WISOL / SFM20R1

DATA SHEET Rev.01

WISOL
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Rep. of Korea

http://www.wisol.co.kr

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1. Approval Revision Record

NO	REASON	RECORD OF REVISION	Date	Remark
1	REV 00	WSSFM20R1 Initial Releases	2017-03-21	-
2	REV 01	Recommend Foot print	2017-04-16	-
		Sigfox Electrical Specification	2017-04-16	-

2. Scope

- Description

  - Sigfox Configuration 2 RC1
  - 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 touchto-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 is SIGFOX verified and that the ETSI are ongoing. ETSI test result will be update.

3. Numbering of product

3-1. Product

3-2. Part No.

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

No.	EXPLANATION
(1),(2)	WISOL
(3),(4)	Application (SF:Sigfox)
(5)	Type (M:Module)
(6),(7)	Group model numbering
(8), (9)	Region Code
(10), (11)	Application Type(Firm Ware Type) AP(API version)

3-3. Lot. No.

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

①	Sigfox Module										
②	Manufacture Area										

Manufacture Area

Packing Lot	A	B	C
Area	Korea	China	Vietnam

③

Year

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Mark	W	X	Y	Z	A	B	C	D	E	F

④

Month

Month	1	2	3	4	5	6	7	8	9	10	11	12
Mark	A	B	C	D	E	F	G	H	I	J	K	L

⑤

Day

Day	1	2	3	4	5	6	7	8	9	10	
Mark	1	2	3	4	5	6	7	8	9	A	
Day	11	12	13	14	15	16	17	18	19	20	
Mark	B	C	D	E	F	G	H	I	J	K	
Day	21	22	23	24	25	26	27	28	29	30	31
Mark	L	M	N	O	P	Q	R	S	T	U	V

⑥⑦	Model Serial Number (10,11,12,13…)
⑧⑨	A Serial Number (1serial: 1,100ea)

4. Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
VCC	Module input voltage	5.5	V
OT	Operating Temperature	-30 to +85	℃
ST	Storage Temperature	-40 to +125	℃

5. DC Characteristics

Symbol	Parameter	Min	Typ.	Max	Unit
VCC	Module input voltage	3.2	3.3	5.0	V

6. I/O Specifications

Symbol	Parameter	Min	Typ.	Max	Unit
VCC	supply voltage		3.0	3.3	V
VIH	High level input voltage	2.1			V
VIL	Low level input voltage			0.9	V

7. RF Specifications

7-1 Sigfox

7-1-1. Electrical Specification

Symbol	Parameter	Min	Typ.	Max	Unit
Current	Tx Current(@"15"setting)		62		mA
	Tx Current(@"14"setting)		54		mA
	Rx Current		16		mA

7-1-2. Receiver, Transmitter Specification

Conditions: VCC=3.3V, Temp=25℃

Parameter		Min	Typ.	Max	Unit
RF Frequency	Tx		868.130		MHz
	Rx		869.525		MHz
Tx output power(at "15" setting)			13.7		dBm
Tx output power(at "14" setting)			12.2		dBm
Frequency Error Tolerance(+25℃)		-2.5	-	+2.5	ppm
2nd Harmonics(conducted)		-	-37	-35	dBm
3nd Harmonics(conducted)		-	-41	-35	dBm
Rx Sensitivity(@600bps, GFSK)		-	-127	-	dBm
Rx Spurious Emission(30MHz~12.75GHz)		-	-	-54	dBm

* Because of output power variation of modules the maximum output power can be over 14dBm, so we recommend to set 14 as default output setting.

7-2 BLE

7-2-1. Electrical Specification

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]		-0.5	3.5	7.5	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

Parameter		Min	Typ.	Max	Unit
Target Power for TX					
2.4GHz	Tx mode, Cont.Tx@11M		290		mA
	Tx mode, Cont.Tx@54M		115		mA
	Tx mode, Cont.Tx@HT20 MCS7		110		mA
	Rx mode, Cont. Rx@11M		77		mA
	Rx mode, Cont. Rx@54M		77		mA
	Rx mode, Cont. Rx@HT20 MCS7		77		mA

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		16	-	-	dB
9Mbps		15	-	-	dB
12Mbps		13	-	-	dB
18Mbps	PER<10%, Packet size = 1024bytes	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

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	15.5	18	20.5	dBm
Output Power in 802.11g mode, OFDM					
6M~24Mbps		14.5	17	19.5	dBm
36Mbps	As specified in IEEE802.11	13.5	16	18.5	dBm
48Mbps		12.5	15	17.5	dBm
54Mbps		11.5	14	16.5	dBm
Output Power in 802.11n mode, HT20, OFDM					
MCS0~4		14.5	17	19.5	dBm
MCS5	As specified in IEEE802.11	13.5	16	18.5	dBm
MCS6		12.5	15	17.5	dBm
MCS7		10.5	13	15.5	dBm
Spectrum mask					
Margin to 802.11b/g/n all mode	Maximum output power	0	-	-	dBr
Modulation Accuracy in 802.11b mode					
1Mbps		-	-	35	%
2Mbps	As specified in IEEE802.11	-	-	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

*Output power can be changed according to the antenna characteristics used in mass production.

