

RED 4^S

UHF RFID Reader/Writer Module Specification



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Revision History

Version	Date	Page	Description
0.1.0	2017.12.14		Preliminary
0.2.0	2018.01.08		Tx dynamic range will be determined next time
0.3.0	2018.01.30		Added the information about Tx dynamic range
1.0.0	2018.02.28		Release Added the information about reliability
1.0.1	2018.03.16		Added the information about the certifications
1.0.2	2018.03.23	21,22	Modified the dimension & footprint
1.0.3	2018.07.18	19	Modified the channel table of Japan band
1.1.0	2019.01.18		Modification of RED4S(R4S5) are reflected Changed a description of Tx dynamic range
1.1.1	2019.10.17	20 14	Modified the channel table of Brazil band Modified initialize time in section 4.8 Operation Mode Control
1.1.2	2020.03.13		Modified the description for 4.2 RESETb Fixed the description of 3.4 RFIO Removed the description for coLink
1.1.3	2022.06.16	15	Modified the description for 4.8 Operation mode control

RED4S is a UHF RFID Reader hybrid module which integrates high performance UHF RFID reader chipset, TCXO, Balun, Coupler, SAW filter, Power amp and low pass filter.

This module is fully compliant with ISO18000-6C/EPC Global Gen II reader protocol and provides all functions of PR9200. It has superior performance, small form factor and advantages in time-to-market. The RED4S includes the enhanced 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.



2 Electrical Specification

2.1 Absolute Maximum Ratings

No.	Item	Unit	Test Condition	Specification			Remark
				min	Typ.	max	
1	Supply voltage: VCC36P	V	-	-	-	6.0	
2	Supply voltage: VCC36	V	-	-	-	5.5	
3	Storage temperature	°C	-	-40		85	

2.2 Functional specification

No.	Item		Unit	Test Condition	Specification			Remark
					min	Typ.	max	
1	Frequency Range		MHz		860		960	
2	Tx Max. Power ^{NOTE1}		dBm				27	
3	Tx Dynamic Range		dB			14		
3	Spurious ^{NOTE2}		dBm		Meet to local regulation: Korea (KCC) US (FCC 15C) Europe (ETSI EN 302 208) Japan (ARIB STD-T107)			
4	Impedance		Ω			50		RF I/O
5	DC Power	VCC36P	V		3.3	3.6	4.2	
		VCC36			3.3		3.6	
6	Operating Temperature		°C		-20		70	
7	Operating Humidity		%		0		90	
8	Current	Power Down	uA	Active current is measured at 27dBm with 50ohm load			20	
		Idle	mA				20	
		Active				550		

NOTE1. Available Tx power is 23dBm under Japan regulation. Current consumption is 380mA at 23dBm CW.

NOTE2. 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	RED4S_v1.2.x or later	R4S2, R4S3
		RED4S_v2.x.x or later	R4S5 or later
2	Region	-	
3	Frequency Hopping	ON	
4	Q	Dynamic Q	
5	Modulation Type	DSB-ASK	
6	Back Link Frequency(BLF)	250 kHz	

2.3 Typical characteristics

Figure 2 shows dynamic range and current consumption according to Tx CW power at T=25°C, VCC36 = 3.6V, VCC36P = 3.6V, Tx Frequency 921.9MHz.

