PHYCHIPS

RED ②

UHF RFID Reader/Writer Module
Specification

Contents

Revision History

Version	Date	Page	Description
0.1.0	2019.12.10		Preliminary
0.1.1	2020.08.03	8	Modified the RESETb of application circuit
1.0.0	2020.09.23	4, 15	Release Modified the block diagram and the channel table of Japan band
1.0.1	2020.11.10	18	Modified the number per outer box

1   Overview

The RED2 is a UHF RFID Reader hybrid module which integrates high performance UHF RFID reader chipset, Crystal, Balun, Coupler, Saw filter and low pass filter.

UHF RFID reader chipset uses PR9200 of PHYCHIPS which integrates 900MHz radio, baseband processor, industry standard enhanced Cortex-M0 MCU, memory (64k Flash & 16k SRAM) and many other features. This module fully compliant with ISO18000-6C/EPC Global Gen II reader protocol and provide all functions of PR9200. Also reduce size, cost and power consumption. The RED2 includes automatic tx leakage cancellation to improve reader's performance and compensate sensitivity for some variation according to the surrounding environment. Also it helps a developer adopt the proper antenna and realize the optimized RFID reader system more easily and quickly.
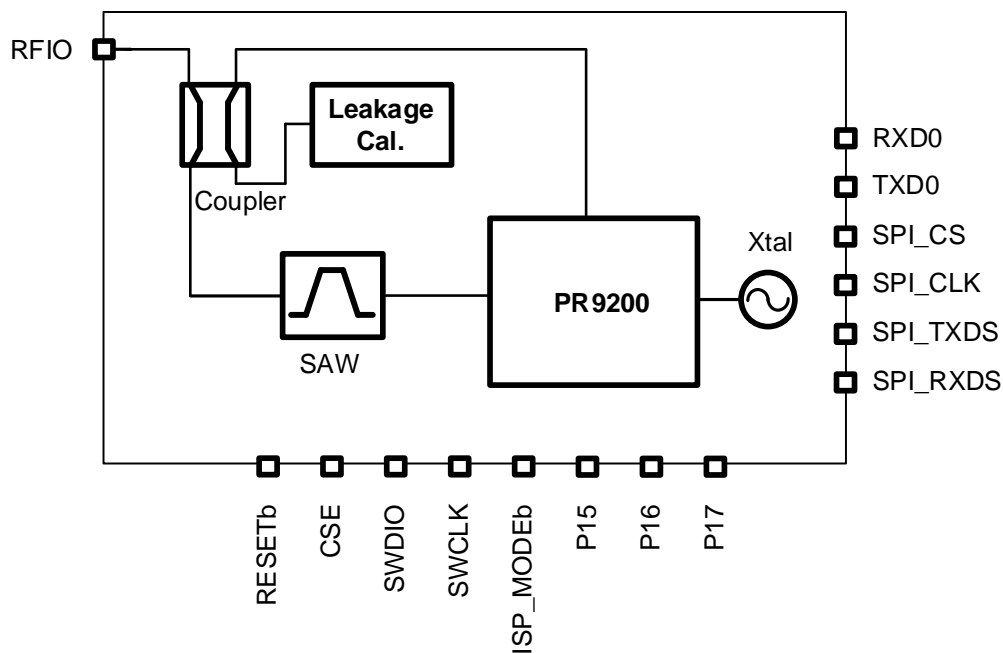

Figure 1   Block Diagram

2 Electrical Specification

2.1 Absolute Maximum Ratings

No.	Item	Unit	Test Condition	min	Typ.	max	Remark
				Specification			
1	Supply voltage : VCC	V	-	-	-	5.5	
2	Storage temperature	°C	-	-40		85	

2.2 Functional specification

No.	Item		Unit	Test Condition	min	Typ.	max	Remark
1	Frequency Range NOTE		MHz		860		960	
2	Tx Power		dBm			16		
3	Spurious		dBm		Meet to national regulation : US (FCC) China (SRRC) Europe (ETSI) Japan (TELEC) Korea (KC)			
4	Impedance		Ω			50		RF I/O
5	Input DC Power		V		3.0		3.6	
6	Digital interface IO voltage		V		3.0		3.6	
7	Operating Temperature		°C		-20		70	
8	Operating Humidity		%		0		90	
9	Current	Power Down	uA	Active current is measured at 16dBm output CW.			20	
		Idle	mA				20	
		Active	mA			210		

NOTE. If you want to know the supportable channel and frequency, refer to 5. Channel number table.

Firmware Default Function

No.	Item	Status	Remark
1	Firmware Version	RED2_v1.x.x or later	
2	Region	-	
3	Frequency Hopping	ON	
4	Q	Dynamic Q	
5	Modulation Type	DSB-ASK	
6	Back Link Frequency(BLF)	250 kHz	

