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# **RP-M2470BW**

## **Datasheet**

**(No. BRP0019)**  
**V.1.1**

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## REVISION HISTORY

Version	Date	Description
V1.0	2012.6.20	▪ First Version Release
V1.1	2015.2.24	▪ Bottom is added in Sec 1.2.2 ▪ Values are updated in Sec 2.3 and Sec 2.4

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# 1. SPECIFICATIONS

This specification is applied to IEEE802.15.4 & RF4CE Transceiver Module. This module is embedded with Chip Antenna, 32MHz X-TAL and Single chip(MG2470B).

## 1.1. Description

### RF Transceiver

- Single-chip 2.4 ~ 2.4835GHz RF Transceiver
- Low Power Consumption
- High Sensitivity of -98dBm at 250Kbps
- No External T/R Switch or Filter Needed
- On-chip VCO, LNA, and PA
- Programmable Output Power up to +8.5dBm
- Direct Sequence Spread Spectrum
- O-QPSK Modulation
- Scalable Data Rate Including 250Kbps Specified in IEEE802.15.4: 31.25Kbps ~ 1Mbps
- RSSI Measurement
- Compliant to IEEE 802.15.4

### Hardwired MAC

- Two 256-byte Circular FIFOs
- FIFO Management
- AES Encryption/Decryption engine(128bit)
- CRC-16 computation and check

### 8051-Compatible MCU

- 8051 compatible(Single Cycle Execution)
- 64KB embedded flash memory
- 6KB data memory
- 128-byte CPU Dedicated memory
- 1KB Boot ROM
- Dual DPTR support
- I2S/PCM interface with two 256-byte FIFOs
- $\mu$ -law/a-law/ADPCM voice Encoder/ Decoder
- Two high-speed UARTs with two 16-byte FIFOs(up to 1Mbps)
- Four timer/counters
- 5 PWM Channels
- Watchdog timer

- Sleep timer using the 32KHz RC-OSC clock
- Quadrature Signal Decoder
- 22 General Purpose I/Os
- Internal 32KHz RC Oscillator for sleep timer
- 16MHz RC Oscillator for the fast start-up from reset & power-down mode
- On-chip Power-on-Reset and Brown-out detector
- 4-Channel 12-bit ADC(ENOB > 10-bit)
- SPI Master/Slave Interface with two 16-byte FIFO
- I2C Master/Slave with 16-byte FIFO
- Programmable IR(Infra-Red) modulator
- ISP(In System Programming)
- External clock output function(500KHz, 1/2/4/8/16/32MHz Selectable)

#### **Clock Inputs**

- 32MHz crystal for system clock

#### **Power**

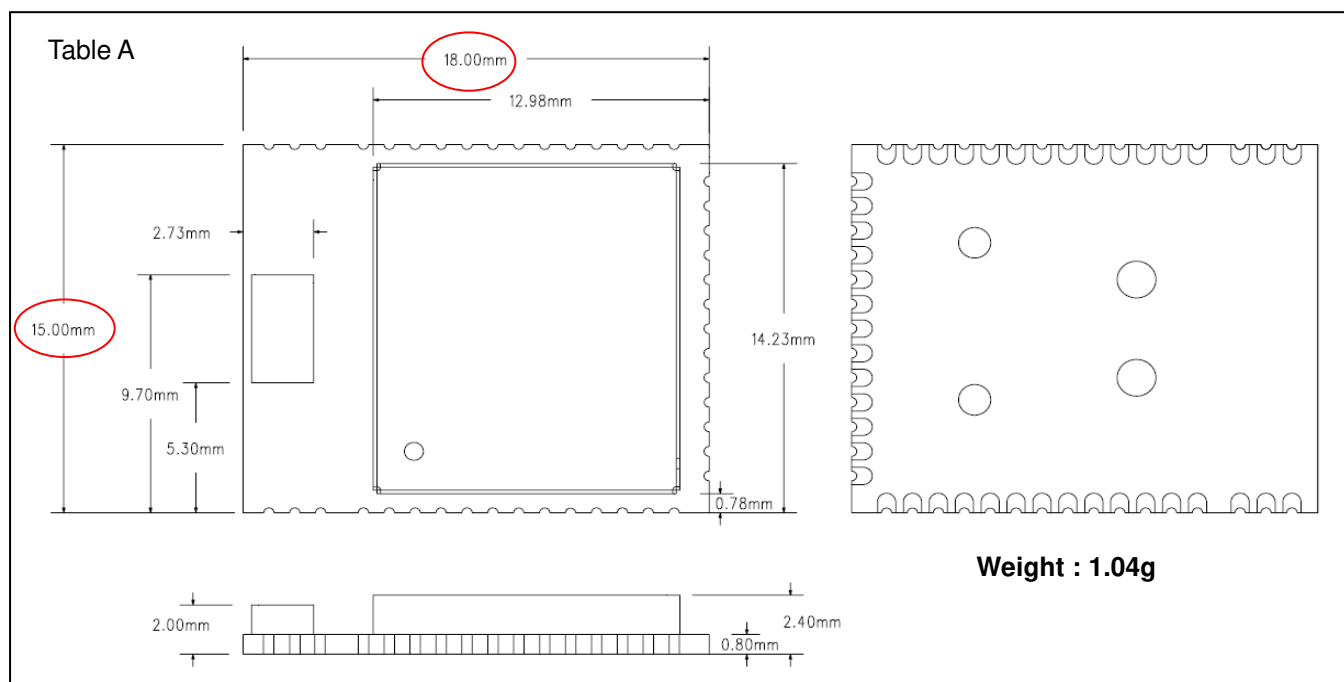
- 1.8V(Core)/2.0~3.6V(I/O) operation
- Power management scheme with deep sleep mode
- Separate on-chip regulators for analog and digital circuitry
- Power supply range for internal regulator(2.0V(Min) ~ 3.6V(Max))