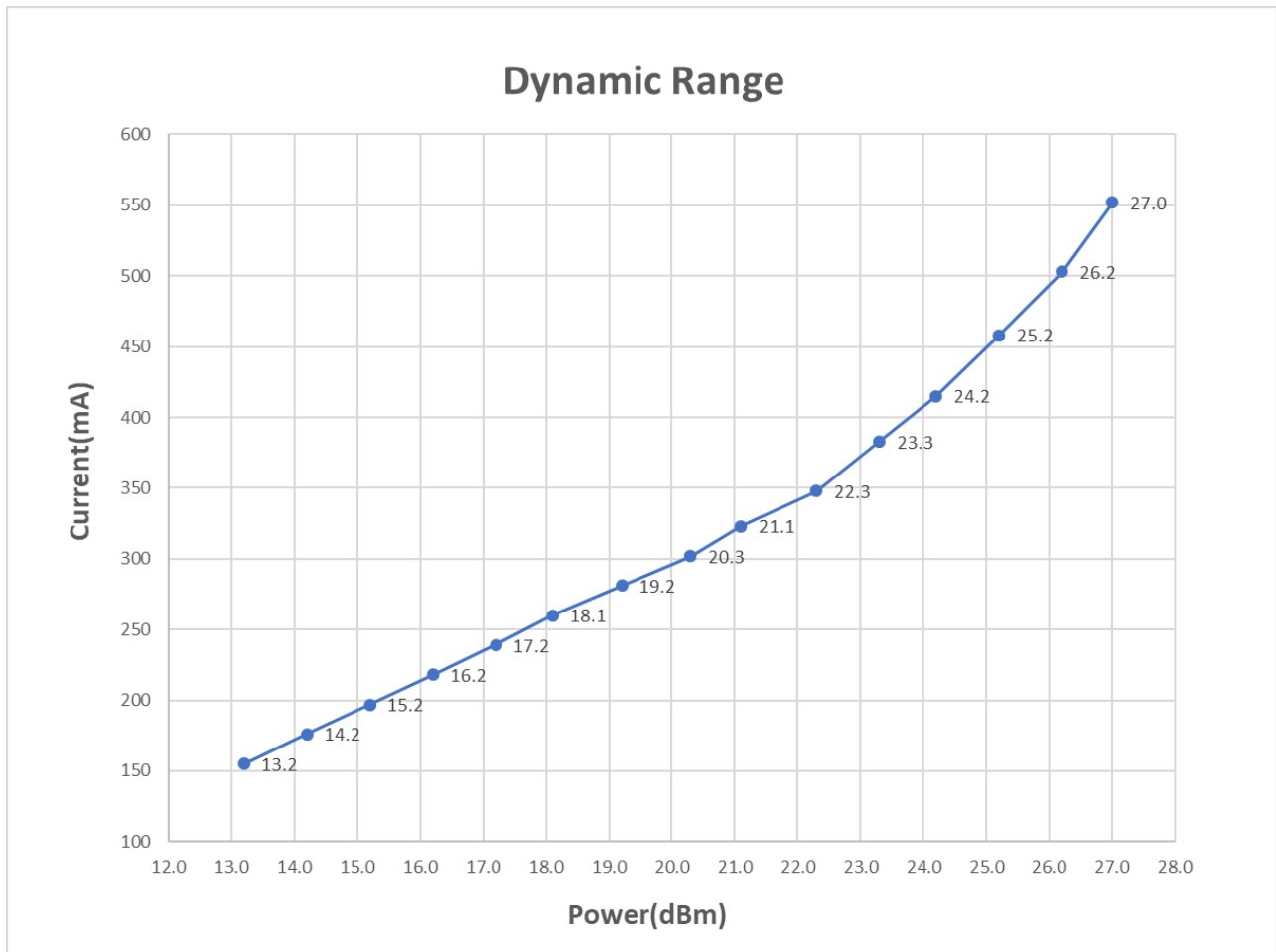


Figure 2 Tx Dynamic Range

2.4 Reliability

No	Item	Test Condition	Duration	Result
1	HTOL	70°C / 3.6V (DC)	100 h	Pass
2	HTST	85°C	100 h	Pass
3	LTST	-40°C	100 h	Pass
4	THB	85°C / 85% R.H / 3.6V (DC)	100 h	Pass
5	T/C	-40°C to 85°C (Each 30min)	100 cycle	Pass
6	PCT	121°C / 100% R.H / 2 [^] 5kPa	192 h	Pass
7	MSL	Moisture Sensitivity Level BAKE : 125 (+5,-0) °C SOAK : 30°C ±2°C, 60% ±3% R.H. REFLOW : ≥260°C	Level 3	Pass
8	ESD (HBM)	2000V (JS-001-2014)		Pass

2.5 Certifications

No	Regulation Standard	ID
1	FCC (part 15)	Y3D-RED4S
2	CE (ETSI EN 302 208)	PC-RED-DOC-RED4S
3	JAPAN MIC	R 011-180006
4	KCC	R-CRM-PHY-RED4S

3 Hardware Interface

RED4S supports two types of connection providing DC power and commutation interface to your HOST. One is solder-down SMD type connection and the other is low profiles DC/signal connector. Antenna port also support U.FL connector or solder-down port.