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

7-4-2. EVB Specification

-With external GPS LNA module(SAW filter + LNA)

Frequency	L1, 1575.42MHz
GPS Sensitivity[1]	
Tracking	-160 dBm
Navigation	-159 dBm
Acquisition (Cold start)	-145 dBm
C/N0[2]	- 39
Time To First Fix[2]	
Hot Start	< 1s
Cold Start	< 35s

[1] Demonstrated with a SFMG2XAB002 (SAW+LNA)
[2] All satellites at -130 dBm

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
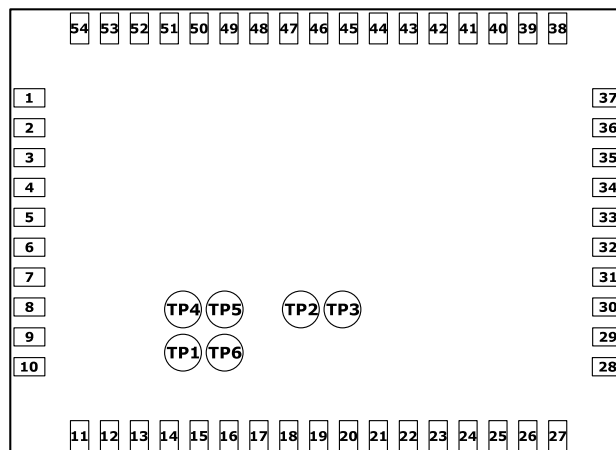
NO	PIN NAME	NO	PIN NAME	NO	PIN NAME
1	STATE_LINK_WIFI	22	I2C0_SCL_DBG	43	GND
2	STATE_WORK_WIFI	23	STATE0	44	NFC2
3	VDD_WIFI_EN	24	WKUP	45	NFC1
4	GND	25	STATE_CPU_SFX	46	GND
5	GPS_RF	26	STATE_RF_SFX	47	DL_EN/INT_WIFI
6	GND	27	GND	48	NRST_WIFI
7	VDD_MAIN_3P0	28	GND	49	UART0_RX_WIFI
8	V_BCKP_GPS	29	VDD_SFX_EN	50	UART0_TX_WIFI
9	VDD_GPS	30	NRST_SFX	51	VDD_WIFI
10	GND	31	SWDCLK	52	GND
11	GND	32	SWDIO	53	WIFI_RF
12	NRST_GPS	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	VDD_GPS_EN	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		

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	VDD_WIFI_EN	O	WiFi power enable
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/O	3.0V Main power
8	V_BCKP_GPS	P/I	GPS backup power
9	VDD_GPS	P/O	GPS Power
12	NRST_GPS	I	GPS Reset , do not connect
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	VDD_GPS_EN	O	GPS power enable
18	BATT	P/I	Supply 3.3V ~ 5.0V
20	2ND_POW_EN	O	Secondary DCDC power enable
21	I2C0_SDA_DBG		Module Debugging port for I2C
22	I2C0_SCL_DBG		Module Debugging port for I2C
23	STATE0	O	Indicate module(BLE) state
24	WKUP	I	Module Wake-up from sleep state
25	STATE_CPU_SFX	O	Sigfox CPU state
26	STATE_RF_SFX	O	Sigfox RF state
29	VDD_SFX_EN	O	Sigfox power enable
30	NRST_SFX	I	Sigfox Reset , do not connect
31	SWDCLK	I	BLE SWD clock input for debug and programming
32	SWDIO	I/O	BLE SWD I/O for debug and programming
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
48	NRST_WIFI	I	WiFi Reset , do not connect
49	UART0_RX_WIFI	I	WiFi Download
50	UART0_TX_WIFI	O	WiFi Download
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 WIFI status PIN
- STATE_LINK_WIFI : TBD
- STATE_WORK_WIFI : WIFI Scan State (0: not working 1: working)

8-2-2 Sigfox status PIN
- STATE_CPU_SFX : Sigfox CPU activity indicator
- STATE_RF_SFX : Sigfox Radio activity indicator