#### **Package**

- SMD Type-48Pin(15.0x18.0x2.0(mm))

## 1.2. Drawing

### 1.2.1. Design Dimension

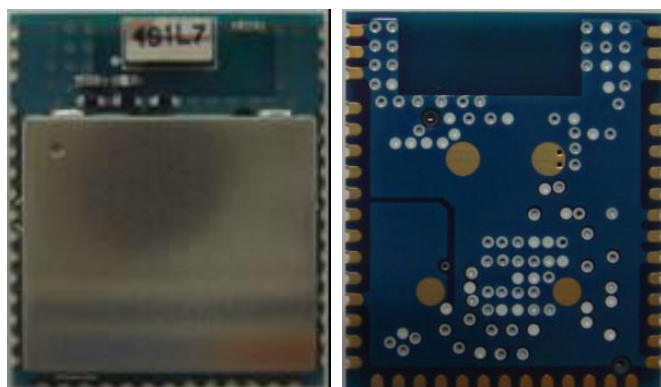


※Table A: Real dimension specification

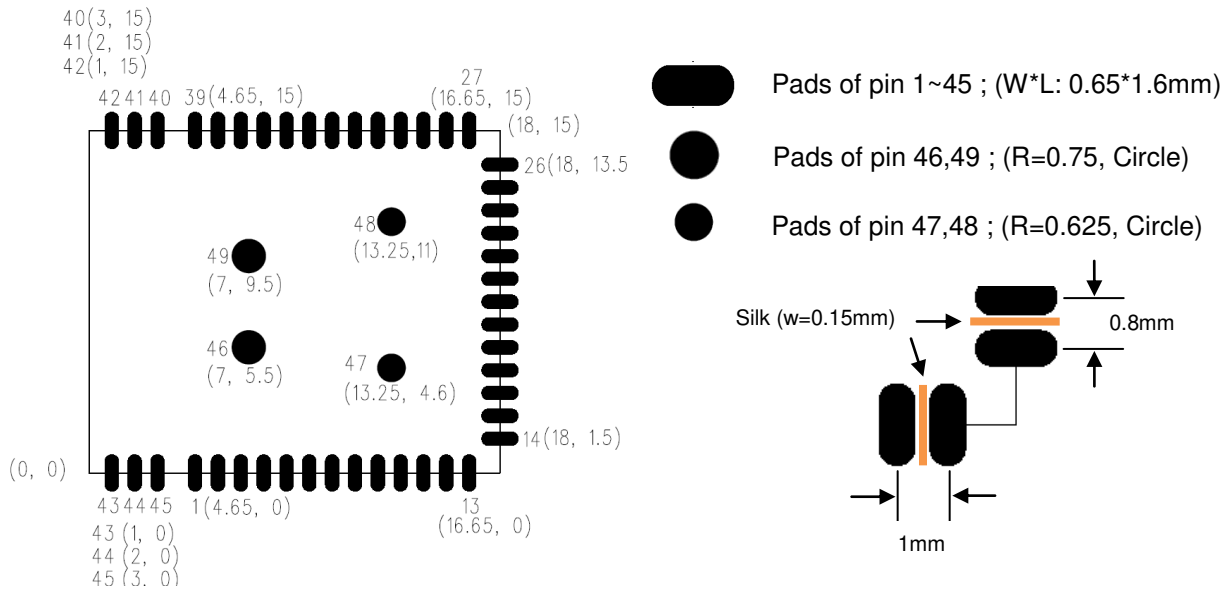
ITEM	Width	Length
Design	15 mm	18 mm
Real dimension value	14.90mm(*)	17.90mm(*)

