UZ2400

Low Power 2.4 GHz Transceiver for IEEE 802.15.4 Standard

U-Power1000 Module User Manual AN-2400-14

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UZ2400

Low Power 2.4 GHz Transceiver for IEEE 802.15.4 Standard

1. General Information

The U-Power1000 module is an IEEE 802.15.4 compliant solution that satisfies the requirements of low-cost and long-range wireless applications. The module, contains UBEC's UZ2400, UP2206, UA2725 and other necessary components, operates in the ISM 2.4 GHz frequency band. The corresponding MCU can accesses to various UZ2400 internal subunits, such as registers, FIFOs, and security key table, via a 4-wire SPI bus. Its small form factor saves the valuable board spaces and provides a reliable delivery of critical data between the devices.

2. Features

- 2.4GHz IEEE 802.15.4 compliant
- 3.0 ~ 3.6V Operation
- Effective Distance: 1000 meters (line of sight, environment dependent, typical)
- SMA Connector
- Additional 2 GSG (ground-signal-ground) Interfaces Provided
- Rx Sensitivity: -101dBm, typical
- Tx Output Power: 19dBm, typical
- Tx Current Consumption: 180mA, typical
- Rx Current Consumption: 34mA, typical
- Dimension: 35.9mm x 14mm x 3.6mm(without SMA connector)
- Shielding case optional

3. Pin Configuration

3.1. Pin Assignment

Top view of a U-Power1000 Module and pin allocation map are shown in Figure 1 and Figure 2 respectively.

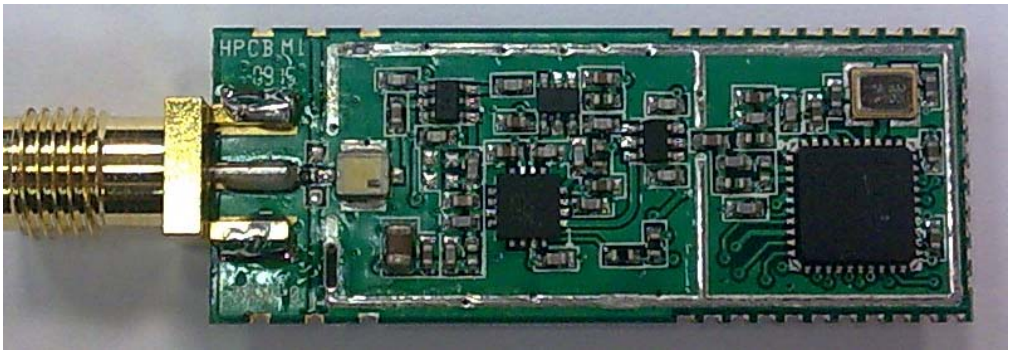

Figure 1. Top View of U-Power1000 Module

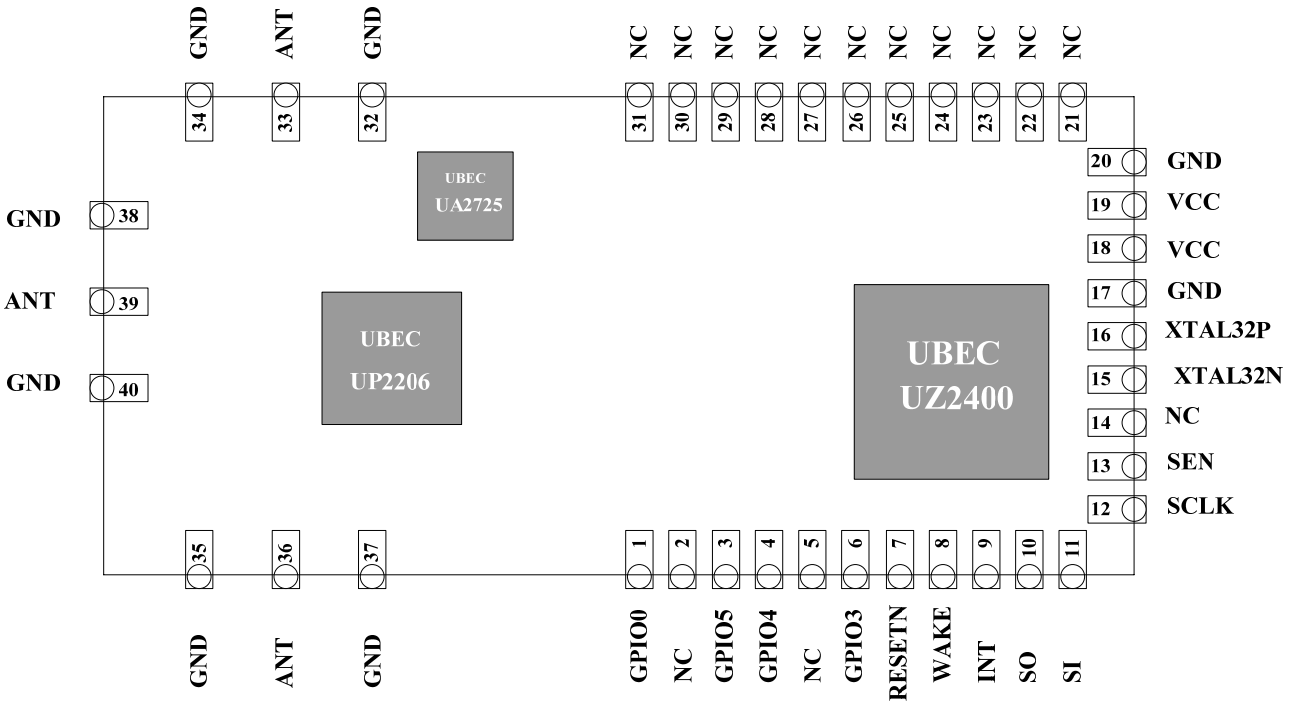

Figure 2. Pin Allocation

3.2. Pin Description

Pin type abbreviation: A = Analog, D = Digital, I = Input, O = Output, P = Power, G = Ground