3.1 Pin diagram

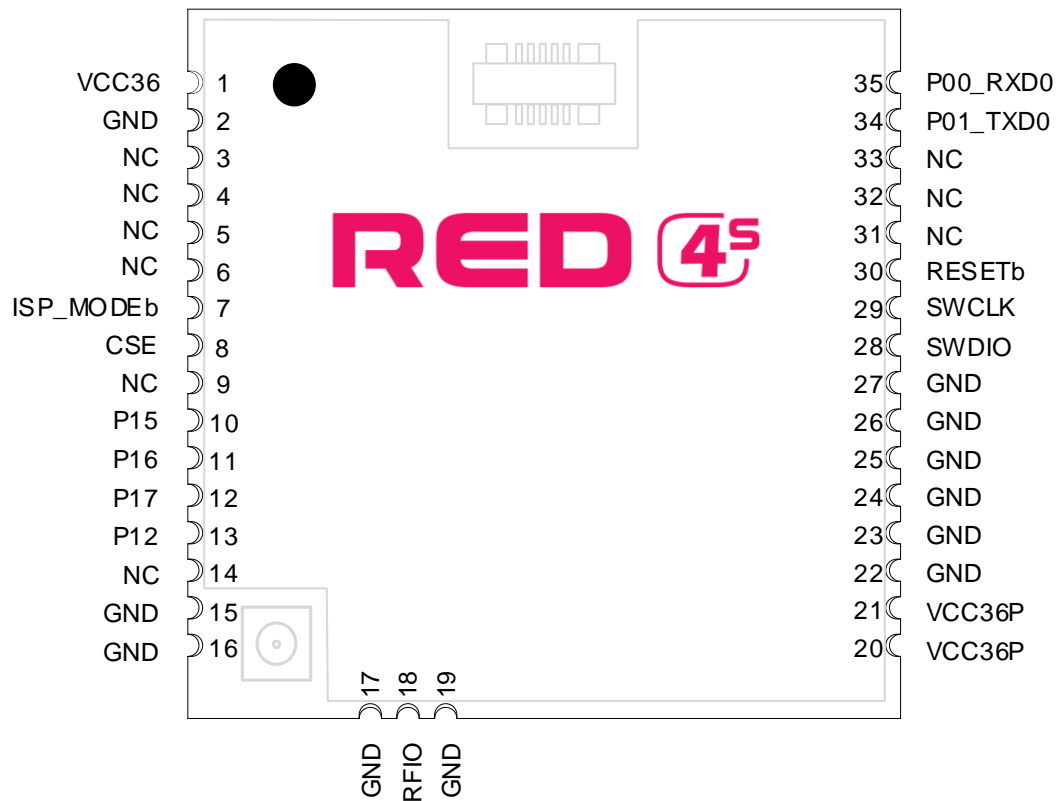


Figure 3 Pin diagram

3.2 Pin description

No.	Pin Name	Description																				
1	VCC36	DC Power for Reader SOC																				
2	GND	Ground																				
3	NC	No Connection																				
4	NC	No Connection																				
5	NC	No Connection																				
6	NC	No Connection																				
7	ISP_MODEb	When ISP_MODEb is Logic 'Low', ISP mode is set as shown below table																				
		<table><tr><th>Pin No.</th><th>7</th><th>12</th><th>11</th><th>10</th></tr><tr><td>MODE</td><td>ISP_MODEb</td><td>P17</td><td>P16</td><td>P15</td></tr><tr><td>Normal</td><td>1</td><td>GPIO/INT</td><td>GPIO/INT</td><td>GPIO/INT</td></tr><tr><td>UART ISP</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table>	Pin No.	7	12	11	10	MODE	ISP_MODEb	P17	P16	P15	Normal	1	GPIO/INT	GPIO/INT	GPIO/INT	UART ISP	0	0	0	0
		Pin No.	7	12	11	10																
		MODE	ISP_MODEb	P17	P16	P15																
		Normal	1	GPIO/INT	GPIO/INT	GPIO/INT																
UART ISP	0	0	0	0																		
[CAUTION] Except ISP mode, ISP_MODEb should be set logic 'High' for robust stability for FLASH memory																						
8	CSE	Chip Select enable / module power enable 0: Disable 1: Enable																				
9	NC	No Connection																				
10	P15	Quasi-bi directional I/O port NOTE. This pin is already used internally. this pin should be used only for ISP mode																				
11	P16	Quasi-bi directional I/O port or External Interrupt 4																				
12	P17	Quasi-bi directional I/O port or External Interrupt 5																				
13	P12	Quasi-bi directional I/O port																				
14	NC	No Connection																				
15	GND	Ground																				
16	GND	Ground																				
17	GND	Ground																				
18	RF IO	Rx Input / Tx Output																				
19	GND	Ground																				
20	VCC36P	DC Power for Power Amp																				
21	VCC36P	DC Power for Power Amp																				
22	GND	Ground																				
23	GND	Ground																				
24	GND	Ground																				
25	GND	Ground																				
26	GND	Ground																				
27	GND	Ground																				
28	SWDIO	Serial Wire Debug data in out																				
29	SWCLK	Serial Wire Debug Clock																				
30	RESETb	Reader SOC Reset signal 0: reset																				
31	NC	No Connection																				
32	NC	No Connection																				
33	NC	No Connection																				
34	P01_TXD0	Quasi-bi directional I/O port or UART0 Output																				
35	P00_RXD0	Quasi-bi directional I/O port or UART0 Input																				

NOTE. NC pins are floated. These pins are not connected to any parts inside module.

