LM2455-EM Datasheet

(No. ADS0105)

V.1.45

REVISION HISTORY

Version	Date	Description
VER.1.0	2007.10.4	▪ First Version
VER.1.1	2007.11.6	▪Section6.1 -Modify [Figure 1] ▪Section6.3 -Modify antenna matching circuit and procedure. ▪Section7 -Modify DC/RF Characteristics.
VER.1.2	2007.12.29	▪Section 6.1 -Modify [Figure 2] ▪Section 6.2 -Modify (a), (b), (c). ▪Section 6.3 -Modify matching circuit(C6A: 6pF -> 1nF) -Modify [Figure 5] ▪Section 7.1 -Change Sleep Current -Consumption Current(Change TX, RX) ▪Section 8 -Table1: Delete Pin 8, 9 and delete input of Pin 6. ▪Section 10 -Modify circuit.
VER.1.3	2007.3.4	▪Section 10 -Modify circuit(delete C17)
VER.1.4	2008.4.10	▪Section 5 -Modify the contents of Power section. ▪Section 6.3 -Correct typing error of RF Matching Procedure(Adjust L2 and C13(C4->C13) value to maximize output level. ▪Section 10 -Modify the schematic.

VER.1.41	2008.12.8	▪Section 6.3 - Correct error in size of RF Matching circuit
VER.1.42	2009.3.4	▪Section 6.2 -Modify ‘module dimension’ ▪Section 6.3 -Modify ‘PCB pattern’ ▪Section 10 -Modify the schematic.
VER.1.43	2009.11.26	▪Section 6.2 - Module dimension((c) bottom) is changed due to added reset IC and increased capacitance(from 10uF to 47uF) in AVDD_1.5.
VER.1.44	2010.5.3	▪Section 10 Schematic is changed. - R3 : GND Change Digital -> Analog - C5B : GND Change Analog -> Digital
VER.1.45	2010.11.5	▪ Section 6.1 - Figure 3 added. ▪ Section 6.2 - Figure 5. MG2455-F48A Module dimension added. ▪ Section 6.3 - Figure 7. MG2455-F48A PCB pattern added. ▪ Section 7.1 - Max value added. ▪ Section 11 circuit added - A module schematic with MG2455-F48A

CONTENTS

1. INTRODUCTION

This document explains LM2455-EM.

1.1. DEFINITIONS

▪**MG2455-F48**: ZigBee and IEEE802.15.4 compliant single chip solution developed by RadioPulse(22GPIO,QFN Type)

▪**LM2455-EM**: ZigBee and IEEE802.15.4 compliant 2.4GHz ZigBee Module for evaluation with MG2455-F48 chip.

▪**MG245X-EVB**: A PC interface board of LM2455-EM and LM2450-EM. This board makes it possible to download user programs to LM2455-EM/LM2450-EM or connect to host programs in PC system.

1.2. REFERENCE

Document Number	Document Name
ADT0002	Device-Programmer MDUser's Guide

2. LM2455-EM

LM2455-EM is ZigBee RF module. This module includes RF Transceiver, RF circuit,8051-compatible MCU and few external components such as resistors and capacitors. In addition, it is compliant to the specification of IEEE802.15.4 and ZigBee specifications. Zpulse, ZigBee 2006 stack library, provided by RadioPulse Inc is included in this module. LM2455-EM module supports data rate from 250Kbps to 1Mbps.

3. APPLICATIONS

- Automatic Meter Reading
- Factory Automation and Motor Control
- Replacement for legacy wired UART
- Voice Applications
- Energy Management
- Remote Keyless Entry with Acknowledgement
- Low Power Telemetry
- Health-care equipments
- PC peripherals
- Toy

4. ENHANCED FEATURES

- Scalable Data Rate; 250kbps for ZigBee, 500kbps and 1Mbps for private applications.
- Voice Codec Support; μ-law/a-law/ADPCM
- High RF RX Sensitivity of -98dBm @1.5V
- High RF TX Power of +8dBm @1.5V
- 96KB Embedded Flash Memory for Program Space
- 8KB Data Memory
- Power Management Scheme with Deep Sleep Mode Support; under 1μA

5. FEATURES

RF Transceiver

- Single-chip 2.4GHz RF Transceiver
- Low Power Consumption
- Low Operating Voltage of 1.5V
- High Sensitivity of –98dBm@1.5V
- No External T/R Switch and Filter needed
- On-chip VCO, LNA, and PA
- Programmable Output Power up to +8dBm@1.5V
- Direct Sequence Spread Spectrum
- O-QPSK Modulation
- Scalable Data Rate: 250Kbps for ZigBee, 500Kbps and 1Mbps for private application

- RSSI Measurement
- Compliant to IEEE802.15.4

Hardwired MAC

- Two 256-byte circular FIFOs
- FIFO management
- AES-128 Engine
- CRC-16 Computation and Check

i8051-Compatible Microcontroller

- Max. 12x Performance of standard 8051
- 96KB Embedded Flash Memory
- 8KB Data Memory
- 128-byte CPU dedicated Memory
- 1KB Boot ROM
- Dual DPTR Support
- Multi-Bank Support for 96KB Program Memory(3Banks)
- I2S/PCM Interface with two128-byte FIFOs
- μ-law/a-law/ADPCM Voice Codec
- Two High-Speed UARTs with Two 16-byte FIFOs (up to 1Mbps)
- 4 Timers/2 PWMs
- Watchdog Timer
- Sleep Timer
- Quadrature Signal Decoder
- 22 General Purpose I/Os
- Internal RC oscillator for Sleep Timer
- On-chip Power-on-Reset
- 4-channel 8-bit ADC
- SPI Master/Slave Interface
- ISP (In System Programming)
- Temperature Sensor

Clock Inputs

- 16MHz Crystal for System Clock
- 19.2MHz Crystal for System Clock (optional)
- 32.768KHz Crystal for Sleep Timer (optional)

Power

- When using Internal Regulator of MG2455
  1.5V(Core)/1.9~3.3V(I/O) Operation
- When NOT using Internal Regulator of MG2455
  1.5V(Core)/1.5V(I/O) Operation
- Power Management Scheme with Deep Sleep Mode Support
- Two On-chip Voltage Regulator for Analog part and Digital part separately.
- Power Supply Range for Internal Regulator(1.9V(Min) ~ 3.6V(Max))
- Battery Monitoring Support

Package

- Lead-Free 48-pin QFN Package (7mm × 7mm x 0.9mm)

6. HARDWARE DESCRIPTION

LM2455-EM is a ZigBee module using MG2455-F48. The components of LM2455-EM are as follows.