3   Pin Description
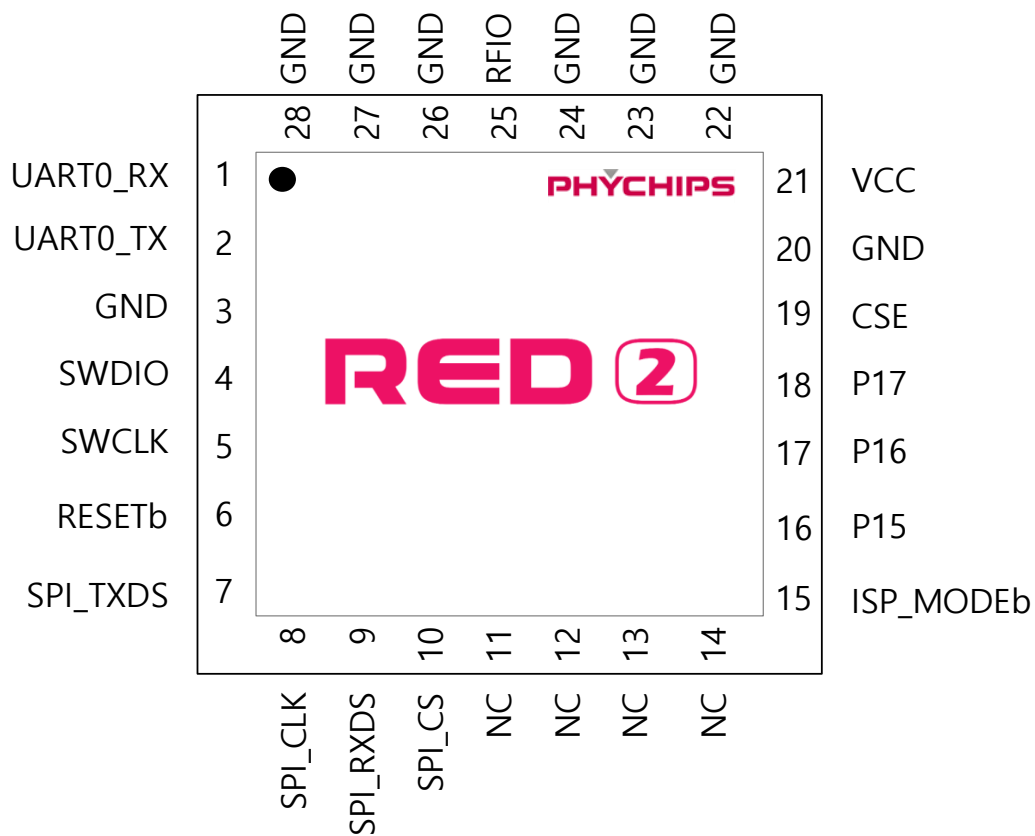
Figure 2 Pin Description

No.	Pin Name	Description
1	UART0_RX	User configurable general purpose I/O port or UART0 Input
2	UART0_TX	User configurable general purpose I/O port or UART0 Output
3	GND	Ground
4	SWDIO	Serial Wire Debug data in out
5	SWCLK	Serial Wire Debug Clock
6	RESETb	Reader SOC Reset signal 0: reset RESETb pin must be required pull- up resistor
7	SPI_TXD	Quasi-bi directional I/O port or SPI Output
8	SPI_CLK	Quasi-bi directional I/O port or SPI Clock
9	SPI_RXD	Quasi-bi directional I/O port or SPI Input
10	SPI_CS	Quasi-bi directional I/O port or SPI Chip Select
11	NC	Not Connection
12	NC	Not Connection
13	NC	Not Connection
14	NC	Not Connection
15	ISP_MODEb	When ISP_MODEb is Logic 'Low', ISP mode is set as shown below table *(see table below)* [CAUTION] Except ISP mode, ISP_MODEb should be set logic 'High' for robust stability for FLASH memory
16	P15	User configurable general purpose I/O port
17	P16	User configurable general purpose I/O port or External Interrupt 4
18	P17	User configurable general purpose I/O port or External Interrupt 5
19	CSE	Chip Select Enable. For the power control of RED2, use ENABLE pin
20	GND	Ground
21	VCC	DC power input for module
22	GND	Ground
23	GND	Ground
24	GND	Ground
25	RF IO	RF input/output. Antenna port
26	GND	Ground
27	GND	Ground
28	GND	Ground

Table within Pin No. 15 (ISP_MODEb):

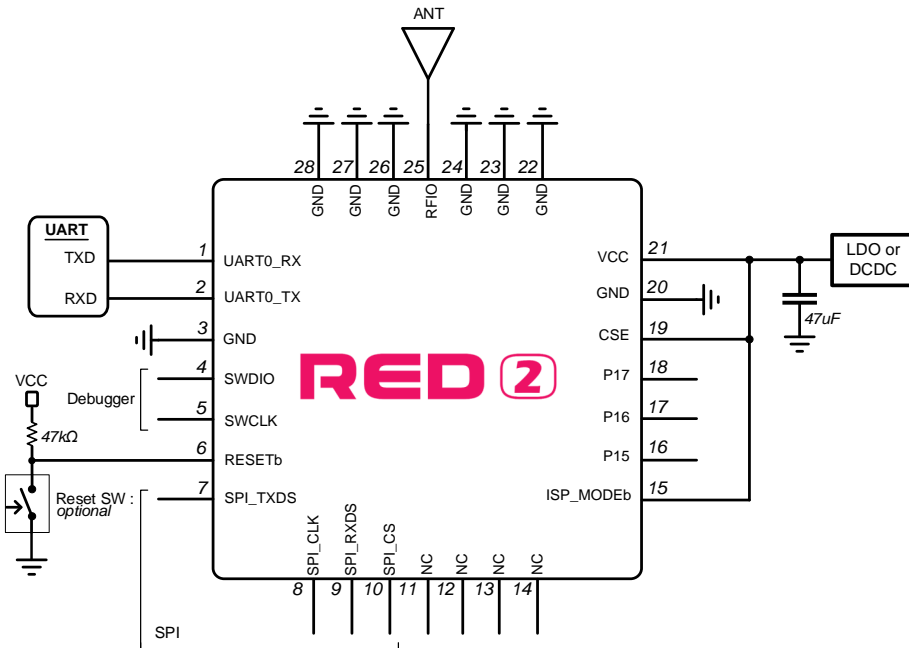| Pin No.	15	16	17	18
Pin Name	ISP_MODEb	P15	P16	P17
Normal	1	GPIO/INT	GPIO/INT	GPIO/INT
FLASH UART ISP	0	0	0	0

4 Application Circuit

Figure 3 Application Circuit

Figure 3 show example of application circuit of RED2. According to your application, you can use a variety of structure. 47uF capacitor is used to meet Japan certification. RESETb pin must be required pull-up resistor.

