LM2475-EM Datasheet

[No. ADS1002]

V1.1

REVISION HISTORY

Version	Date	Description
VER. 1.0	2015.3.26	▪ First version release.
VER. 1.1	2015.4.22	▪ Modify data memory (6KB →7KB)

CONTENTS

1. INTRODUCTION

LM2475-EM is a module applied by the MG2475, System-on-Chip (SOC) based on 2.4GHz ISM Band(2.405 ~ 2.48GHz).

It is designed for IEEE802.15.4 and ZigBee RF4CE and includes internal 64KB flash memory and 8051 MCU embedded with 7KB RAM.
Also, it supports multiple data-rate modes(250K/1Mbps) applied with channel coding beside IEEE802.15.4 data-rate.

2. DEFINITIONS

MG2475-F40: 2.4GHz System-on-Chip developed by RadioPulse.

LM2475-EM: 2.4GHz Evaluation module applied to ZigBee, IEEE802.15.4, RF4CE, and Smart Grid.**(2-Layer)**

3. APPLICATIONS

- 2.4 GHz IEEE 802.15.4 Applications
- RF4CE Remote Control Systems
- Lighting Systems
- Voice Applications
- Home/Building Automation
- Industrial Control and Monitoring
- Energy Management
- Low Power Wireless Sensor Networks
- Consumer Electronics
- Health-care equipments
- Toys

4. FEATURES

RF Transceiver

- Integrated 2.4GHz RF Transceiver
- Low Power Consumption
- High Sensitivity of –98.5dBm at 250kbps
- No External T/R Switch or Filter needed
- On-chip VCO, LNA, and PA
- Programmable Output Power up to +9.0dBm
- Direct Sequence Spread Spectrum
- O-QPSK Modulation
- High Data Rate including 250Kbps specified in IEEE802.15.4: 1Mbps
- RSSI Measurement
- Compliant to IEEE802.15.4

Hardwired MAC

- Two 128-byte FIFOs for Modem Tx and Rx
- CRC-16 Computation and Check
- Address filtering enhanced
- Voice MAC header H/W generation

8051-Compatible MCU

- 8051 Compatible (single cycle execution)

- 64KB Embedded Flash Memory
- 7KB Data Memory (support the retention in all power down modes, power-off is possible)
- 128-byte CPU dedicated Memory
  (support the retention in all power down modes, power-off is possible)
- 1KB Boot ROM
- Dual DPTR Support
- 4-channels peripheral DMA(channel 0 is only for MAC RX)
- AES-128 Encryption/Description Engine
- ECC(Error Checking and Correction) logic for the Flash or RAM data integrity
- I2S/PCM Interface with two 128-byte FIFOs
- μ-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 internal RC-OSC
- Quadrature Signal Decoder
- 22 General Purpose I/Os (support the retention in deep sleep mode)
- 16 MHz RC oscillator for the fast start-up from reset & power-down mode
- On-chip Power-on-Reset and Brown-out detector
- SPI Master/Slave Interface with two 16-byte FIFOs
- I2C Master/Slave with 16-byte FIFO
- Programmable IR(Infra-Red) Modulator
- ISP (In System Programming)
- External clock output function(500KHz, 1/2/4/8/16/32 MHz selectable)

Clock Inputs

- 32MHz Crystal for System Clock

Power

- 1.2V(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

- Lead-Free 40-pin QFN Package (6mm x 6mm)

5. HARDWARE DESCRIPTION

The components of LM2475-EM are as follows;

- MG2475-F40 : ZigBee System-on-Chip (SOC)
- Crystal : 32MHz Crystal
- RF Connector : SMA type RF connector
- CON(20PIN) : 20-Pin Connector with 1.27mm pin pitch (*2)

In addition, this module needs a few components such as resistors and capacitors.

5.1. Block Diagram

As shown in [Figure 1], LM2475-EM includes the following features.

- MG2475: ZigBee Single chip embedded with 2.4GHz RF transceiver, base-band modem, hardwired MAC, 64KB internal flash memory, 8051 MCU, 7KB data RAM, voice codec block, I2C, and 5-channel PWM
- SMA type Antenna.
- Various peripherals such as 22 General Purpose I/Os, and Two High-Speed UARTs.
- Firmware downloading by UART1 in ISP(In-System-Programming) mode.

