGE}$	Max. input level during off mode or HPD power mode	CW signal or other UWB, no damage	-	7	dBm
VESDH	ESD susceptibility (Human Body Model)	1500 Ω, 100 pF; EIA/JESD22-A114-D	-	2	kV
VESDC	ESD susceptibility (Charge Device Model)	Field induced model; EIA/JESC22-C101-C, for all IO except RF group	-	1	kV
Total Power Dissipation		All Modes	-	TBD	mW
Storage Temperature		-	-55	150	°C

7. Recommended Operating Conditions

Table 3. Recommended operating conditions

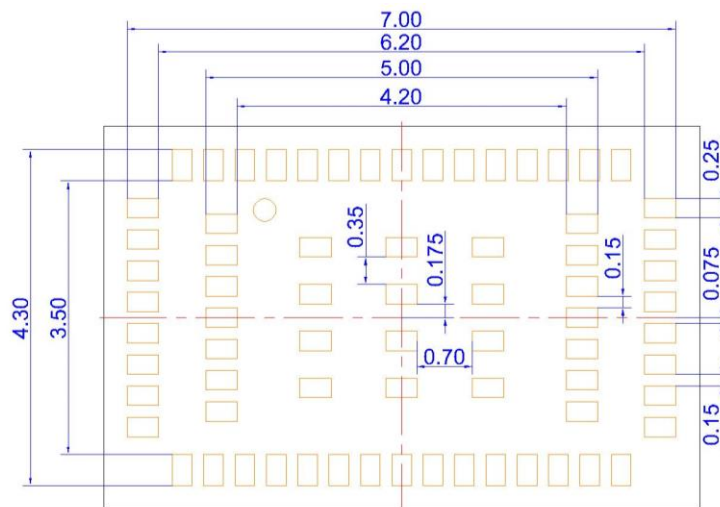| Parameter	Conditions	Min	Typ	Max	Unit
Frequency Range	Operating frequency Ch5,Ch6, Ch8 and Ch9	6.24	-	8.24	GHz
Operating Temperature	Ambient temperature	-30	+25	+85	°C
Supply Voltage	VDD supply	1.71	1.8	1.98	V
Max input level	CW signal or other UWB, no damage	-	-	7	dBm
	UWB signal, functional	-	-14	1	dBm
Start-up time	From wake-up or reset release to start of application execution	-	500	-	ms
Maximum allowed operating junction temperature before module enters automatic DPD state		-	-	+118	°C

8. Power Up Sequence

a~b : >=0us
a~c : >=0us < 50us
b~c : >=0us
c~d : >=900us

9. DC / RF Characteristics

Table 4. Quick reference data

Parameter	Conditions	Min	Typ	Max	Unit
Supply Current	Hard Power Down State (HPD)	-	17	-	µA
	DPD State retention mode	-	51	-	µA
	Active State, CPU Idle	-	15	-	mA
	Active State, signed and encrypted FW download	-	18	-	mA
	Active State, UWB time base maintenance, an frame processing during active ranging	-	55	-	mA
Peak Current RX	Single RX	-	206	-	mA
	Dual RX	-	283	-	mA
Peak Current TX	TX Max output power	-	245	-	mA
	TX at +7 dB peak output power	-	215	-	mA
	TX at +4 dB peak output power	-	190	-	mA
	TX 12 dBm CW	-	245	-	mA
DS-TWR average current consumption excluding DPD during active ranging	Controller/initiator average current consumption	-	79	-	mA
	Controlee/responder average current consumption in dual RX mode	-	90	-	mA
	Controlee/responder average current consumption in single RX mode	-	79	-	mA
DS-TWR average current consumption including DPD for 100ms ranging block	Controller/initiator average current consumption	-	10	-	mA
	Controlee/responder average current consumption in dual RX mode	-	11	-	mA
	Controlee/responder average current consumption in single RX mode	-	10	-	mA
Data Rate	Supported data rate	0.85	6.8	31.2	Mbps

