SEONG JI / SRM200A

Monarch Quad-mode Module
P/N: WSSRM200A00

DATA SHEET Rev0.0

SEONG JI INDUSTRIAL CO., LTD
54-33, DongtanHana1(i)-gil, Hwaseong-si, Gyeonggi-do, 18423.
Rep. of Korea

Duong so 14, Lo X2, Khu cong nghiep Ho Nai, xa Ho Nai 3,
HUyen Trang Bom, Tinh Dong Nai, Vietnam

http://www.seongji.co.kr

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1. Approval Revision Record

NO	REVISION	RECORD OF REVISION	Date	Remark
1	REV 0.0	WSSRM200A00 Initial Releases	2019-12-01	-
2	REV 0.1	certification No. added.	2019-12-24	

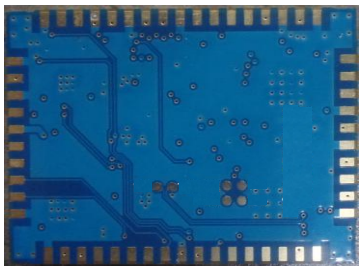
2. Scope

- Description
  - Sigfox Configuration RC1, RC2, RC3, RC4, RC5, RC6
  - WIFI (2.4GHz) : Supports 802.11 b/g/n.
  - BLE : Support version BT4.2.
  - NFC : Type 2 near field communication (NFC-A) tag with wakeup-on-field and touch to-pair capabilities.
  - GPS : Supports GPS and GLONASS.
  - Accelerometer : ±2g/±4g±/8g dynamically selectable full-scale.
- Type : SMD Type
- PBA Size : 29mm(W) x 21mm(L) x 2.3mm(H)

This module has completed SIGFOX P1 verification and ETSI, FCC, IC, Telec and KC RF regulatory certification.

3. Numbering of product

3-1. Product



3-2. Part No.

W	S	S	R	M	2	0	0	A	0	0
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

No.	EXPLANATION
(1),(2)	Product Type(WS:Wireless Solution)
(3)	Application(S:Sigfox)
(4)	Application(R:Roaming)
(5)	Type(M:Module)
(6),(7),(8)	Group model(200: Quad mode)
(9)	Derived model : Sub Part(A:Default)
(10),(11)	Managed Code : Default(00)

3-3. Lot. No.

S	A	C	J	A	2	1	0	1
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

(1)	Sigfox Module
(2)	Manufacture Area Packing Lot: A / B / C Area: Korea / China / Vietnam
(3)	Year 2018 E, 2019 F, 2020 G, 2021 H, 2022 I, 2023 J, 2024 K, 2025 L, 2026 M, 2027 N
(4)	Month 1 A, 2 B, 3 C, 4 D, 5 E, 6 F, 7 G, 8 H, 9 I, 10 J, 11 K, 12 L
(5)	Day 1 1, 2 2, 3 3, 4 4, 5 5, 6 6, 7 7, 8 8, 9 9, 10 A 11 B, 12 C, 13 D, 14 E, 15 F, 16 G, 17 H, 18 I, 19 J, 20 K 21 L, 22 M, 23 N, 24 O, 25 P, 26 Q, 27 R, 28 S, 29 T, 30 U, 31 V
(6), (7)	Group Model
(8), (9)	A Serial Number (00,01,02…1serial: 600ea)

4. Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
VCC	Module input voltage	3.6	V
OT	Operating Temperature	-30 to +85	℃
ST	Storage Temperature	-40 to +125	℃
Ves	Electrostatic handling(HBM)	+/-2000	V

5. DC Characteristics

Symbol	Parameter	Min	Typ.	Max	Unit
VCC	Module input voltage	3.0	3.3	3.6	V

6. I/O Specifications

Symbol	Parameter	Min	Typ.	Max	Unit
VCC	supply voltage		3.3	3.6	V
VIH	High level input voltage	2.1			V
VIL	Low level input voltage			0.9	V

7. Specifications

7-1. Sigfox

7-1-1. Electrical Specification

Conditions: VCC=3.3V, Temp=25℃

Parameter		Min	Typ.	Max	Unit
Current	Tx Current(@+14.5dBm,CW)RC1,RC6		32		mA
	Tx Current(@+13.0dBm,CW)RC3,RC5		28		mA
	Tx Current(@+23.5dBm,CW)RC2,RC4		230		mA
	RX Current		18.5		mA
	Sleep Current		30		uA

7-1-2. Receiver, Transmitter Specification

Conditions: VCC=3.3V, Temp=25℃

Parameter			Min	Typ.	Max	Unit
RF Frequency Range	RC1	Tx	868.034	868.130	868.226	MHz
		Rx	869.429	869.525	869.621	MHz
	RC2	Tx	902.104	902.200	902.296	MHz
		Rx	905.104	905.200	905.296	MHz
	RC3	Tx	923.104	923.200	923.296	MHz
		Rx	922.104	922.200	922.296	MHz
	RC4	Tx	920.704	920.800	920.896	MHz
		Rx	922.204	922.300	922.396	MHz
	RC5	Tx	923.004	923.100	923.196	MHz
		Rx	922.004	922.100	922.196	MHz
	RC6	Tx	865.104	865.200	865.296	MHz
		Rx	866.204	866.300	866.396	MHz
Tx output power	RC1, RC6		+12.5	+14.5	-	dBm
	RC2, RC4		+21.5	+23.5	-	dBm
	RC3, RC5		+11.0	+13.0	-	dBm
Frequency Error Tolerance(+25℃)			-3.0	-	+3.0	ppm
2nd Harmonics(conducted)			-	-45	-35	dBm
3nd Harmonics(conducted)			-	-53	-35	dBm
Rx Sensitivity(@600bps, GFSK)			-	-	-123	dBm
Rx Spurious Emission(30MHz~12.75GHz)			-	-	-54	dBm

7-2. BLE

7-2-1. Electrical Specification

Conditions: VCC=3.3V, Temp=25℃

Parameter		Min	Typ.	Max	Unit
Target Power for TX					
BLE	Tx mode, Cont.Tx		14		mA
	Rx mode		13		mA

7-2-2. Receiver, Transmitter Specification

Conditions: VCC=3.3V, Temp=25℃

Parameter		Min	Typ.	Max	Unit
RF Characteristics					
RF Frequency Range		2.402	-	2.480	GHz
Output Power [TRM-LE/CA/01/C]		-1.0	3.0	7	dBm
In Band Emission[TRM-LE/CA/03/C] ±2MHz offset ±3MHz offset				-20 -30	dBm
Modulation Characteristics [TRM-LE/CA/05/C]	Delta F1 Avg.	225	-	275	KHz
	Delta F2 Max.	185	-	-	KHz
	Delta F2 Avg/F1 Avg	0.8	-	-	-
Carrier Frequency Offset and Drift [TRM-LE/CA/06/C]	Initial Center Frequency Tolerance	-50	-	50	KHz
	|Fn| Max.	-150	-	150	KHz
	|F0 -Fn| Max.	-	-	50	KHz
	|F1 – F0|	-	-	20	KHz
	|Fn = Fn-5| max.	-	-	20	KHz
Receiver Sensitivity [PER<30.8%, 1500packets]		-	-93.5	-70	dBm
Maximum input lever [PER<30.8%, 1500packets]		-10	0		dBm

7-3. WiFi

7-3-1. Electrical Specification

Conditions: VCC=3.3V, Temp=25℃

Parameter		Min	Typ.	Max	Unit
Target Power for TX					
2.4GHz	Tx mode, Cont.Tx@11M		215		mA
	Tx mode, Cont.Tx@54M		155		mA
	Tx mode, Cont.Tx@HT20 MCS7		156		mA
	Rx mode, Cont. Rx@11M		77		mA
	Rx mode, Cont. Rx@54M		77		mA
	Rx mode, Cont. Rx@HT20 MCS7		77		mA

Note: The above mentioned values have been obtained according to our own measuring methods and may very depend on the circuit, in which the component is actually incorporated. Therefore, you are kindly requested to test the performance of the component actually in your set.