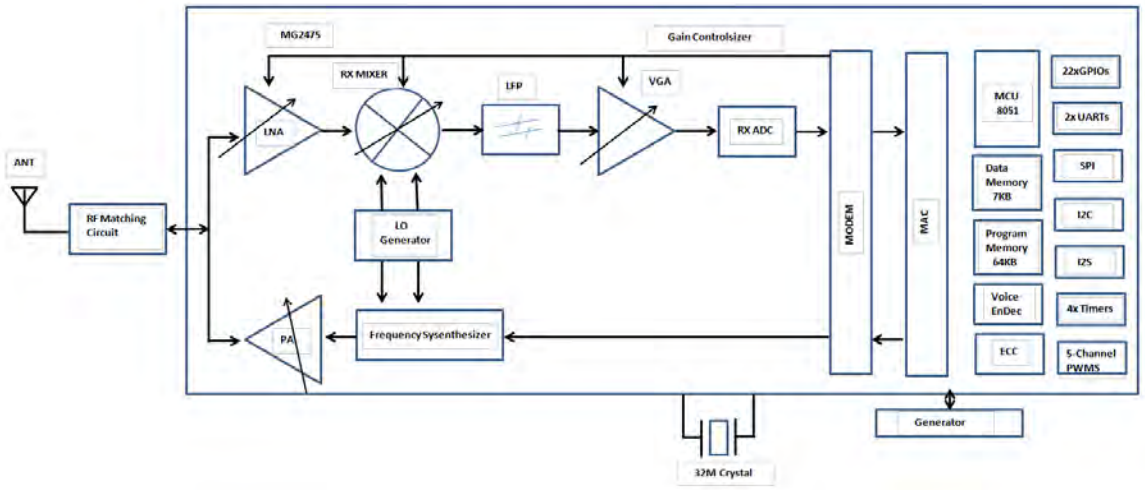


Figure 1. LM2475–EM Block Diagram

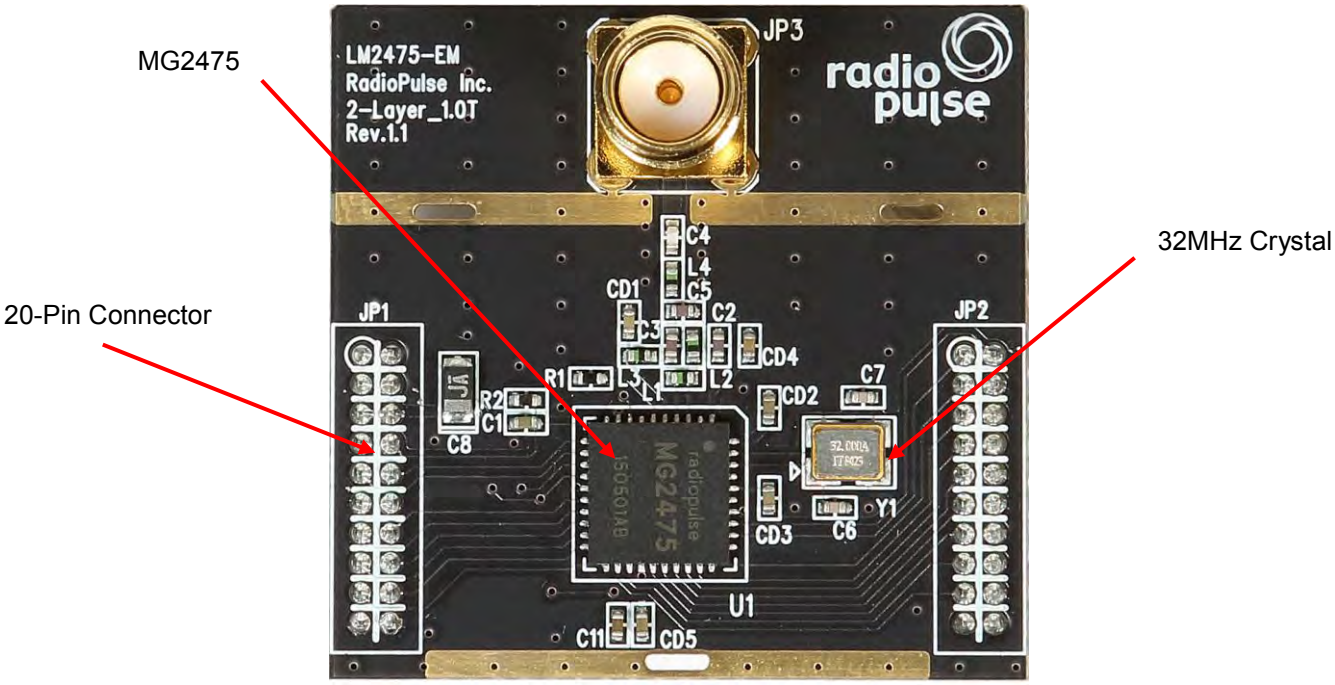
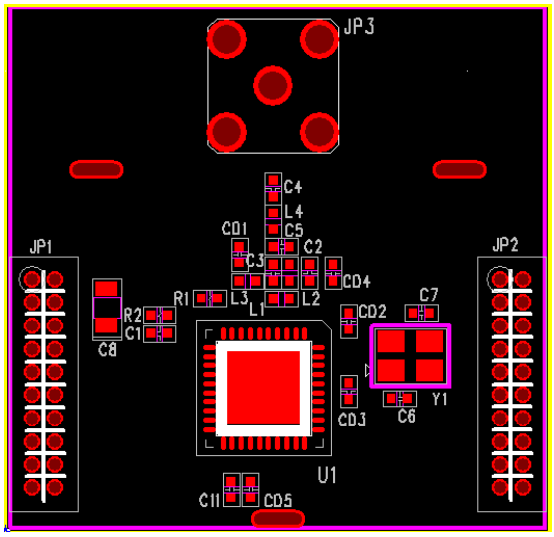