(\*) : 0.1mm is cut by Dicing blade

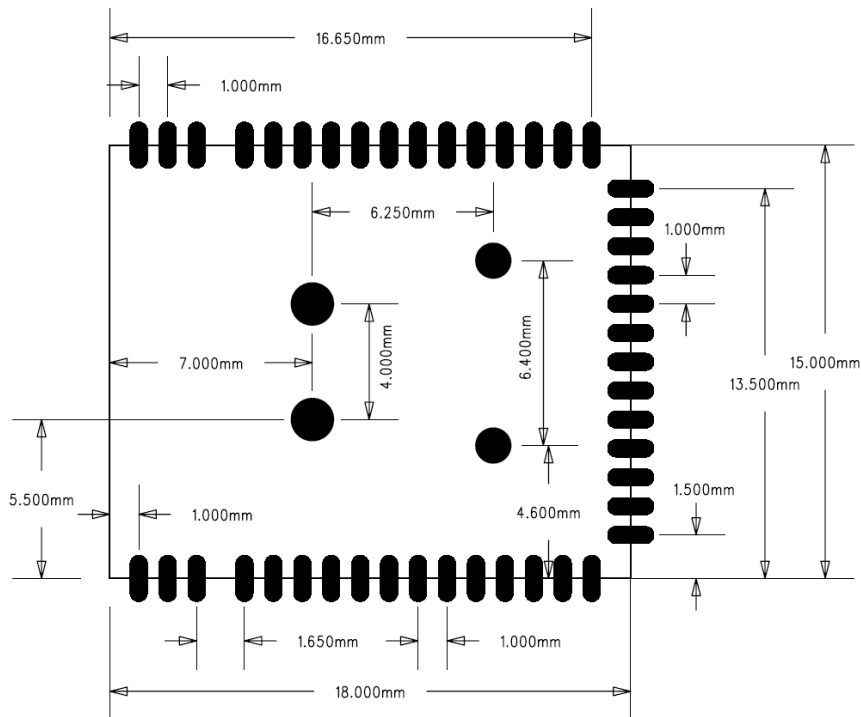
### 1.2.2. Outline



1.2.3. PCB drawing 1 (top view)






1.2.4. PCB drawing 2 (top view)

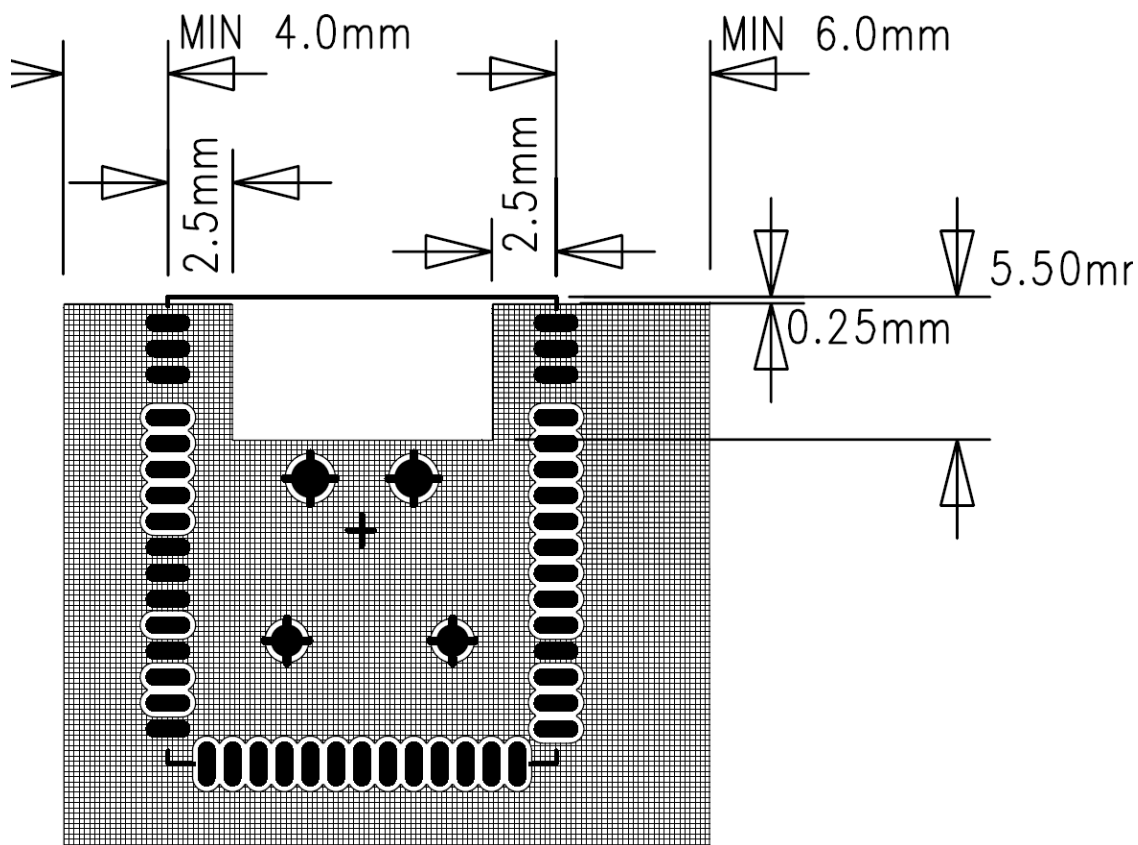




### 1.2.5. Soldermask opening guide

PAD TYPE	PAD SIZE	MASK open	RESULT
	W: 0.65mm L: 1.60mm	W:0.615mm L:1.76~1.8mm	W: About 95% L: About 110~115%
	R=0.75mm	R=0.35mm	46.7%
	R=0.625mm	R=0.25mm	40%

### 1.2.6. Copper pour rules of Ground for antenna matching



## 2. PIN DESCRIPTION

### 2.1. Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
VDD	Chip core supply voltage	-0.3 to 2.0	V
3V_IN	I/O supply voltage	-0.3 to 3.6	V
ST	Storage Temperature	-40 to 85	°C

### 2.2. DC Characteristics

Parameter	Name	MIN	TYP	MAX	Unit
3V_IN	I/O supply voltage(VDDIO)	2.0	3.0	3.6	V
VIH	High level input voltage	2.5	-	3.6	V
VIL	Low level input voltage	0	-	0.4	V
VOH	High level output voltage	2.5	-	3.6	V
VOL	Low level output voltage	-	-	0.4	V
TA	Air temperature	-40	-	85	°C

## 2.3. Electrical Specifications

(Condition: EVM Board, at 25°C, 3V\_IN=3.0V)

Parameter	Min	Typ.	Max	Unit
<b>Current consumption</b>				
MCU active without RX/TX operation, Peripherals [UART1 & RNG] active @ MCU clock = 8MHz @ MCU clock = 16MHz	-	4.2 5.2	-	mA
TX mode. MCU active @ MCU clock = 8MHz @ maximum transmit output power @ 0dBm	-	34.1 21.0	36.5	mA
RX Mode (MCU active and peripherals[UART1 & RNG] active) @ MCU clock = 8MHz	-	22	-	mA
Power mode1. Digital regulator on, 16MHz RCOSC and 32MHz crystal oscillator off, 32kHz RCOSC, POR, BOD, and sleep timer active.	-	-	40	uA
Power mode1. Digital regulator on, 16MHz RCOSC, 32MHz crystal oscillator off, 32.768kHz crystal oscillator, POR, BOD, and sleep timer active.	-	-	50	uA
Power mode2. Digital regulator off, 16MHz RCOSC, 32MHz crystal oscillator off, 32kHz RCOSC and sleep timer active.	-	-	2	uA
Power mode2. Digital regulator off, 16MHz RCOSC, 32MHz crystal oscillator off, 32.768kHz crystal oscillator and sleep timer active.	-	-	12	uA
Power mode3. Digital regulator off, 16MHz RCOSC, 32MHz crystal oscillator off, 32kHz RCOSC(32.768kHz crystal oscillator) and sleep timer off.	-	-	1	uA
<b>Wake-up and timing</b>				
Power mode1 → Active Digital regulator on, 16MHz RCOSC and 32MHz crystal oscillator off. Start-up of 16MHz RCOSC		5		us
Power mode2 → Active Digital regulator off, 16MHz RCOSC and 32MHz crystal oscillator off. Start-up of regulator and 16MHz RCOSC		100		us
MCU Active → TX or RX Initially running on 16MHz RCOSC, Added start-up time of 32MHz crystal oscillator.		992		us
TX / RX and RX / TX turnaround	-	-	192	us

