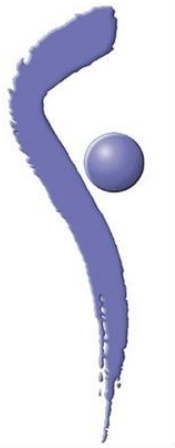
MMRW User Manual

Product Name	MM Chip Reader / Writer module [UHF]
Product Number	MMRW-MD-U01



FEC International (M) SDN BHD
2nd Nov. 2011

Contents

1 Introduction

This MMRW-MD-U01 is a reader/writer module complied with multiband RFID chip dubbed as "MM Chip". This document contains the instructions to use and evaluate the functions and the performance of this device. For external interface connection, either USB or UART serial connection can be applied, which is applicable to almost all of the controller systems.

For more details on the product specifications, please refer to "MMRW-U02 Product Specification Document".

2 Usage Important Points

[Regulation/Standards]

This product follows the guidance for reading/writing communication equipment. It is important to check the regulation/standard and the seller or user of the intended country.

[Points to take notes before using the product]

1) This product is designed for general use and should not be utilized with application such as medical appliances related to human life or in space satellite environment which requires high reliability. Our company will not be responsible for any accidents caused from the said events, such as personal accident, fire accident or any public related accident.
2) This product is emitting radio wave which can affect medical appliances such as the pacemaker device.
3) Do not place this product near any radio device since it can cause interference.
4) Do not touch the connector terminal as it can result in electrical shock and will eventually destroy the product.

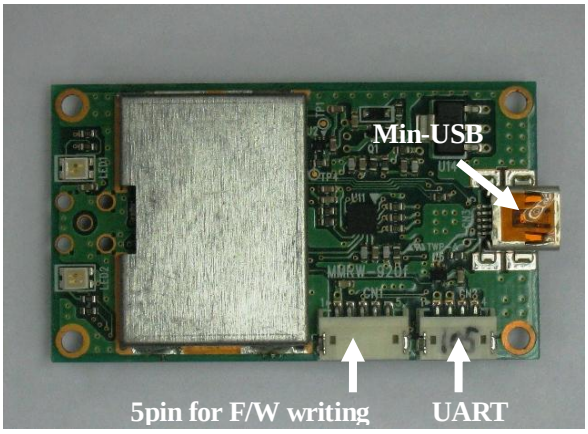
3 Key features

- Support MM2 chip air interface protocol and commands
- Light weight, compact size module
- UART serial and USB communication available
- RF output: 100mW
- Operation voltage: 5VDC

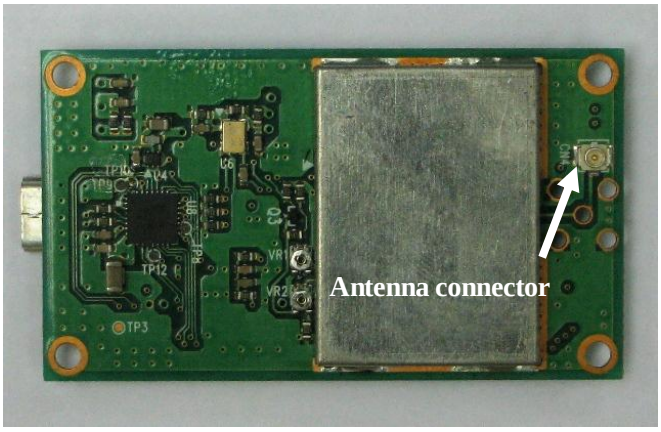
4 Reader/writer module package content

[RFID reader / writer board: MMRW-MD-U01]

Top side



Back side



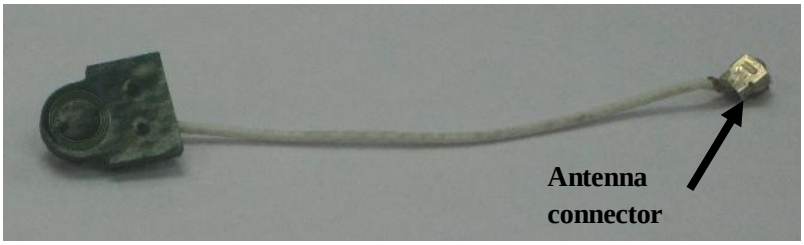
USB (Mini B)

Packet communication complies with USB2.0/1.1

UART serial

- Communication speed
  Variable according to a command (default : 9,600bps)
  (1,200/2,400/4,800/9,600/19,200/38,400/57,600bps)
- Data bit: 8bit
- Stop bit: 1bit
- Parity bit: N/A
- Flow control: N/A

[Board antenna: MMATU-OCA]



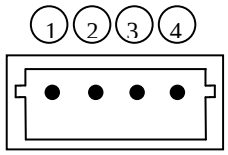
[CD with SDK and documentation]
Included in the CD are SDK and related documents, product specifications and various manuals. For more details, please see “readme.txt” included in the CD.

5 Connections

The first step is to connect the components. Connect antenna board to the RFID reader / writer board using the connector. Terminal and reader/writer can be connected by USB or UART serial port.
Pin assignment for UART serial is stated in the table below. Please prepare a harness cable for the connection to device terminal.

No.	Signal name	I/O	Content
1	VCC	-	Provide DC 5V (+/-0.25V)
2	GND	-	GND
3	TXD	OUT	UART serial signal output (LV-TTL)
4	RXD	IN	UART serial signal input (LV-TTL)

[Pin assignment]



6 Function and use

The equipment is ready to be operated once all connections are completed.

Next, equipment operating with SDK package will be explained. SDK Package is prepared for application development of MMRW series. SDK Package contains demo software, USB driver, USB communication library, and sample source code. For further details, please refer to “Demo Software Manual” before using MMRW demo software.

Please refer to “MMRW Command Library Function Specification” to develop application.