Table 4. Quick reference data

Parameter	Conditions	Min	Typ	Max	Unit
PDoA: Phase difference of Arrival accuracy with 95% confidence level	Received signal at RX1 and RX2 > -80 dBm at chip input in line of sight Chanel condition	-3	-	+3	Deg
Secure Ranging ToF accuracy with 95 % confidence level	Line of sights accuracy when STS is used	-10	-	+10	cm
Pulse Repetition Rate	-	-	62.4	-	MHz
		-	124.8	-	MHz
		-	249.6	-	MHz
Output Power	Ch5 max output power	-	8.75	-	dBm
	Ch9 max output power	-	9.5	-	dBm
RX Sensitivity±10ppm carrier offset	850 kbps data rate	-	-	-100.5	dBm
	6.8 Mbps data rate	-	-	-92.5	dBm
	27 Mbps data rate	-	-	-89.5	dBm
	31.2 Mbps data rate	-	-	-89.5	dBm
Dual RX Sensitivity ±10ppm carrier offset	850 kbps data rate	-	-	-102.5	dBm
	6.8 Mbps data rate	-	-	-94.5	dBm
	27 Mbps data rate	-	-	-91.5	dBm
	31.2 Mbps data rate	-	-	-91.5	dBm
Double-Sided Pulse Band Width	Supporting 499.2 MHz bandwidth channels as specified in IEEE 802.15.4 (3 dB)	-	600	-	MHz
	Supporting 499.2 MHz bandwidth channels as specified in IEEE 802.15.4 (10 dB)	-	800	-	MHz

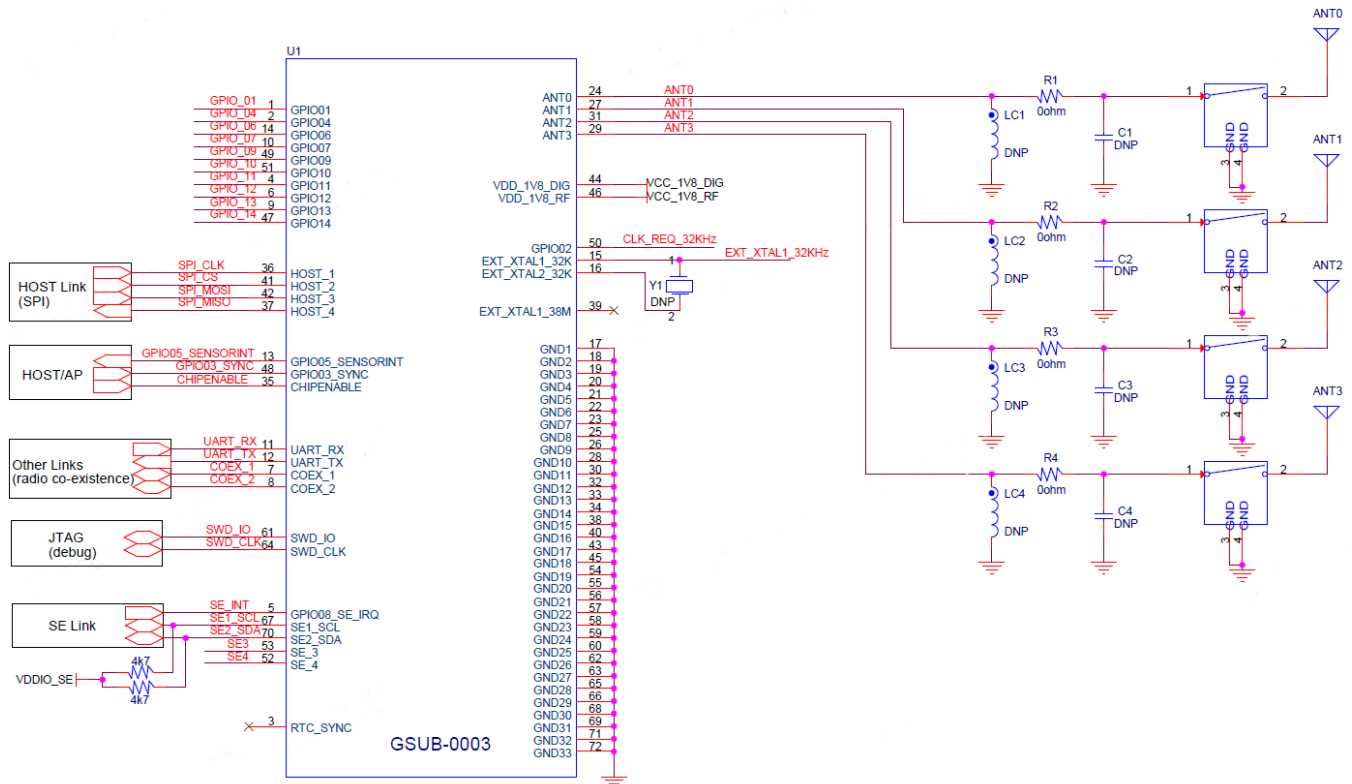# 10. Recommended Footprint Pattern

Top View

(unit : mm)

Note: This land pattern is for reference purpose only. Consult your manufacturing group to ensure your company's manufacturing guidelines are met.