## 2.4. RF Characteristics

Parameter	Min	Typ.	Max	Unit
<b>RF Characteristics</b>				
RF Frequency Range	2394	-	2507	MHz
Maximum Input Level (PER=1%) @250kbps	-	-2	-	dBm
Received RF Bandwidth	-	2	-	MHz
Channel Bandwidth	-	5	-	MHz
Receiver Sensitivity (PER≤1%, Packet length of 22-byte) @1000kbps @250kbps @125kbps @62.5kbps @31.25kbps	-	-89 -92 -93 -97 -99	-	dBm
Adjacent Channel Rejection +5MHz -5MHz	-	27 27	-	dB
Alternate Channel Rejection +10MHz -10MHz	-	48 47	-	dB
Co-Channel Rejection	-	-8.9	-	dB
Blocking / Desensitization -250MHz -100MHz -50MHz +50MHz +100MHz +250MHz	-	-25 -35 -38 -37 -35 -31	-	dBm
TX output power	-	+2	-	dBm
Transmit chip rate	-	2	-	Mcps
Spurious Emission(30Hz~1GHz)	-	-60	-	dBm
Spurious Emission(1GHz~12.75GHz)	-	-45	-	dBm
Spurious Emission(5.15GHz~5.3GHz)	-	-70	-	dBm
2 <sup>nd</sup> Harmonics	-	-45	-	dBm
3 <sup>rd</sup> Harmonics	-	-55	-	dBm

Frequency Error Tolerance	-96	-	+96	KHz
Error Vector Magnitude(EVM)	-	7	-	%
<b>Frequency Synthesizer</b>				
Phase Noise (Unmodulated carrier) @±100KHz offset @±1MHz offset @±2MHz offset @±3MHz offset @±5MHz offset	-	-78.5 -102.1 -112.7 -118.9 -123.2	-	dBc/Hz
PLL Lock Time	-	-	192	usec
<b>32MHz Crystal Oscillator</b>				
Crystal Frequency	-	32	-	MHz
Crystal Frequency Accuracy Requirement	-40	-	+40	ppm

## 2.5. Analog Temperature

Parameter	Min	Typ	Max	Unit
<b>Analog Temperature</b>				
Output Voltage at -40 °C	-	716	-	mV
Output Voltage at 0 °C	-	847	-	mV
Output Voltage at 40 °C	-	978	-	mV
Output Voltage at 80 °C	-	1109	-	mV
Temperature Coefficient	-	3.275	-	mV/°C
※ All measurement results are obtained using the 12 bit ADC				
<b>Analog Temperature</b>				
Input Voltage	0	-	VDD	V
Input Resistance	-	150	-	kΩ
Full-scale signal	-	-	3	V
Effective number of bits(ENOB) Single-ended input, 12bit setting	-	10.8	-	bits
Effective noise and distortion(SINAD) Single-ended input, 12bit setting	-	66.78	-	dB
Current Consumption	-	0.46	-	mA
Internal Reference Voltage	-	1.25	-	V

## 2.6. Specification on Chip Antenna

### 2.6.1. Electrical Specifications

No	Item	Spec.	Remark
1	Frequency Range [GHz]	2.4 ~2.485	
2	VSWR	Max 3.0:1	
3	Peak Gain [dBi]	typ. 2.9	
4	Total Avg. Gain [dBi]	typ. -0.5	
5	Efficiency [%]	typ. 90	
6	Polarization	Linear	
7	Impedance [ $\Omega$ ]	Nominal 50	

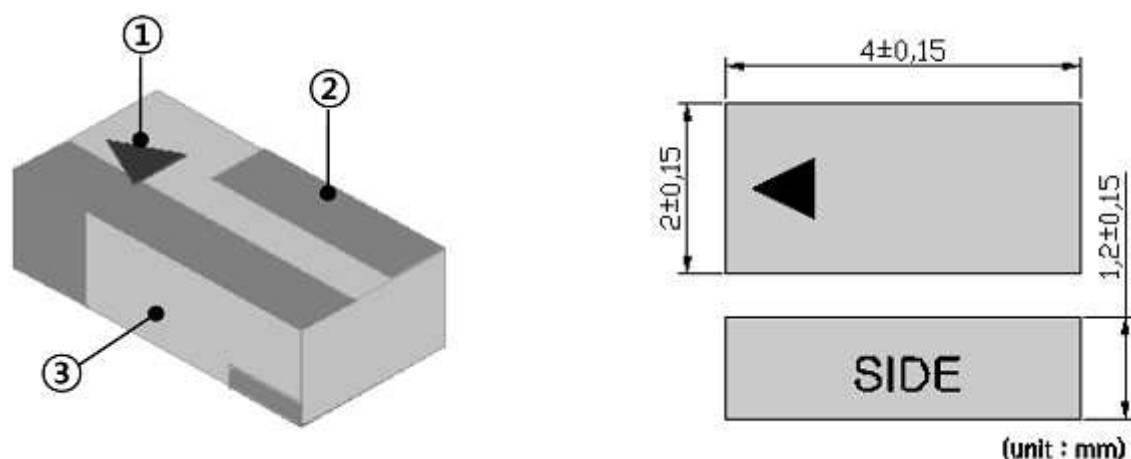
- ※ The results are measured on the 50x50mm<sup>2</sup> evaluation board(EVB).
- ※ See to Sec 2.3 for more detailed gain parameter.