7 Hardware

7.1 Transmitting circuit

Fig 1

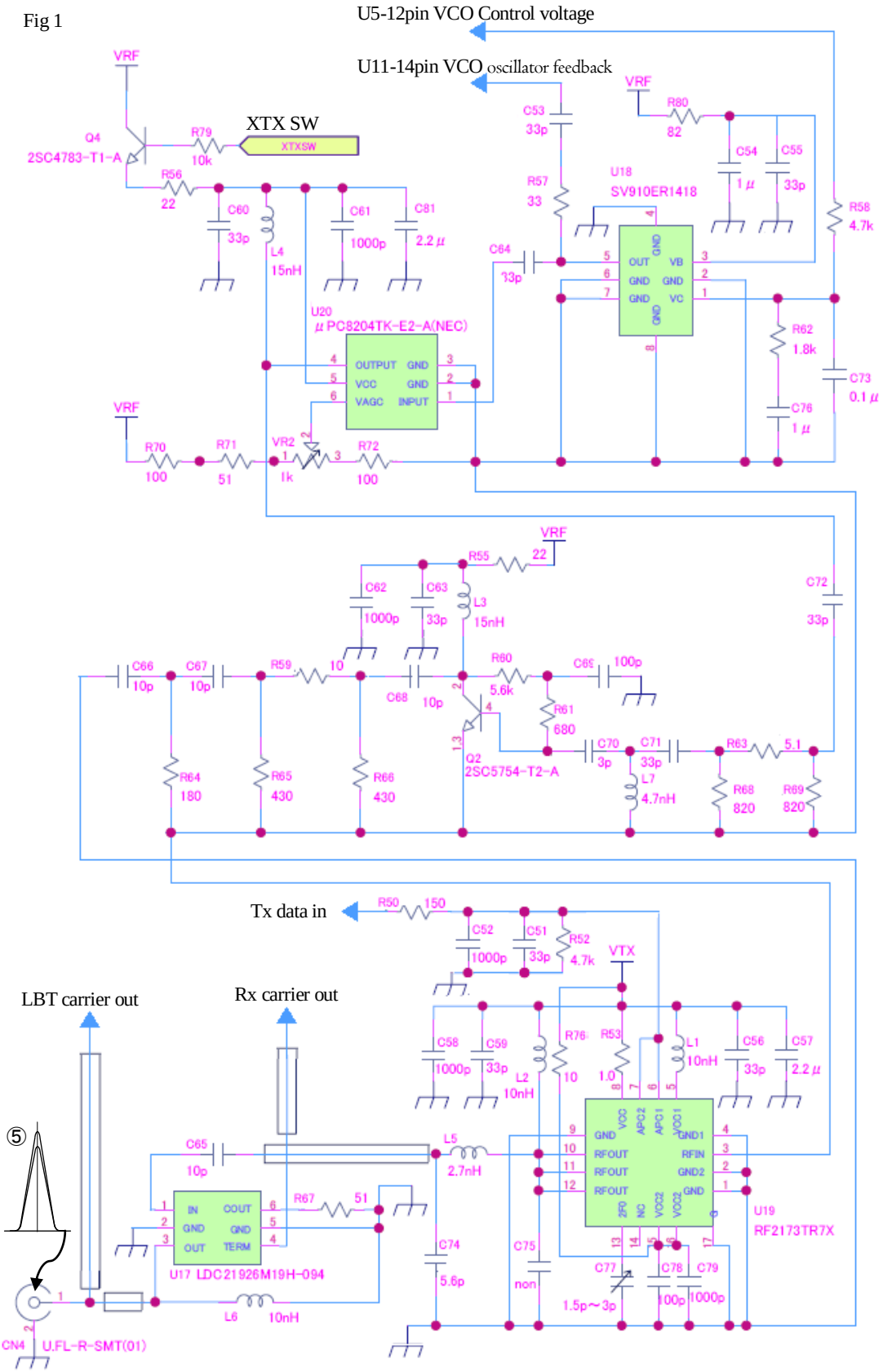


Fig1 is Transmitting circuit. When VCO Control voltage from U11 PLL Synthesizer LMX2433 12pin is input, VCO SV910ER1418 of U18 oscillate the 919.0MHz - 923.0MHz (Malaysia band, waveform ①). C53 output is an oscillator feedback out for U15. Oscillating out can control Gain with Gain Control Amplifier of U20 μ

PC8204 and VR2. It does input to Q2 high frequency amplifier transistor base and outputs waveform ③. R63, R68 and R69 are -1dB π type attenuator. U19 RF2173 is a high frequency power amplifier. It becomes ASK modulation (waveform ④) by Tx data Signal from U5 TC7S14. And, it is adjusted to 10% modulation with R50. U19's out outputs Tx carrier (waveform ⑤) from ANT out by passing U17 Directional coupler. Tx carrier level is adjusted to 100mW with VR1.