4.1 Power Supply

VCC (pin21) is to supply for RED2. Total current consumption of RED2 is typically 210mA at 16dBm Tx CW output power. LDO can be connected to VCC. To reduce power consumption, DCDC also can be connected.

4.2 RESETb

RED2 have internal RESET circuit including POR (Power On Reset) and BOD (Brown Output Detector). When you power up, reset time is made internally by RESET circuit. Although you enter POWER DOWN mode by asserted CSE to logic low, the RESET circuit is also operated when exit POWER DOWN by asserted CSE to logic high.

So Basically, you don't have to control "RESETb". But if you should adjust the reset yourself, follow the reset timing below
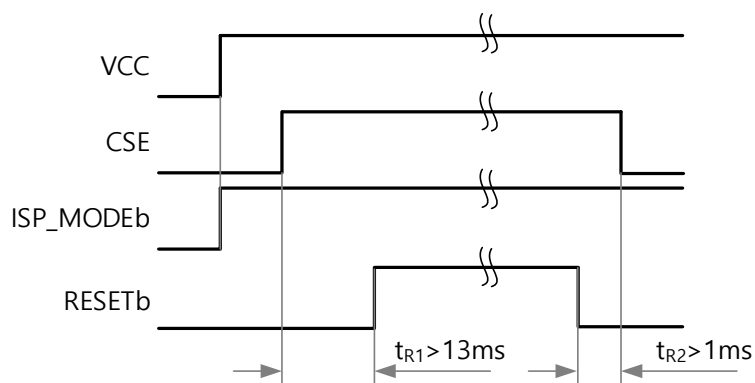

Figure 3 RESET timing (User defined)

4.3 **UART**

The serial interface is assigned with two wires. RXD0, which pin is assigned to pin 1, is for receiving command from host and TXD0, which pin is assigned to pin 2, is for transmitting response to host. Pin connection is shown as below figure.
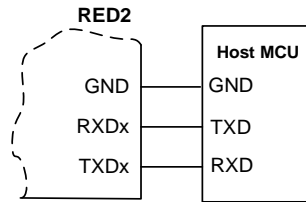

Figure 4 Host MCU Connection

RS232C transceiver is required to interface with PC that connection diagram is shown as below figure.
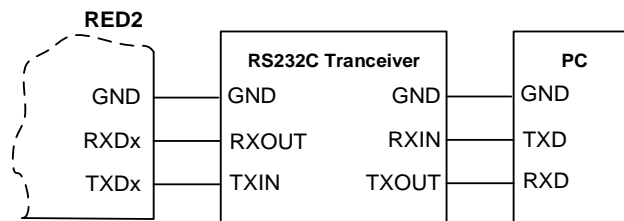
Figure 5 RS232 transceiver connection

Following configuration is used for interfacing to USB transceiver.
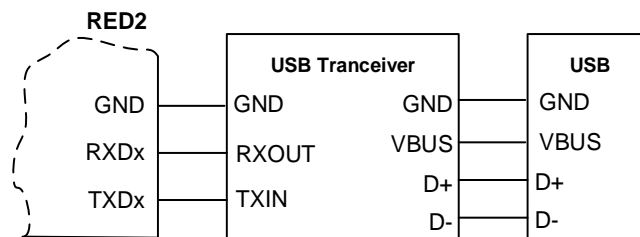
Figure 6 USB transceiver connection

4.4 **GPIO**

RED2 provides 7 bi-directional I/O ports while default serial interface is UART.

4.5 **ISP Mode**

If your module has normally operating firmware, you can update firmware without hardware setting using RED utility. This is called IAP mode.
However, if the firmware fails and you cannot download the firmware in IAP mode, you must use ISP mode.
 In order to enter UART ISP mode, some hardware setting is required.
Set pins ISP_MODEb, P17, P16 and P15 to logic "Low".

Mode name	H/W control				Programming Port
	ISP_MODEb	P17	P16	P15	
ISP UART	0	0	0	0	UART0

If you need more detailed information, please refer to RED_FDM.pdf

4.6 **Debugger**

In order to debug firmware, these ports should be connected with H/W debugger which is available on ULINK2. (for details, please refer to the 'RED_FDM.pdf')

4.7 **Operation Mode Control**

RED2 is configured in 5 main modes of operation according to PR9200.
The following table describes block condition and current according to each operation state.

Operation state

State name	H/W set	PR9200		current	Function
		Analog	Digital		
POWER DOWN	ENABLE=0	OFF	OFF	20uA	Module power off
SLEEP	ENABLE=1	OFF	Sleep	15mA	Sleep mode, Wake-up internal/external interrupt.
IDLE	ENABLE=1	OFF	ON	20mA	Block initialization
ACTIVE	ENABLE=1	ON	ON	210mA^{NOTE}	Ramp-up Tag read / write / access / lock .. Ramp-down

 NOTE. Active current is measured at Tx CW condition.