7-3-2. Receiver Specification

Conditions: VCC=3.3V, Temp=25℃

Parameter	Conditions	Min	Typ.	Max	Unit
Minimum Receiver Sensitivity in 802.11b mode					
1Mbps	PER<8%, Packet size = 1024bytes	-	-95	-80	dBm
2Mbps		-	-91	-80	dBm
5.5Mbps		-	-84	-76	dBm
11Mbps		-	-84	-76	dBm
Minimum Receiver Sensitivity in 802.11g mode					
6Mbps	PER<10%, Packet size = 1024bytes	-	-89	-82	dBm
9Mbps		-	-88	-81	dBm
12Mbps		-	-87	-79	dBm
18Mbps		-	-85	-77	dBm
24Mbps		-	-82	-74	dBm
36Mbps		-	-79	-70	dBm
48Mbps		-	-74	-66	dBm
54Mbps		-	-72	-65	dBm
Minimum Receiver Sensitivity in 802.11n mode					
HT20, MCS7	PER<10%	-	-70	-64	dBm
Maximum Input Signal Level					
802.11b mode	PER<8%	-10	-	-	dBm
802.11g mode	PER<10%	-20	-	-	dBm

802.11n mode	PER<10%	-20	-	-	dBm
Adjacent channel rejection (ACR) in 802.11b mode					
1Mbps	PER<8%, Packet size = 1024bytes	35	-	-	dB
2Mbps		35	-	-	dB
5.5Mbps		35	-	-	dB
11Mbps		35	-	-	dB
Adjacent channel rejection (ACR) in 802.11g mode					
6Mbps	PER<10%, Packet size = 1024bytes	16	-	-	dB
9Mbps		15	-	-	dB
12Mbps		13	-	-	dB
18Mbps		11	-	-	dB
24Mbps		8	-	-	dB
36Mbps		4	-	-	dB
48Mbps		0	-	-	dB
54Mbps		-1	-	-	dB
Adjacent channel rejection (ACR) in 802.11n mode					
MCS0	PER<10%	16	-	-	dB
MCS7		-2	-	-	dB

7-3-3. Transmitter Specification

The WiFi output power of the SRM200A module is set as the below table value.
The output power set in the SRM200A module is RF regulatory certification based on the SEONGJI reference board and the external antenna (INNO-LINK: INNO-EWFSWS-151).
Refer to "WiFi RF Output Power Control_ver01" for power control method to increase output power by using internal antenna or chip antenna which is lower efficiency than SEONGJI reference antenna.
If the output power set in the SRM200A module is changed, WiFi RF regulatory certification of the product is required.

Conditions: VCC=3.3V, Temp=25℃

Parameter	Conditions	Min	Typ.	Max	Unit
Output Power in 802.11b mode, CCK					
1~11Mbps	As specified in IEEE802.11	7.5	10	12.0	dBm
Output Power in 802.11g mode, OFDM					
6M~54Mbps	As specified in IEEE802.11	7.5	10	12.0	dBm
Output Power in 802.11n mode, HT20, OFDM					
MCS0~7	As specified in IEEE802.11	7.5	10	12.0	dBm
Spectrum mask					
Margin to 802.11b/g/n all mode	Maximum output power	0	-	-	dBr

Modulation Accuracy in 802.11b mode					
1Mbps	As specified in IEEE802.11	-	-	35	%
2Mbps		-	-	35	%
5.5Mbps		-	-	35	%
11Mbps		-	-	35	%
Modulation Accuracy in 802.11g mode					
6Mbps	As specified in IEEE802.11	-	-	-5	dB
9Mbps		-	-	-8	dB
12Mbps		-	-	-10	dB
18Mbps		-	-	-13	dB
24Mbps		-	-	-16	dB
36Mbps		-	-	-19	dB
48Mbps		-	-	-22	dB
54Mbps		-	-	-25	dB
Modulation Accuracy in 802.11n mode					
HT20, MCS7	Full packet	-	-	-27	dB
Frequency Tolerance					
802.11b/g/n	Operating Temp.	-25	0	25	ppm

7-4. GPS

7-4-1. Module Specification

Conditions: VCC=3.3V, Temp=25℃

Frequency	L1, 1575.42MHz
GPS Sensitivity	
Tracking	-158 dBm
Navigation	-157 dBm
Acquisition (Cold start)	-143 dBm
C/N0[2]	- 37
Time To First Fix[2]	
Hot Start	< 1s
Cold Start	< 35s

7-5. NFC

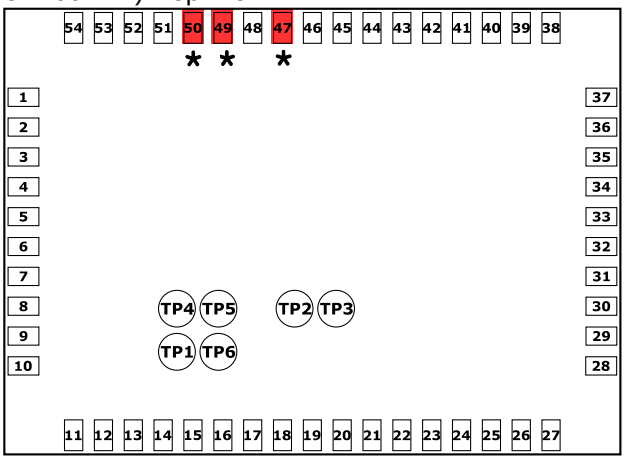
7-5-1. Electrical Specification

Parameter	Min	Typ.	Max	Unit
RF Input Frequency		13.56		MHz
ISO-14443A				
Carrier modulation index	95			%
Data Rate		106		Kbps
Modulation sub carrier frequency		13.56 /16		MHz
NFC Reader	Min	Typ.	Max	Unit
ACR122U (ACS)[1] reading range	40			mm
Dragon (DUAL I)[2] reading range	50			mm

1.Measurement NFC reader
[1]ACR122U: http://www.acs.com.hk/en/products/3/acr122u-usb-nfc-reader/
[2]Dragon: http://duali.com/eng/nfc-product/nfc-reader/nfc-desktop-readers.html
2. Demonstrated with a reference antenna included in the EVK.