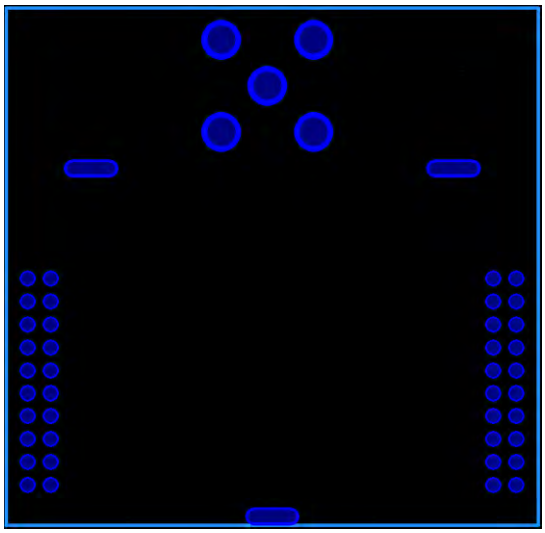
Figure 2. Appearance of LM2475-EM

5.2. Module Dimension

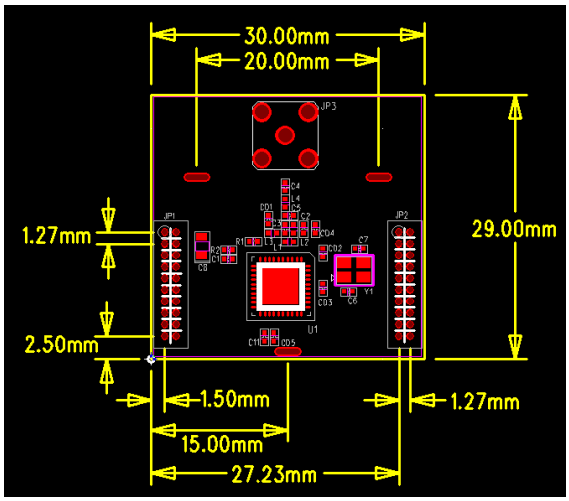
The following [Figure 3] shows the dimension of the LM2475-EM. (a) and (b) show the component placement. (c) is the dimension of LM2475-EM. Two 20-pin connectors are located at the bottom.



(a) Top



(b) Bottom



(c) Dimension

Figure 3. LM2475-EM

5.3. Antenna Matching Circuitry

[Figure 4] shows the recommended RF matching circuit. For PCB pattern, please refer to the [Figure 5] below.