Pin Number	Pin Name	Type	Description
1	GPIO0	DIO	General purpose digital I/O, also used as an external PA enable
2	NC		No connection
3	GPIO5	DIO	General purpose digital I/O
4	GPIO4	DIO	General purpose digital I/O
5	NC		No connection
6	GPIO3	DIO	General purpose digital I/O
7	RESETN	DI	Global hardware reset pin, active low
8	WAKE	DI	External wake up trigger, active high / low can be programmable.
9	INT	DO	Interrupt pin to microprocessor : Level trigger, Hi / Low programmable
10	SO	DO	Serial interface data output from UZ2400 or I2C clock
11	SI	DIO	Serial interface data input to UZ2400 or I2C data in/out
12	SCLK	DI	Serial interface clock
13	SEN	DI	Serial interface enable
14	NC		No connection
15	XTAL32N	AI	32 kHz Crystal input (-) for internal RTC used
16	XTAL32P	AI	32 kHz Crystal input (+) for internal RTC used
17	GND	G	Ground
18	VCC	P	Power Supply
19	VCC	P	Power Supply
20	GND	G	Ground
21~31	NC		No connection
32	GND	G	Ground
33	ANT	AIO	Antenna Port
34	GND	G	Ground
35	GND	G	Ground
36	ANT	AIO	Antenna Port
37	GND	G	Ground
38	GND	G	Ground
39	ANT	AIO	Antenna Port
40	GND	G	Ground

Table 1. Pin Assignment

4. Electrical Specifications

Test conditions: T_A = 25°C, VDD = 3.3 V, Pout,UZ2400=-10dBm

ITEM	Condition	Specification			Unit
		Min.	Typ.	Max.	
Frequency		2405		2480	MHz
Supply voltage		3.0	3.3	3.6	V
TX Current consumption	(P_{out} =19 dBm)		180		mA
RX Current consumption			34		mA
TX Output power	P_{out}(UZ2400)=-10dBm		19		dBm
TX EVM	P_{out}(UZ2400)=-10dBm		15		%
RX sensitivity	PER<=1% O-QPSk 250kbps		-101		dBm
Communication Range	Throughput >120kbps at 250kbps data rate, LOS		1000		m

Table 2. Electrical Specifications

For detail electrical characteristic of the UZ2400 chip, please refer to UZ2400 datasheet.