8-2-3 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
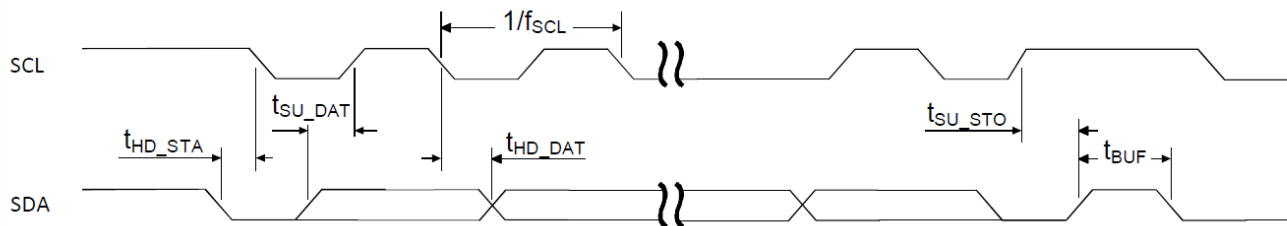
TWI timing diagram, 1 byte transaction

8-2-4 I2C Slave for debug
- upto 400Khz

8-2-5 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)

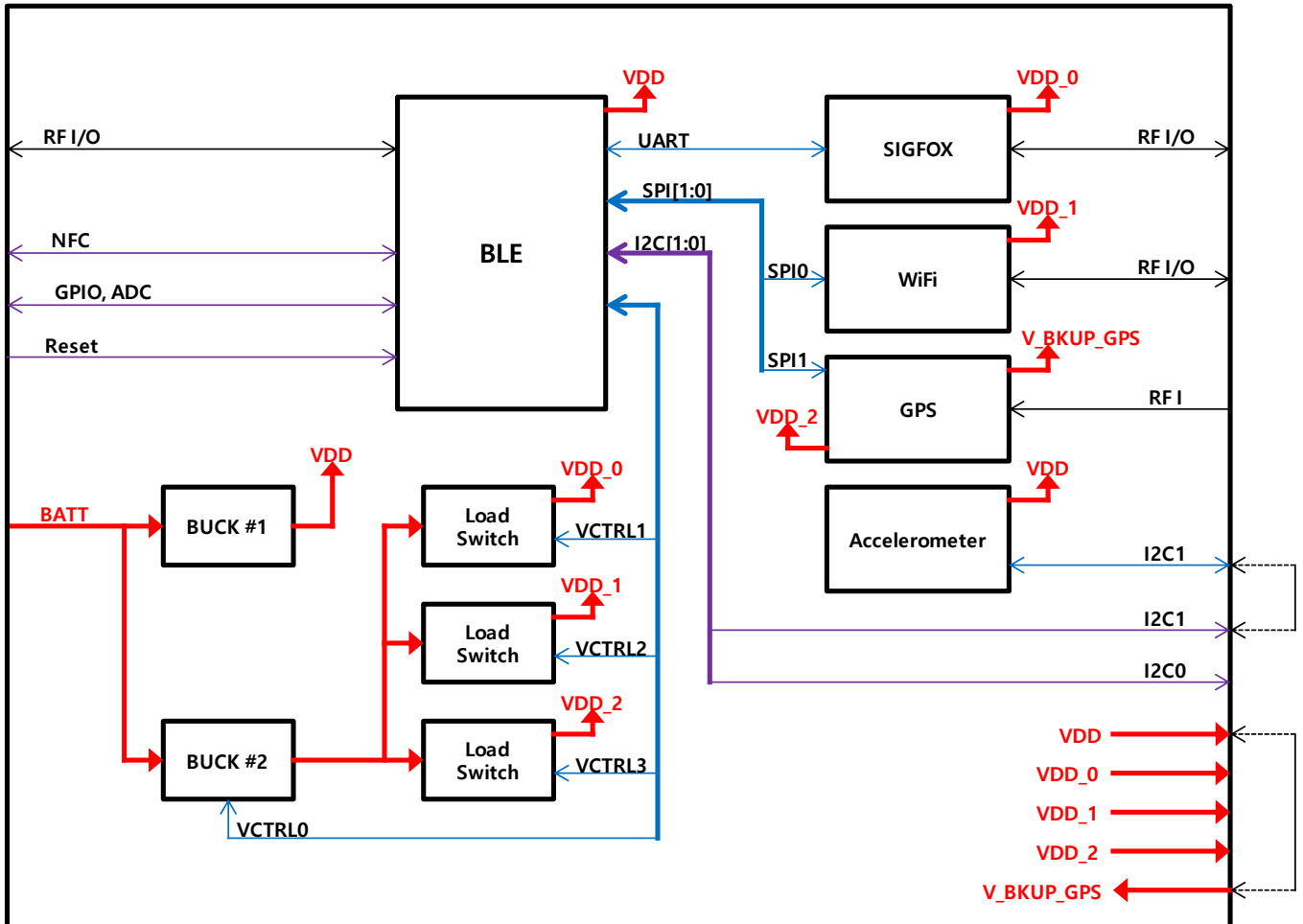8-2-6 GPIOs
- support 4 GPIO
  STATE0
  WKUP
  AIN1
  AIN0