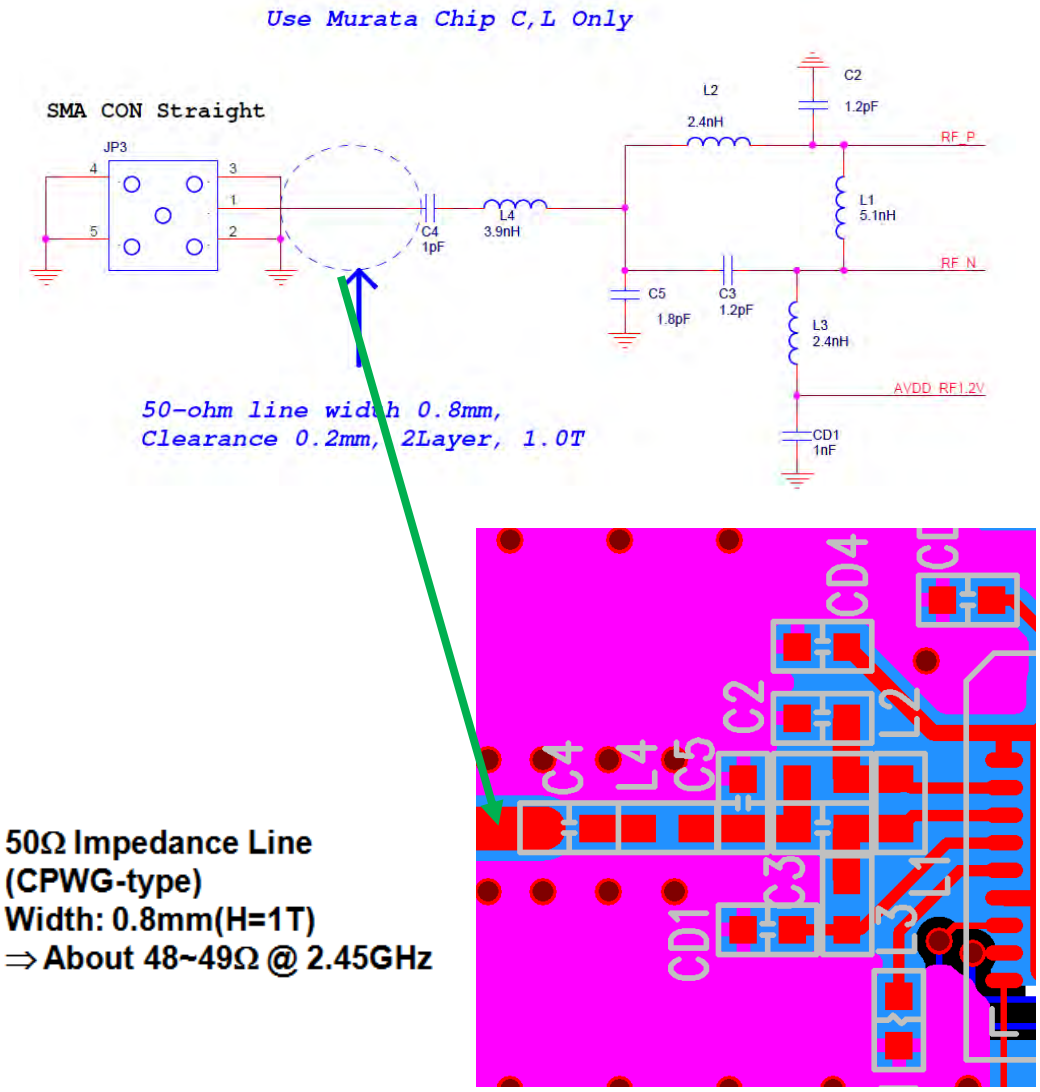


Figure 4. Antenna Matching Circuit

RF Matching Procedure

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① The value of L2/C2/L3/C3 is adjusted to 2.4GHz.
② L4 and C5 are fixed value to organize Narrow Band-Filter.
③ Adjust L1 and C4 value to maximize output level.
④ Adjust L4 and C5 value to minimize the 2nd and 3rd harmonic.

Table 1. PCB Thickness 50ohm Line Width

H(mm)	W(mm)	Z0(Ohm)
0.4	0.5	49.487
0.8	0.7	50.514
1.0	0.8	49.798
1.2	0.8	50.821
1.6	0.9	50.192