8. Pin Description

8-1. Interface PIN(SMD Type : 60 Pin) Top view



NO	PIN NAME	NO	PIN NAME	NO	PIN NAME
1	STATE_LINK_WIFI	22	I2C0_SCL_DBG	43	GND
2	STATE_WORK_WIFI	23	STATE0	44	NFC2
3	NC	24	WKUP	45	NFC1
4	GND	25	SWCLK_SFX	46	GND
5	GPS_RF	26	SWDIO_SFX	47	DL_EN/INT_WIFI *
6	GND	27	GND	48	NRST_SFX
7	VDD_MAIN_3P0	28	GND	49	UART0_RX_WIFI *
8	V_BCKP_GPS	29	STATE_RF_SFX	50	UART0_TX_WIFI *
9	VDD_GPS	30	DIO7/BOOT	51	VDD_WIFI
10	GND	31	SWDCLK	52	GND
11	GND	32	SWDIO	53	WIFI_RF
12	INT1_ACC	33	VDD_SFX	54	GND
13	I2C1_SDA_ACC	34	NRST	TP1	NC (VDD USB For GPS)
14	I2C1_SCL_ACC	35	GND	TP2	NC (USB DM For GPS)
15	I2C1_SCL_BLE	36	SIGFOX_RF	TP3	NC (USB DP For GPS)
16	I2C_SDA_BLE	37	GND	TP4	NC (GND for GPS)
17	DIO13	38	GND	TP5	NC
18	BATT	39	AIN1	TP6	NC
19	GND	40	AIN0		
20	2ND_POW_EN	41	GND		
21	I2C0_SDA_DBG	42	BLE_RF		

***** In case of RF regulatory certification, connect to external connector or Test-point to download WiFi test firmware. For details, refer to "8-2-1 Hardware connection for RF Regulatory Certification".

8-2. Interface PIN description

NO.	PIN NAME	TYPE	DESCRIPTION
1	STATE_LINK_WIFI	O	WiFi Link state, 0: unlinked 1: linked
2	STATE_WORK_WIFI	O	WiFi working state, 0: not working 1: working
3	NC		Not connect
4,6,10,11,19, 27,28,35,37,38, 41,43,46,52,54	GND	P	Ground
5	GPS_RF	RF	GPS RF Input
7	VDD_MAIN_3P0	P/I	Supply 3.0V ~ 3.6V
8	V_BCKP_GPS	P/I	GPS backup power
9	VDD_GPS	P/O	GPS Power
12	INT1_ACC	I	Accelerometer interrupt
13	I2C1_SDA_ACC*		Accelerometer Side, connect pin16(I2C1_SDA_BLE)
14	I2C1_SCL_ACC*		Accelerometer Side, connect pin15(I2C1_SCL_BLE)
15	I2C1_SCL_BLE*		BLE(CPU) Side, connect to pin14(I2C1_SCL_ACC)
16	I2C1_SDA_BLE*		BLE(CPU) Side, connect to pin13(I2C1_SDA_ACC)
17	DIO13	I/O	General purpose I/O BlueNRG
18	BATT	P/I	Supply 3.0V ~ 3.6V
20	2ND_POW_EN	O	Secondary DCDC power enable
21	I2C0_SDA_DBG		Module Debugging port for I2C. **It must be connected to an external connector or TP for use in RF regulatory certifications.**
22	I2C0_SCL_DBG		Module Debugging port for I2C. **It must be connected to an external connector or TP for use in RF regulatory certifications.**
23	STATE0	O	Indicate module(BLE) state
24	WKUP	I	Module Wake-up from sleep state
25	SWCLK_SFX	I	Sigfox BlueNRG SW Clock input for programming **It must be connected to an external connector or TP for use in RF regulatory certifications**
26	SWDIO_SFX	I/O	Sigfox BlueNRG SWD I/O for programming **It must be connected to an external connector or TP for use in RF regulatory certifications**
29	STATE_RF_SFX	O	Sigfox RF state output
30	DIO7/BOOT	I	Bootloader pin, General purpose digital I/O
31	SWDCLK	I	BLE SWD clock input for debug and programming. **It must be connected to an external connector or TP for use in RF regulatory certifications.**
32	SWDIO	I/O	BLE SWD I/O for debug and programming.

			It must be connected to an external connector or TP for use in RF regulatory certifications.
33	VDD_SFX	P/O	Sigfox Power output
34	NRST	I	BLE Reset , Main reset , active low
36	SIGFOX_RF	RF	Sigfox RF In/Out
39	AIN1	I/O	Analog input, General purpose I/O
40	AIN0	I/O	Analog input, General purpose I/O
42	BLE_RF	RF	BLE RF In/Out
44	NFC2	I/O	NFC antenna connection , General purpose I/O
45	NFC1	I/O	NFC antenna connection , General purpose I/O
47	DL_EN/INT_WIFI	I	WiFi Download enable , active high. **It must be connected to an external connector or TP for use in RF regulatory certifications.**
48	NRST_WIFI	I	WiFi Reset , do not connect
49	UART0_RX_WIFI	I	WiFi Download **It must be connected to an external connector or TP for use in RF regulatory certifications.**
50	UART0_TX_WIFI	O	WiFi Download **It must be connected to an external connector or TP for use in RF regulatory certifications.**
51	VDD_WIFI	P/O	WiFi Power output
53	WIFI_RF	RF	WiFi RF In/Out
TP1	NC		Internal connection
TP2	NC		Internal connection
TP3	NC		Internal connection
TP4	NC		Internal connection
TP5	NC		Internal connection
TP6	NC		Internal connection

- To use internal accelerometer sensor, connect pin 13 to pin 16 and pin 14 to pin 15.
- Slave address of internal accelerometer is 0x18(7bit)
- External I^2C devices can be connected to pin 15 and 16.

8-2-1. Hardware connection for RF Regulatory Certification

When performing RF certification on products using the SRM200A module, you must have the following hardware connections to control each RF block and download the test-firmware.

- **WiFi control and firmware download**

The specified test-firmware must be downloaded to the internal flash memory of the SRM200A module and controlled using the AT command to RF certification proceed. Hardware pin47, pin49 and pin50 must be connected to an external connector or test-point.

- **Sigfox, BLE, GPS control**

There is no need to download a test-firmware, and one of the two below must be connected to an external connector or test-point to control the RF block.

[Case 1]
The SWD(pin31 and pin32) port can be used to control Sigfox, BLE and GPS.
However, JTAG equipment such as J-link is required.
[Case 2]
The I2C(pin21 and pin22) port can be used to control Sigfox, BLE and GPS.
However, I2C to USB converter is required.

8-2-2. WIFI status PIN

- STATE_LINK_WIFI : TBD
- STATE_WORK_WIFI : WIFI Scan State (0: not working 1: working)

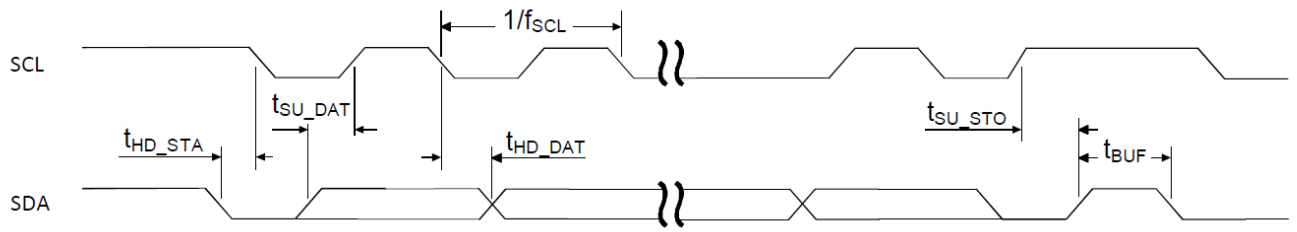
8-2-3. Sigfox status PIN

- STATE_RF_SFX: Sigfox RF state output

8-2-4. I2C Master for external sensors

- The TWI master is compatible with I2C operating at 100 kHz and 400 kHz.