### 2.6.2. Mechanical Specifications

No	Item	Spec.	Remark
1	Dimensions (LxWxH)	4.0x2.0x1.2 mm <sup>3</sup>	
2	Unit Weight	typ. 35 mg	
3	Operating Temperature	-35 ~ +85 °C	

### 2.6.3. Appearance & Material

No	Item	Function	Material
①	Marking	Feeding Index	Ink
②	Electrode	Radiation Element	Ag
③	Ceramic Body	-	Ceramic



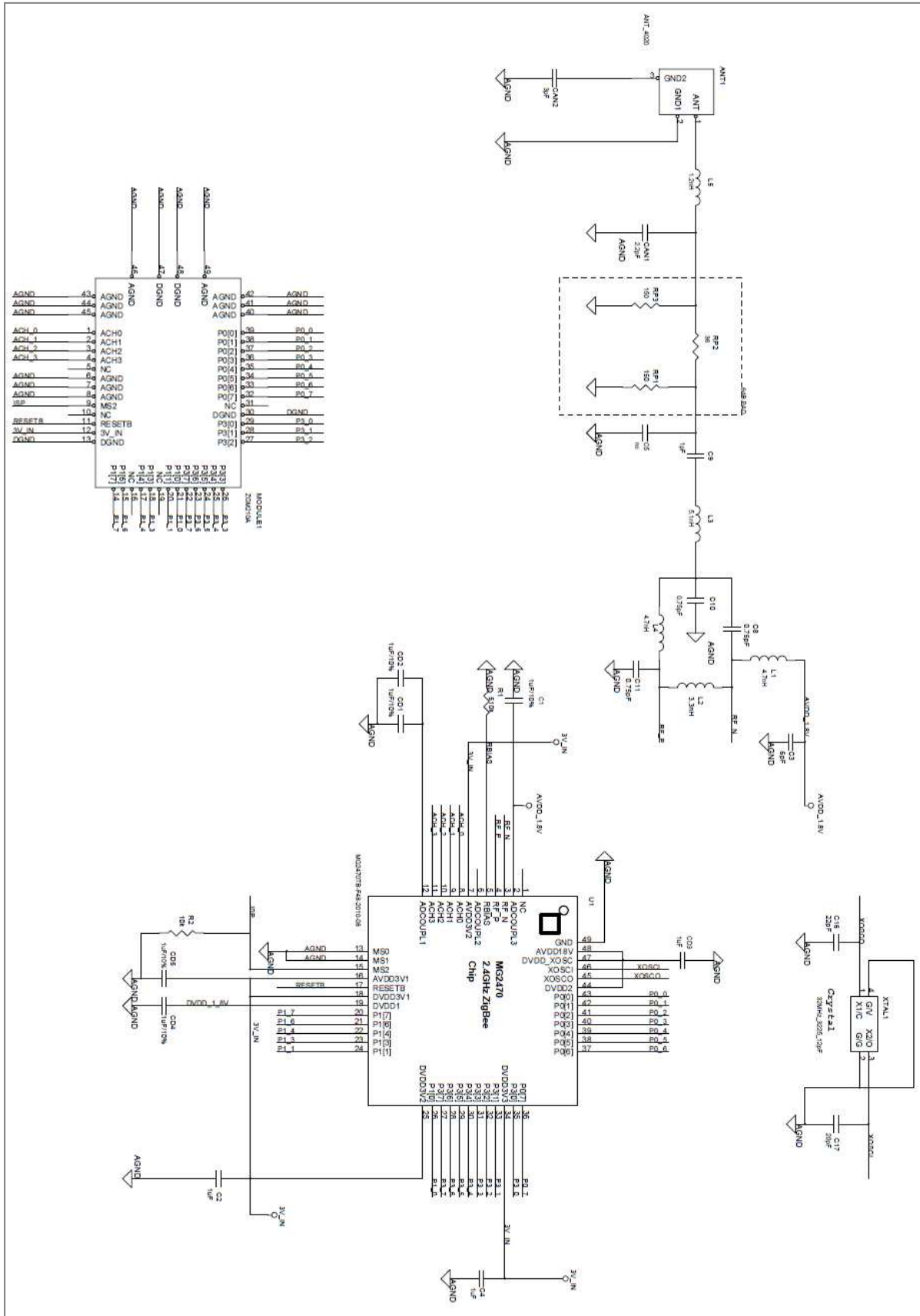
## 2.7. Electrical Interface

Terminal	NAME	Inter face	I/O	Description
1	ACH0	Analog	I/O	Sensor ADC input
2	ACH1	Analog	I/O	Sensor ADC input
3	ACH2	Analog	I/O	Sensor ADC input
4	ACH3	Analog	I/O	Sensor ADC input
5	NC	-	-	-
6	AGND	Ground	-	RF Ground
7	AGND	Ground	-	RF Ground
8	AGND	Ground	-	RF Ground
9	MS[2]	Digital	I	ISP
10	NC	-	-	-
11	RESETB	Digital	I	Reset (Active Low)
12	3V_IN	Power	I	3V Power supply
13	DGND	Ground	-	Ground for digital core and I/O
14	P1[7]	Digital	B	Port P1.7/I2C_SDA/TRSW
15	P1[6]	Digital	B	Port P1.6/I2C_SCL/TRSWB
16	NC	-	-	-
17	P1[4]	Digital	B	Port P1.4/QUADZB/EXT_RTC_CLK/PTC_GATE4/XOSC32K_IN
18	P1[3]	Digital	B	Port P1.3/QUADZA/PTC_GATE3/IR_TX/CLK_OUT/XOSC32K_OUT
19	NC	-	-	-
20	P1[1]	Digital	B	Port P1.1/TXD1
21	P1[0]	Digital	B	Port P1.0/RXD1
22	P3[7]	Digital	B	Port P3.7/CTS1/SPICSN
23	P3[6]	Digital	B	Port P3.6/RTS1/SPICLK
24	P3[5]	Digital	B	Port P3.5/CTS0/QUADYB/SPIDO/T1