4.1. TX Output Power

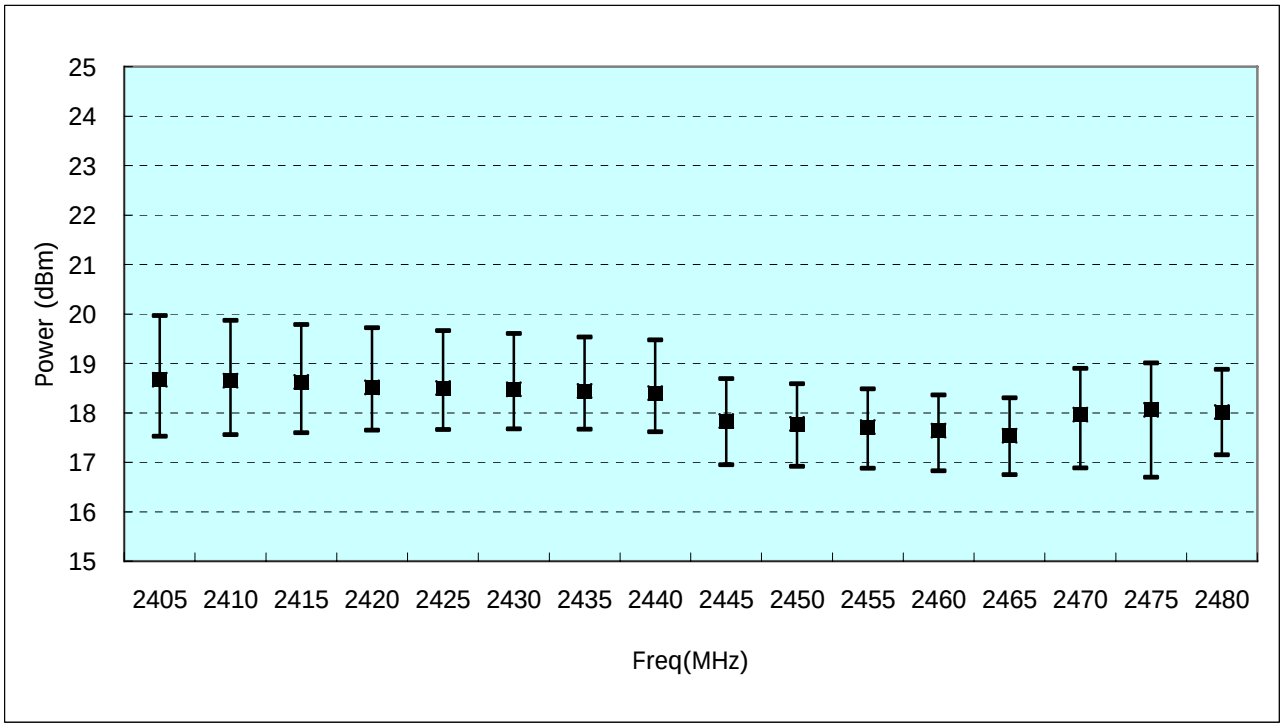

Figure 3. Typical TX Output Power

4.2. TX EVM

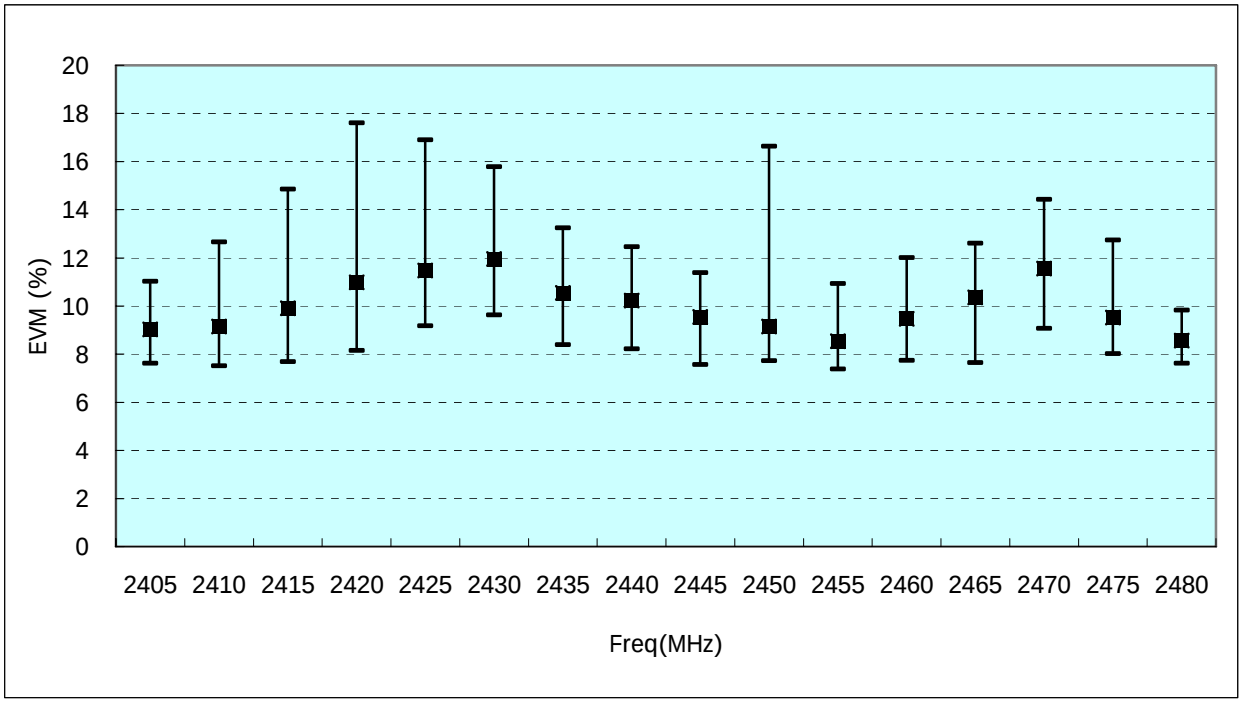

Figure 4. Typical TX EVM (Pout shown in Figure 3)

4.3. RX Sensitivity

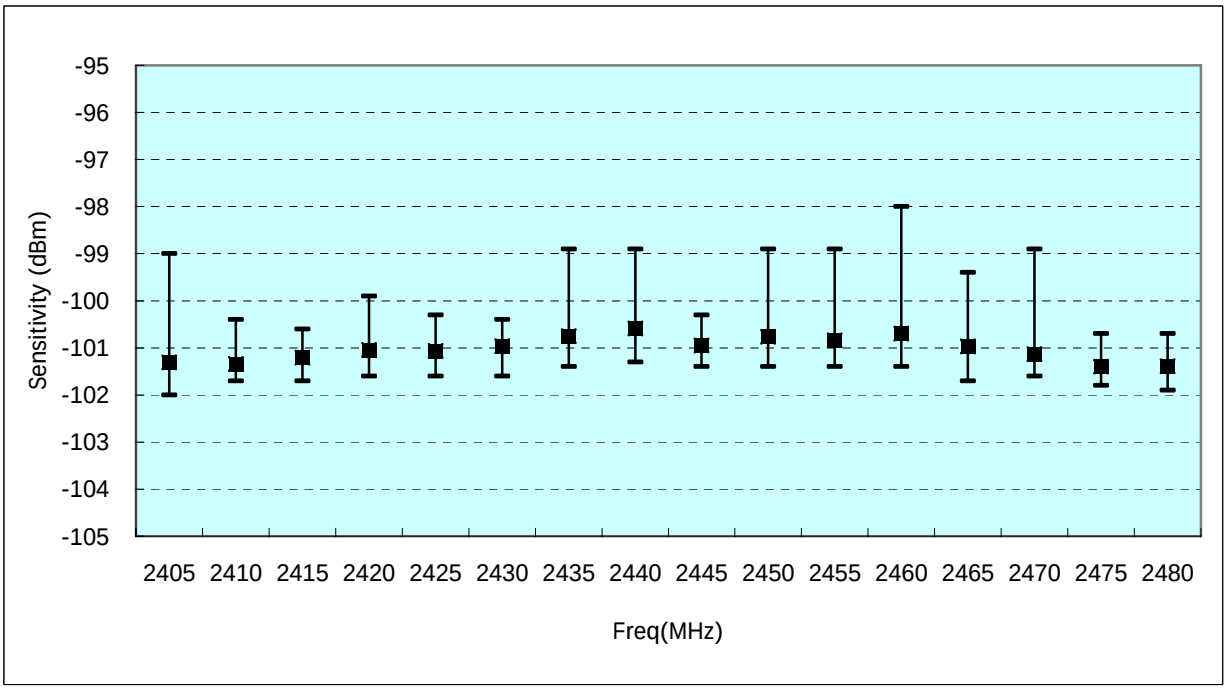

Figure 5. Typical RX Sensitivity

5. Register Initial Setting

The procedure to configure the initial setting is described as below.