- MG2455-F48/MG2455-F48A: RadioPulse ZigBee Single Chip Transceiver
- 16MHz Crystal : 16MHz Crystal
- RF Connector : SMA Type RF Connector
- CON(20PIN) : 20-Pin * 2 Connector with 1.27mm pin pitch.

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

6.1. Block Diagram

As shown in [Figure 1], LM2455-EM includes the following features.

- MG2455-F48/MG2455-F48A: 2.4GHz RF transceiver, base-band modem, a hardwired MAC and an embedded 8051 microcontroller.
- SMA type Chip Antenna.
- 22 General Purpose I/Os, 4-channel 8-bit ADC, various peripherals such as Two High-Speed UARTs etc.
- Firmware downloading by UART1 in ISP mode (In-System-Programming) mode.

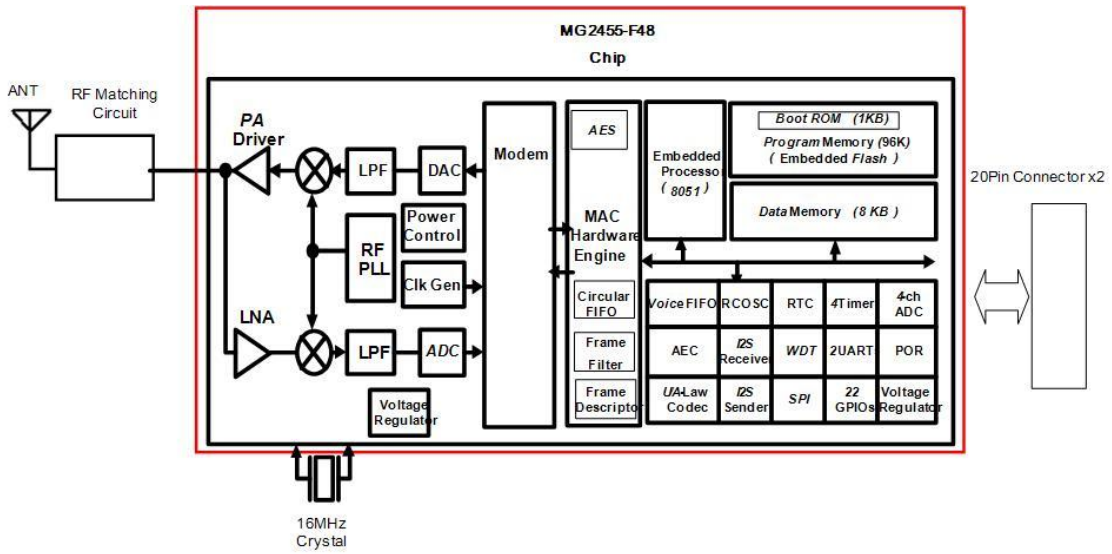


Figure 1. Functional Block of LM2455-EM

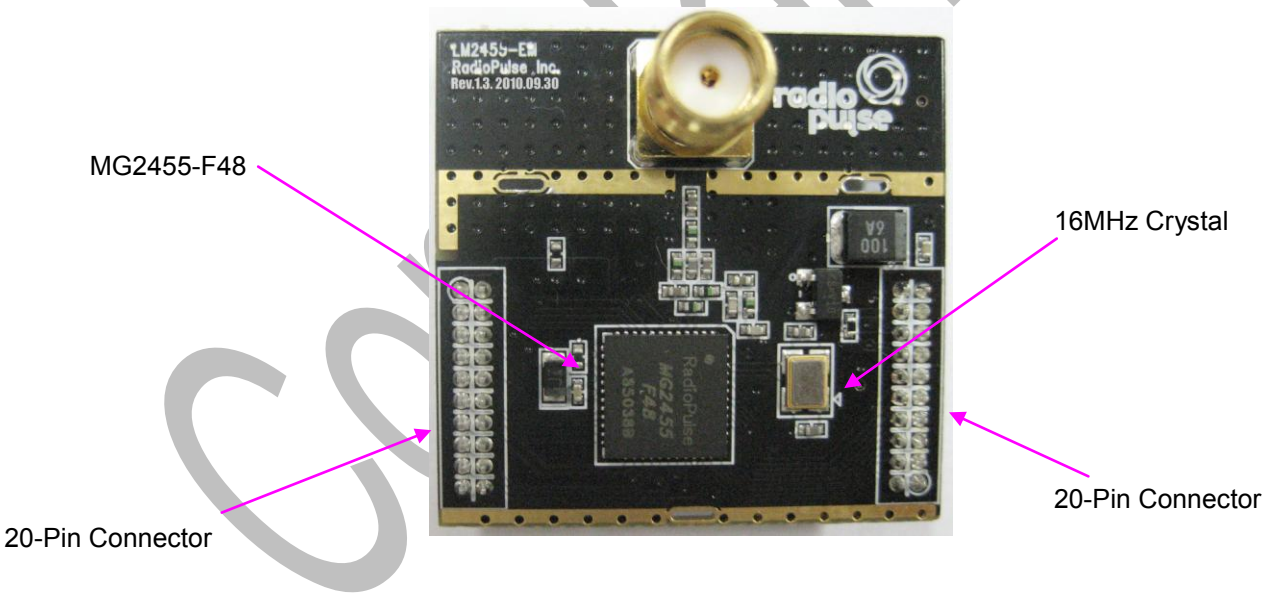


Figure 2. LM2455-EM Rev1.2A(MG2455)