8-2-7 NFC
- Type 2 near field communication (NFC-A) tag with wakeup-on-field and touchto-pair capabilities

8-2-8 Reset Pin
- Chip reset input. Active low.
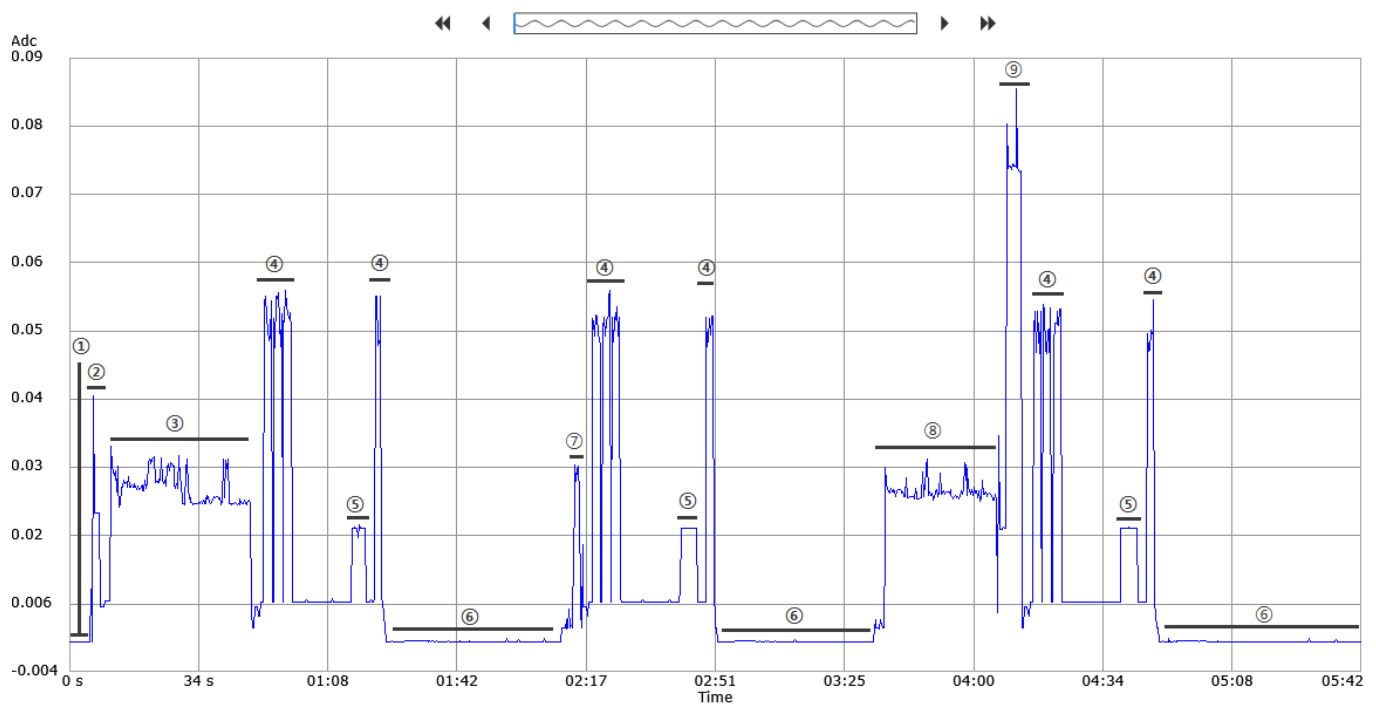
9. Block Diagram