7.2 Receiving circuit / comparator circuit

Fig 2

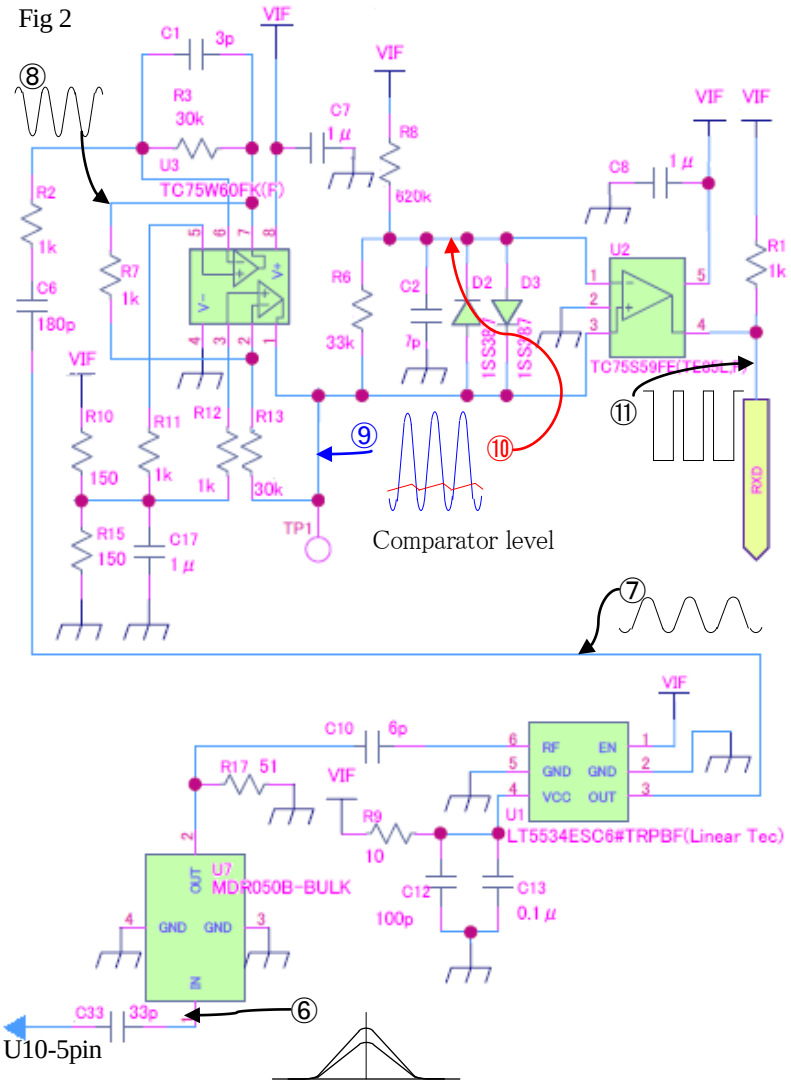


Fig 2 shows receiving circuit / comparator circuit. Career Signal (waveform ⑥) input from U10-5pin passes U7 band pass filter, and outputs career wave (waveform ⑦) at U1 high frequency amplifier/detect IC LT5534. Career wave is amplified by U3 operational amplifier TC75W60 and outputs waveform⑧, ⑨. Waveform ⑨ inputs to U2 Comparator TC75S59 non inverting input. Other waveform ⑨ becomes threshold Signal ⑩ by R6 and C3 integrating circuit. It inputs to inverting input and outputs Rx data out (waveform ⑪) to U8-1pin and 2pin.

7.3 Microprocessor

Fig 3

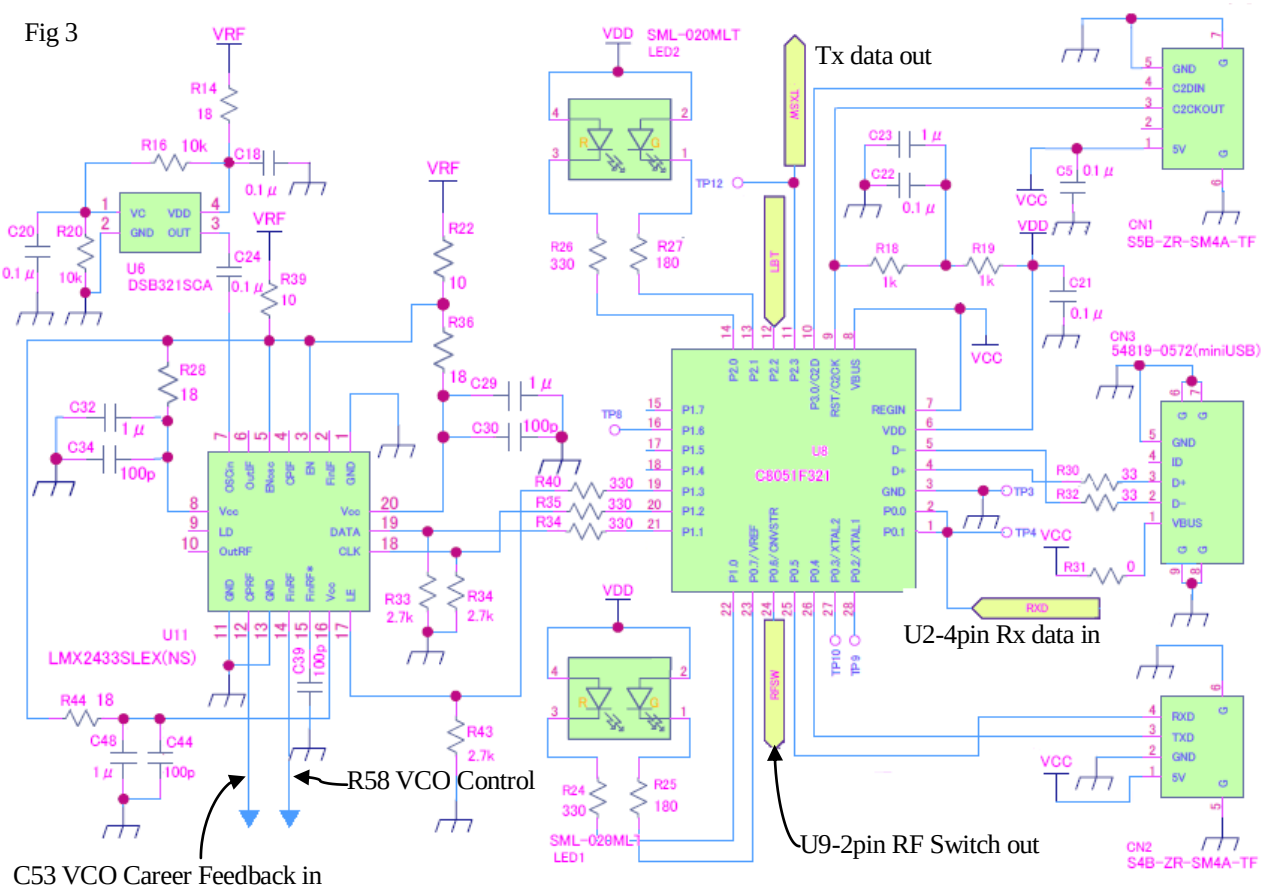
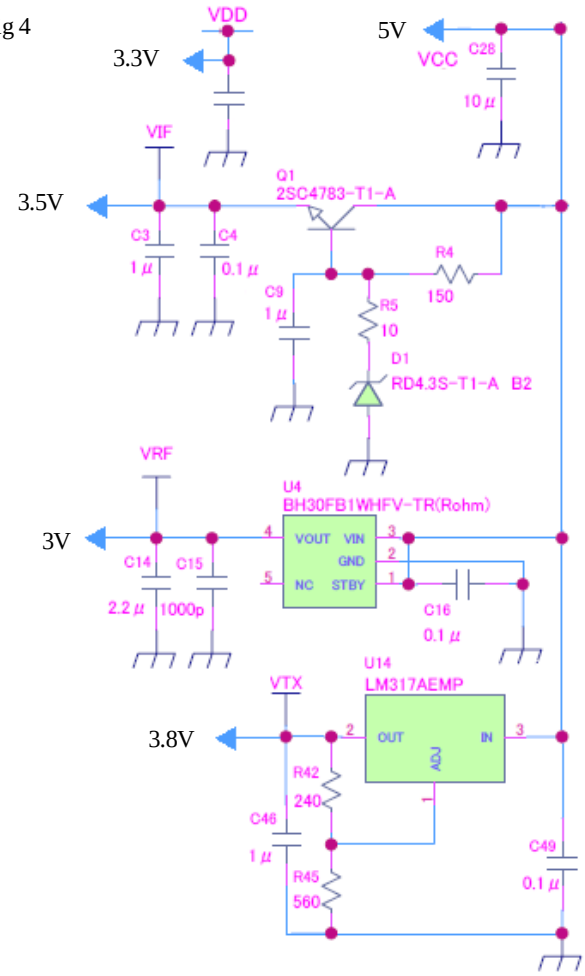