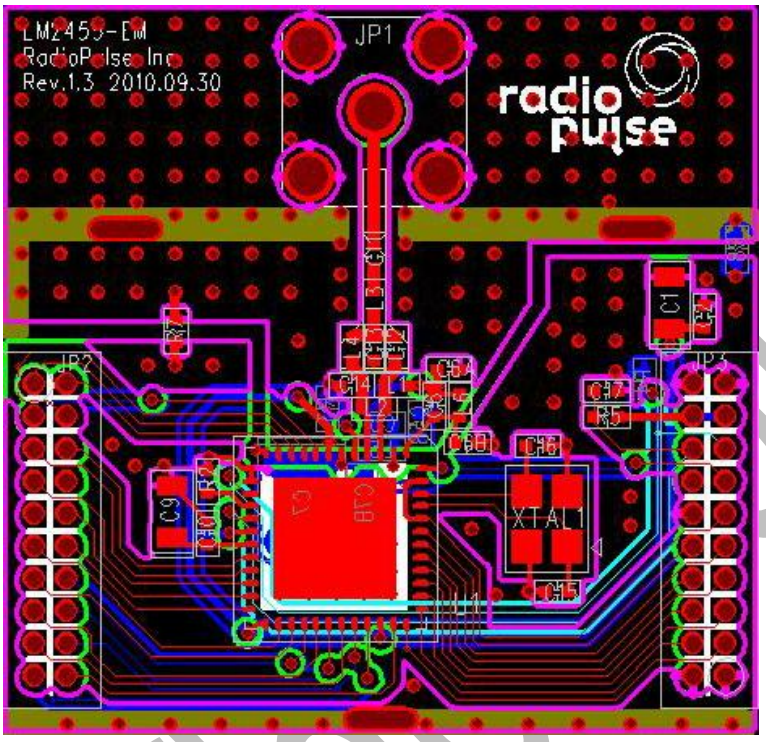


Figure 3. LM2455-EM Rev 1.3(MG2455A)

6.2. Module Dimension

The following [Figure 4, 5] shows the dimension of the LM2455-EM module. (a), (c) in [Figure 4, 5] shows the component placement. (b) in [Figure 4, 5] shows the dimension of LM2455-EM and placement for the connector pin. Two 20-pin connectors are located at the bottom.

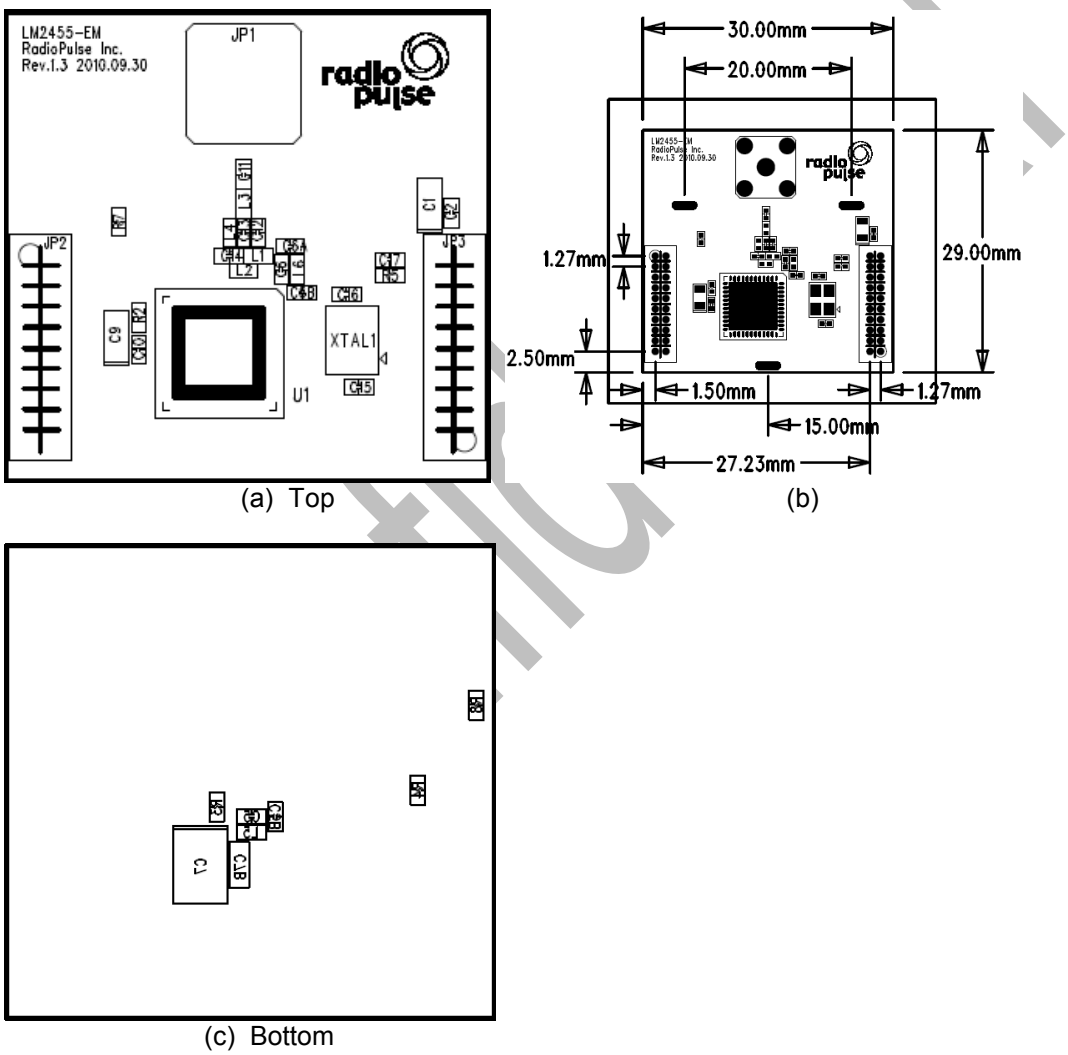
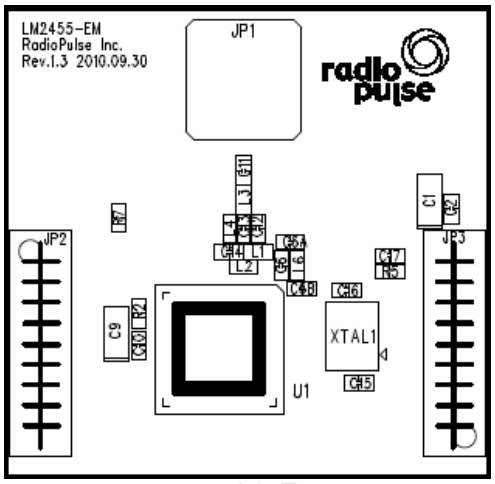
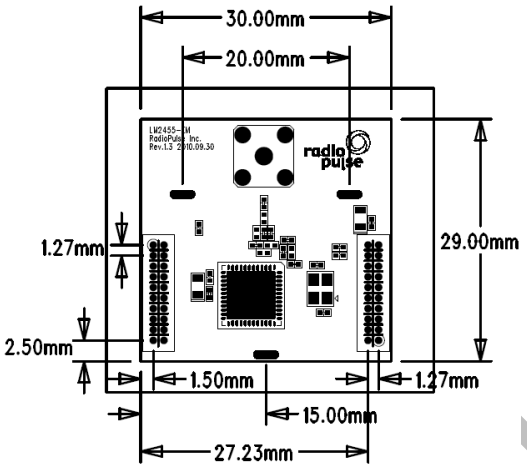