25	P3[4]	Digital	B	Port P3.4/RTS0/QUADYA/SPIDI/T0
26	P3[3]	Digital	B	Port P3.3/nINT1(active low)
27	P3[2]	Digital	B	Port P3.2/nINT0(active low)
28	P3[1]	Digital	B	Port P3.1/TXD0/QUADXB
29	P3[0]	Digital	B	Port P3.0/RXD0/QUADXA
30	DGND	Ground	-	Ground for digital core and I/O
31	NC	-	-	-
32	P0[7]	Digital	B	Port P0.7/I2STX_MCLK/PTC_GATE2
33	P0[6]	Digital	B	Port P0.6/I2STX_BCLK/PTC_GATE1
34	P0[5]	Digital	B	Port P0.5/I2STX_LRCLK/PTC_GATE0
35	P0[4]	Digital	B	Port P0.4/I2STX_DO/PWM4, 16mA drive capability
36	P0[3]	Digital	B	Port P0.3/I2SRX_MCLK/PWM3, 16mA drive capability
37	P0[2]	Digital	B	Port P0.2/I2SRX_BCLK/PWM2, 16mA drive capability
38	P0[1]	Digital	B	Port P0.1/I2SRX_LRCLK/PWM1, 16mA drive capability
39	P0[0]	Digital	B	Port P0.0/I2SRX_DI/PWM0, 16mA drive capability
40,41,42	AGND	Ground	-	RF Ground
43,44,45	AGND	Ground	-	RF Ground
46,49	AGND	Ground	-	RF Ground
47,48	DGND	Ground	-	Ground for digital core and I/O