The state diagram shows the modes RED2 can operate in. it also includes transition time between the states. When RED2 enter ACTIVE mode, RF Block is activated and ramp-up the system and it start to read RFID tag. Entering IDLE mode from POWER DOWN mode, initial time is needed. The initial time of RED2 is 21ms including system power ON.
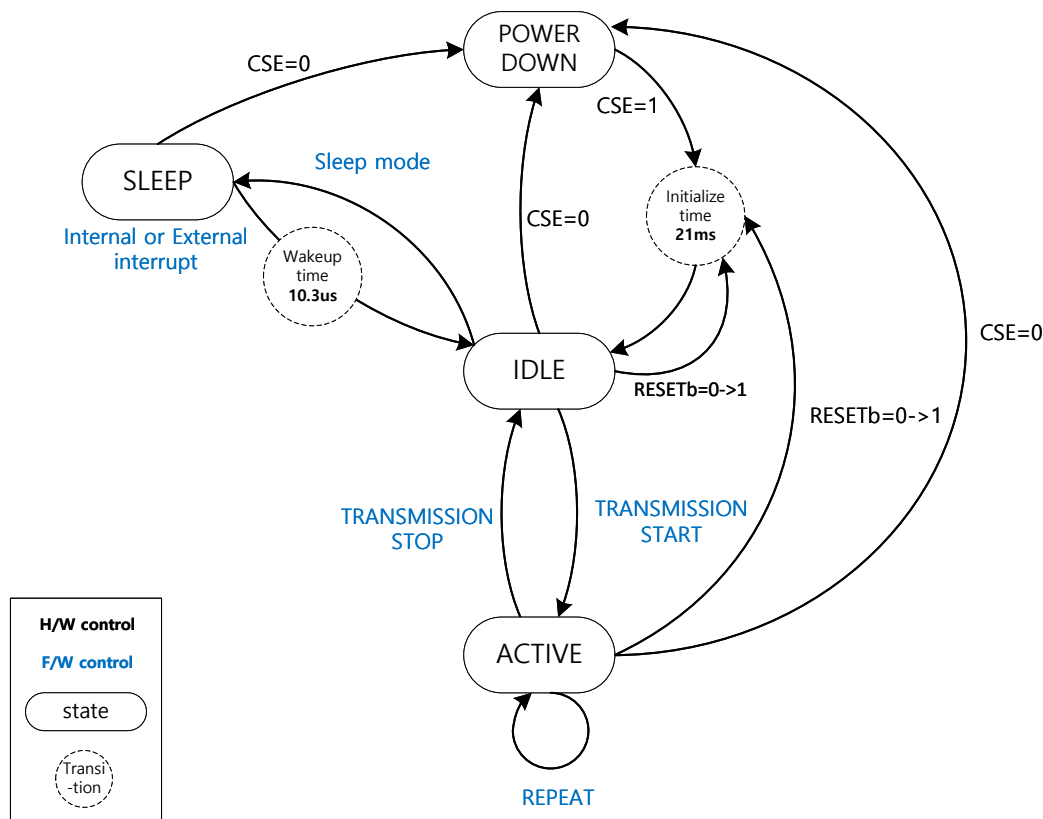
Figure 7 Operation Sequence

4.8 **Available GPIO**

  As RED2 is based on PR9200 SOC, some GPIO of PR9200 are already in use.
  In order to configure the functions of module, please refer to the available GPIO which is marked in yellow at below table.

GPIO	GPIO Function	RED2
P00	UART0 RXD	UART_RXD0
P01	UART0 TXD	UART_TXD0
P02	Ext.0	
P03	Ext.1	
P04	SSP TXDS	
P05	SSP RXDS	
P06	SSP SCK	
P07	SSP SEL	
P10	Ext.2	
P11	I2C SDA	Internally used
P12	I2C SCL	Internally used
P13	UART1 RXD(Ext.3)	Internally used
P14	UART1 TXD	Internally used
P15	-	
P16	Ext.4	
P17	Ext.5	

5   Channel Number Table

5.1 Narrow US band

Channel	Channel Frequency	Channel	Channel Frequency
1	917.10 MHz	26	922.10 MHz
2	917.30 MHz	27	922.30 MHz
3	917.50 MHz	28	922.50 MHz
4	917.70 MHz	29	922.70 MHz
5	917.90 MHz	30	922.90 MHz
6	918.10 MHz	31	923.10 MHz
7	918.30 MHz	32	923.30 MHz
8	918.50 MHz	33	923.50 MHz
9	918.70 MHz	34	923.70 MHz
10	918.90 MHz	35	923.90 MHz
11	919.10 MHz	36	924.10 MHz
12	919.30 MHz	37	924.30 MHz
13	919.50 MHz	38	924.50 MHz
14	919.70 MHz	39	924.70 MHz
15	919.90 MHz	40	924.90 MHz
16	920.10 MHz	41	925.10 MHz
17	920.30 MHz	42	925.30 MHz
18	920.50 MHz	43	925.50 MHz
19	920.70 MHz	44	925.70 MHz
20	920.90 MHz	45	925.90 MHz
21	921.10 MHz	46	926.10 MHz
22	921.30 MHz	47	926.30 MHz
23	921.50 MHz	48	926.50 MHz
24	921.70 MHz	49	926.70 MHz
25	921.90 MHz	50	926.90 MHz

NOTE1. The available band in US is from 902MHz to 928MHz. but in many application, antennas can't cover this all range. So RED series support narrow US band. It also meet FCC regulation.
If you want, you can use all US band named Wide US (North America previously) band as table 5.2