3.3 DC/signal connector

3.3.1 Connector description

- ✓ Connector type: 0.35mm pitch 0.8mm Height Hybrid power/signal connector
- ✓ Model part No.: BM24-10DP/2-0.35V (51) [HIROSE]

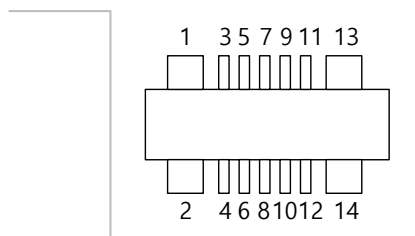


Figure 4 connector

pin No.	Pin name	Pin No.	Pin name
1	GND	2	GND
3	P17	4	P00_RXD0
5	CSE	6	P01_TXD0
7	ISP_MODEb	8	RESETb
9	P15	10	VCC36
11	P16	12	VCC36
13	VCC36P	14	VCC36P

NOTE. Receptacle for this header is BM24-10DS/2-0.35V (51)

3.4 RF IO

3.4.1 Description

- ✓ Connector type: Coaxial Micro-Receptacle
- ✓ Model part No.: U.FL-R-SMT-1 (Hirose)

4.2 RESETb

RED4S 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

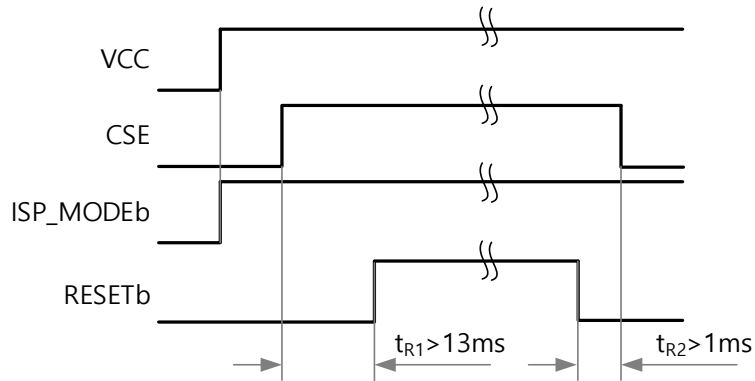


Figure 7 RESET timing (User defined)

4.3 UART

The serial interface is assigned with two wires. RXD0, which pin is assigned to pin 35, is for receiving command from host and TXD0, which pin is assigned to pin 34, is for transmitting response to host. Pin connection is shown as below figure.

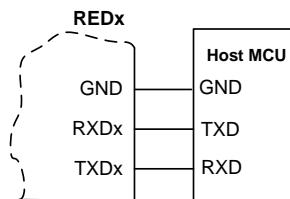


Figure 8 Host MCU connection

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

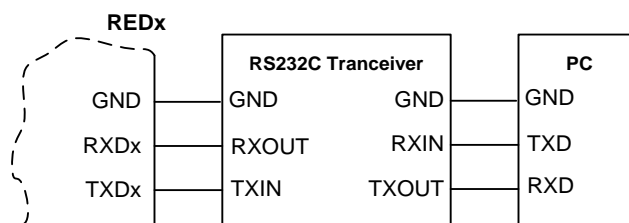


Figure 9 RS232 transceiver connection

Following configuration is used for interfacing to USB-to-UART Bridge IC.

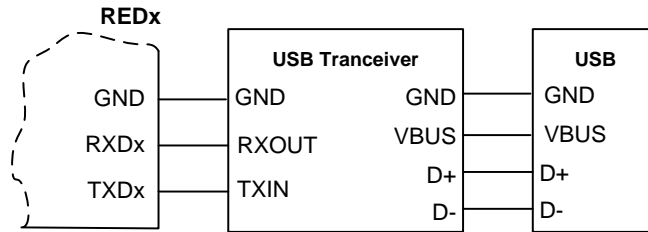


Figure 10 USB-to-UART bridge IC

4.4 GPIO

RED4S provides 4 bi-directional I/O ports.

4.5 External Interrupt

RED4S provides 2 external interrupt that is unstopable except by reset.

- Dedicated non-maskable Interrupt input.
- Support for both level-sensitive and pulse-sensitive interrupt lines.

4.6 ISP Mode

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

NOTE. Firmware download can be executed by download menu of RED utility without hardware control under normal condition.

4.7 Debugger

To debug firmware, these ports should be connected to H/W debugger which is available on both the ULINK2. (For details, please refer to the ‘RED_FDM.pdf’)

4.8 Operation Mode Control

RED4S is configured in 4 main modes of operation according to PR9200.

The following table describes block condition and current according to each operation state.