Fig3 shows circuit that centers on U8 C8051F321 microprocessor. It is composed of LED drive, USB interface, serial data interface, U6 career oscillator, U11 PLL Synthesizer, and power reset circuit. The crystal oscillator is unnecessary, because clock generator is built-in. Moreover, 3.3V voltage regulator and USB driver are built into it. 3.3V constant voltage is output from 6Pin. This Vdd is used so as not to change brightness of LED by the Vcc change. R18, R19, C22, and C23 are for set time constant. CN3 is USB interface connector, and CN4 is a connector for the serial interface. CN1 is CPU firmware write connector. CN4-1Pin must use 5V when you use the serial interface connector.

MMRW-MD-U01 uses five power supplies.

Fig 4



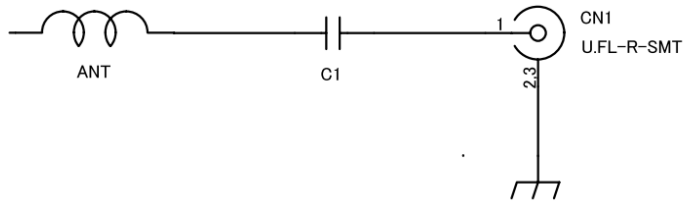
Vcc5V=U8 CPU farm wear write power voltage.
Vdd3.3V=U8 CPU internal, U5 power voltage, LED1-2 power voltage, U9 power voltage.
VIF3.5V=U1,U2,U3,U12,U15,U16,R1,VR1 power voltage.
VRF3V =U6 career oscillator, U11 PLL Synthesizer, U18 VCO, Q2, Q3 power voltage.
VTX3.8V=U19Transmitting circuit.

7.4 Microprocessor's pin assignment

Pin#	Name	Signal Name	I/O	Type	ACTIVE	RESET	Description
1	P0.1	RXD	I	open-drain	?	?	RF Rx
2	P0.0	RXD	I	open-drain	?	?	RF Rx
3	GND	GND	-	-	-	-	GND
4	D+	D+	I/O	-	-	-	USB D+
5	D-	D-	I/O	-	-	-	USB D-
6	VDD	VDD	-	-	-	-	VDD(3.3V)
7	REGN	POWER(VCC)	-	-	-	-	VCC(5V)
8	VBUS	USB/POWER(VCC)	I	-	-	-	VCC(5V)
9	RST/C2CK	RESET	O	-	-	-	Device Reset/C2CK
10	P3.0/C2D	P3.0	O	push-pull	-	H	C2D
11	P2.3	TXSW	I	open-drain	L	H	RF Tx
12	P2.2	COP(+)/LBT	O	open-drain		H	LBT sense(UHF only)
13	P2.1	LED2_G	O	open-drain	L	L	LED
14	P2.0	LED2_R	I	open-drain	L	H	LED
15	P1.7	COP(-)	O	open-drain	-	H	LBT sense(UHF only)
16	P1.6	DEBUG0	O	push-pull	-	-	Debug port
17	P1.5	ANTSW0	O	open-drain	H	L	Antenna SW (UHF only)
18	P1.4	ANTSW1	O	open-drain	H	L	Antenna SW (UHF only)
19	P1.3	PLL_LE	O	push-pull	H	L	Synthesizer control
20	P1.2	PLL_CLK	O	push-pull	H	L	Synthesizer control
21	P1.1	PLL_DAT	O	push-pull	H	H	Synthesizer control
22	P1.0	LED1_R	O	open-drain	L	H	LED
23	P0.7/VREF	LED1_G	O	open-drain	L	H	LED
24	P0.6/CNVSTR	RFSW	O	push-pull	L	H	LBT sense(UHF)
25	P0.5	UART_RXD	I	open-drain	L	H	UART Rx
26	P0.4	UART_TXD	O	push-pull	L	H	UART Tx
27	P0.3/XTAL2	Power_Change	O	push-pull	H(Fix)	H	Output power control
28	P0.2/XTAL1	DEBUG1	O	push-pull	-	-	Debug port