5.2 Wide US band

Channel	Channel Frequency	Channel	Channel Frequency
1	902.75 MHz	26	915.25 MHz
2	903.25 MHz	27	915.75 MHz
3	903.75 MHz	28	916.25 MHz
4	904.25 MHz	29	916.75 MHz
5	904.75 MHz	30	917.25 MHz
6	905.25 MHz	31	917.75 MHz
7	905.75 MHz	32	918.25 MHz
8	906.25 MHz	33	918.75 MHz
9	906.75 MHz	34	919.25 MHz
10	907.25 MHz	35	919.75 MHz
11	907.75 MHz	36	920.25 MHz
12	908.25 MHz	37	920.75 MHz
13	908.75 MHz	38	921.25 MHz
14	909.25 MHz	39	921.75 MHz
15	909.75 MHz	40	922.25 MHz
16	910.25 MHz	41	922.75 MHz
17	910.75 MHz	42	923.25 MHz
18	911.25 MHz	43	923.75 MHz
19	911.75 MHz	44	924.25 MHz
20	912.25 MHz	45	924.75 MHz
21	912.75 MHz	46	925.25 MHz
22	913.25 MHz	47	925.75 MHz
23	913.75 MHz	48	926.25 MHz
24	914.25 MHz	49	926.75 MHz
25	914.75 MHz	50	927.25 MHz

5.3 Korea band

Channel	Channel Frequency	Channel	Channel Frequency
1	917.1 MHz	**17**	**920.30 MHz**
2	**917.30 MHz**	18	920.50 MHz
3	917.50 MHz	19	920.70 MHz
4	917.70 MHz	20	920.90 MHz
5	**917.90 MHz**	21	921.10 MHz
6	918.10 MHz	22	921.30 MHz
7	918.30 MHz	23	921.50 MHz
8	**918.50 MHz**	24	921.70 MHz
9	918.70 MHz	25	921.90 MHz
10	918.90 MHz	26	922.10 MHz
11	**919.10 MHz**	27	922.30 MHz
12	919.30 MHz	28	922.50 MHz
13	919.50 MHz	29	922.70 MHz
14	**919.70 MHz**	30	922.90 MHz
15	919.90 MHz	31	923.10 MHz
16	920.10 MHz	32	923.30 MHz

NOTE1. The channels written in Bold can be used by 4W (CH 2,5,8,11,14,17)
The channels (CH1,3,4,6,7,9,10,12,13,15,16,18,19) are used by 3mW

5.4 China band

Channel	Channel Frequency	Channel	Channel Frequency
1	920.125 MHz	11	922.625 MHz
2	920.375 MHz	12	922.875 MHz
3	920.625 MHz	13	923.125 MHz
4	920.875 MHz	14	923.375 MHz
5	921.125 MHz	15	923.625 MHz
6	921.375 MHz	16	923.875 MHz
7	921.625 MHz	17	924.125 MHz
8	921.875 MHz	18	924.375 MHz
9	922.125 MHz	19	924.625 MHz
10	922.375 MHz	20	924.875 MHz

5.5 **Japan band**

Channel	Channel Frequency	Channel	Channel Frequency
24	920.6 MHz	32	922.2 MHz
25	920.8 MHz	33	922.4 MHz
26	921.0 MHz	34	922.6 MHz
27	921.2 MHz	35	922.8 MHz
28	921.4 MHz	36	923.0 MHz
31	922.0 MHz		

5.6 **EU band**

Channel	Channel Frequency
1	-
2	-
3	-
4	865.70 MHz
5	-
6	-
7	866.30 MHz
8	-
9	-
10	866.90 MHz
11	-
12	-
13	867.50 MHz
14	-
15	-