***PCB Thickness: 1mm /0.5 OZ(2-Layer)**

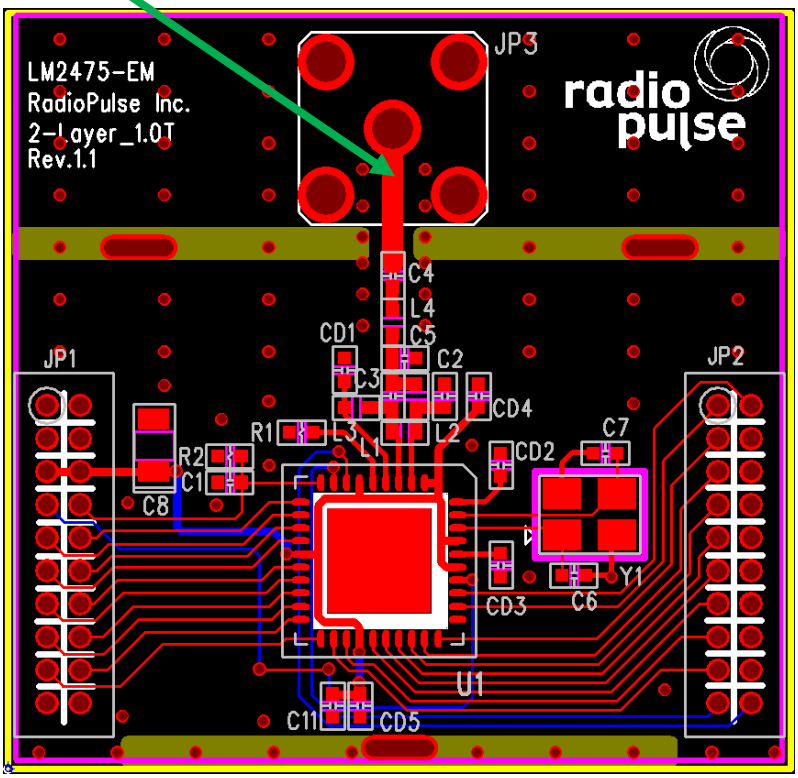


Figure 5. Antenna PCB Pattern

6. SPECIFICATION

6.1. Absolute maximum ratings

Symbol	Parameter	Rating	Unit
VCC_3V	AVDD_PLL3V,AVDD_RF3V,AVDD_ANA3V,DVDD_3V,DVDD_F3V, DVDD_IO3V	-0.3 to 3.6	V
Core	AVDD_RF12V, AVDD_ANA12, XOSCI, XOSCO	-0.3 to 1.32	V
RFIN	Input RF level	10	dBm
TSTG	Storage Temperature	-40 to 85	℃

6.2. DC Characteristics

Symbol	Parameter	Min	Typ.	Max	Unit
VCC_3V	I/O supply voltage(VDD_IO3V)	2	3.0	3.6	V
V_{IH}	High level input voltage	2.0		3.6	V
V_{IL}	Low level input voltage	-0.3		0.8	V
V_{OH}	High level output voltage	2.4			V
V_{OL}	Low level output voltage			0.4	V
R_{PU}	Pull-up Resistance		66		kΩ
R_{PD}	Pull-down Resistance		66		kΩ
R_{SPU}	Strong Pull-up Resistance DVDD_IO3V=3.3V	1.42	1.62	1.92	kΩ
TA	Air temperature	-40		85	℃

6.3. RF Characteristics (25℃)

6.3.1. Electrical specifications

Condition: EVM Board, at 25℃, 3V_IN=3.0V, F_{req}=2.45GHz, Chip rate =2MCPS

Parameter	Min	Typ.	Max	Unit
Current consumption (Data rate=250kbps)				
TX Mode @+9dBm output power @+8dBm output power @+7dBm output power @+6dBm output power @+5dBm output power @+4dBm output power @+3dBm output power @+2dBm output power @+1dBm output power @ 0dBm output power		 36.5 30.8 27.0 24.1 22.4 21.3 19.9 19.7 18.7 16.9		mA
RX Mode		16.3		mA
Deep Sleep Mode (PM3)		1.7		uA

Condition: EVM Board, at 25℃, 3V_IN=3.0V, F_{rf} =2.45GHz, Chip rate =2MCPS

Parameter	Min	Typ.	Max	Unit
RF Characteristics(Data rate=250kbps)				
RF Frequency Range	2.405		2.480	GHz
TX output power		9		dBm
Received RF Bandwidth (Chip Rate)		2		MHz
Channel Spacing		5		MHz
Receiver sensitivity 250kbps		 -98.5		 dBm
Max. input Level(250kbps)		10		dBm
Receiver Spurious Radiation		-70		dBm
Adjacent Channel Rejection +5MHz -5MHz		 36.2 34.7		dB

Alternate Channel Rejection +10MHz(+20MHz) -10MHz(-20MHz)		 47.7 48.1		dB
Co-Channel Rejection		-4		dB
Wi-Fi IEEE 802.11n Rejection		45.5		dB