10. Power Modes

10-1. Test condition
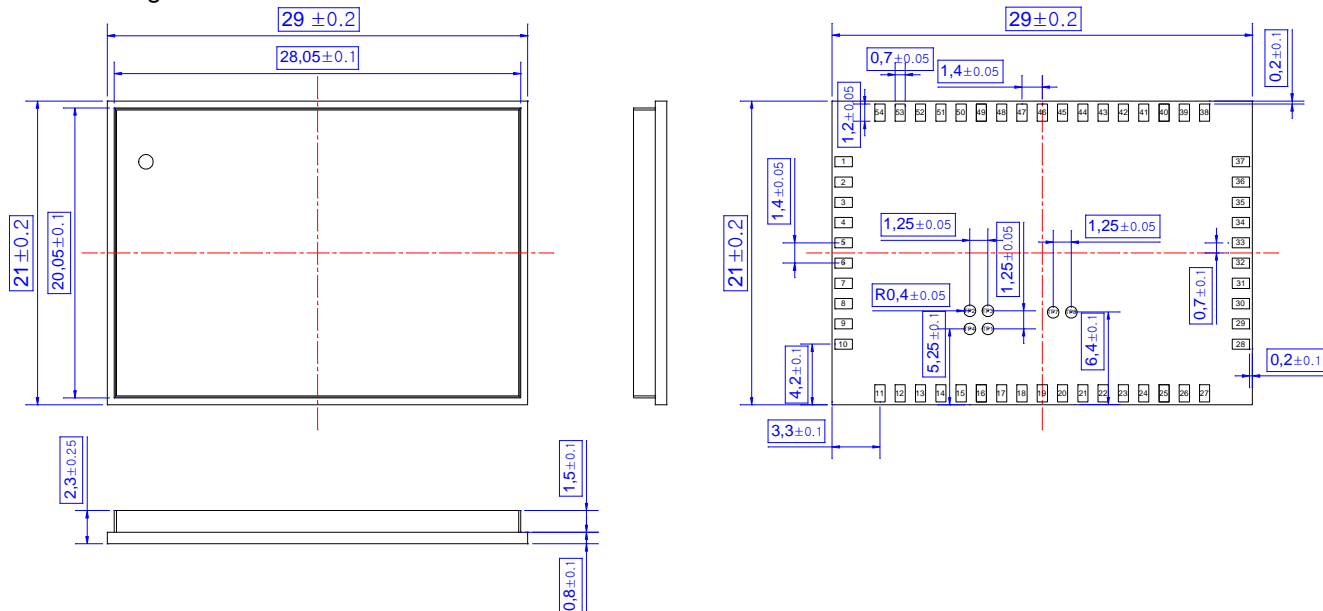
Time Interval : 250ms
Measurement : DC Current
Range(Adc) : 0.1A

Power Off (DeepSleep)	Power On	GPS (ublox)	WIFI	Sigfox		BLE (Sleep)
				Tx	Rx	
average 5uA	average 36mA	average 23mA	average 75mA	average 53mA	average 23mA	average 40uA
①	②	③ ⑦ ⑧	⑨	④	⑤	⑥

11. Dimensions & drawing

11-1. Design dimension

11-2. Recommend　Foot print


foot print

Anti copper & not via
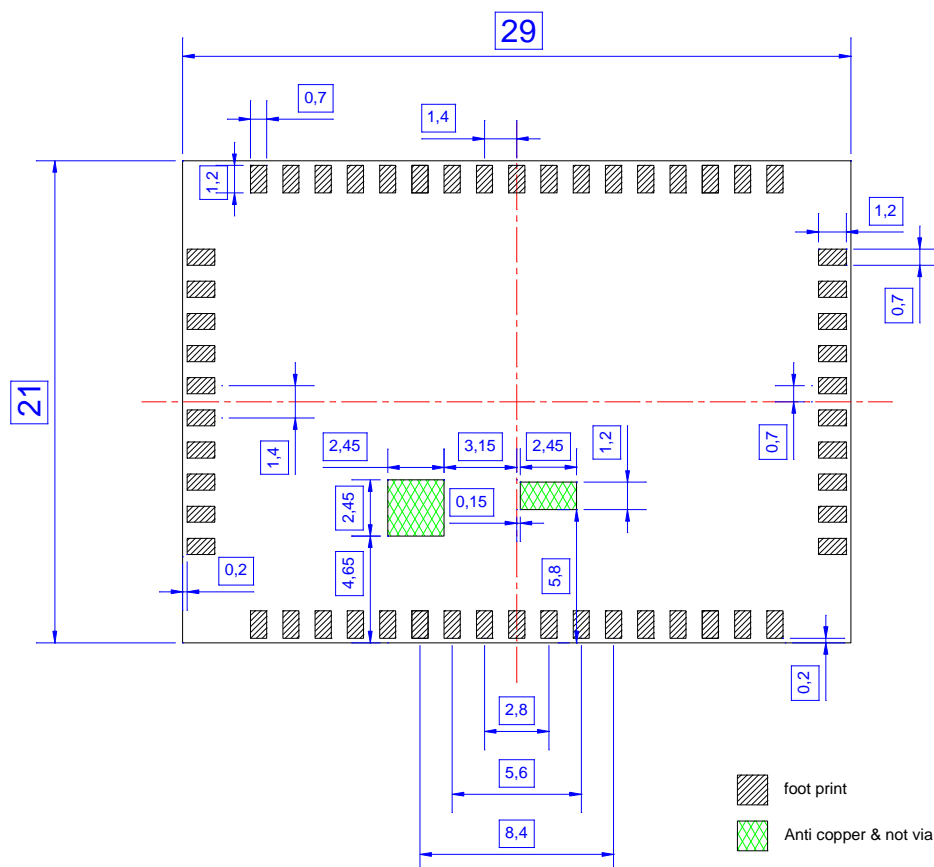
- **X-ray by Foot print size**