Sep 1. Initialization

Address mode	Address	Register Name	Descriptions	Setting Value(hex)
SREG	0x2A	SOFTRST	Software reset	0x07
SREG	0x3A	BBREG2	Set CCA mode to ED	0x80
SREG	0x3E	BBREG6	Append RSSI value in Rx packets	0x40
SREG	0x3F	RSSITHCCA	ED threshold for CCA	0x60
SREG	0x18	FIFOEN	Increase TXON time	0x98
SREG	0x2E	TXPEMISP	VCO calibration period	0x95
SREG	0x35	SLPACK	20MHz clock recovery time	0x5F
LREG	0x201	RFCTL1	RF optimized control	0x01
LREG	0x202	RFCTL2	RF optimized control	0x80
LREG	0x206	RFCTL6	RF optimized control	0x90
LREG	0x207	RFCTL7	RF optimized control	0x80
LREG	0x208	RFCTL8	RF optimized control	0x10
LREG	0x220	SCLKDIV	sleep clock frequency control	0x01
SREG	0x32	INTMSK	Enable all interrupt	0x00

Step 2. Set Channel

The module operates in the 2.4 GHz ISM unlicensed band. The operating frequency is divided into 16 channels. RFCTL0(LREG0x200) should be configured for selected channel.

Address mode	Address	Register Name	Descriptions	Setting Value(hex)	Note	
					Channel	Frequency
LREG	0x200	RFCTL0	Set RF operation channel	02	11	2405 MHz
				12	12	2410 MHz
				22	13	2415 MHz
				32	14	2420 MHz
				42	15	2425 MHz
				52	16	2430 MHz
				62	17	2435 MHz
				72	18	2440 MHz
				82	19	2445 MHz
				92	20	2450 MHz
				A2	21	2455 MHz
				B2	22	2460 MHz
				C2	23	2465 MHz
				D2	24	2470 MHz
				E2	25	2475 MHz
				F2	26	2480 MHz

***Step 3.* RESET**

After the operation channel is set, RF state machine should be reset by setting RFCTL(SREG0x36) to “0x04” and then setting RFCTL(SREG0x36) to “0x00”. After reset, 192us should be waiting for VCO calibration to calibrate PLL block to the correct frequency.

Address mode	Address	Register Name	Descriptions	Setting Value(hex)
SREG	0x36	RFCTL	Reset RF state machine	0x04
SREG	0x36	RFCTL	Reset RF state machine	0x00

By finishing all the above three steps, a basic initialization procedure is done. This configuration procedure is valid for most of the application conditions.

***Step 4.* PA/LNA Control**

Address mode	Address	Register Name	Descriptions	Setting Value(hex)
LREG	0x22F	TESTMODE	GPIO0, GPIO1, GPIO2 are configured to control external PA, LNA or switch	0x0F
LREG	0x203	RFCTL3	RF optimized control for U-Power1000	0x40