Symbol	Description	Min.	Typ.	Max.	Units
f_{TWI},SCL,100k	SCL clock frequency, 100 kbps		100		kHz
f_{TWI},SCL,400k	SCL clock frequency, 400 kbps		400		kHz
t_{TWI},SU_DAT	Data setup time before positive edge on SCL – all modes	300			ns
t_{TWI},HD_DAT	Data hold time after negative edge on SCL – all modes	500			ns
t_{TWI},HD_STA,100k	TWI master hold time for START and repeated START condition, 100k	10000			ns
t_{TWI},HD_STA,400k	TWI master hold time for START and repeated START condition, 400k	2500			ns
t_{TWI},SU_STO,100k	TWI master setup time from SCL high to STOP condition, 100k	5000			ns
t_{TWI},SU_STO,400k	TWI master setup time from SCL high to STOP condition, 400k	1250			ns
t_{TWI},BUF,100k	TWI master bus free time between STOP and START conditions, 100k	5800			ns
t_{TWI},BUF,400k	TWI master bus free time between STOP and START conditions, 400k	2100			ns



TWI timing diagram, 1 byte transaction

8-2-5. I2C Slave for debug

- Up to 400Khz

8-2-6. Two-pin Serial Wire Debug (SWD) interface

- The debug and trace system offers a flexible and powerful mechanism for non-intrusive debugging.

The main features of the debug and trace system are:
. Two-pin Serial Wire Debug (SWD) interface
. Flash Patch and Breakpoint Unit (FPB) supports:
. Two literal comparators
. Six instruction comparators
. Data Watchpoint and Trace Unit (DWT)
. Four comparators
. Instrumentation Trace Macrocell (ITM)
. Embedded Trace Macrocell (ETM)

8-2-7. GPIOs

- support 4 GPIO
  STATE0
  WKUP
  AIN1
  AIN0

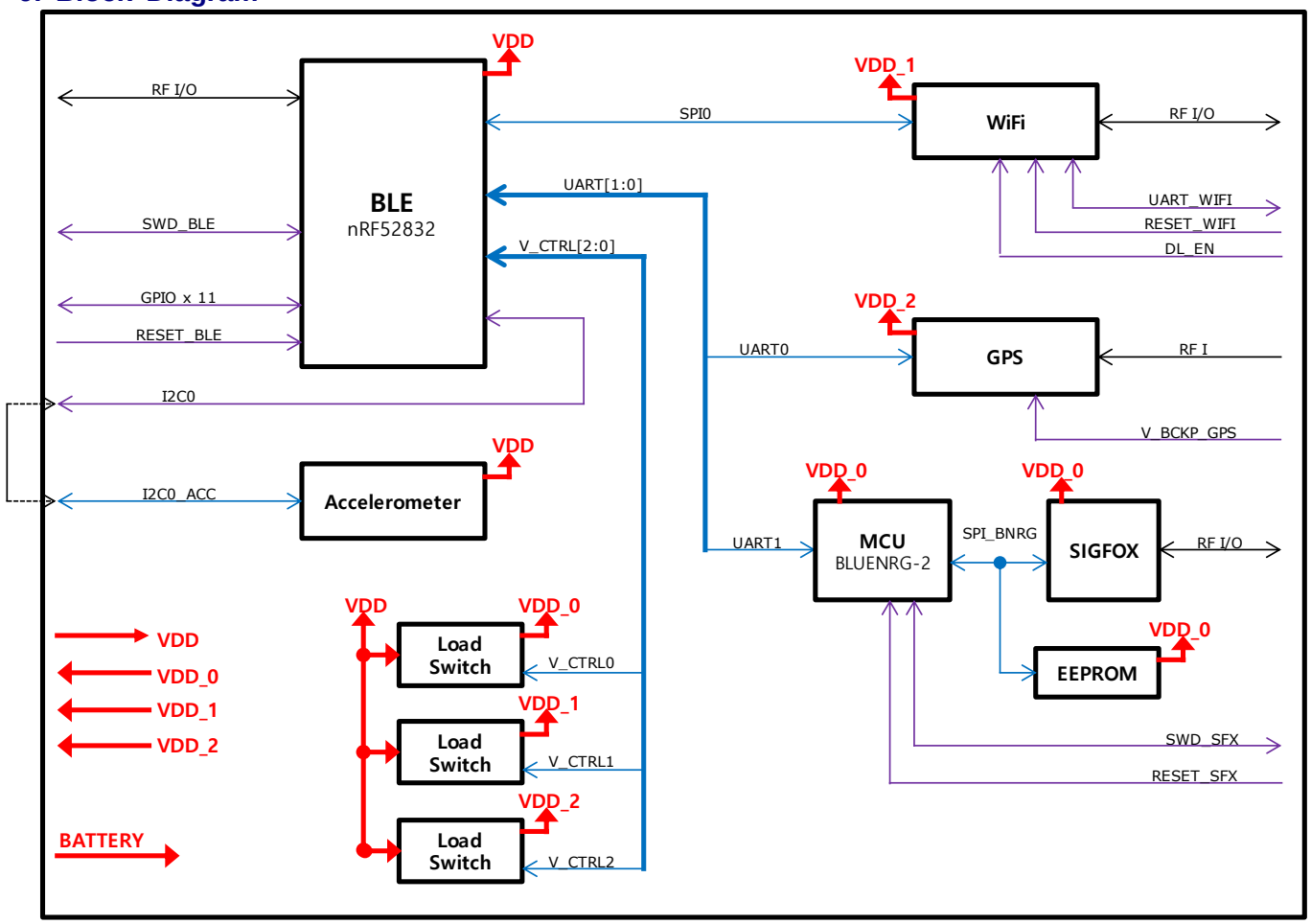
8-2-8. NFC

- Type 2 near field communication (NFC-A) tag with wakeup-on-field and touch to-pair capabilities

8-2-9. Reset Pin

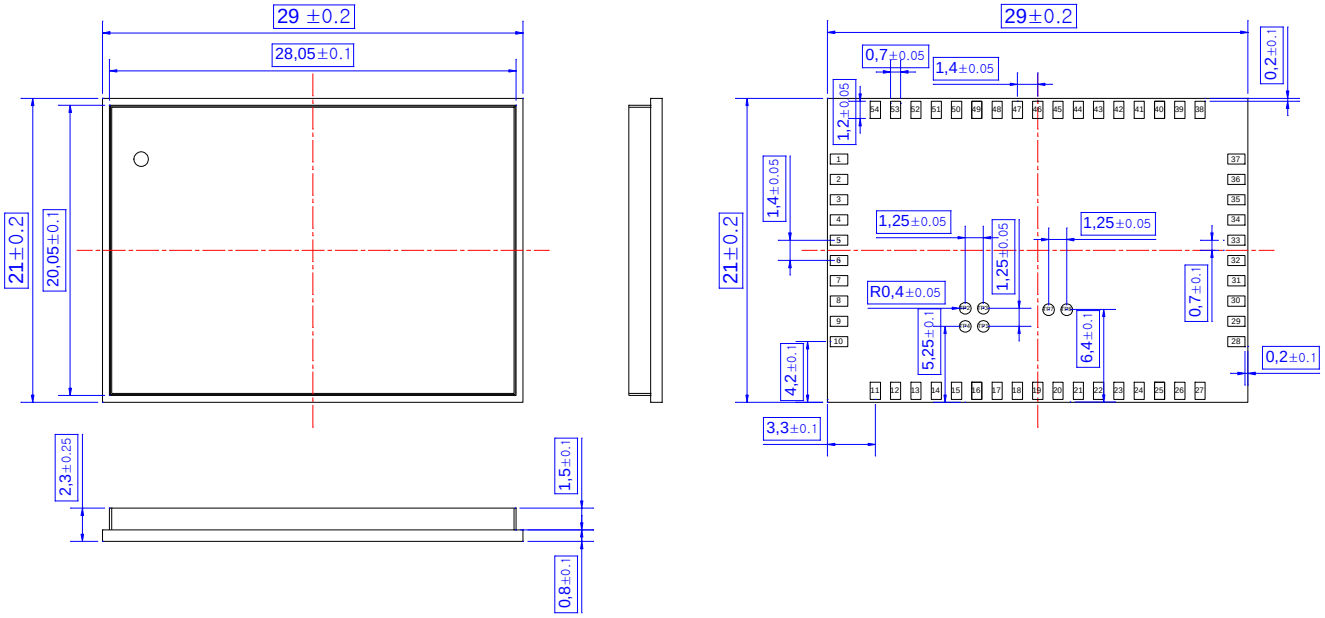
- Chip reset input. Active low.