6 Dimension
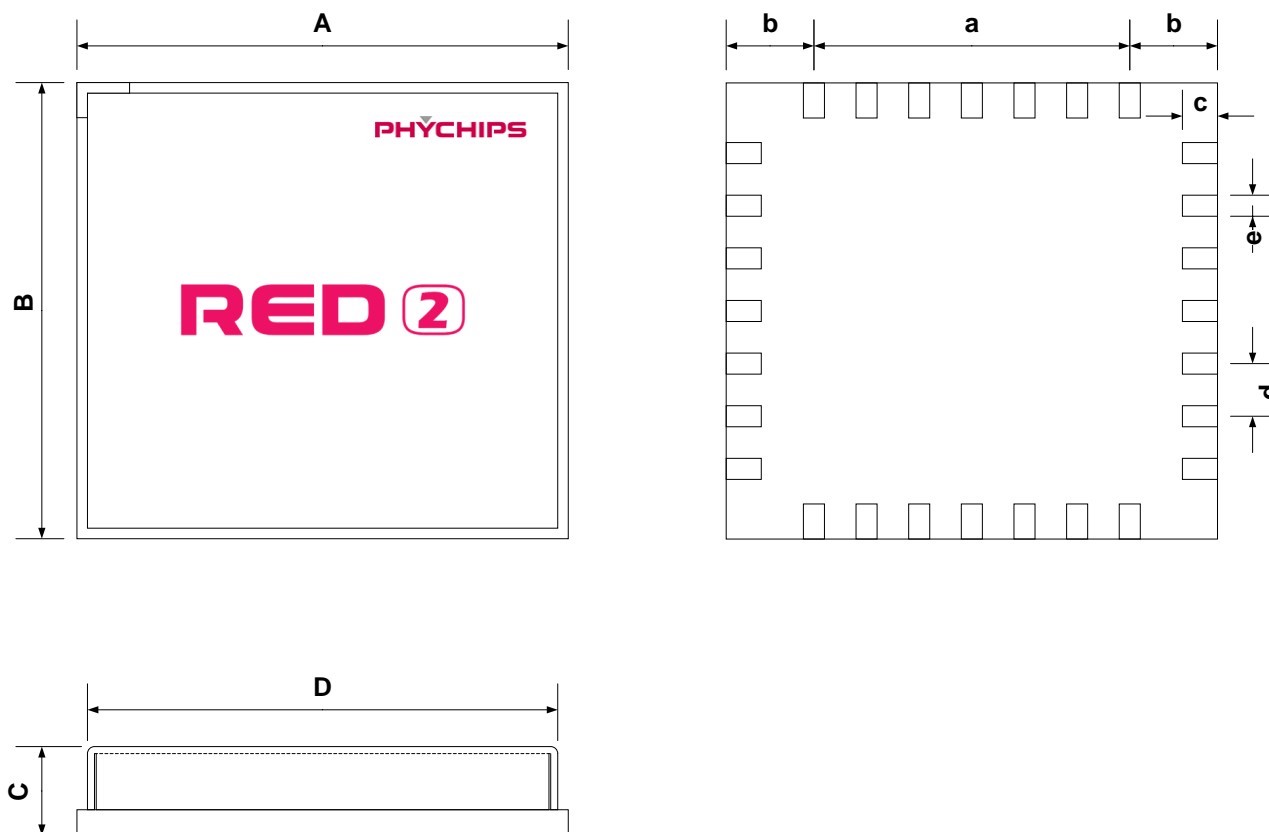
Figure 8 Dimension

Package on Dimension (Unit : mm)				
SYM	**MIN**	**TYP**	**MAX**	**Remark**
A	13.50	14.00	14.50	
B	12.50	13.00	13.50	
C	2.43	2.53	2.63	
D		13.40		
a		9.00		
b		2.50		
c		1.00		
d		1.50		
e		0.60		

7 Footprint
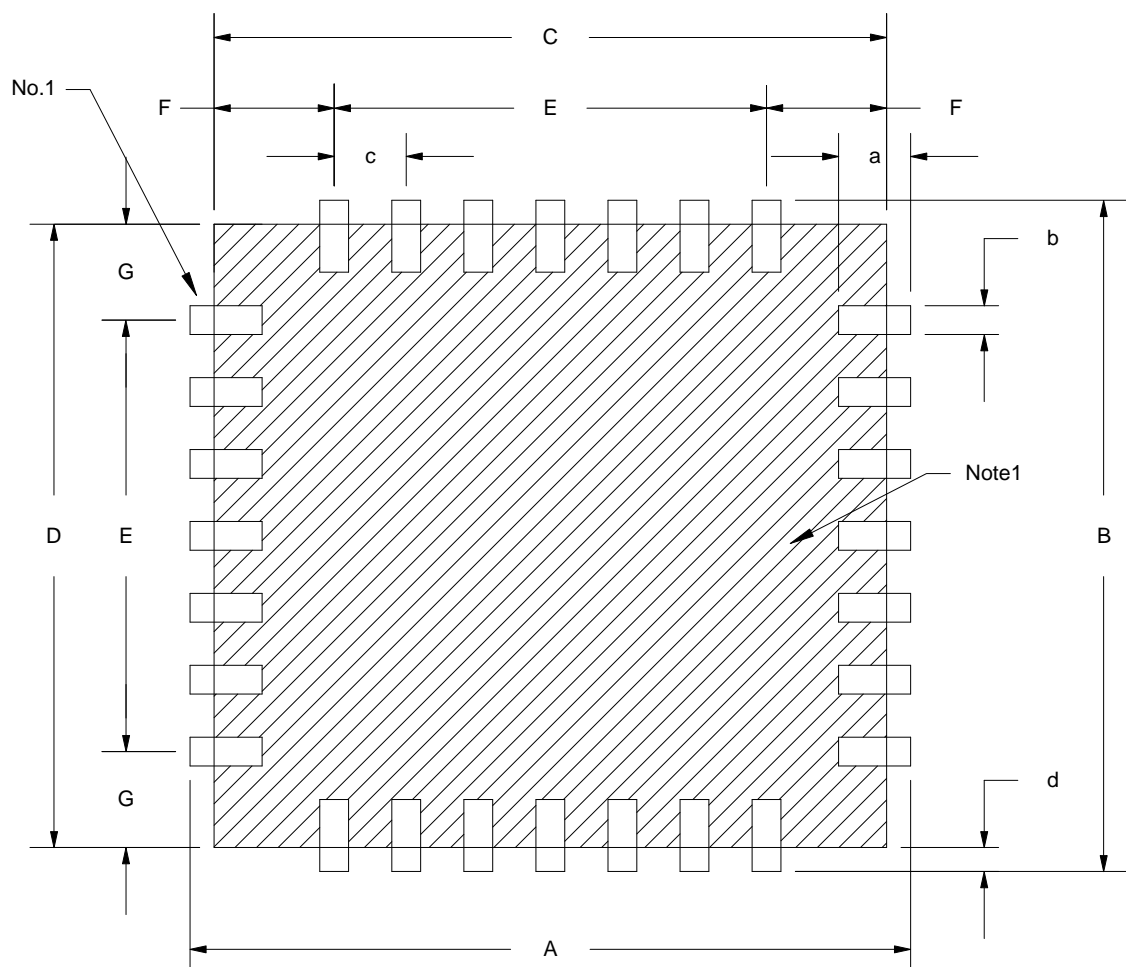
Figure 9 Footprint

NOTE1. Do not place VIA on the hatched area, if you should use through VIA, print silkscreen on this area to prevent signal short problem with the bottom of RED2.