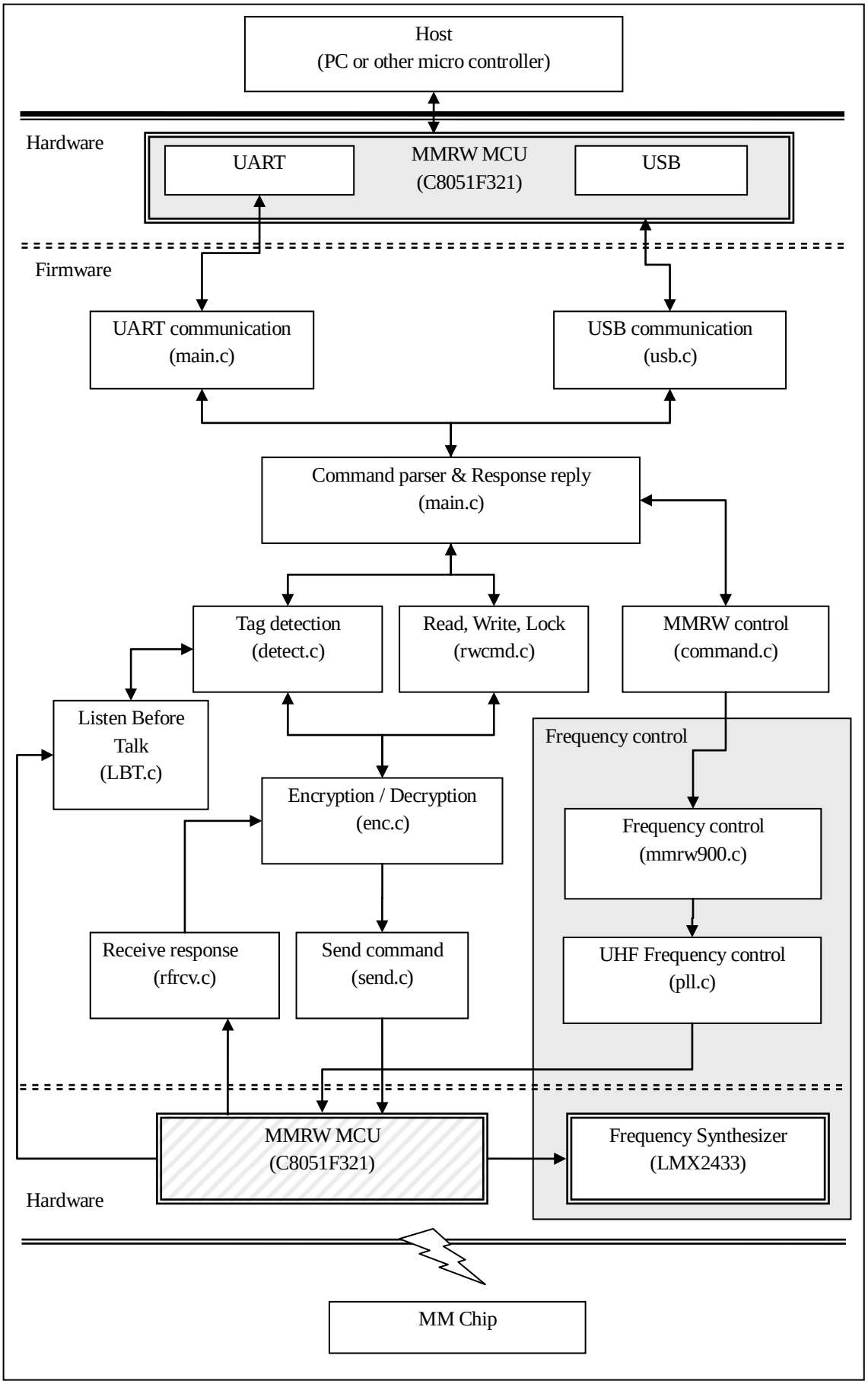
7.5 RF antenna

MMATU-OCA is 50Ω antenna connected to MMRW-MD-U01. The antenna prepares four types (866, 912, 923, 953). The antenna is a spiral antenna.



C1 = 1.5pF
Antenna connector = U.FL receptacle
C1 is used to adjust VSWR of the antenna.

8 Firmware



The firmware was developed using "Keil C51 compiler" under Silicon Labs IDE. The firmware can be loaded into the microcontroller using the "on-chip Silicon Labs 2-Wire (C2) debug interface" connected to a USB debug

adapter, driven by Silicon Labs IDE.
C8051F320.h contains the firmware specific C51 code. (Input, output pins, etc.).
The file mmrwmmrw900r.wsp is Silicon Labs IDE project file.

9 Firmware Writing Procedures

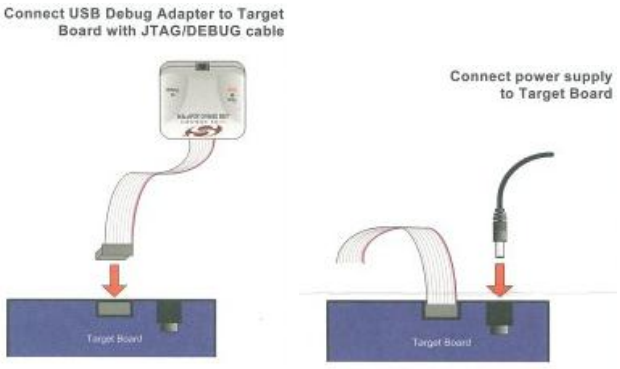
9.1 Firmware writing application start-up and installation

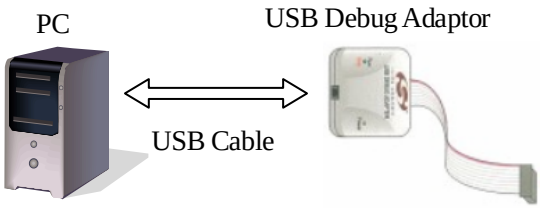
For firmware writing (OS: Windows XP SP2 or higher is recommended), double click「mcu_ide.exe」and follow instructions on the screen accordingly.
http://www.silabs.com/products/mcu/Pages/SoftwareDownloads.aspx
"Start" → "Silicon Laboratories" → Select and start "Silicon Laboratories IDE".

9.2 Firmware writing

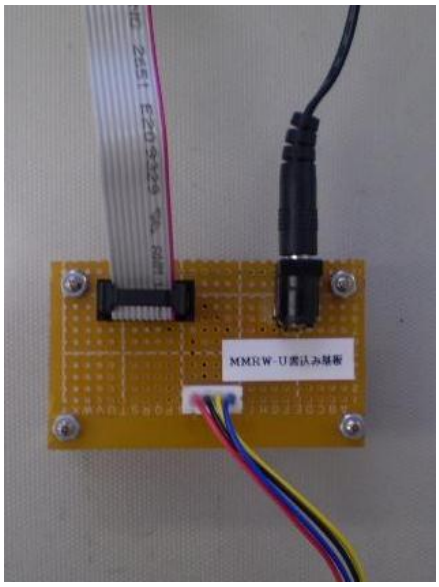
(1) Firmware file (MMRW-UHFver01.00.OMF) is saved in any folder in the PC used for firmware writing.