9. Block Diagram

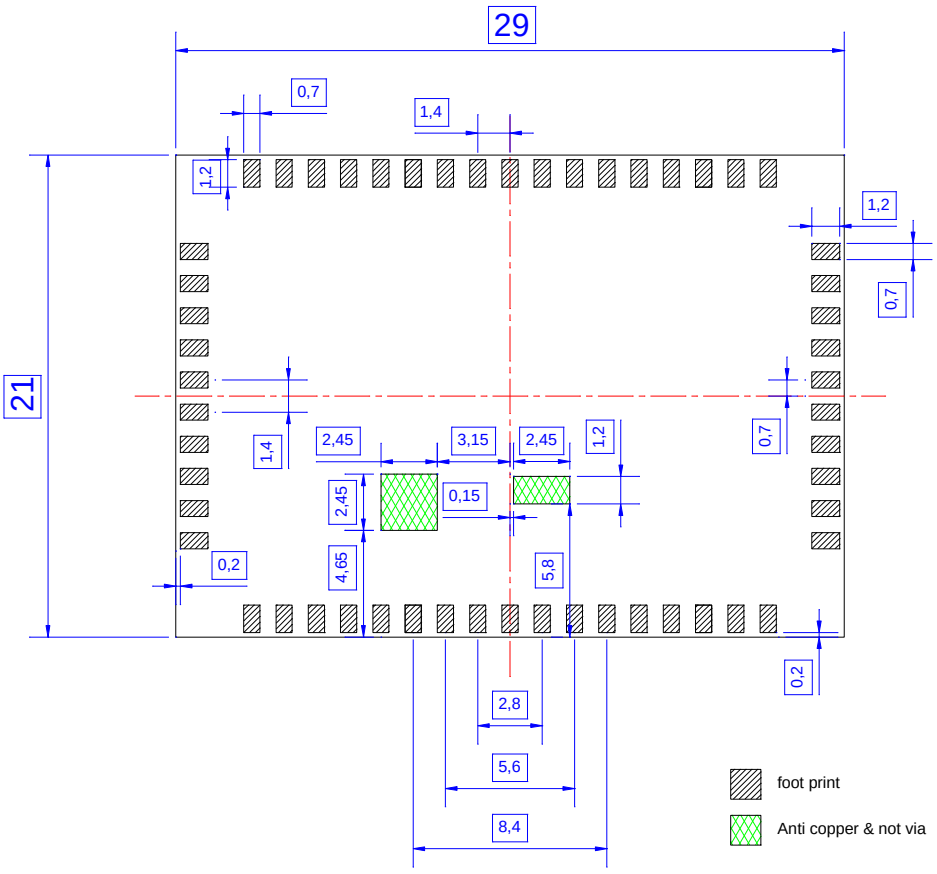


10. Dimensions & drawing

10-1. Design dimension

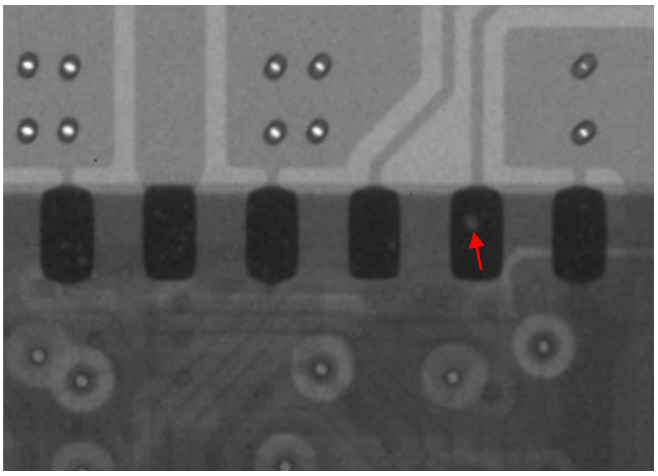
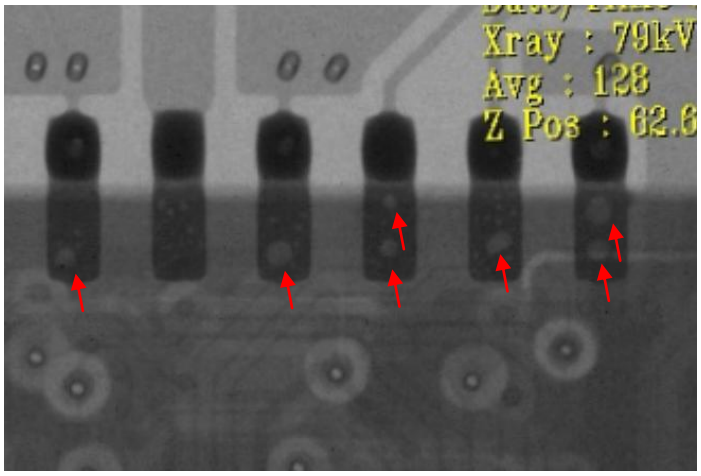
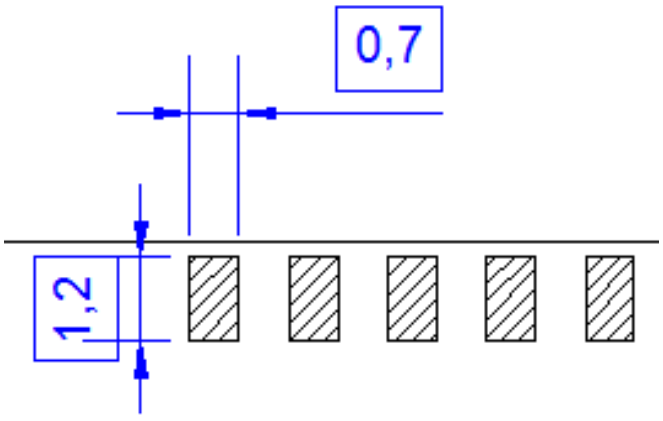
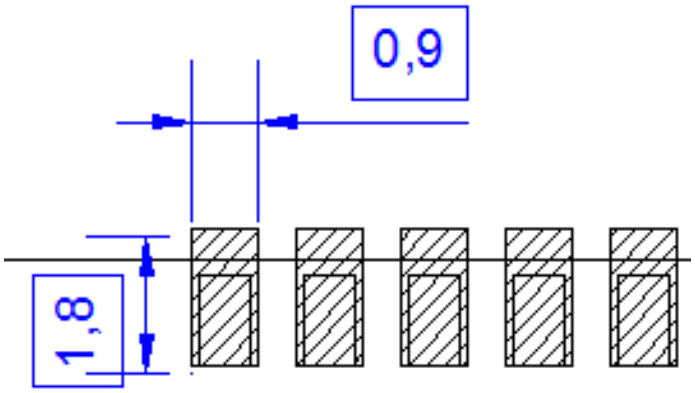