Footprint on Dimension (Unit : mm)				
SYM	**MIN**	**TYP**	**MAX**	**Remark**
A		15.00		
B		14.00		
C		14.00		
D		13.00		
E		9.00		
F		2.50		
G		2.00		
a		1.50		
b		0.60		
c		1.50		
d		0.50		

8 Packing Information

Packing materials for the RED2 shipment consist of the anti-static tray and the outer box which can hold up to 1,500 pcs of the RED2 each box.

8.1 Tray dimension

Dimension of the tray to store the RED2, which can hold up to 100 pcs of the RED2, is approximately measured to W = 280mm, L = 240mm, H = 10mm. Tray helps to avoid both interference between the products and static from the outside. Detailed shape refer to figure 10 as below.
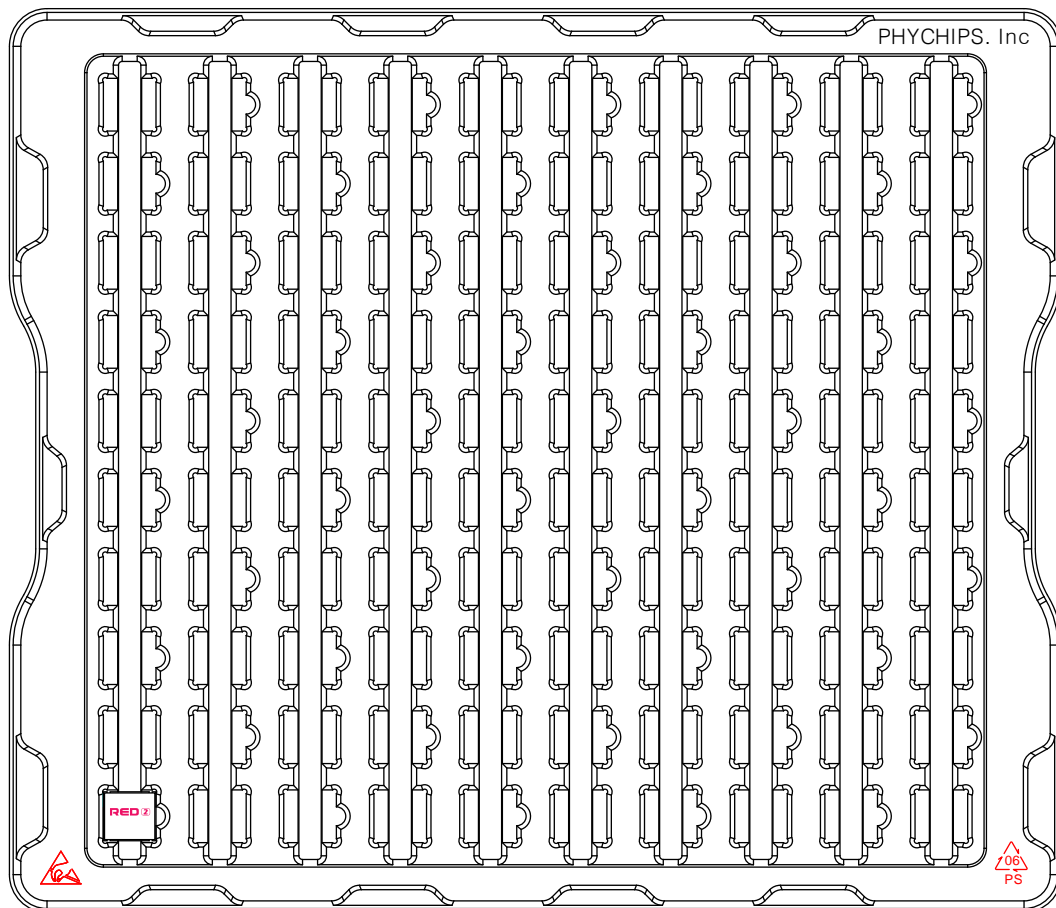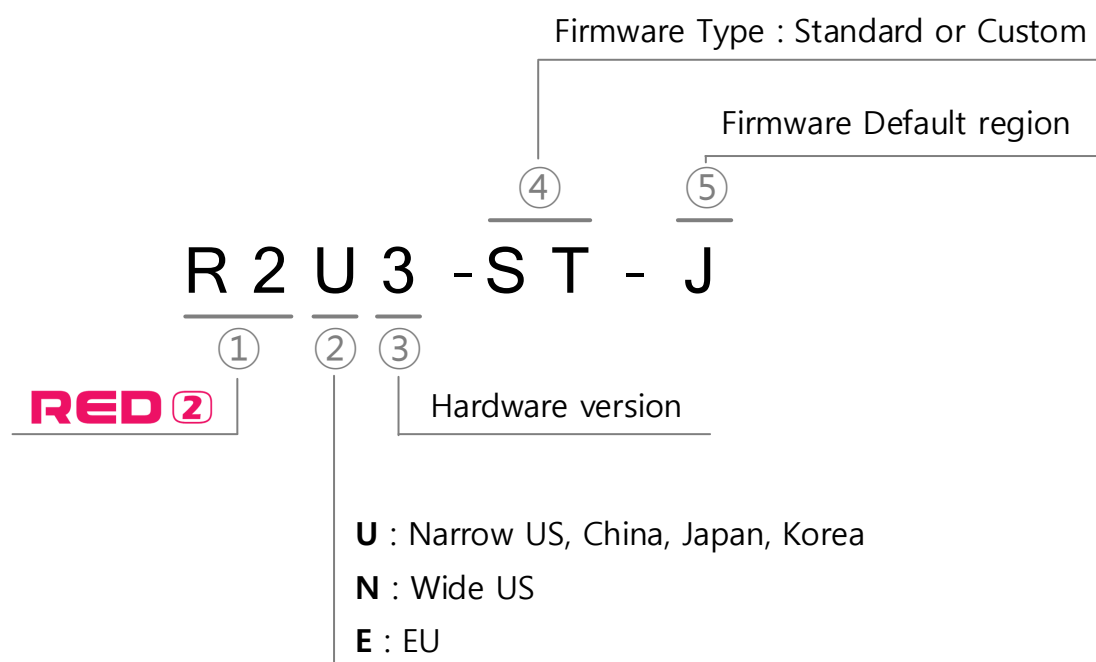