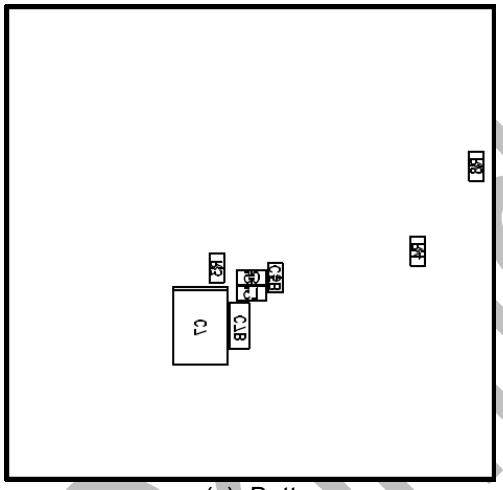
Figure 4. The dimension of the LM2455-EM(MG2455-F48)



(a) Top



(b)



(c) Bottom

Figure 5. The dimension of LM2455-EM(MG2455-F48A)

6.3. Antenna Matching Circuitry

[Figure 6] shows the recommended RF matching circuit. For PCB pattern, please refer to the [Figure 7].

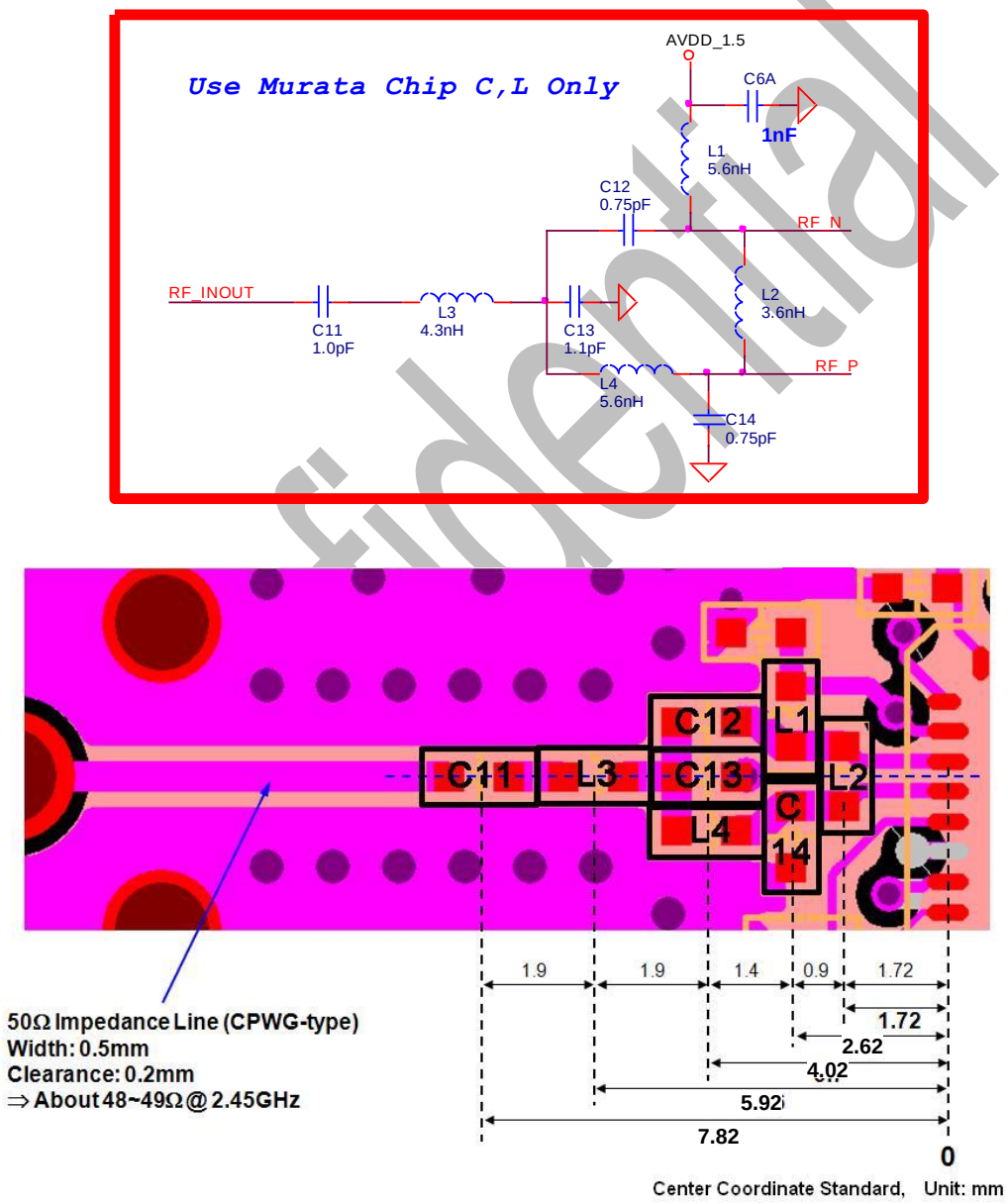


Figure 6. RF Input Output Matching Circuit

RF Matching Procedure

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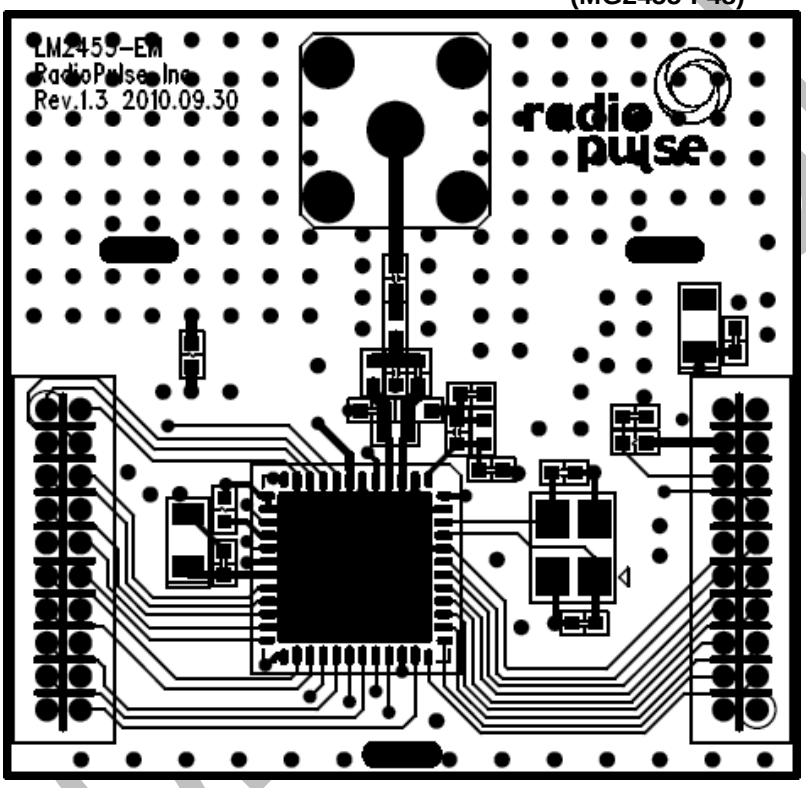
① The value of L1/C12/L4/C14 is adjusted to 2.4GHz.
② L3 and C11 organize narrow band-pass.
③ Adjust L2 and C13 value to maximize output level.
④ Adjust L3 and C11 to minimize 2nd and 3rd harmonic.

(MG2455-F48)



(MG2455-F48A)

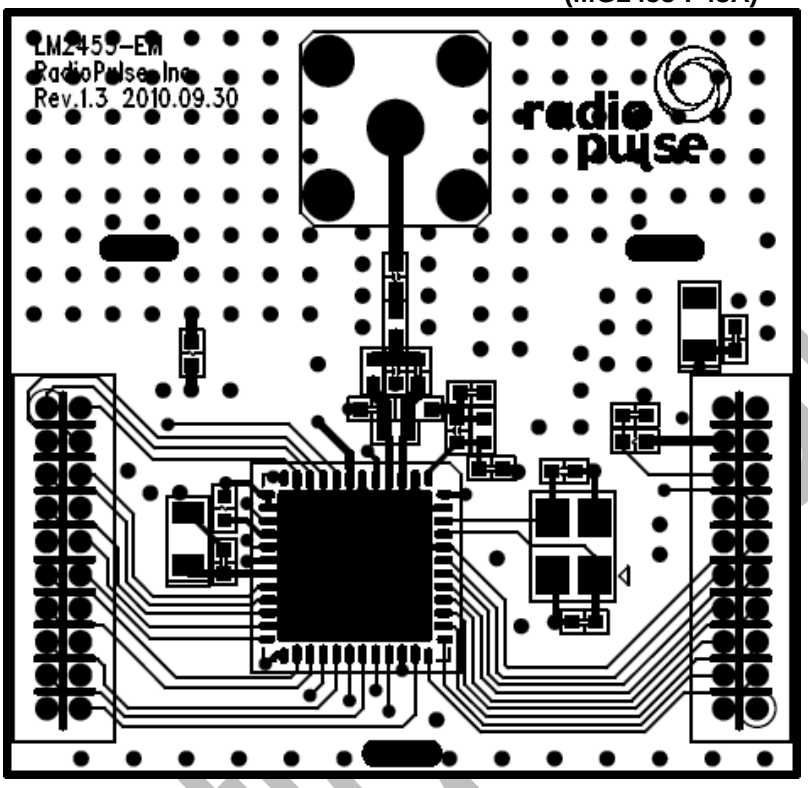
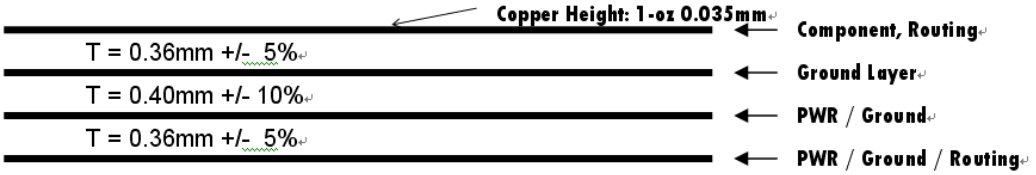


Figure 7. RF Input Output Matching PCB pattern

PCB Layer Structure



PCB : 1.2mm, FR-4 , Er = 4.5

7. SPECIFICATION

7.1. DC Characteristics

Item		Spec	Remark