10-2. Recommend Foot print



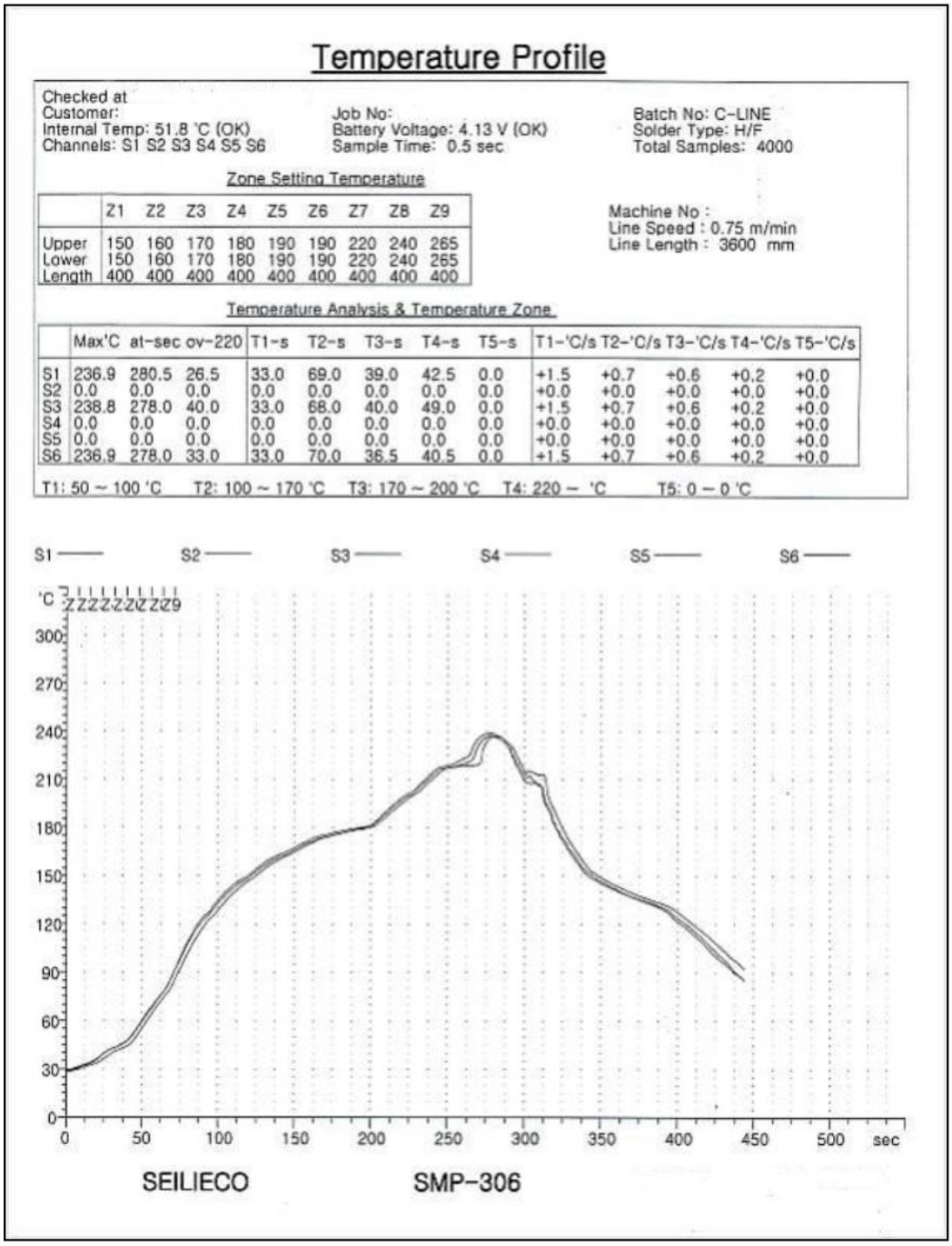
- **X-ray by Foot print size**

The foot print size was designed 0.7x1.2mm and 0.9x1.8mm then the SMD was performed.
It is not a big difference, but it can be seen that the design with 0.7x1.2mm has better soldering performance with less Void as seen in the X-ray below. The disadvantage is that manual soldering is not possible, so it may be better to design 0.9x1.8mm for development stage. However, we recommend a foot print of 0.7 x 1.2mm for mass production.
Please don't use a bigger PAD like as 0.9x1.8mm than recommended PAD except for the development stage.

	
	
[Foot print size : 0.7 x 1.2mm]	[Foot print size : 0.9 x 1.8mm]