Figure 10 Dimension of the tray

8.2 Outer box dimension

The outer box is made printed card board, which may avoid dust, moisture and shock from the outside and convenient to ship. Dimension of the outer box is approximately measured to W = 285mm, L = 250mm, H = 115mm.

※ Packing materials are able to change dimension larger or smaller according to shipped quantity of mass product or/and internal policies so that shipment can be controlled easily and safely.

9 Ordering information

Firmware Type : Standard or Custom

Firmware Default region

④ ⑤

R 2 U 3 - S T - J

① ② ③

Hardware version

U : Narrow US, China, Japan, Korea

N : Wide US

E : EU

Name	Contents
① Module name	RED2
② Region selection	U : Narrow US(917 to 927MHz), china, Japan, Korea N : Wide US (902 to 928MHz) E : EU (865 to 868MHz)
③ Hardware version	3 : current version
④ Firmware version	ST : Standard xx : custom version
⑤ Firmware Default region	U : Narrow US C : China J : Japan K : Korea N : Wide US E : EU Others

[NOTE] RED2 has different hardware according to operation region

10 Reflow information

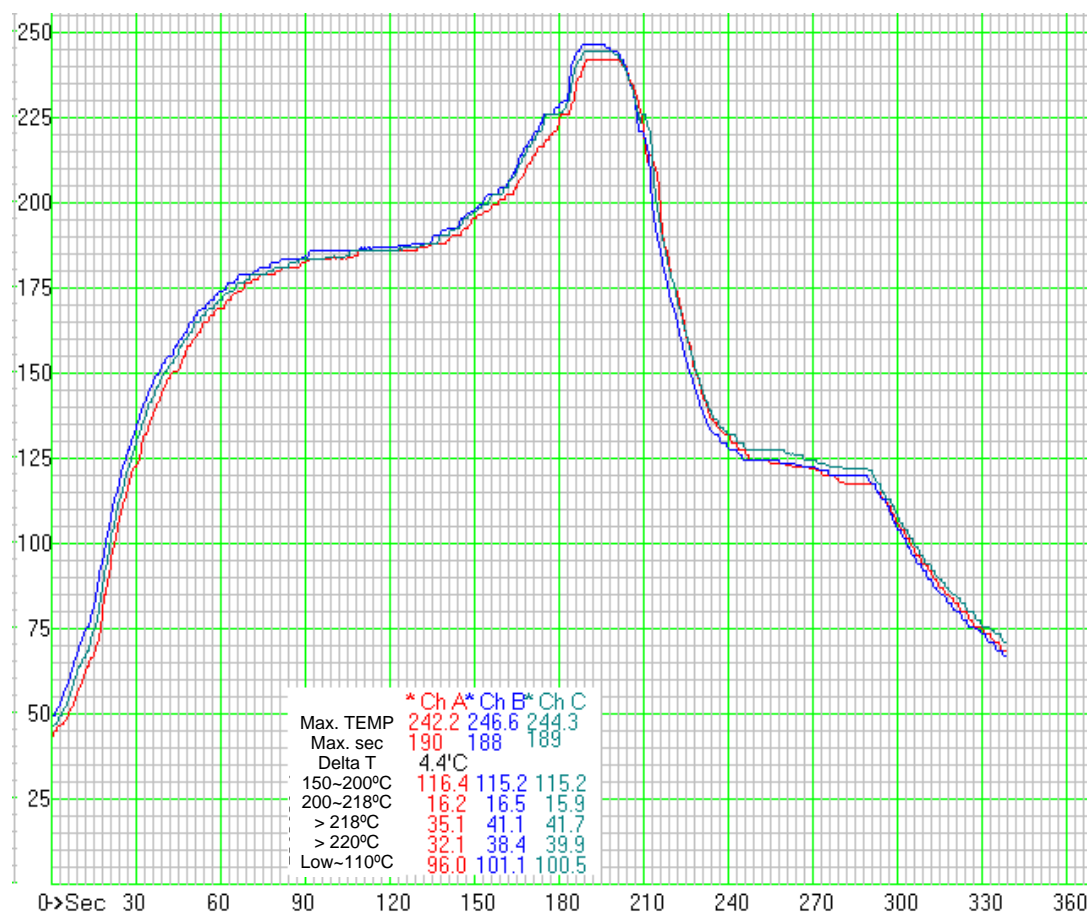The recommended reflow profile is shown in figure 11.

Figure 11 Reflow chart

11 Address Information

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