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.
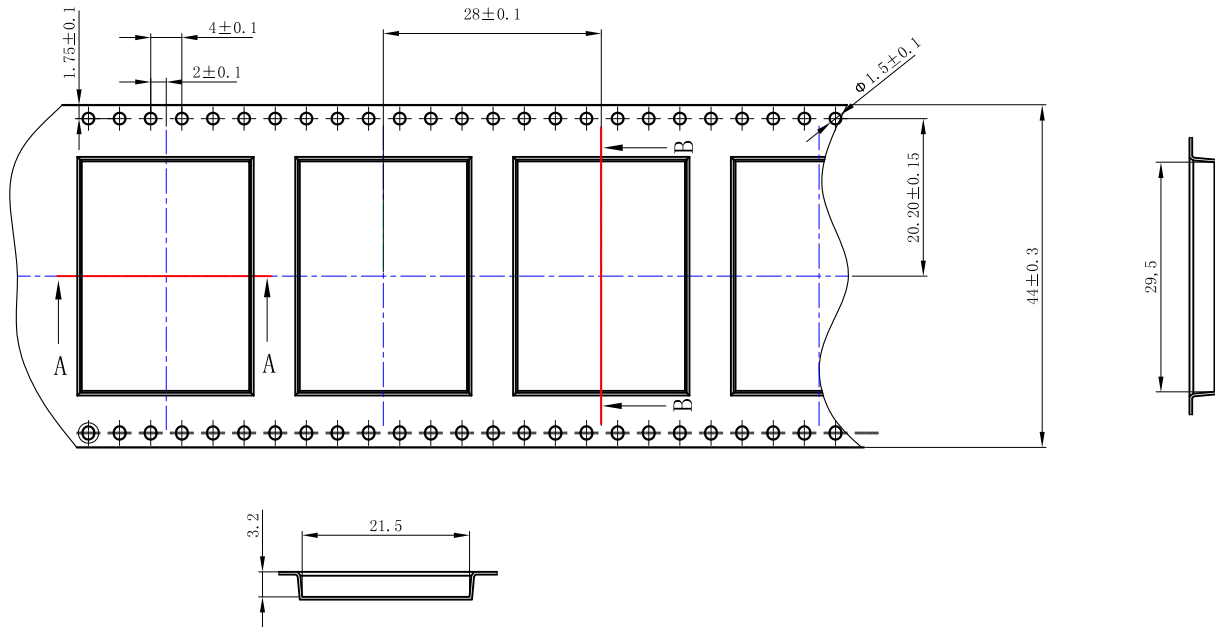