11. Reflow profile

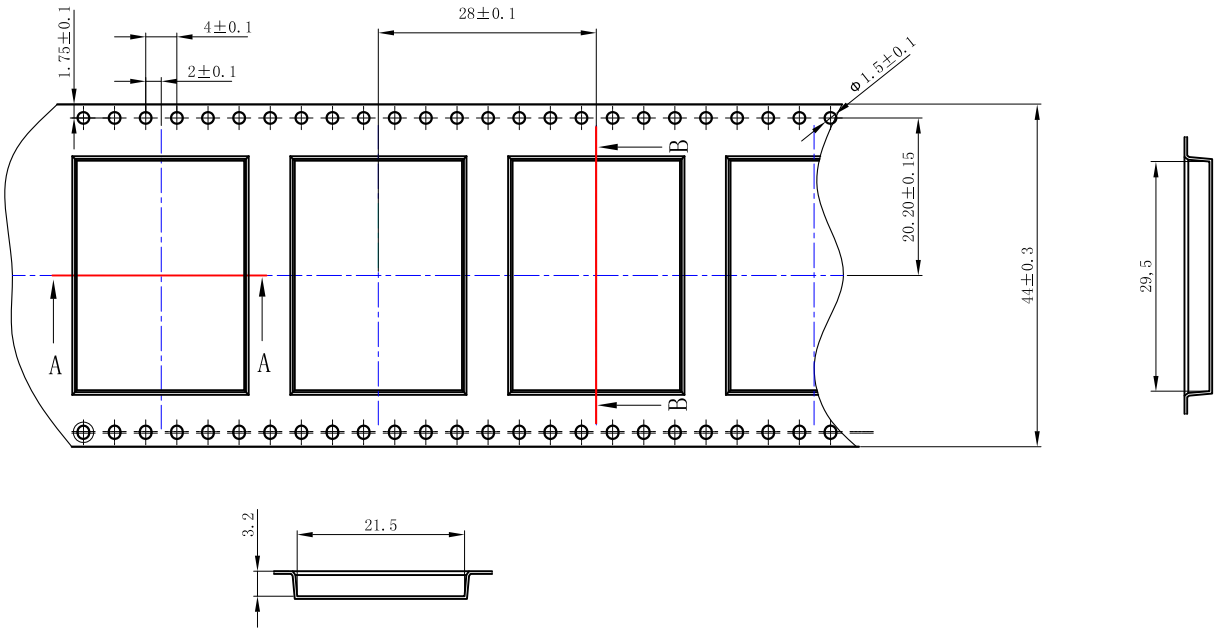
<Reflow profile of Module>



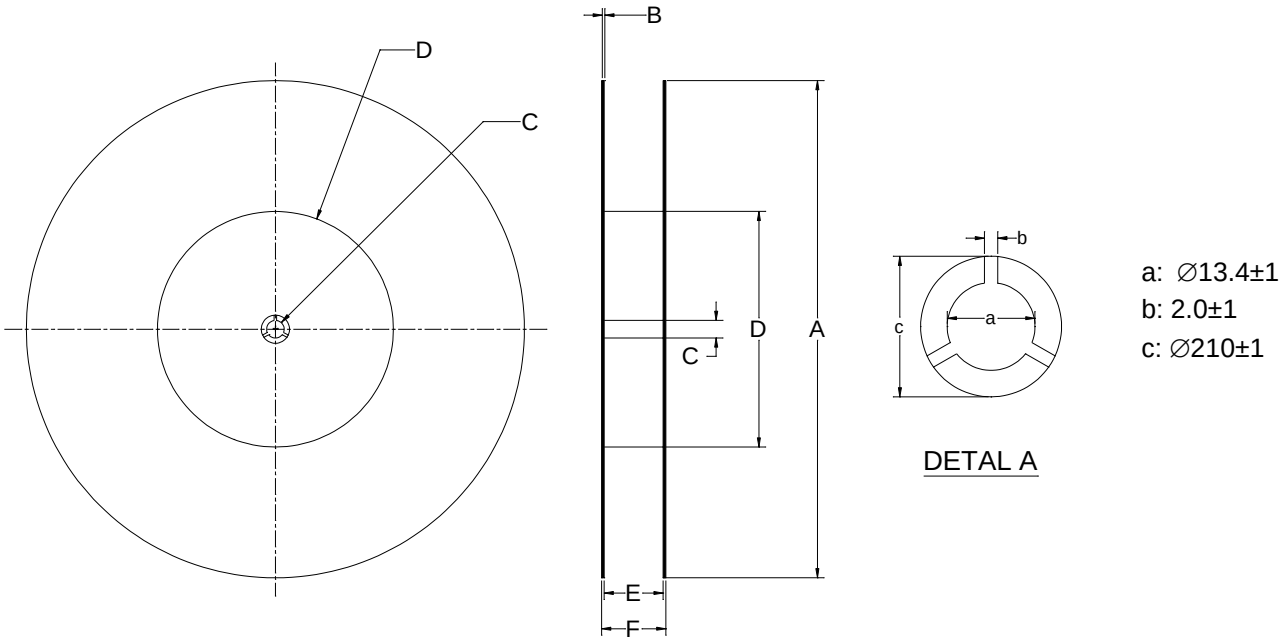
	Preheat	Soak	Ramp	PEAK
SPEC	50~100℃	100~170℃	220℃ ↑	240℃
	1~2℃/sec	60~100sec	30~50sec	±5℃
result of measurement	1.5	69	44	237.5
	OK	OK	OK	OK