6. Schematic

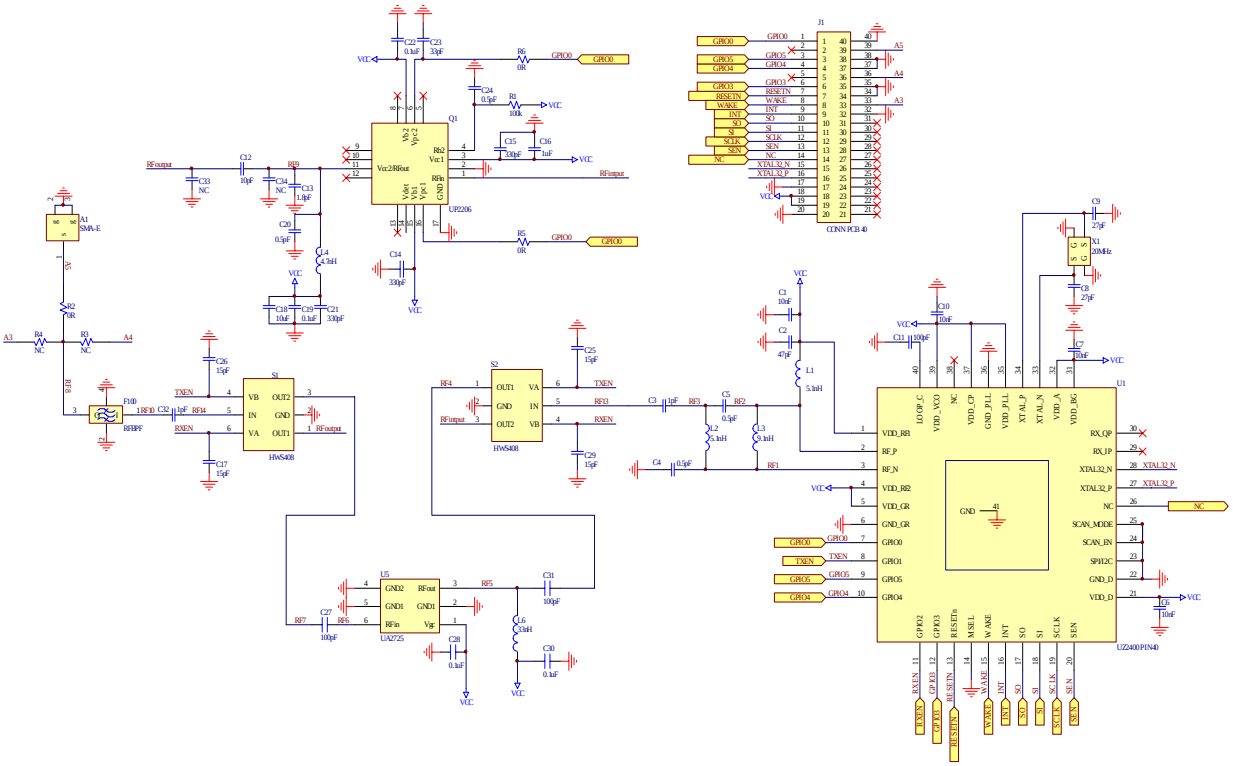

Figure 6. Schematic of U-Power1000 Module

7. PCB Layout

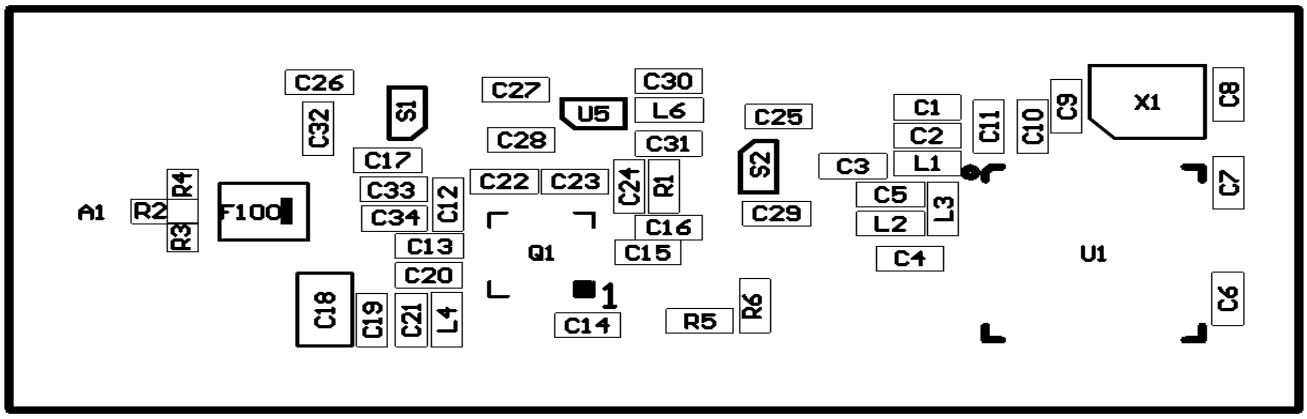

Figure 7. Top Overlay

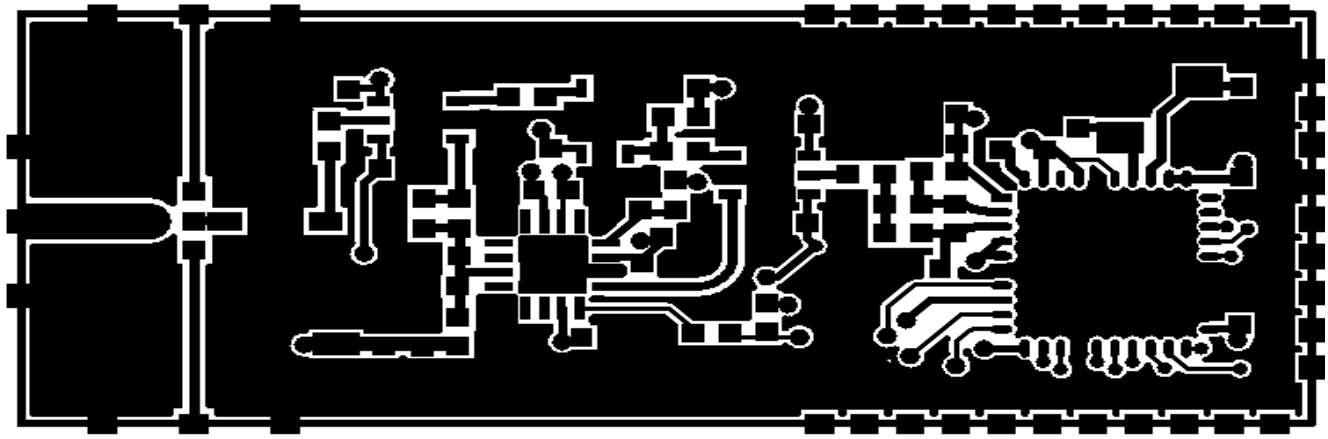

Figure 8. Top Layer (Signals)

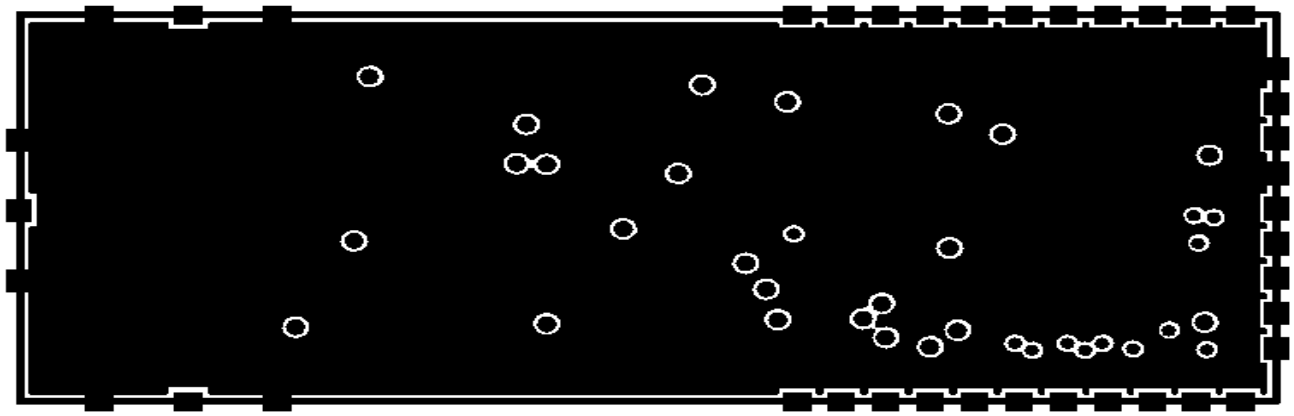

Figure 9. Midlayer2 (GND)