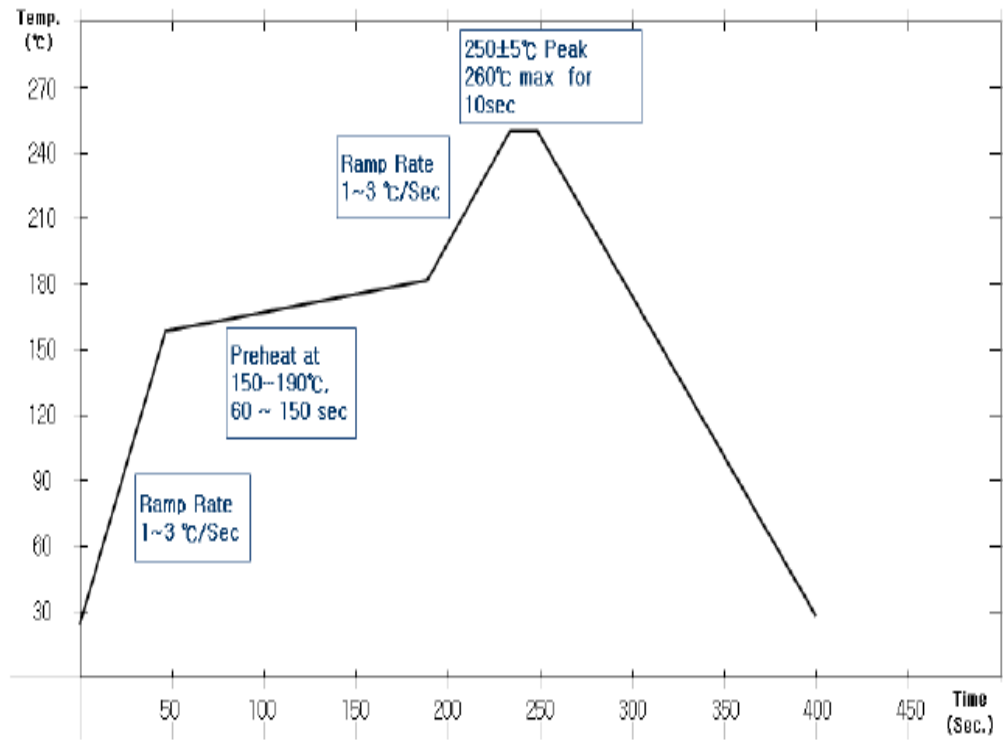
### 3. SCHEMATIC for APPLICATION



## 4. RELIABILITY

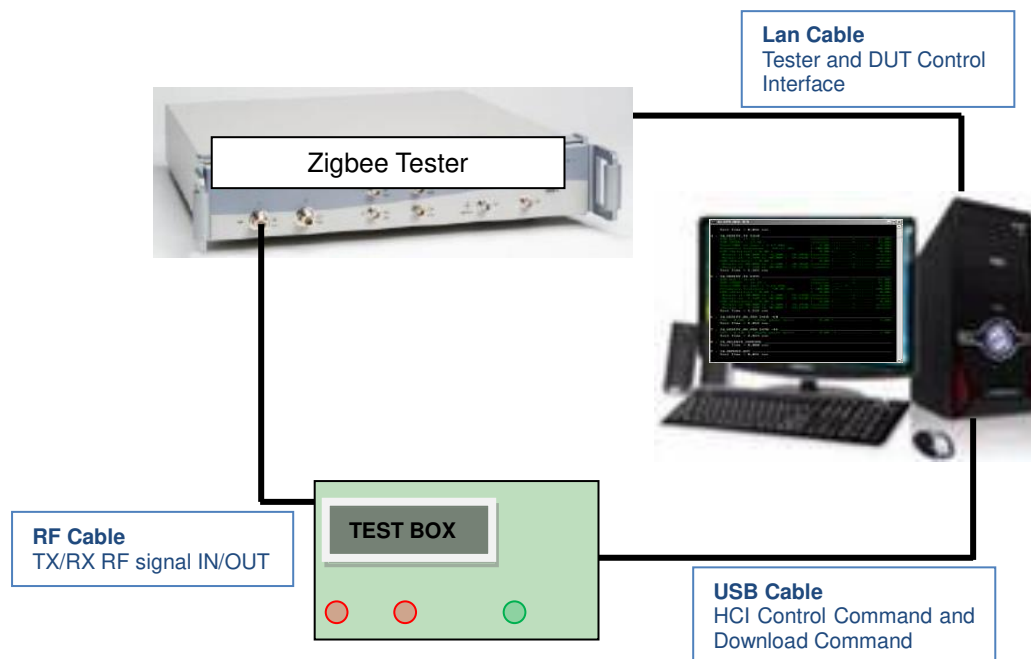
No	Test item	Test condition
1	Thermal Shock Cycle	30min. at -40°C, 30min. at 80°C, 100Cycles Recovery Time 2hours
2	Vibration Test	50Hz -> 500Hz -> 50Hz , 15min/Cycle X,Y,Z : Each 12 times [Total : 9hours]
3	High Temperature Storage Test	96 hours at 80°C±2°C, Recovery Time 2hours
4	Low Temperature Storage Test	96 hours at -40°C±2°C, Recovery Time 2hours
5	High Temperature & Humidity Storage Test	96 hours at 60°C±2°C & 95%RH±2%RH. Recovery Time 2hours
6	Operating Temperature TEST	96hours at -20°C, 70°C
7	High Temperature & Humidity Operating Test	24hours at 60°C & 85%±2%RH.
8	Drop Test (After Mold case bonding)	Height min 76cm, All sides onto Iron plate (T=min. 2mm).

## 5. REFLOW PROFILE



## 6. RF TEST

### 6.1. RF Test Block Diagram



### 6.2. Test Method

- 1) Testing instrument
  - a. IQFLEX-802.11A/B/G Test instrument (LITEPOINT 's)
  - b. PC : Test Program and Software
  - c. Test JIG
- 2) Testing method
  - a. Insert RF Module.
  - b. Push <POWER >button on JIG  
=> First, connected with module
  - c. Enter a <START>key, start RF testing.  
=> PC TOOL "PASS" "NG" displayed
  - d. Push <POWER>button on JIG  
=> Remove Product