Operation state

State name	HW set	PR9200		PAM	current	Function
		Analog	Digital	PA		
POWER DOWN	CSE=0	OFF	OFF	OFF	20uA	Module power off
SLEEP	CSE=1	OFF	Sleep	OFF	15mA	Sleep mode, Wake-up external interrupt.
IDLE	CSE=1	OFF	ON	OFF	20mA	Block initialization
ACTIVE	CSE=1	ON	ON	ON	550mA	Ramp-up Tag read / write / access / lock .. Ramp-down

NOTE. Active current is measured at Tx CW condition.

The state diagram shows the modes RED4S can operate in. It also includes transition time between the states. When RED4S 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 RED4S is 105ms including system power ON.

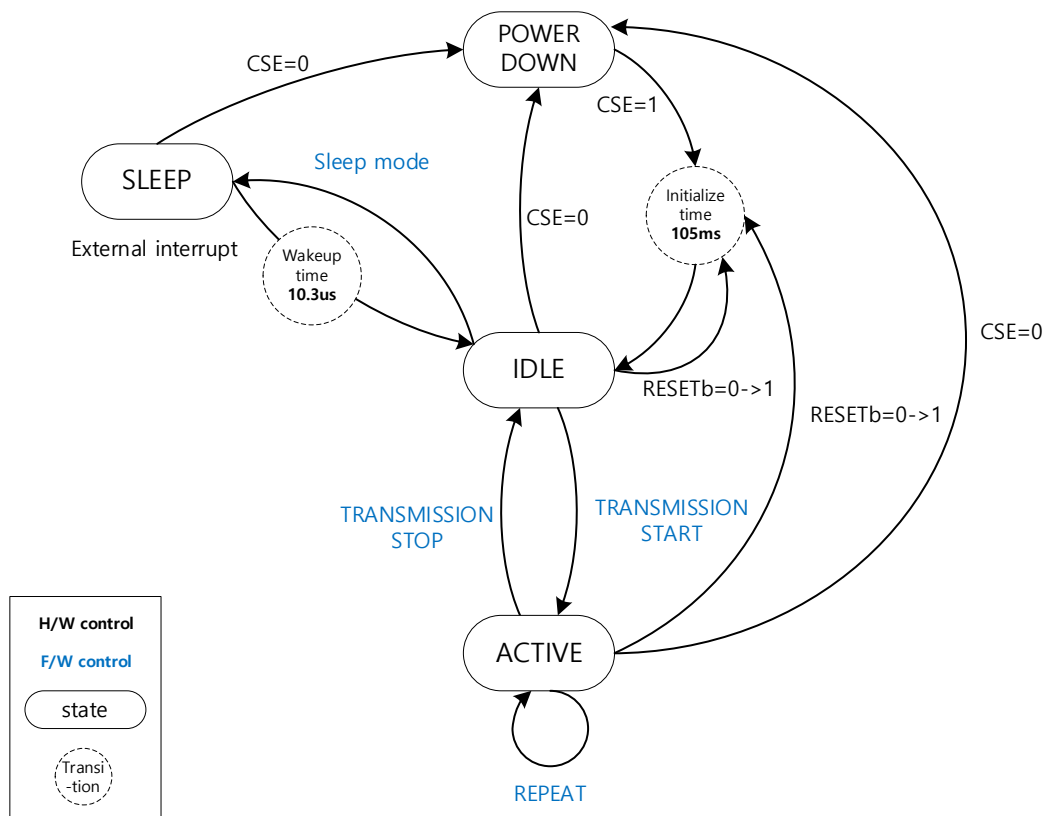


Figure 11 Operation Sequence

4.9 Available GPIO

RED4S is based on PR9200 SOC. To configure the functions of module, some GPIO of PR9200 are already used. Below table shows the available GPIO which is marked in yellow box.

GPIO	GPIO Function	RED4S
P00	UART0 RXD	UART_RXD0
P01	UART0 TXD	UART_TXD0
P02	Ext.0	Internally used (PA_EN)
P03	Ext.1	Internally used
P04	SSP TXDS	Internally used
P05	SSP RXDS	Internally used (H/L Gain Control)
P06	SSP SCK	Internally used
P07	SSP SEL	Internally used
P10	Ext.2	Internally used
P11	I2C SDA	Internally used
P12	I2C SCL	
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

NOTE. 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 meets FCC regulation.
If you want, you can use all US band named Wide US 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

NOTE. The channels written in Bold are default value which can be used by 4W (CH 2,5,8,11,14,17). The channels (CH 1,3,4,6,7,8,10,12,13,15,16,18,19) 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	33	922.4 MHz
25	920.8 MHz	34	922.6 MHz
26	921.0 MHz	35	922.8 MHz
27	921.2 MHz	36	923.0 MHz
28	921.4 MHz		
29	921.6 MHz		
30	921.8 MHz		
31	922.0 MHz		
32	922.2 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	-