Supply input voltage		+3Vdc(+2.7~+3.3V)	Typical +3Vdc
Consumption Current	TX	43mA(Max: 45mA)	MCU Clock(8MHz)
		46 mA(Max: 48mA)	MCU Clock(16MHz)
	RX	33mA(Max: 35mA)	MCU Clock(8MHz)
		36mA(Max: 38mA)	MCU Clock(16MHz)
Sleep Current(PM1)		25μA(Max: 110μA)	25μA(Max: 110μA)

7.2. RF Characteristics(+25℃)

Item		Spec	Remark
Frequency Range		2400~2483.5MHz	
Frequency Tolerance		<±20ppm	
Occupied B.W		2MHz	
Output Power (Normal)		7dBm (±1dB)	
VSWR		<2.0 : 1	
Flatness		<1dB	
Spurious Emissions 1GHz Under 1GHz ~ 2.4GHz ~ 12GHz		 <-30dBm <-30dBm <-30dBm	
2nd Harmonic		<-45dBm	
3rd Harmonic		<-70dBm	
Inband Spurious		<-45dBm	
Adjacent Channel Rejection	±3.5MHz	>40dBc	
Secondary Radiated Emission		<-58dBm	Limit of secondary radiated emissions.
Phase Noise	1MHz	-110dBc / Hz	
	2MHz	-112dBc / Hz	

	3MHz	-118dBc / Hz	
Rx Sensitivity		<-96dBm	
Max. Input Power Level		+5dBm	
Error Vector Magnitude		<13%	

8. PIN DESCRIPTION

The following [Table 1] and [Table 2] describes the interface signals to be used to communicate with external devices.