11. Reference Circuit

12. CLK Interface

The GSUB-0003 module requires 2 different clocks:

● RF clock: reference clock for RF PLL（38.4MHz）has been integrated into the module

● LF clock: a 32.768kHz reference clock used for the digital core（CPU, UART）

The GSUB-0003 module can support two different clock sources:

● Clock provided by an external XTAL oscillator

● Reference clock provided by an external source（system platform clock, AC coupled, single ended）

The crystal of 32 kHz must be connected to the GSUB-0003 input clock port "EXT_XTAL1_32K" "EXT_XTAL2_32K" and the oscillator must be connected to the GSUB-0003 input clock port "EXT_XTAL1_32K" as shown in the reference circuit, "EXT_XTAL2_32K" is to be left OPEN . The external clock source shall comply with the following requirements as shown in table 5.

Table 5. 32kHz input clock requirements, AC coupling, single-ended

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Fxtal	Crystal frequency	-	-	32.768	-	kHz
Fxtal	Crystal frequency accuracy	Full operating range	-40	-	+40	ppm
ESR	Equivalent series resistance	-	-	70	90	kΩ
C_L	Load capacitance	-	7	9	12.5	pF
Pxtal	XTAL drive level	-	-	0.1	0.5	µW
Φ_n	Phase noise	Input noise floor at 1kHz offset	-	-	-90	dBc/Hz
Tstartup(xtal)	start-up time for crystal	-	-	0.3	1	s

Note: Load capacitors are not required if an 9pF XTAL is selected.
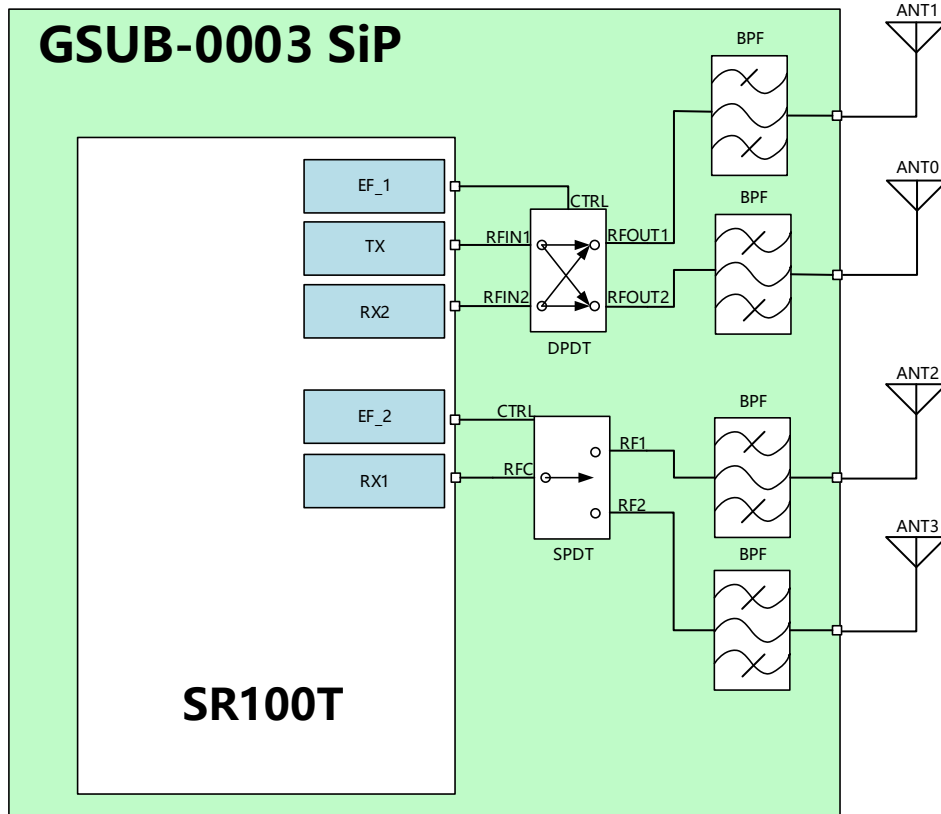
32 KHz ADPLL clock input requirements as shown in table 6.