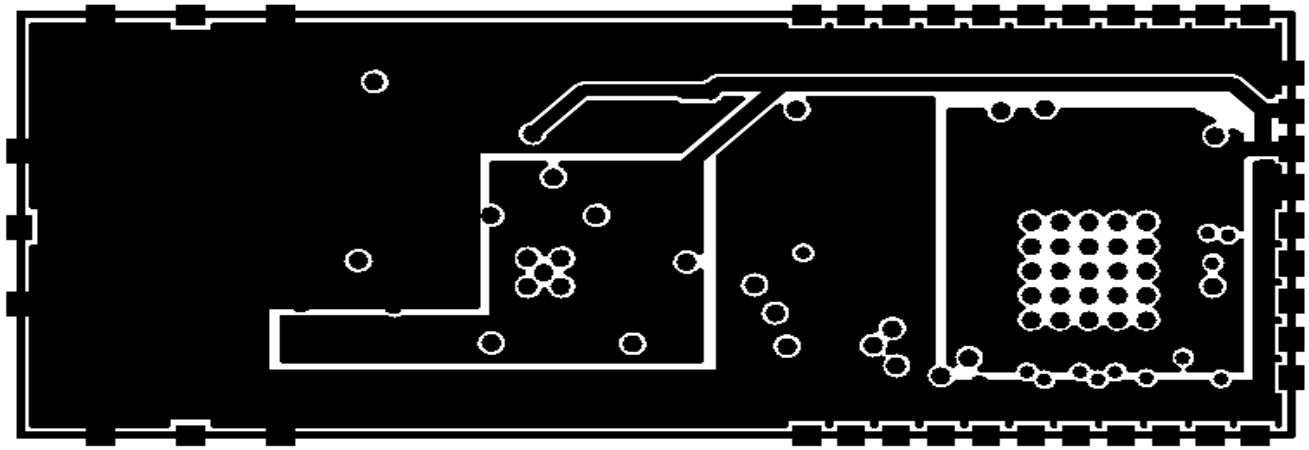

Figure 10. Midlayer3 (Power)

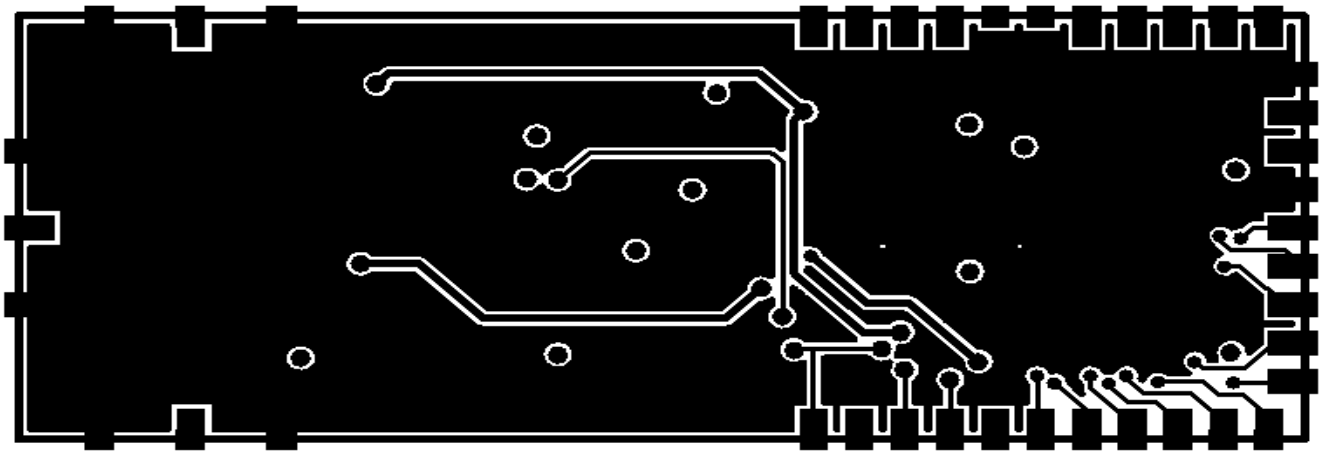

Figure 11. Bottom Layer (Signals and GND)

8. BOM List

Item	Part name	Footprint	Tolerance	Specification Rating	Dielectric Material	Manu-facturer	Vendor Part No.	Q'ty	Reference
1	0R	0402	±5%	1/16W		Yageo	RC0402JR-070R	3	R5, R6, R2
2	100k	0402	±5%	1/16W		Yageo	RC0402JR-07100K	1	R1
3	0.5pF	0402	±0.25pF	50V	NP0	Yageo	C0402CRNP09BNR50	4	C4, C5,C20, C24
4	1pF	0402	±0.25pF	50V	NP0	Yageo	C0402CRNP09BN1R0	2	C3, C32
5	1.8pF	0402	±0.25pF	50V	NP0	Yageo	CC0402CRNPO9BN1R8	1	C13
6	10pF	0402	±5%	50V	NP0	Yageo	C0402JRNP09BN100	1	C12
7	15pF	0402	±5%	50V	NP0	Yageo	C0402JRNP09BN150	4	C17, C25, C26, C29
8	27pF	0402	±5%	50V	NP0	Yageo	CC0402JRNPO9BN270	2	C8, C9
9	33pF	0402	±5%	50V	NP0	Yageo	CC0402JRNPO9BN330	1	C23
10	47pF	0402	±5%	50V	NP0	Yageo	CC0402JRNPO9BN470	1	C2
11	100pF	0402	±5%	50V	NP0	Yageo	CC0402JRNPO9BN101	3	C11, C27, C31
12	330pF	0402	±5%	50V	C0G	Yageo	C0402KRX7R9BB331	3	C14, C15, C21
13	10nF	0402	-20~+80%	16V	Y5V	Yageo	C0402ZRY5V7BB103	4	C1, C6, C7, C10
14	100nF	0402	±10%	16V	Y5V	Yageo	C0402ZRY5V7BB104	4	C19, C22, C28, C30
15	1uF	0402	-20~+80%	6.3V	Y5V	Yageo	C0402ZRY5V5BB105	1	C16
16	10uF	0805	-20~+80%	10V	Y5V	Yageo	C0805ZKY5V6BB106	1	C18
17	4.7nH	0402	±0.3nH	300mA		Murata	LQG15HN4N7S02	1	L4
18	5.1nH	0402	±0.3nH	300mA		Murata	LQG15HN5N1S02	2	L1, L2
19	9.1nH	0402	±5%	300mA		Murata	LQG15HN9N1J02	1	L3
20	33nH	0402	±5%	200mA		Murata	LQG15HN33NJ02	1	L6
21	CRYSTAL 20MHz	CX_101F	16pF/10ppm/80ohm/-10~+70C/3.2*2.5*0.75mm			Ecera	FL2000006	1	X1
22	SWITCH	SOT363	GaAs/DC-2.5GHz/			Hexawave	HW408	2	S1, S2
23	SMA connector	SMA-E	Connector SMA F型(母頭公PIN)			BO-JIANG	2867LS502BD003R	1	A1
24	2.4G_BPF	DEA252450BT-2031A1				TDK	DEA252450BT-2031A1	1	F100
25	UP2206	QFN3*3 16 LEAD				UBEC		1	Q1
26	UA2725	SOT363				UBEC		1	U5
27	UZ2400	TQPF40				UBEC		1	U1