Condition: EVM Board, at 25℃, 3V_IN=3.0V, F_{rf} =2.45GHz, Chip rate =2MCPS

Parameter	Min	Typ.	Max	Unit
RF transmit Section(Data rate=250kbps)				
Transmit chip rate RF BW=2MHz		2		Mcps
Error Vector Magnitude Offset EVM 2MHz		6		%
Harmonics 2^{nd} 3^{rd}		 -45 -50		dBm
Spurious Emission 30Hz~1GHz 1GHz~2.5GHz 2.5GHz~12.7GHz 5.15GHz~5.3GHz		 -60 -70 -70 -70		dBm
Phase Noise @ ±100kHz offset @ ±1MHz offset @ ±2MHz offset @ ±3MHz offset @ ±5MHz offset @ ±10MHz offset @ ±50MHz offset		 -82.3 -108.8 -116.6 -120 -125.2 -134.9 -151.7		dBc/Hz
PLL Lock Time			80	usec

Condition: EVM Board, at 25℃, 3V_IN=3.0V, Frf =2.45GHz, Chip rate =2MCPS

Parameter	Min	Typ.	Max	Unit
Crystal Oscillator				
Crystal Frequency		32		MHz
Crystal Frequency Accuracy Requirement	-40		+40	ppm
ESR			60	Ω
Recommend C0			5	pF
Recommend CL			16	pF

7. PIN DESCRIPTION

The following [Table 2] and [Table 3] describe the interface signals to be used to communicate with external devices.

Table 2. Left Pin Header (JP1) pins

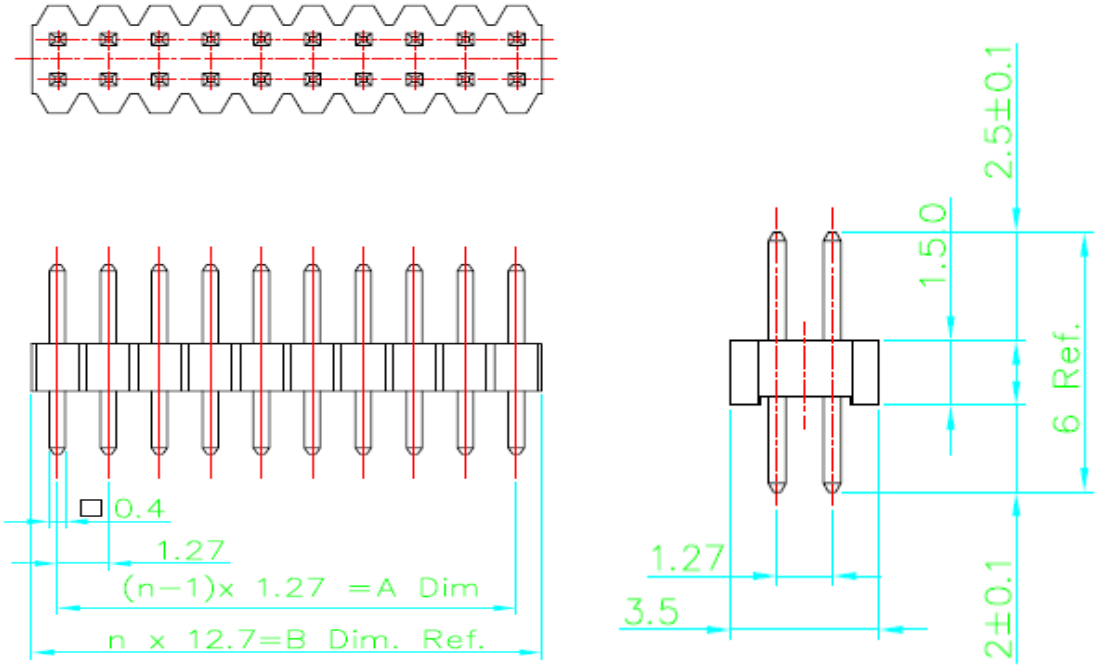
Pin	Name	Type	Description
1	NC	NC	NC
2	NC	NC	NC
3	NC	NC	NC
4	NC	NC	NC
5	VCC	3.0V	POWER(3.0V)
6	VCC	3.0V	POWER(3.0V)
7	RESETB	INPUT	Active Low RESETB Input
8	ISP	INPUT	Active High In-System-Programming Input
9	P1_6	IN/OUT	Port P1.6/I2C_SCL
10	P1_7	IN/OUT	Port P1.7/I2C_SDA
11	P1_3	IN/OUT	General Purpose IO Port P1.3/QUADZA/PTC_GATE3/IR_TX/CLK_OUT /XOSCO_32K
12	P1_4	IN/OUT	General Purpose IO Port P1.4/QUADZB/EXT_RTC_CLK/PTC_GATE4 /XOSCI_32K
13	P1_0 / RXD1	IN/OUT	General Purpose IO, UART1 RXD1
14	P1_1 / TXD1	IN/OUT	General Purpose IO, UART1 TXD1
15	P3_6	IN/OUT	General Purpose IO (Port P3.6/RTS1/SPICLK)
16	P3_7	IN/OUT	General Purpose IO (Port P3.7/CTS1/SPICSN)
17	P3_4	IN/OUT	General Purpose IO Port P3.4/RTS0/QUADYA/SPIDI/T0
18	P3_5	IN/OUT	General Purpose Port P3.5/CTS0/QUADYB/SPIDO/T1
19	GND	GND	GND
20	GND	GND	GND