5.7 Brazil band

Channel	Channel Frequency
1	915.25
2	915.75
3	916.25
4	916.75
5	917.25
6	917.75
7	918.25
8	918.75
9	919.25
10	919.75
11	920.25
12	920.75
13	921.25
14	921.75
15	922.25
16	922.75
17	923.25
18	923.75
19	924.25
20	924.75
21	925.25
22	925.75
23	926.25
24	926.75
25	927.25
26	927.75

6 Dimension

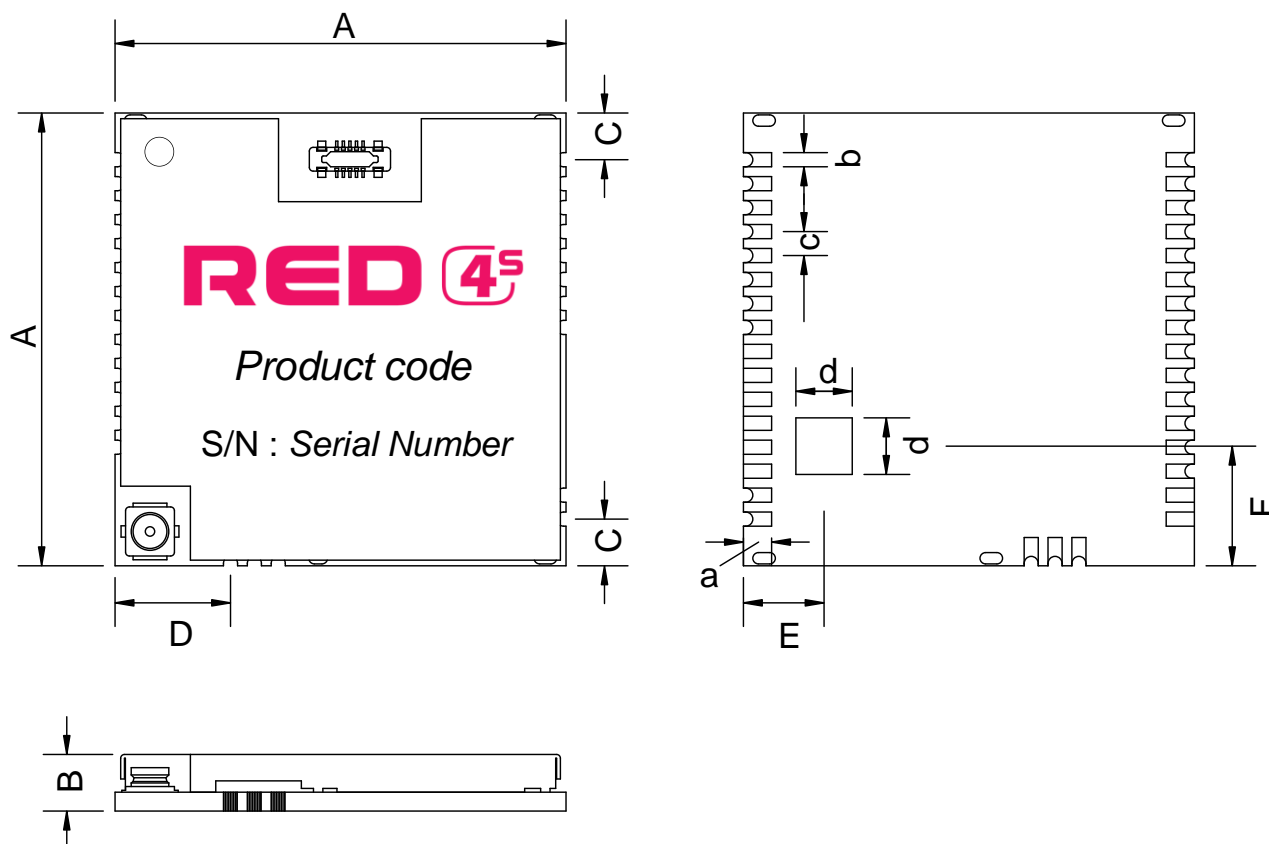


Figure 12 Dimension

Package on Dimension (Unit: mm)				
SYM	MIN	TYP	MAX	Remark
A	23.500	24.000	24.500	
B	2.900	3.000	3.300	
C		2.475		
D		6.145		
E		4.290		
F		6.340		
a		1.500		
b		0.750		
c		1.270		
d		3.000		

NOTE. please use the additional materials such as CAD file for the user who want to use DC/signal connector on the homepage or DK