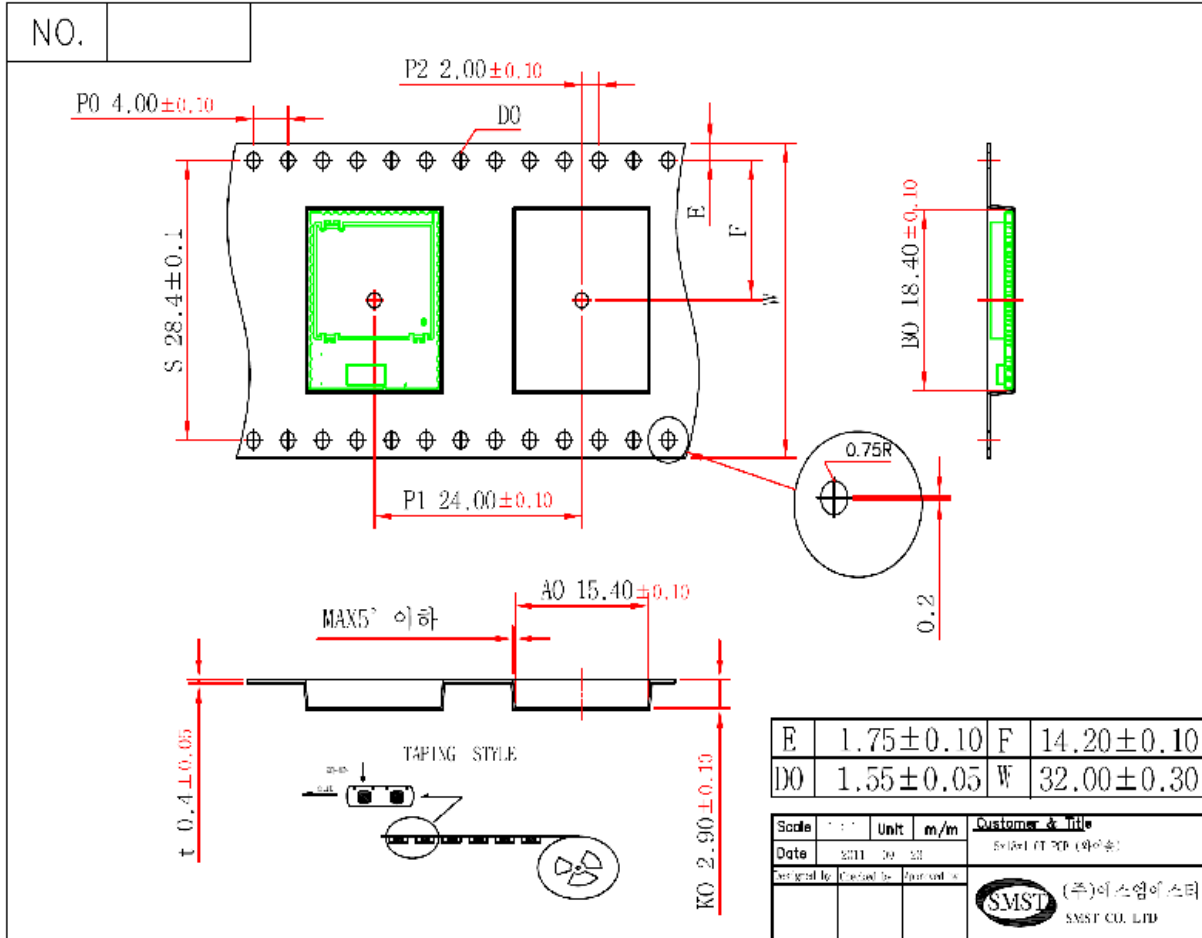
### 6.3. RF Test Report

Specification	2405MHz TX BLOCK						2480MHz TX BLOCK						RX PER		Overall Pass
	EVM ALL	EVM (PSDU)	POWER (RMS no Gap)	Frequency Tolerance	SEM (Relative)	SEM (Absolute)	EVM ALL	EVM (PSDU)	POWER (RMS no Gap)	Frequency Tolerance	SEM (Relative)	SEM (Absolute)	2405_RX Sensivity	2480_RX Sensivity	
	≤ 35%	≤ 35%	1 ~ 9 dBm	-96 ~ 96 KHz	0.000	0.000	≤ 35%	≤ 35%	1 ~ 9 dBm	-96 ~ 96 KHz	0	0	≤1%(@-96dBm)	≤1%(@-96dBm)	
Sample #1	15.95	15.88	7.03	0.86	0.00	0.00	16.84	16.54	6.61	0.58	0.00	0.00	0.00	0.00	PASS
Sample #2	20.50	20.61	7.05	-1.35	0.00	0.00	26.17	26.05	6.81	-1.88	0.00	0.00	0.00	0.00	PASS
Sample #3	20.18	20.11	7.35	5.14	0.00	0.00	23.65	23.26	6.54	4.76	0.00	0.00	0.00	0.00	PASS
Sample #4	21.98	21.87	7.24	0.07	0.00	0.00	16.19	15.76	6.50	-0.24	0.00	0.00	0.00	0.00	PASS
Sample #5	24.70	24.67	6.58	5.58	0.00	0.00	22.05	21.67	6.32	5.31	0.00	0.00	0.00	0.00	PASS
Sample #6	13.29	13.32	7.36	4.45	0.00	0.00	13.35	12.86	7.68	4.08	0.00	0.00	0.00	0.00	PASS
Sample #7	15.44	15.39	7.09	1.74	0.00	0.00	16.95	16.52	7.13	1.42	0.00	0.00	0.00	0.00	PASS
Sample #8	23.75	23.66	7.12	-2.83	0.00	0.00	25.91	25.72	6.65	-3.38	0.00	0.00	0.00	0.00	PASS
Sample #9	17.16	16.94	7.47	8.85	0.00	0.00	17.20	16.96	6.98	8.61	0.00	0.00	0.00	0.00	PASS
Sample #10	17.97	17.92	6.95	5.19	0.00	0.00	22.85	22.71	7.25	4.76	0.00	0.00	0.00	0.00	PASS
Sample #11	17.23	17.31	7.14	4.63	0.00	0.00	14.95	14.60	7.44	4.45	0.00	0.00	0.00	0.00	PASS
Sample #12	11.07	10.65	7.52	3.55	0.00	0.00	14.91	14.37	7.41	3.06	0.00	0.00	0.00	0.00	PASS
Sample #13	20.88	20.69	7.55	-2.49	0.00	0.00	19.21	18.98	6.90	-2.84	0.00	0.00	0.00	0.00	PASS
Sample #14	17.80	17.78	7.18	3.52	0.00	0.00	13.40	13.02	7.54	3.31	0.00	0.00	0.00	0.00	PASS
Sample #15	19.18	19.26	7.29	-0.92	0.00	0.00	15.40	14.97	7.43	-1.34	0.00	0.00	0.00	0.00	PASS
Sample #16	21.08	21.05	6.83	2.40	0.00	0.00	15.88	15.42	7.75	1.99	0.00	0.00	0.00	0.00	PASS
Sample #17	17.33	17.32	7.26	7.01	0.00	0.00	16.44	15.97	6.62	6.81	0.00	0.00	0.00	0.00	PASS
Sample #18	13.74	13.45	7.22	-1.05	0.00	0.00	18.87	18.41	7.12	-1.47	0.00	0.00	0.00	0.00	PASS
Sample #19	24.09	24.07	7.01	3.77	0.00	0.00	24.29	23.96	6.83	3.32	0.00	0.00	0.00	0.00	PASS
Sample #20	11.26	11.30	7.69	-1.45	0.00	0.00	15.44	15.08	6.78	-1.98	0.00	0.00	0.00	0.00	PASS

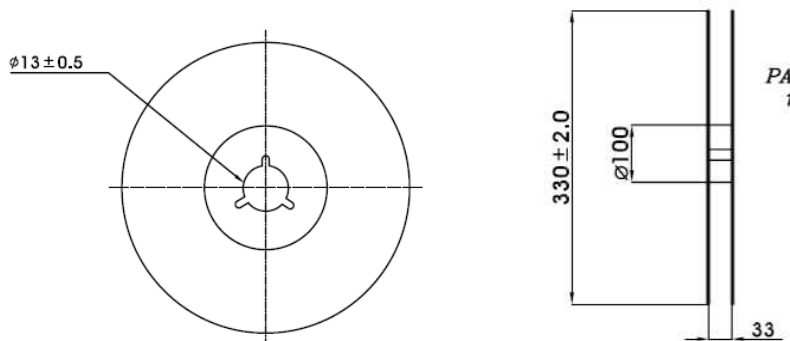
## 7. PACKAGE

### 7.1. Dimensions of tape

\* Resistance:  $1 \times 10^5 \sim 1 \times 10^{11}$  [ohm]



### 7.2. Dimensions of Reel





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### **About RadioPulse Inc.**

**RadioPulse** is a Being Wireless solution provider offering wireless communication & network technologies and developing next generation wireless networking technologies.

The new wireless networking solutions envisioned by RadioPulse will enable user to enjoy wireless technologies with easy interface.

Founded in April of 2003, the company maintains it headquarters and R&D center in Seoul, Korea.

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