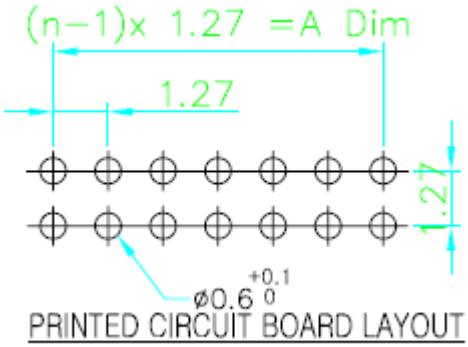
Table 3. Right Pin Header(JP2) pins

Pin	Name	Type	Description
1	P0_1	IN/OUT	General Purpose IO Port P0.1/I2SRX_LRCLK/PWM1
2	P0_0	IN/OUT	General Purpose IO Port P0.0/I2SRX_DI/PWM0
3	P0_2	IN/OUT	General Purpose IO Port P0.2/I2SRX_BCLK/PWM2
4	GND	GND	Ground
5	P0_3	IN/OUT	General Purpose IO Port P0.3/I2SRX_MCLK/PWM3
6	NC	NC	NC
7	P0_4	IN/OUT	General Purpose IO Port P0.4/I2STX_DO/PWM4/TRSWB
8	NC	NC	NC
9	P0_5	IN/OUT	General Purpose IO Port P0.5/I2STX_LRCLK/PTC_GATE0/TRSW
10	GND	GND	GND
11	P0_6	IN/OUT	General Purpose IO Port P0.6/I2STX_BCLK/PTC_GATE1
12	GND	GND	GND
13	P0_7	IN/OUT	Port P0.7/I2STX_MCLK/PTC_GATE2
14	GND	GND	GND
15	P3_0 / RXD0	IN/OUT	General Purpose IO (8051 Port P3.0) UART0 RXD0/QUADXA
16	GND	GND	GND
17	P3_1 / TXD0	IN/OUT	General Purpose IO (8051 Port P3.1) UART0 TXD0/QUADXB
18	GND	GND	GND
19	P3_2 / INT0#	IN/OUT	General Purpose IO Port P3.2/nINT0
20	P3_3 / INT1#	IN/OUT	General Purpose IO Port P3.3/nINT1/ATEST0

8. CONNECTOR DIMENSION

■ **20-Pin male Connector**

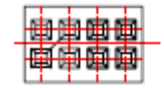


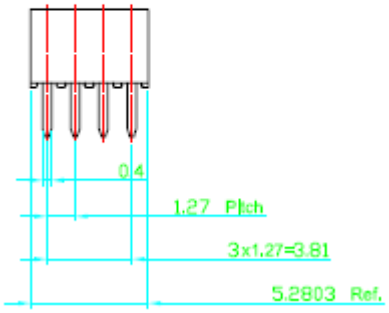


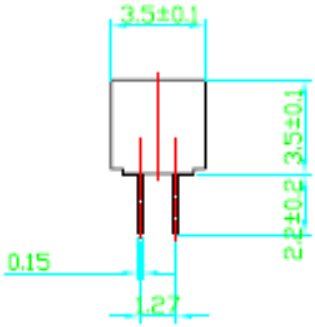
PRINTED CIRCUIT BOARD LAYOUT

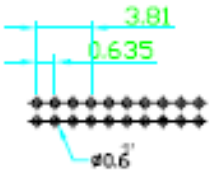
NOTE
1. HOUSING MATERIAL : THERMOPLASTIC.
   COLOR : BLACK
2. PIN MATERIAL : BRASS
   FINISH : Gold Flash
3. Number of Position : 02 ~ 100