(2) USB Debug Adaptor and 5V-AC Adaptor are connected to MMRW-U writing substrate, and this debug adaptor is connected to PC via USB cable.



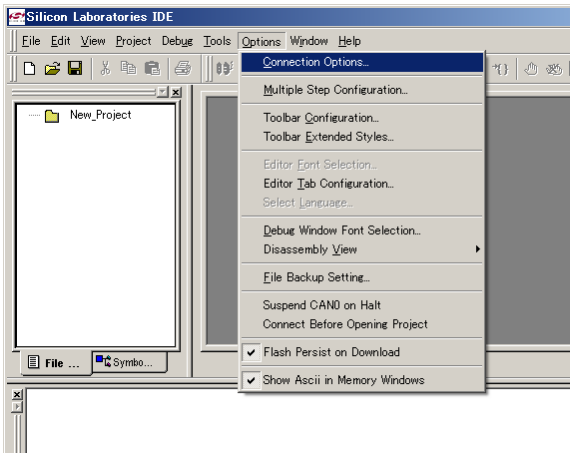


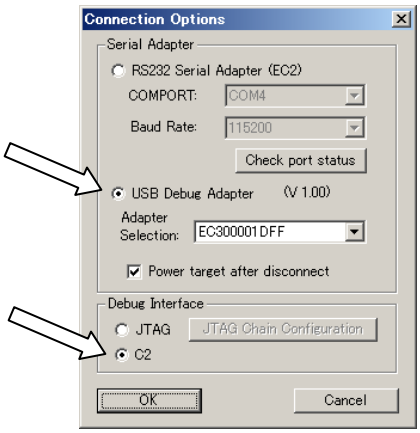
Completed Installation



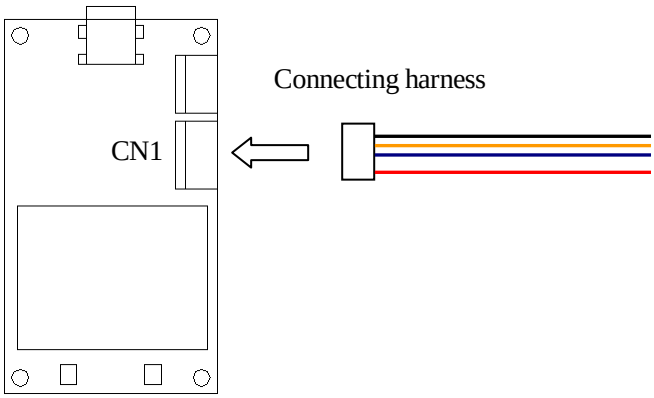
(3) Silicon Laboratories IDE starts.

(4) Set connection method for PC and connection substrate.
From the toolbar, select “Options” → “Connection Options”, then set USB debug adaptor to connector.

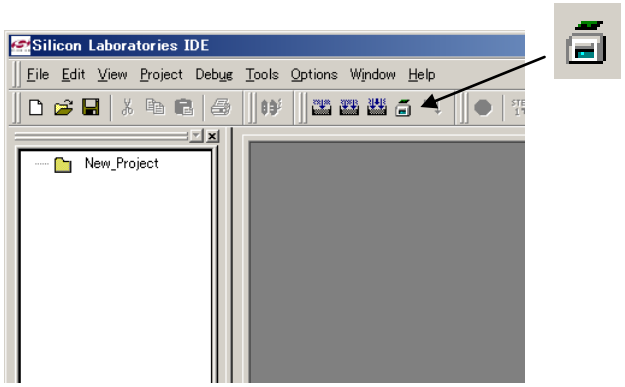




(5) MMRW module is connected to “MMRW-U writing substrate”.
Harness for MMRW-U writing substrate is then connected to MMRW module CN1 (5 pin connector).

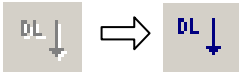


(6) PC and module connect electronically.



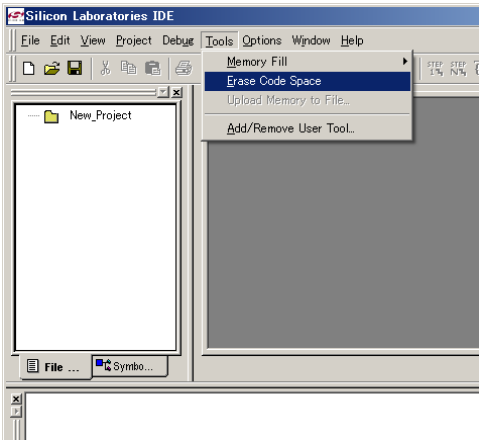
Click

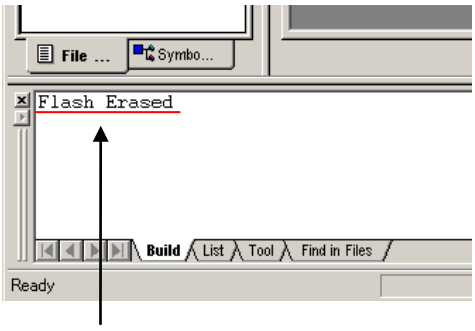
Connected correctly



Icon will be displayed

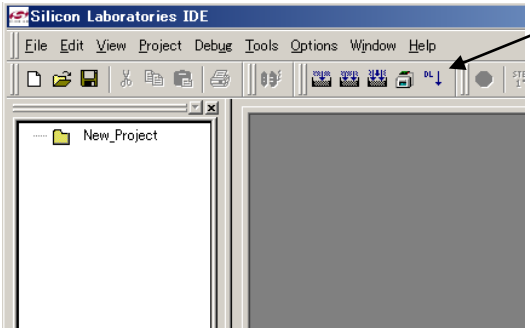
(7) In case where firmware has already been written, it is necessary to delete the firmware. If firmware is newly written, delete procedure is unnecessary.
Select “Tools” → ”Erase Code Space” from Toolbar, and erase firmware.