7 Footprint

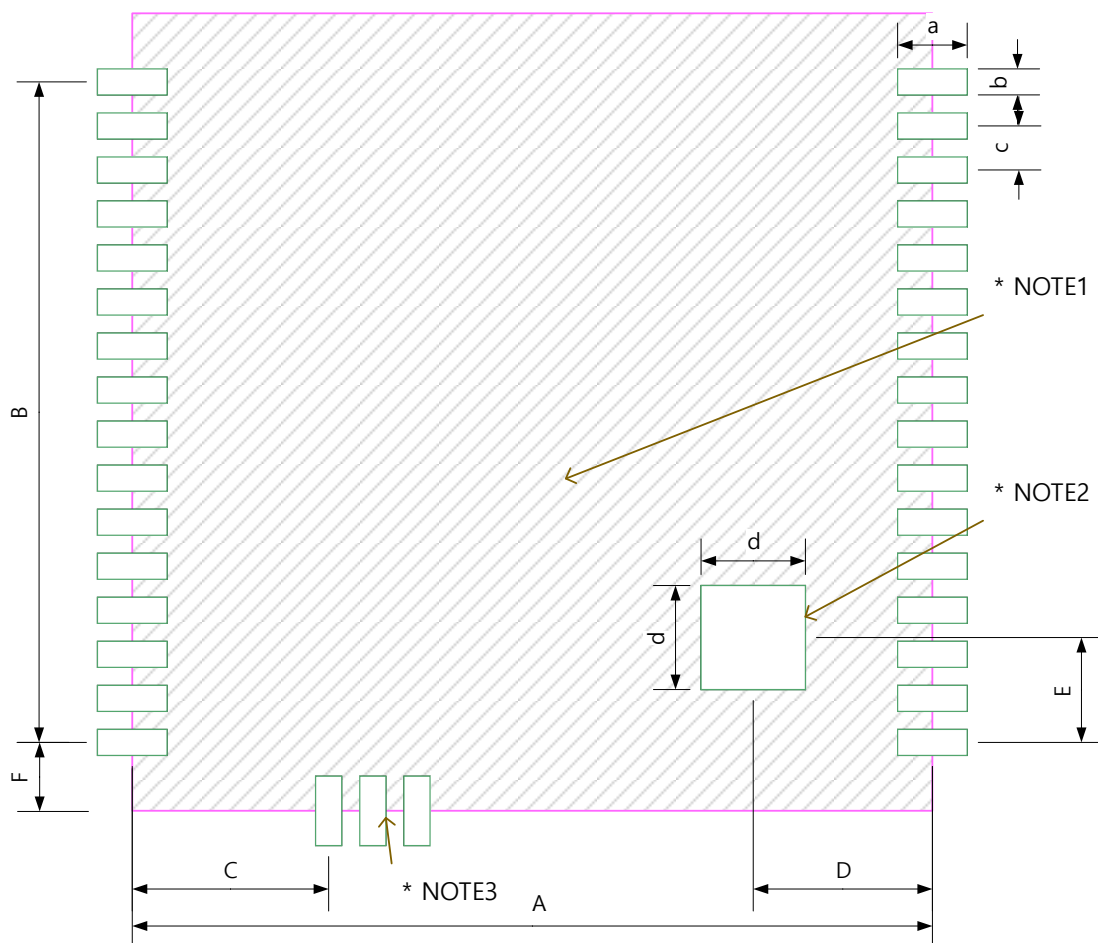


Figure 13 Footprint

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 RED4S.

NOTE2. Exposed paddle should be connected to ground.

NOTE3. If you use own U.FL antenna connector of RED4S, remove the RF_IO pad refer to the PCB DECAL of tech support on the homepage

Footprint on Dimension (Unit: mm)				
SYM	MIN	TYP	MAX	Remark
A		23.000		
B		19.050		
C		5.645		
D		3.790		
E		3.865		
F		1.975		
a		2.000		
b		0.750		
c		1.270		
d		3.000		

8 Packing Information

Packing materials for the RED4S shipment consist of the anti-static tray and the outer box which can hold up to five hundred pieces of the RED4S each box.

8.1 Tray dimension

Dimension of the tray to store the RED4S, which can hold up to 25 pcs of the RED4S, is approximately measured to $W = 280\text{mm}$, $L = 240\text{mm}$, $H = 10\text{mm}$. Tray helps to avoid both interference between the products and static from the outside. Detailed shape refers to **Figure 14** as below.