Table 1. Left Pin Header(JP2) pins

Pin	Name	Type	Description
1	ACH2	ANALOG IN	1.5V Level Analog ADC2 Input
2	ACH3	ANALOG IN	1.5V Level Analog ADC3 Input
3	ACH0	ANALOG IN	1.5V Level Analog ADC0 Input
4	ACH1	ANALOG IN	1.5V Level Analog ADC1 Input
5	P1_6	IN/OUT	General Purpose IO (8051 Port P1.6)
6	P1_7	OUT	General Purpose O (8051 Port P1.7)
7	P1_4	IN/OUT	General Purpose IO (8051 Port P1.4)
10	P1_3	IN/OUT	General Purpose IO (8051 Port P1.3)
11	P1_0 / RXD1	IN/OUT	General Purpose IO (8051 Port P1.0) UART1 RXD1
12	P1_1 / TXD1	IN/OUT	General Purpose IO (8051 Port P1.1) UART1 TXD1
13	P3_7	IN/OUT	General Purpose IO (8051 Port P3.7)
14	P3_6	IN/OUT	General Purpose IO (8051 Port P3.6)
15	P3_5	IN/OUT	General Purpose IO (8051 Port P3.5)
16	P3_4	IN/OUT	General Purpose IO (8051 Port P3.4)
17	P3_3 / INT1#	IN/OUT	General Purpose IO (8051 Port P3.3) External Active Low Interrupt Input
18	P3_2 / INT0#	IN/OUT	General Purpose IO (8051 Port P3.2) External Active Low Interrupt Input
19	P3_1 / TXD0	IN/OUT	General Purpose IO (8051 Port P3.1) UART0 TXD0
20	P3_0 / RXD0	IN/OUT	General Purpose IO (8051 Port P3.0) UART0 RXD0

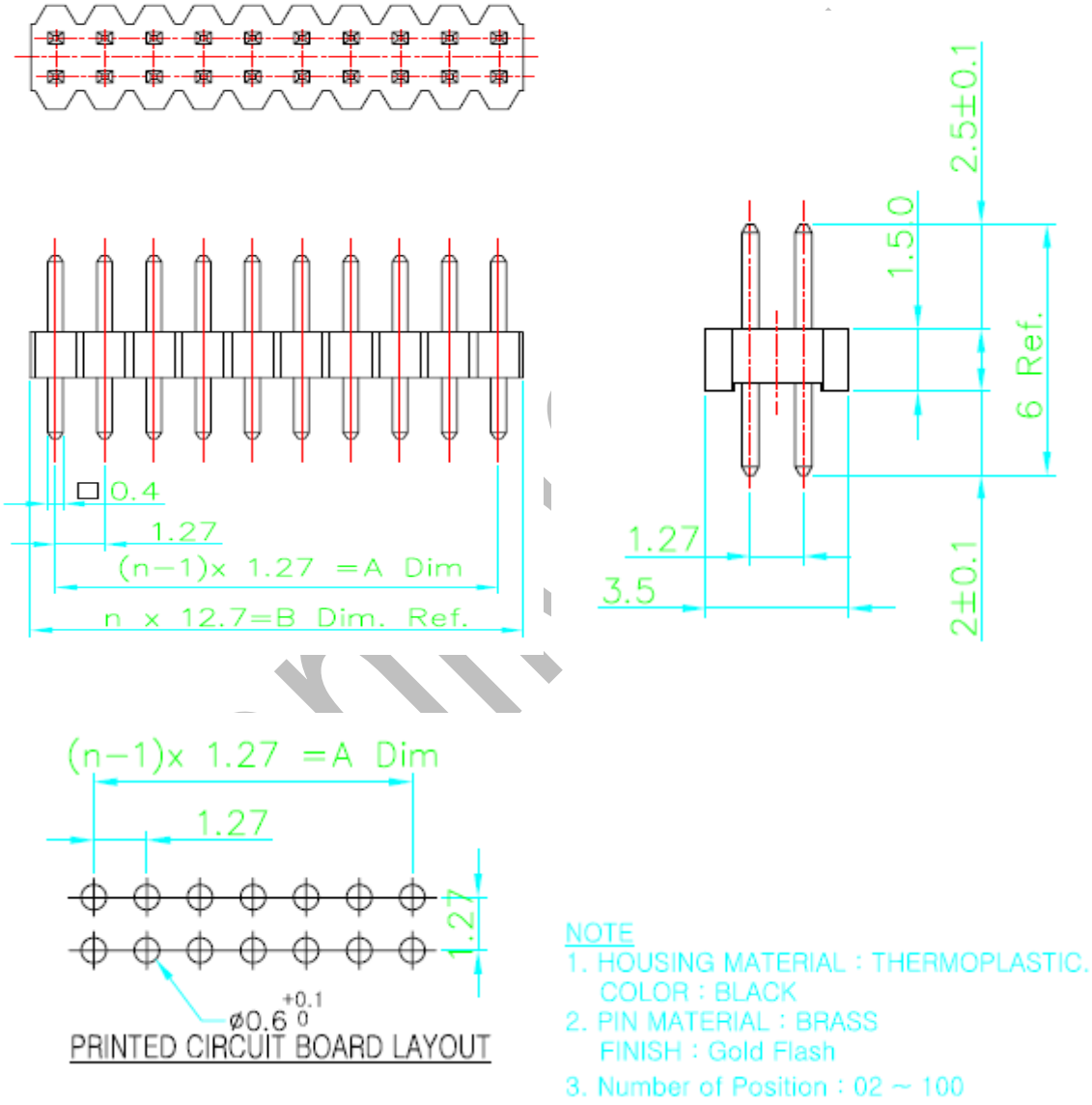
Table 2. Right Pin Header(JP3) pins

Pin	Name	Type	Description
1	GND	Ground	Ground
2	GND	Ground	Ground
3	P0_7	IN/OUT	General Purpose IO (8051 Port P0.7)