| [Foot print size : 0.7 x 1.2mm] | [Foot print size : 0.9 x 1.8mm] |

12. Reflow profile

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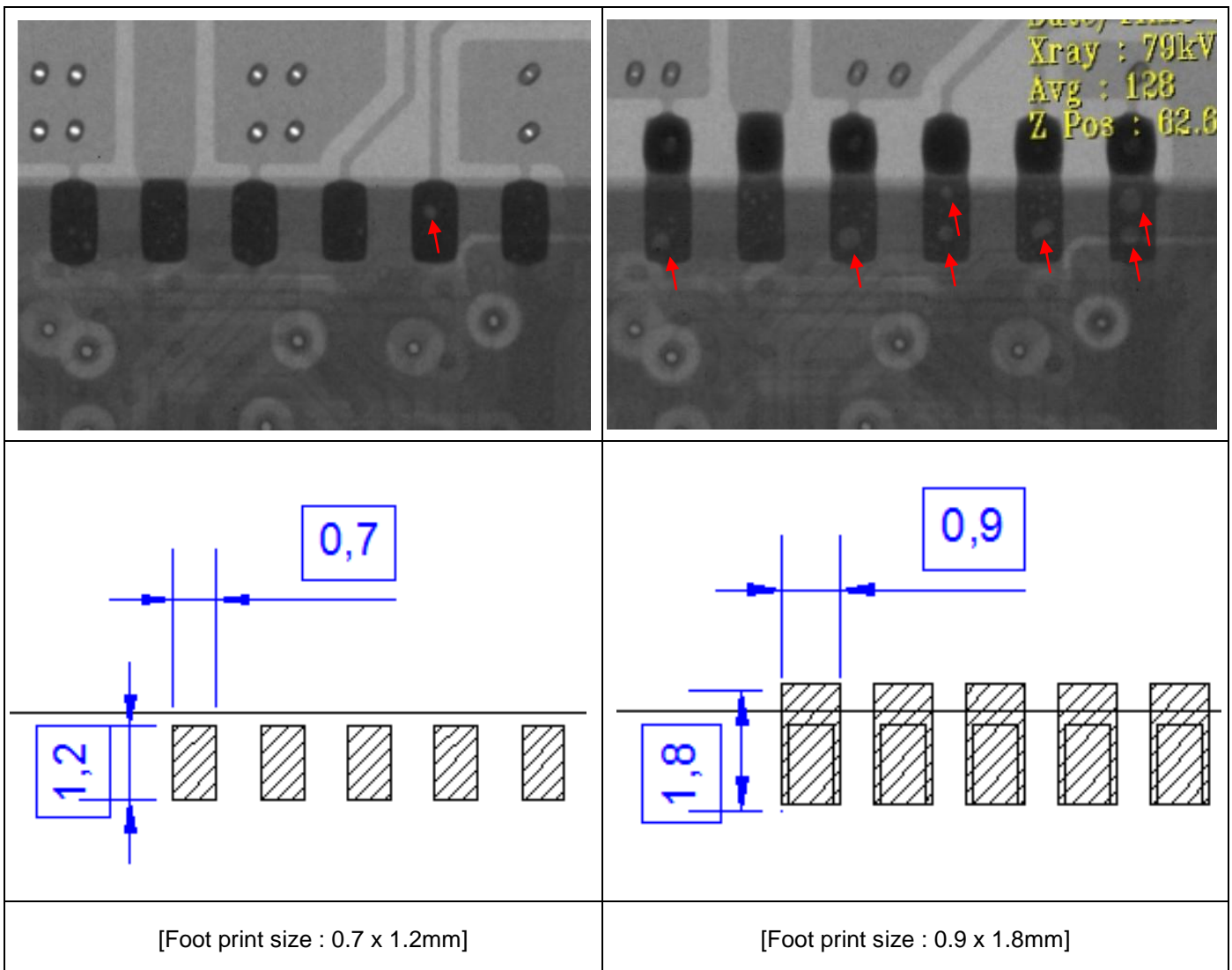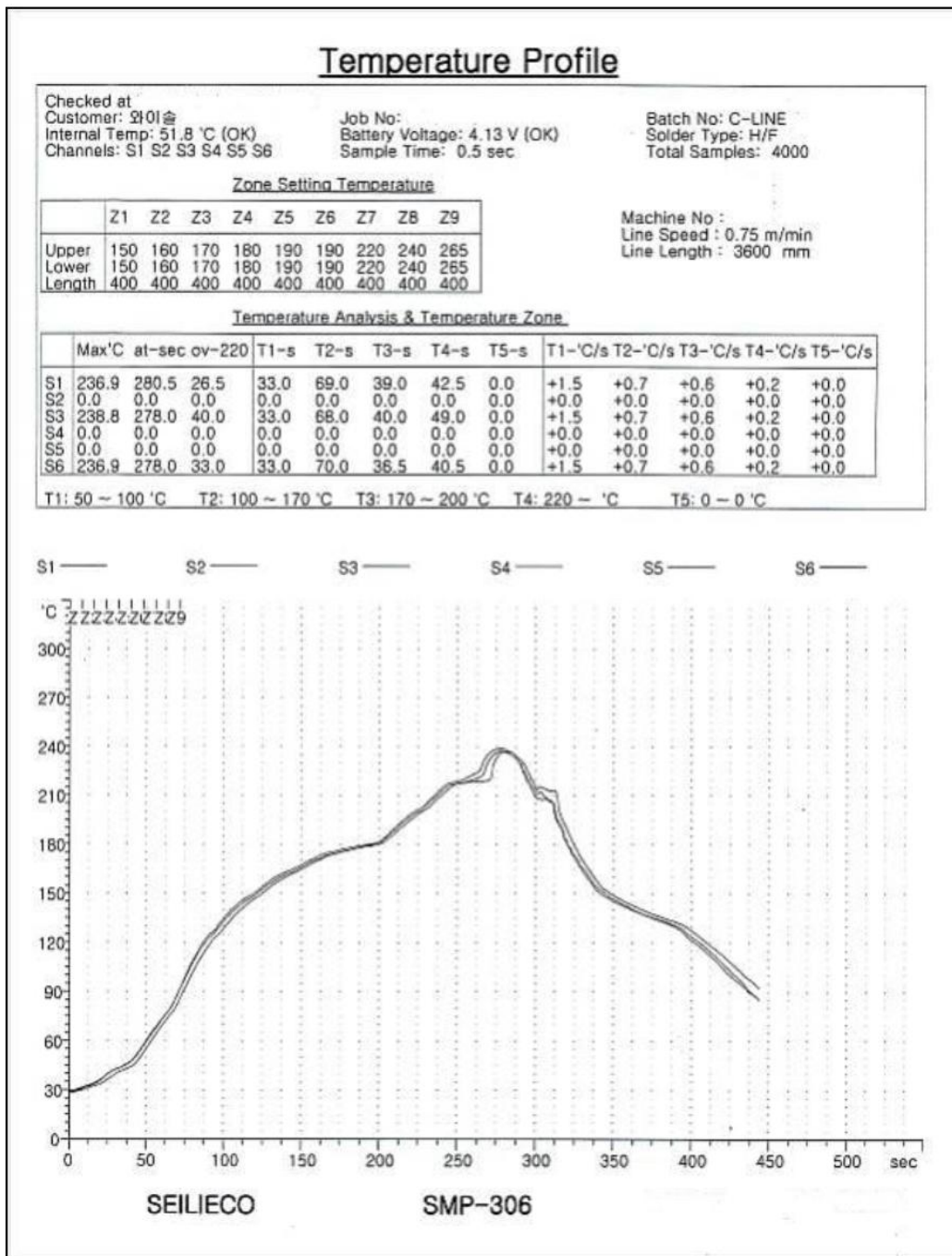
	Preheat	Soak	Ramp	PEAK
SPEC	50~100℃	100~170℃	220℃ ↑	240℃
	1~2℃/sec	60~100sec	30~50sec	±5℃
result of measurement	1.5	69	44	237.5
	OK	OK	OK	OK