Table 6. 32kHz input clock requirements, AC coupling, single-ended

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Fxtal	Clock frequency	ISO/IEC and FCC compliancy	-	32.768	-	kHz
Fi(ref)acc	Reference input frequency accuracy	Extended full operating Temperature -30°C to +85°C	-200	-	+200	ppm
Φ_n	Phase noise	Input noise floor at 1kHz offset	-	-	-90	dBc/Hz
Tstartup(xtal)	Start-up time for crystal	-	-	0.3	1	s
Square Shape						
ViH(clk)	Clock input voltage low level	-	-	-	10% of VDDIO	V
ViL(clk)	Clock input voltage high level	-	10% of VDDIO	-	-	V

13. RF Antenna Switching

Typically 3 antennas（ANT1/ANT2/ANT3） are used for 3D AOA, the 4th（ANT0） antenna is only used for ranging.

Table 7. Control Logic

EF_1	CTRL	DPDT	Logic State	Description
Low	Low	RFIN1- RFOUT1 RFIN2- RFOUT2	TX- ANT1 RX2- ANT0	RFIN1 connected to RFOUT1 and RFIN2 connected to RFOUT2
High	High	RFIN1- RFOUT2 RFIN2- RFOUT1	TX- ANT0 RX2- ANT1	RFIN1 connected to RFOUT2 and RFIN2 connected to RFOUT1
EF_2	**CTRL**	**SPDT**	**Logic State**	**Description**
Low	Low	RFC- RF1	RX1- ANT2	RF1 connected to RFC RX1 connected to ANT2
High	High	RFC- RF2	RX1- ANT3	RF2 connected to RFC RX1 connected to ANT3

Table 8. Switch Operating Conditions

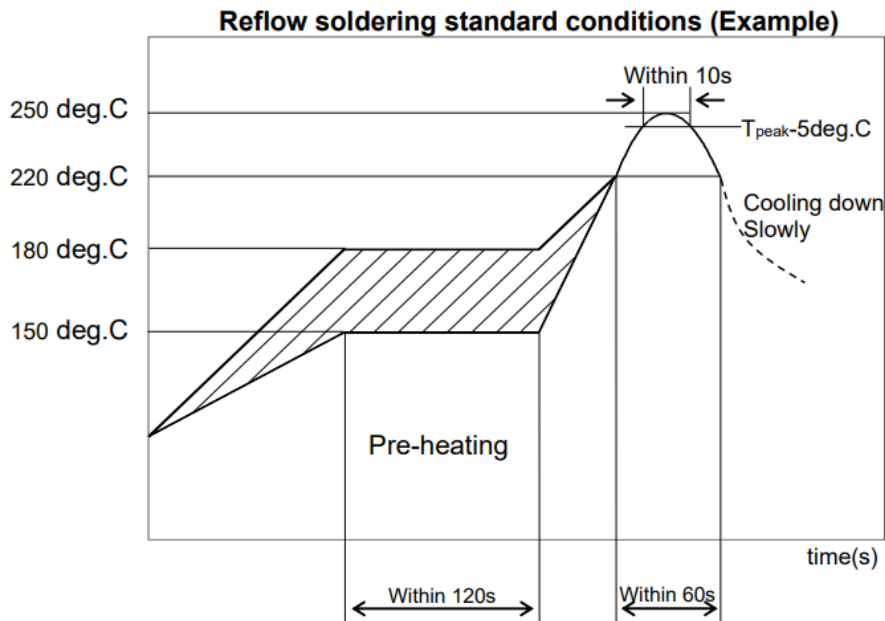| Switch	Parameter	Min	Typ	Max	Unit
SPDT	CTRL Logic High Voltage	1.62	1.80	1.98	V
	CTRL Logic Low Voltage	0.00	0.00	0.45	V
	CTRL Logic High Current	-	0.36	-	µA
	Switching Speed – Measured CTRL Voltage to 90% RF	-	300	400	ns
DPDT	CTRL Logic High Voltage	1.65	1.80	1.95	V
	CTRL Logic Low Voltage	0.00	0.00	0.45	V
	CTRL Logic High Current	-	0.1	0.5	µA
	Switching Speed – Measured CTRL Voltage to 90% RF	-	300	400	ns

14. Other Specification and Methods

14.1 Soldering Conditions

The recommendation conditions of soldering are as in the following figure.

Soldering must be carried out by the mentioned conditions to prevent products from damage.

Set up the highest temperature of reflow within 260 °C. Contact Goertek Microelectronics before use if concerning other soldering conditions.

Reflow soldering standard conditions (Example)

Please use the reflow within 2 times.

Use rosin type flux or weakly active flux with a chlorine content of 0.2 wt % or less.

15. Tape and Reel Packing (TBD)

15.1 Dimension of Tape

15.2 Dimensions of Reel

15.3 Packing Explain