4	P0_6	IN/OUT	General Purpose IO (8051 Port P0.6)
5	P0_5	IN/OUT	General Purpose IO (8051 Port P0.5)
6	P0_4	IN/OUT	General Purpose IO (8051 Port P0.4)
7	P0_3	IN/OUT	General Purpose IO (8051 Port P0.3)
8	P0_2	IN/OUT	General Purpose IO (8051 Port P0.2)
9	P0_1	IN/OUT	General Purpose IO (8051 Port P0.1)
10	P0_0	IN/OUT	General Purpose IO (8051 Port P0.0)
11	DVDD 1.5V	OUT	1.5V Regulator Voltage Output(Digital)
12	GND	Ground	Ground
13	AVDD 1.5V	OUT	1.5V Regulator Voltage Output(Analog)
14	NC	-	-
15	ISP	INPUT	Active High In-System-Programming Input
16	RESET#	INPUT	Active Low RESET# Input
17	VCC	3.0V	POWER(3.0V)
18	VCC	3.0V	POWER(3.0V)
19	GND	Ground	Ground
20	GND	Ground	Ground

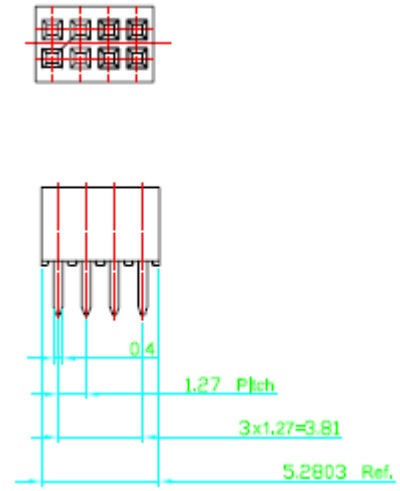
9. CONNECTOR DIMENSION

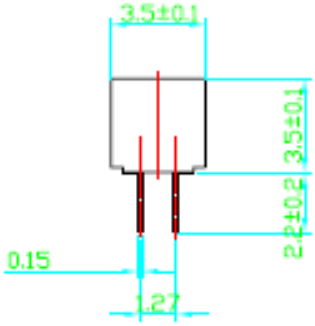
■ **20-Pin male Connector**

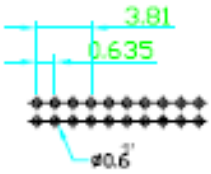


NOTE
1. HOUSING MATERIAL : THERMOPLASTIC.
   COLOR : BLACK
2. PIN MATERIAL : BRASS
   FINISH : Gold Flash
3. Number of Position : 02 ~ 100

■ **20-Pin Female Connector**



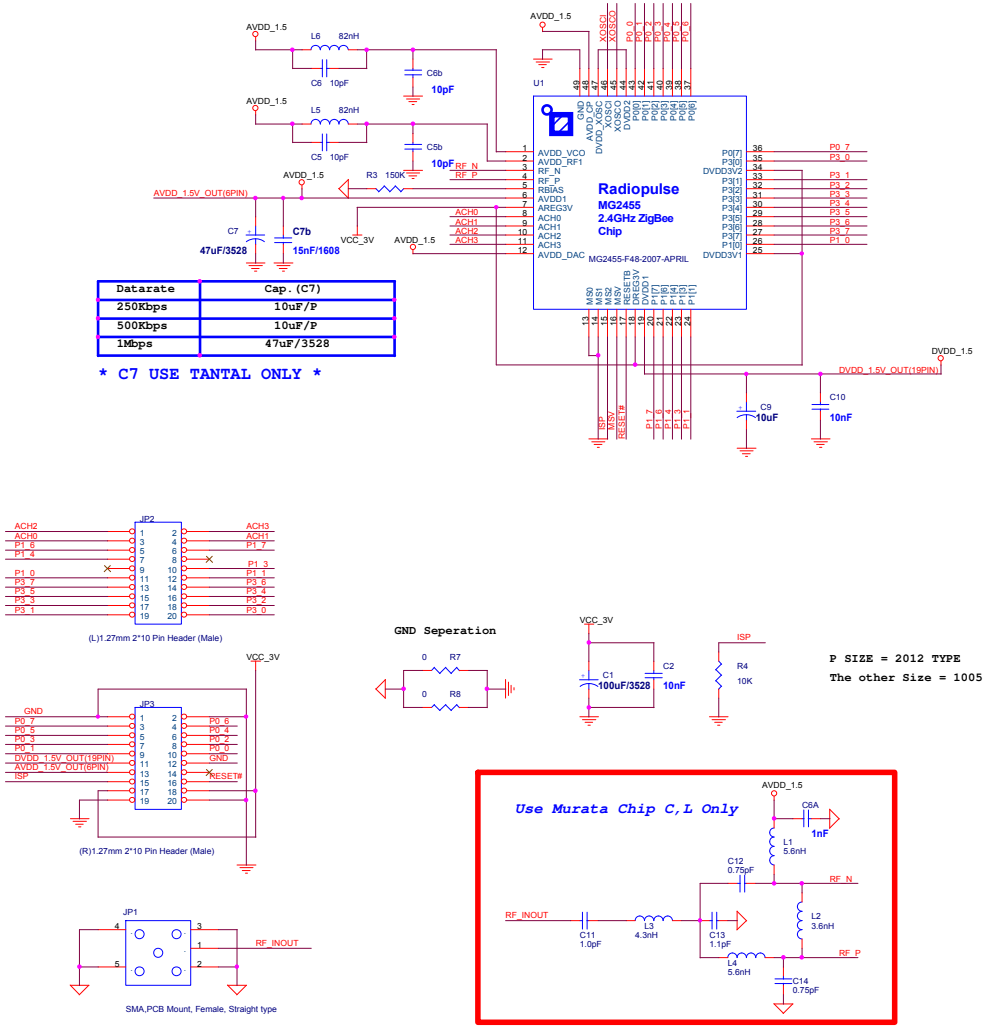




PRINTED CIRCUIT BOARD LAYOUT

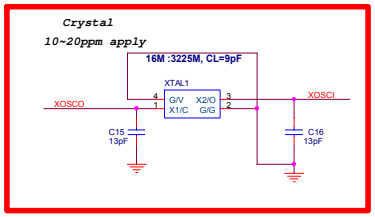
NOTE
1. HOUSING MATERIAL : THERMOPLASTIC.
   COLOR : BLACK
2. PIN MATERIAL : P-Bronze
   FINISH : Gold Flash