Table 3. BOM List of U-Power1000 Module

9. Mechanical Dimension

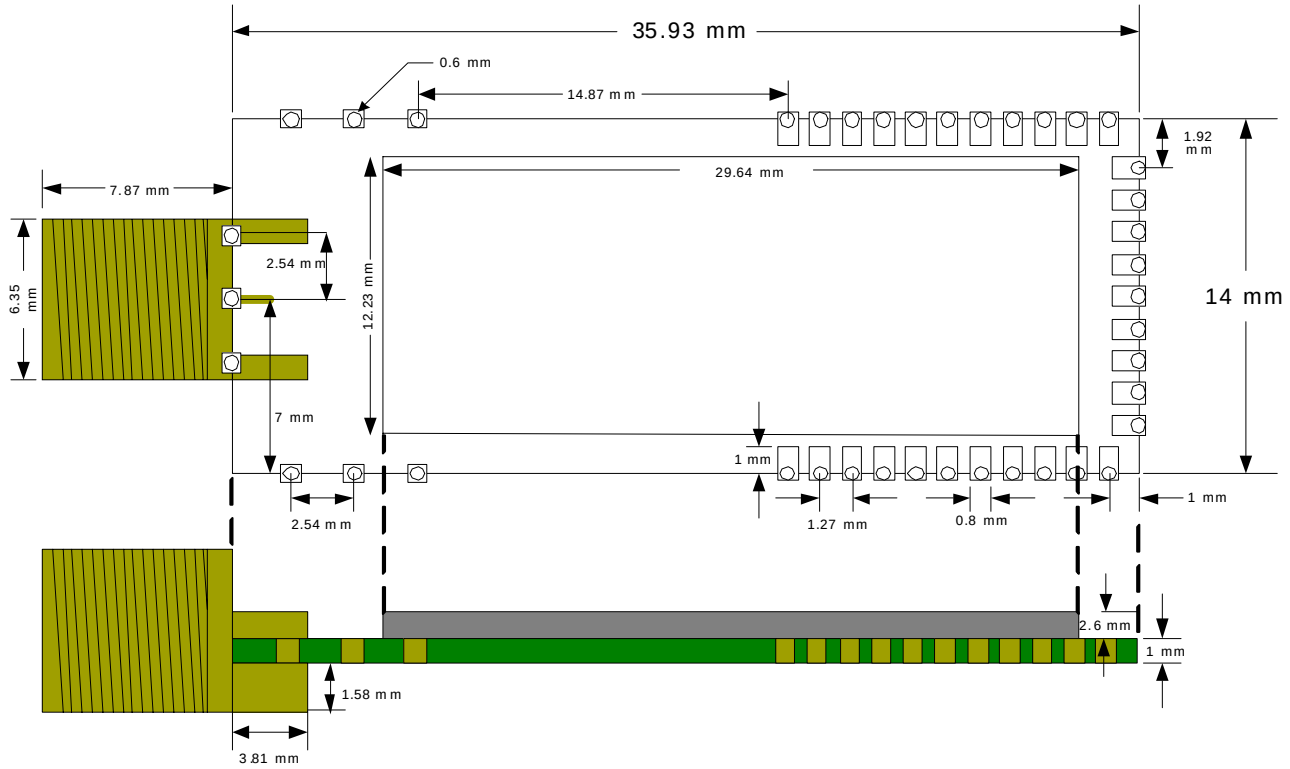

Figure 12. Dimensions of U-Power1000 Module

10. Dot-Power1000 Module

10.1. General Introduction

The Dot-Power1000 module is derived from the U-Power1000 module by attaching a pin-header 2x14 (pitch: 2.54mm) to the interface board. Flexible RF connectors including SMA and SMC are implemented. Through the GSG (ground-signal-ground) interface on the U-Force module, the RF loss is kept to less than 0.3dB. Because of the flexibility offered by the interface boards, Dot-Power1000 module can be readily used for various applications.