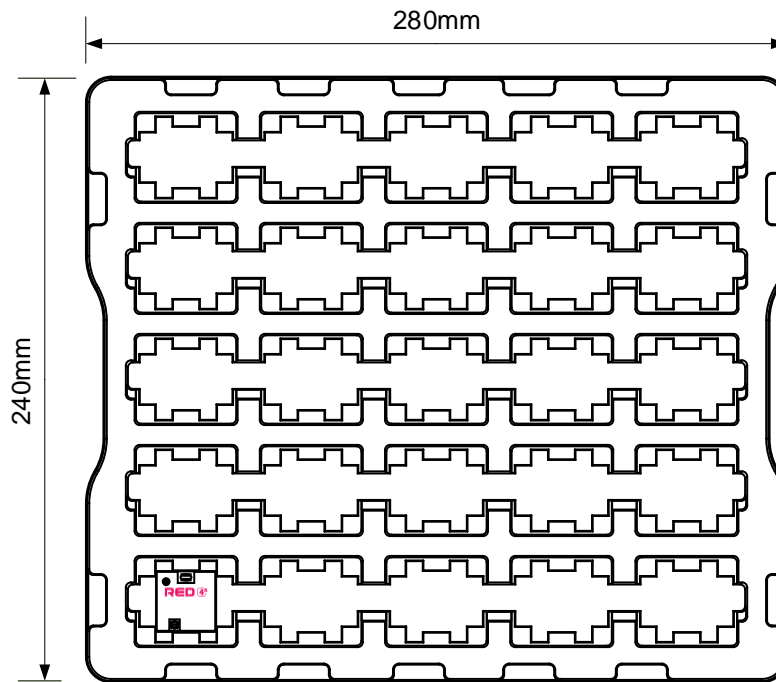


Figure 14 Dimension of tray

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 $W = 285\text{mm}$, $L = 250\text{mm}$, $H = 115\text{mm}$.

- ※ Packing materials are subject 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 Reflow information

The recommended reflow profile is shown in Figure 15.

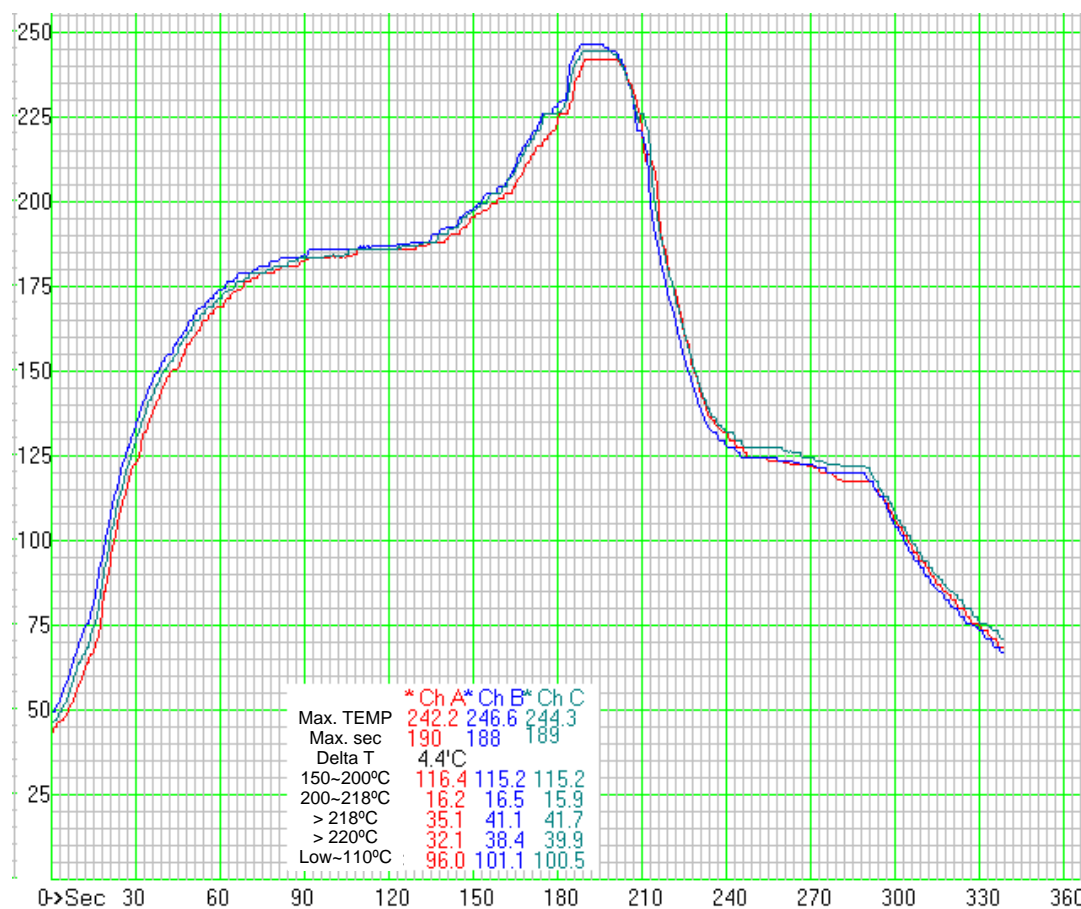


Figure 15 Reflow chart

10 Address Information

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