12. Package

12-1. Dimension of Tape

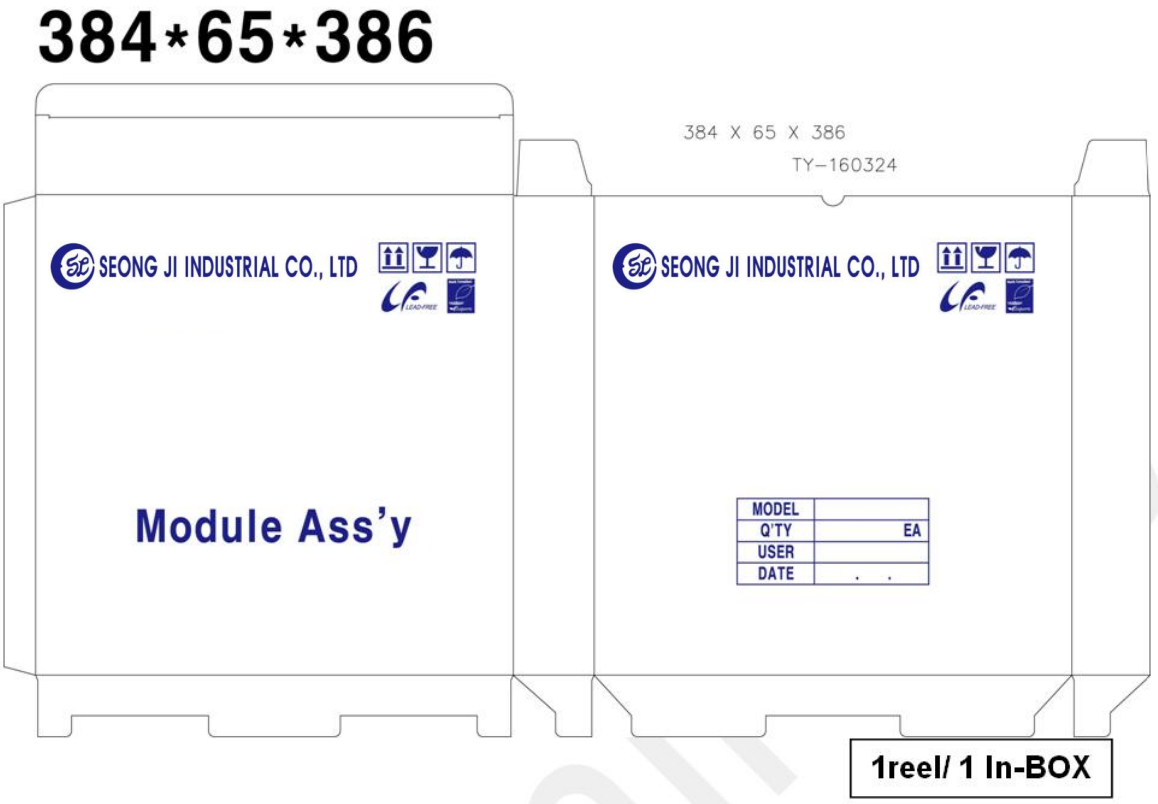


12-2. Dimension of Reel

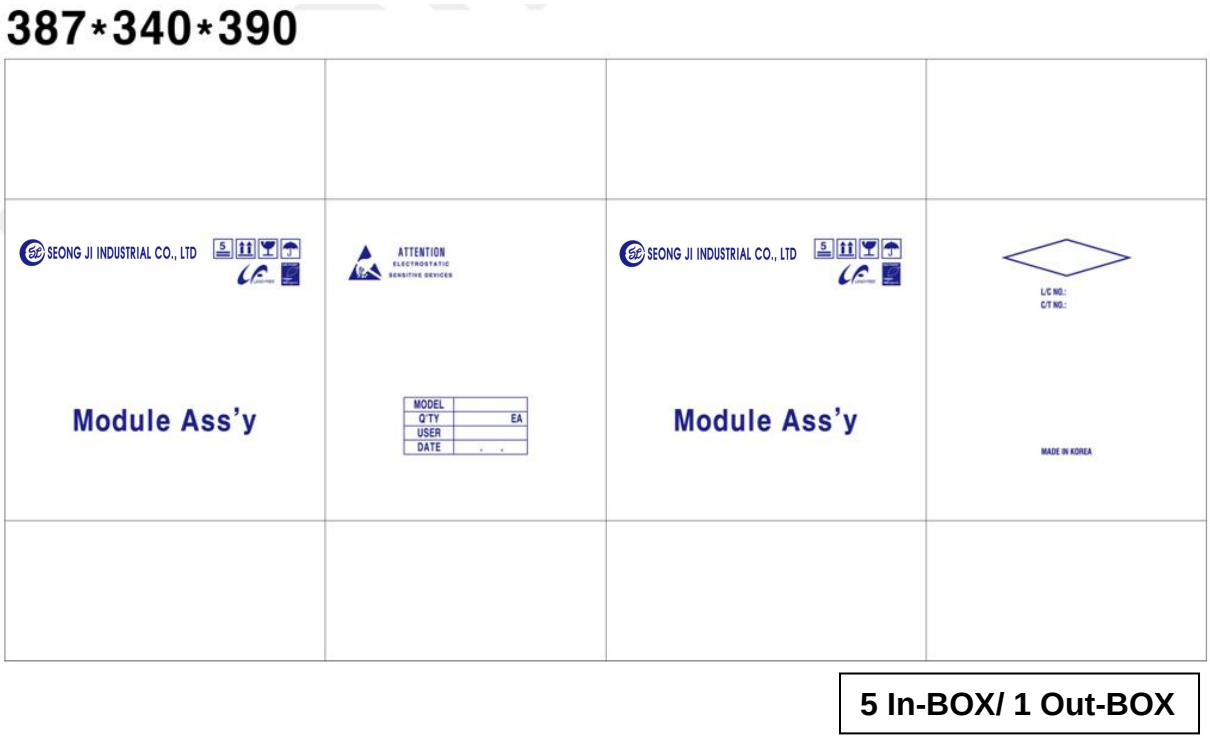


A	B	C	D	E	F
380 ± 1 mm	2 ± 1 mm	13.4 ± 1 mm	180 ± 1 mm	45 ± 1 mm	49 ± 1 mm

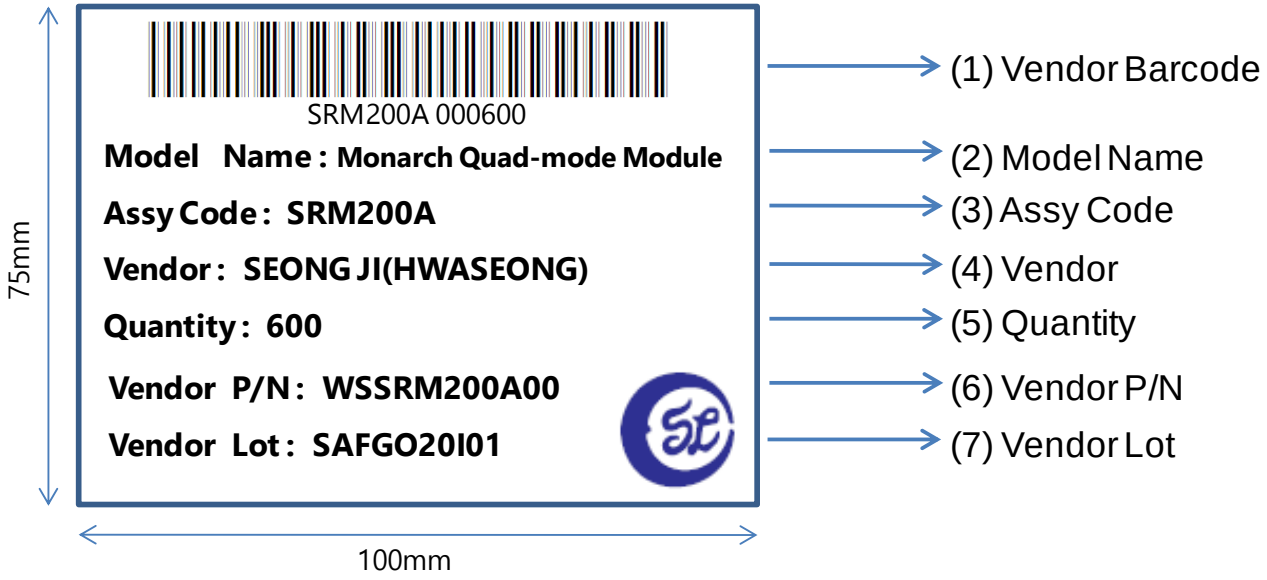
12-3. IN BOX



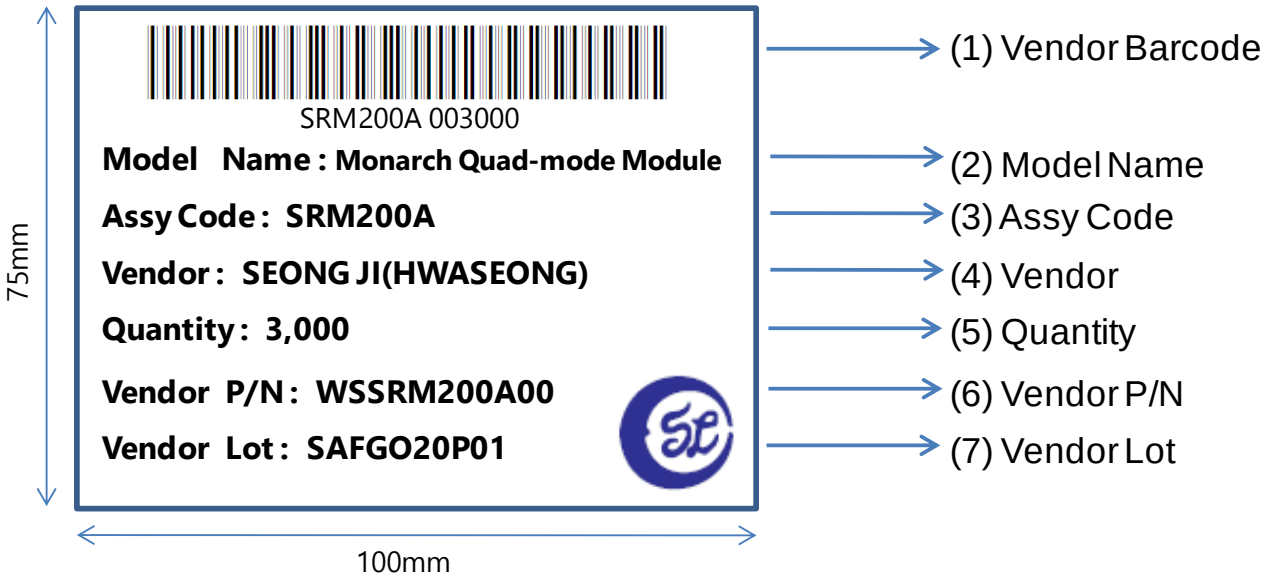
12-4. OUT BOX



12-5. IN BOX Label



12-6. OUT BOX Label



ESD Warning

This modules are ESD sensitive devices, appropriate precautions should be taken during the module assembly in the final product.
Mechanical impact and harsh tools must be avoided during the module assembly in the final product.

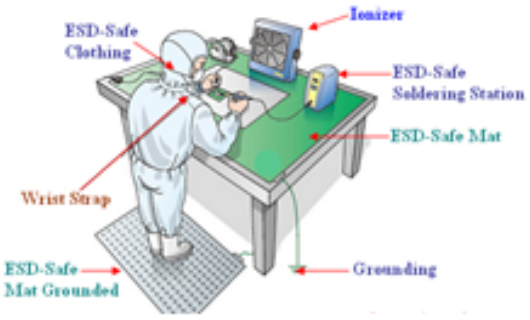
Product ESD specification:
- HBM ±2kV

The following precautions must be taken:

- Do not open the protective conductive packaging until you have use the following, and are at an approved anti-static work station.

- Use a conductive wrist strap attached to a good earth ground.

- If working on a prototyping board, use a soldering iron or station that is marked as ESD-safe.
- If possible, use SMT equipment(reflow) when making prototype boards.
- Use an approved anti-static mat to cover your work surface.



- Always discharge yourself by touching a grounded bare metal surface or approved anti-static mat before picking up an ESD - sensitive electronic component.