Figure 13. Top View of Dot-Power1000 Module with Shielding Case

10.2. Pin header information

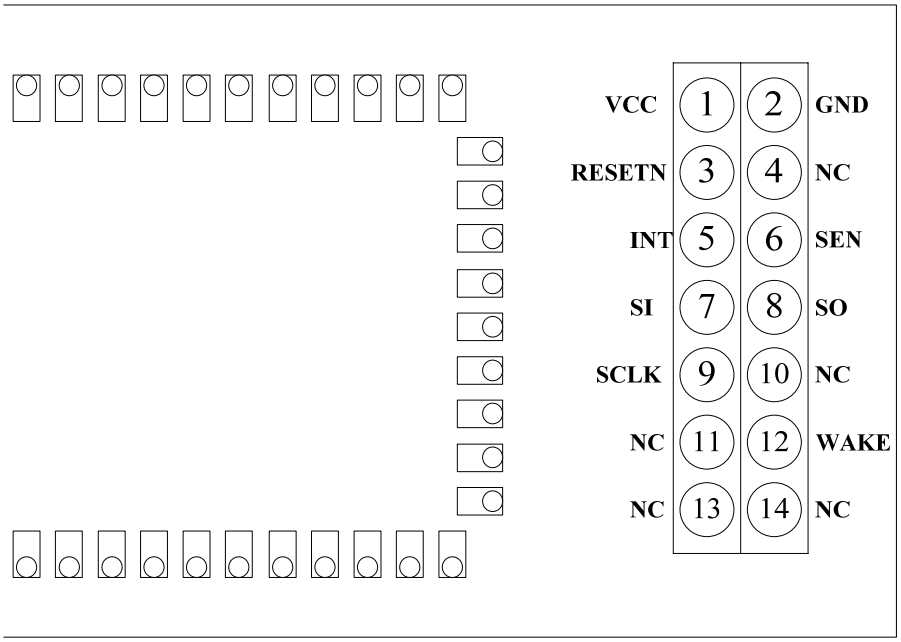

Figure 14. Pin Header Map

10.3. Mechanical Dimension

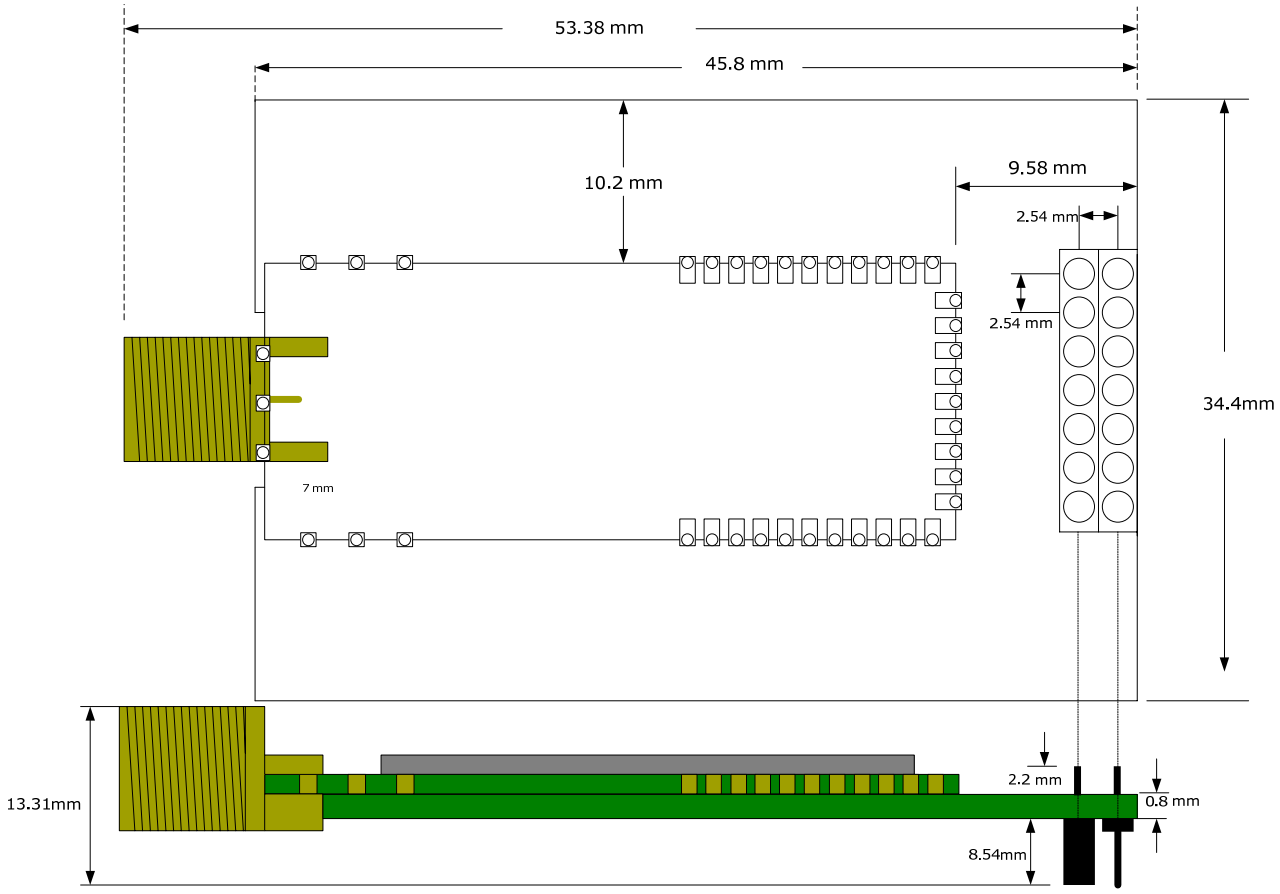

Figure 15. Dimensions of Dot-Power1000

Revision History

Revision	Date	Description of Change
0.0	2007/10/30	Initial release.
0.1	2008/7/28	Update schematic.
1.0	2009/05/21	1. Update schematic. 2. Add register initial setting steps and Certificate of Conformity.
1.1	2009/09/10	Correct Figure 2. Top View of U-Power1000 Module.

Contact UBEC:

Headquarters
Address: 6F-1, No. 192, Dongguang Rd., Hsinchu, 300 Taiwan
Tel: +886-3-5729898
Fax:+886-3-5718599
Website: http://www.ubec.com.tw

Sales Services
Tel: +886-3-5729898
Fax:+886-3-5718599
E-mail: sales@ubec.com.tw

FAE Services
Tel: +886-3-5729898
Fax: +886-3-5718599
E-mail: fae@ubec.com.tw

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