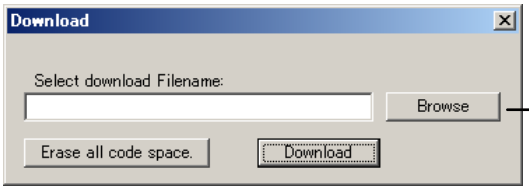
“Flash Erased” is displayed when deleting succeed

(8) Writing firmware into microcontroller.

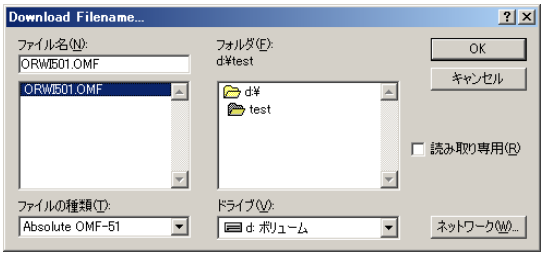


Click

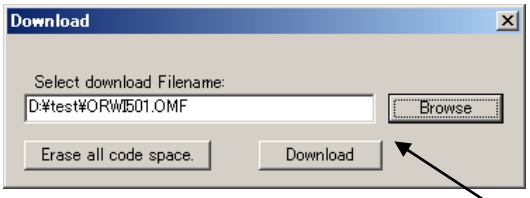
Get started with below shown window, select the folder where firmware file (MMRW-UHF ver01.00 OMF) is saved, click “Download” button and thereby firmware writing starts.



Clicking “Browse” button then select is possible too

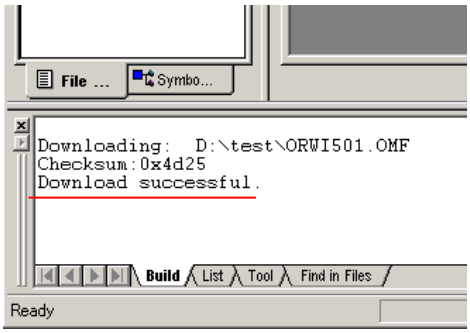


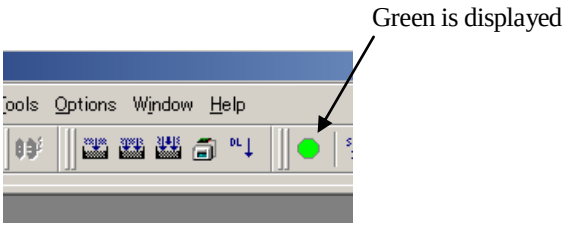
(Eg. Screen shows ORWI501.OMF saved in D:¥test)



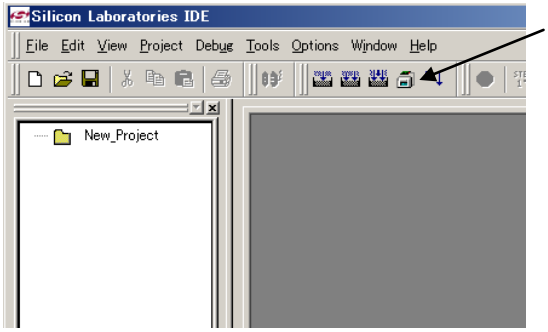
Click “Download” button

Once writing is succeed, below shown window will be displayed.





(9) PC and module electronically disconnected.



Click

Normal disconnection

Icon will be disabled.

(10) MMRW module will detach from MMRW-U writing substrate.
Before module is detached, PC and module MUST follow procedure (9) for release.
Detach harness and therefore module is detached too.

Repeat (5) - (10) for the next firmware writing.
To end firmware writing, close the application.