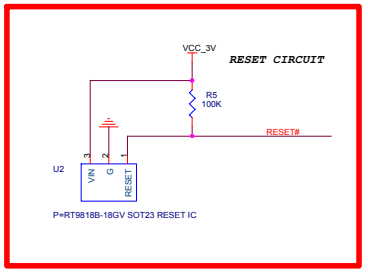
10. SCHEMATIC_LM2455-EM_Rev 1.2A

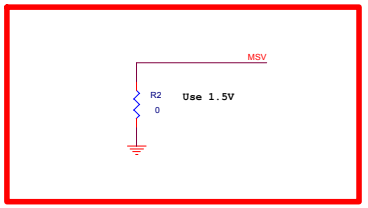


Datarate	Cap. (C7)
250Kbps	10uF/P
500Kbps	10uF/P
1Mbps	47uF/3528

* C7 USE TANTAL ONLY *





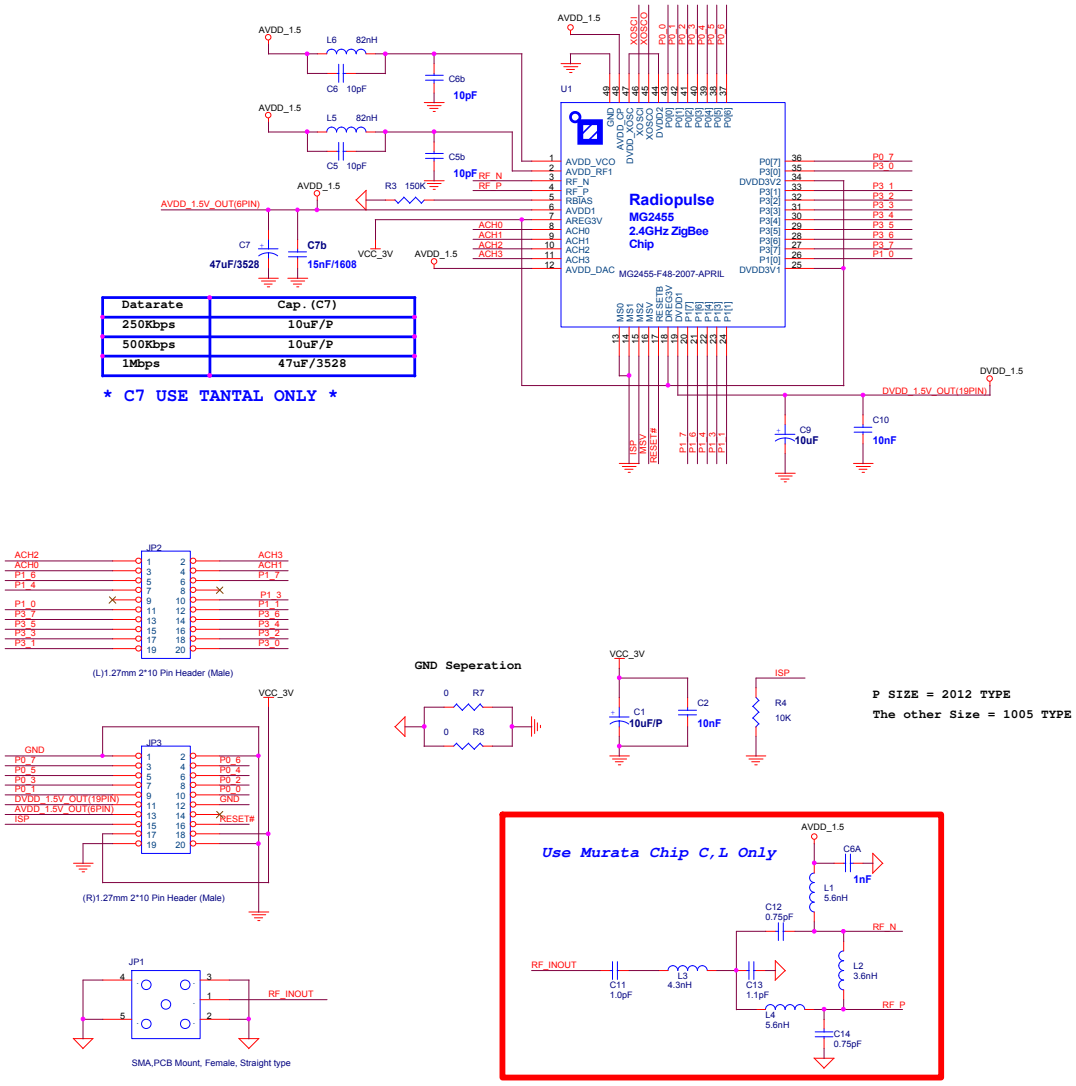


P SIZE = 2012 TYPE
The other Size = 1005 TYPE

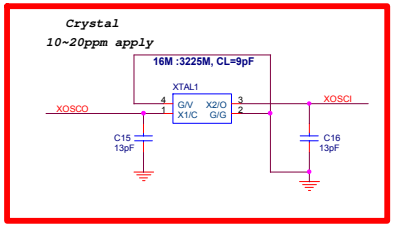
Title	LM2455-EM_Rev1.2A		
Size C	Document Number LM2455-EM		Rev 1.2A
Date: Monday, May 03, 2010	Sheet 2	2	

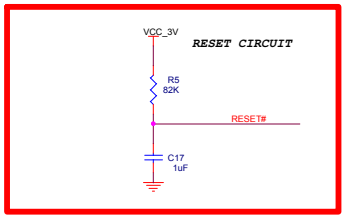
LM2455-EM Rev 1.2A is a module with MG2455-F48 and applied with Reset IC.

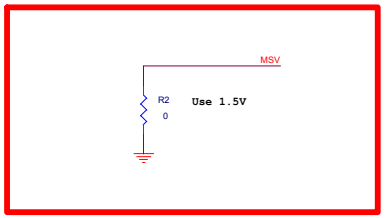
11. SCHEMATIC-LM2455-EM_Rev 1.3



Datarate	Cap.(C7)
250Kbps	10uF/P
500Kbps	10uF/P
1Mbps	47uF/3528







P SIZE = 2012 TYPE
The other Size = 1005 TYPE

Title	LM2455-EM_Rev1.3	
Size C	Document Number LM2455-EM	Rev 1.3
Date: Thursday, September 30, 2010	Sheet 2 of 2	

LM2455-EM_Rev 1.3 is a module with MG2455-F48A and Reset IC is removed.

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sales@radiopulse.co.kr

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.