■ 20-Pin Female Connector





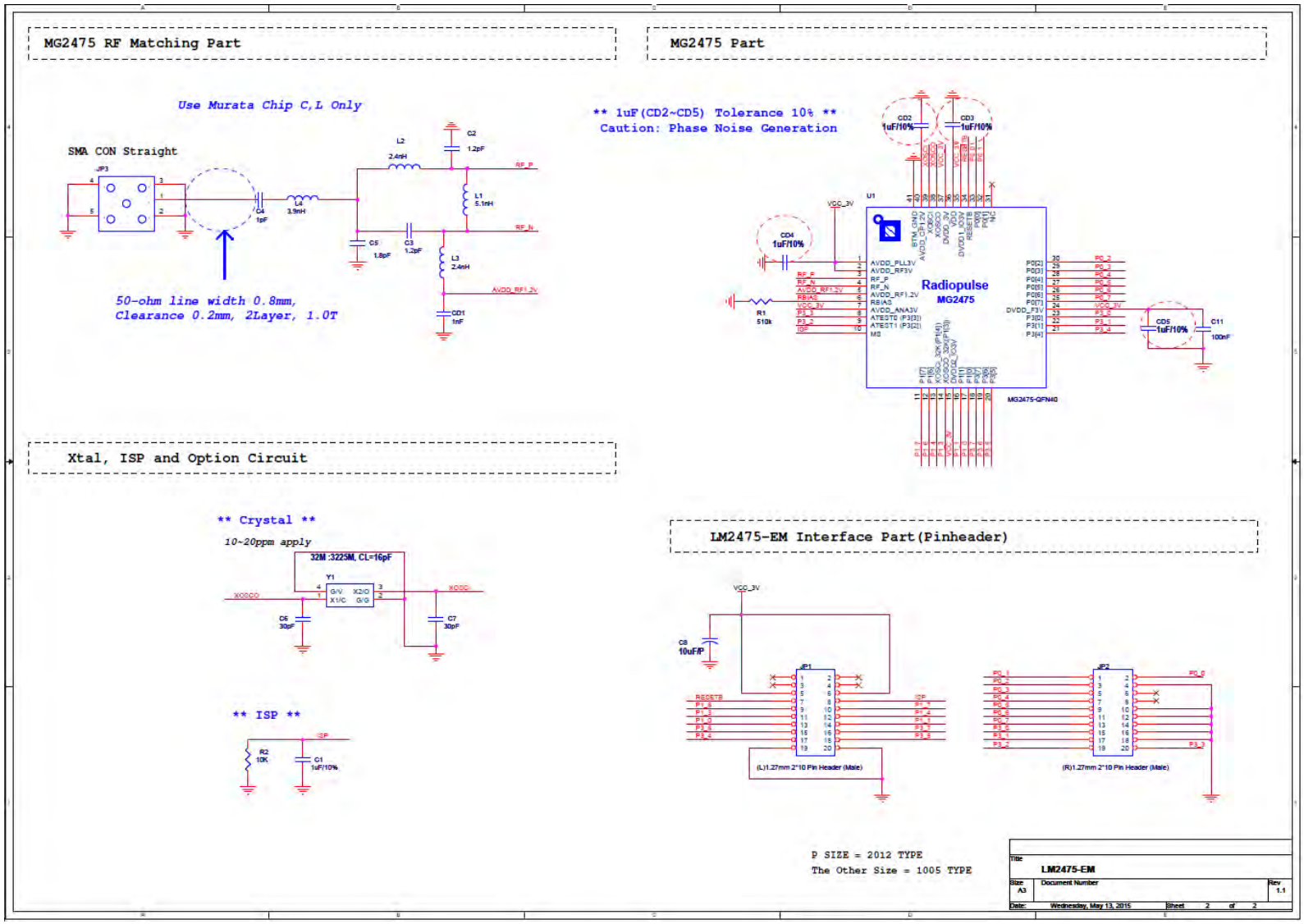




PRINTED CIRCUIT BOARD LAYOUT

NOTE
1. HOUSING MATERIAL : THERMOPLASTIC.
   COLOR : BLACK
2. PIN MATERIAL : P-Bronze
   FINISH : Gold Flash

9. SCHEMATIC


MG2475 RF Matching Part
MG2475 Part
Use Murata Chip C,L Only
SMA CON Straight
50-ohm line width 0.8mm,
Clearance 0.2mm, 2Layer, 1.0T
** 1uF(CD2~CD5) Tolerance 10% **
Caution: Phase Noise Generation
Radiopulse
MG2475
Xtal, ISP and Option Circuit
** Crystal **
10~20ppm apply
32M :3225M, CL=16pF
** ISP **
LM2475-EM Interface Part(Pinheader)
P SIZE = 2012 TYPE
The Other Size = 1005 TYPE
LM2475-EM

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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.