13. Package

13-1. Dimension of Tape

13-2. Dimension of Reel

a: ⌀13.4±1
b: 2.0±1
c: ⌀210±1

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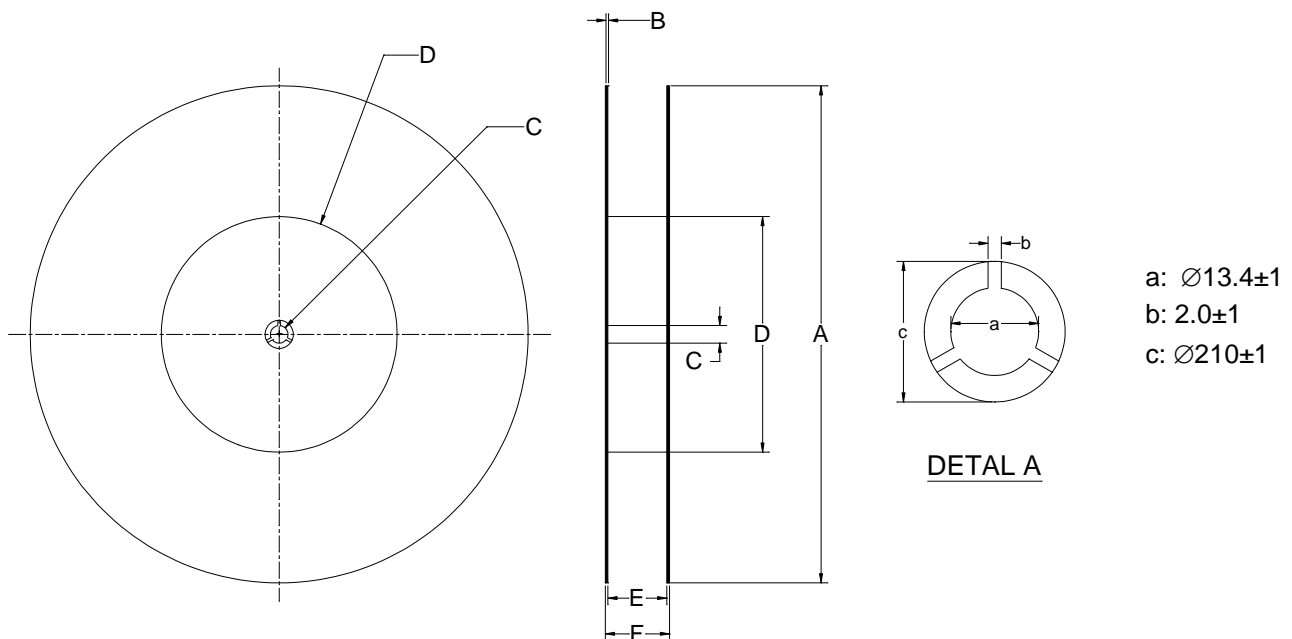
A	B	C	D	E	F
380 ± 1 mm	2 ± 1 mm	13.4 ± 1 mm	180 ± 1 mm	45 ± 1 mm	49 ± 1 mm

13-3. IN BOX

384 * 65 * 386

와이솔

384 X 65 X 386

TY—160324

Module Ass'y

MODEL	
Q'TY	EA
USER	
DATE	. .

1reel/ 1 In-BOX

13-4. OUT BOX

387 * 340 * 390

ATTENTION
ELECTROSTATIC
SENSITIVE DEVICES

Module Ass'y

MODEL	
Q'TY	EA
USER	
DATE	. .

Module Ass'y

L/C NO.:
C/T NO.:

MADE IN KOREA

4 In-BOX/ 1 Out-BOX