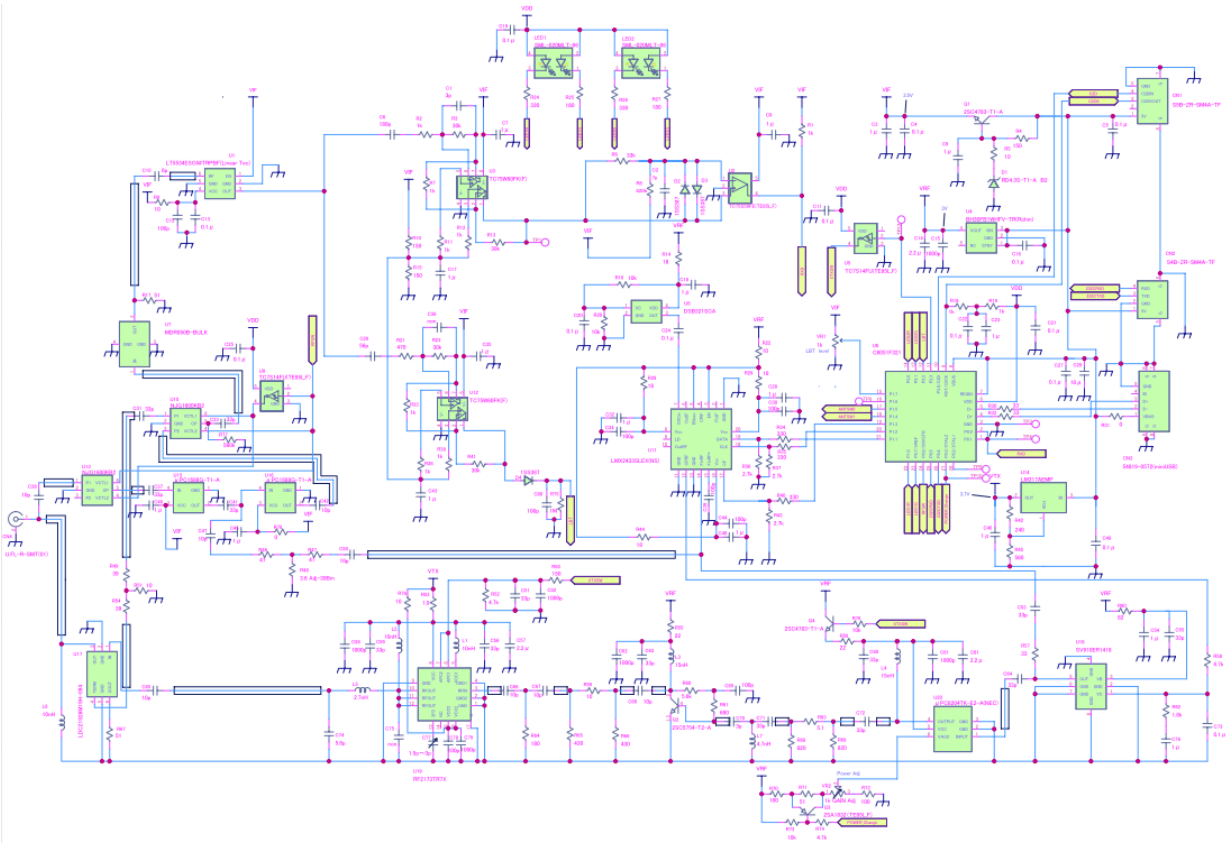
10 Product general specification

Items	Specification
Product number	MMRW-MD-U01
Appearance diagram	58(D) x 33(W) x 9.4(H) mm (Excluding surface bump's presence)
Operation frequency	UHF
Communication standard	MM Chip original protocol communication
IC card/tag	IC card/tag with MM chip (Excluding on-chip antenna)
Modulation	Receive: ASK10%　Transmit: 90%
Communication speed	Receive: 25Kbps　Transmit: 40Kbps
Input power supply	DC5V (Power supply voltage variation: ±0.25V) (USB bus power supply / external supply)
Current consumption	RF carrier ON:　Approximately 430mA (Standard) RF carrier OFF:　Approximately 80mA (Standard)
RF output	Approximately 100mW
Antenna output impedance	50Ω
Temperature environment	Storage temperature range: -30ºC～+80ºC Operation temperature range: -10ºC～+60ºC Storage / operation humidity range: Below 90%RH (Non-condensation situation)
Anti-collision	Unsupported
RF output I/F	2pin-ZH Connector/Side type SM4

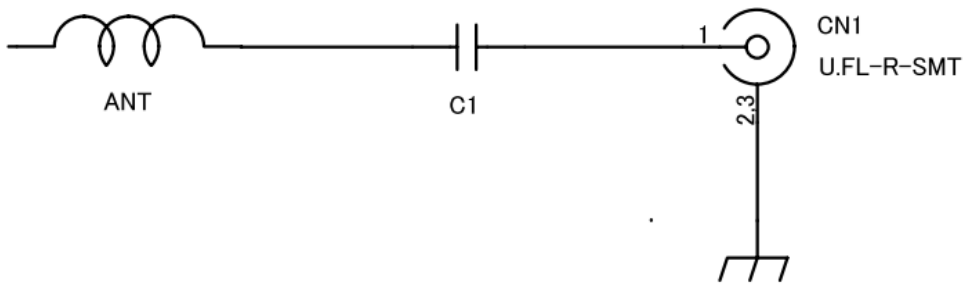
11 Annexes

11.1 Schematics

MMRW-MD-U01:



MMATU-OCA:



11.2 List of components

MMRW-MD-U01

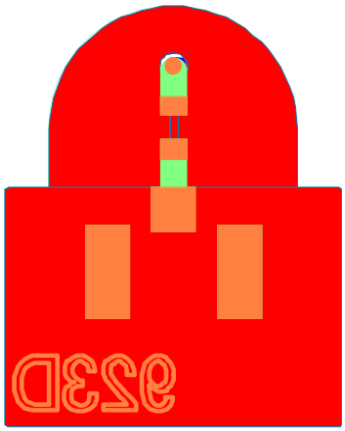
Part Name	Specification	Qty	Part No.
RF Power Detector		1	U1
Comparator		1	U2
Dual Operational Amplifier		2	U3, 12
Regulator IC		1	U4
〃		1	U14
L-MOS		2	U5,9
TCXO		1	U6
B P for 915MHz		1	U7
MCU	16KB	1	U8
SPDT Switch		2	U10,13
Dual PLL IC		1	U11
Analog IC		2	U15,16
Hybrid Coupler		1	U17
Voltage-Controlled- Oscillator		1	U18
PA for GSM		1	U19
Variable Gain AMP		1	U20
Chip Resistor	1608 0Ω	2	R31,78
〃	1608 1Ω	1	R53
〃	1608 3.6Ω	1	R48
〃	1608 5.1Ω	1	R63
〃	1608 10Ω	6	R5,9,22,51,59,76
〃	1608 18Ω	4	R14,28,29,44
〃	1608 22Ω	2	R55,56
〃	1608 33Ω	3	R30,32,57
〃	1608 39Ω	2	R49,54
〃	1608 47Ω	2	R46,47
〃	1608 51Ω	3	R17,67,71
〃	1608 82Ω	1	R80
〃	1608 100Ω	2	R70,72
〃	1608 150Ω	4	R4,10,15,50
〃	1608 180Ω	3	R25,27,64
〃	1608 240Ω	1	R42
〃	1608 330Ω	5	R24,26,34,35,40
〃	1608 430Ω	2	R65,66
〃	1608 470Ω	1	R21
〃	1608 560Ω	1	R45
〃	1608 680Ω	1	R61
〃	1608 820Ω	2	R68,69
〃	1608 1KΩ	10	R1,2,7,11,12,18,19,33,,38,39
〃	1608 1.8KΩ	1	R62
〃	1608 2.7KΩ	3	R36,37,43
〃	1608 4.7KΩ	3	R52,58,74
〃	1608 5.6KΩ	1	R60
〃	1608 10KΩ	4	R16,20,73,79
〃	1608 30KΩ	4	R3,13,23,41
〃	1608 33KΩ	1	R6
Chip Resistor	1608 620KΩ	1	R8

〃	1608 560KΩ	1	R77
〃	1608 1MΩ	1	R75
Variable Resistance	Surface Mount 1KΩ	2	VR1,2
Chip Capacitor	1608 3pF	2	C1,70
〃	1608 5.6pF	1	C74
〃	1608 6pF	1	C10
〃	1608 7pF	1	C2
〃	1608 10pF	8	C38,42,47,50,65,66,67,68
〃	1608 33pF	14	C31,33,37,41,51,53,55,56,
			C59,60,63,64,71,72
〃	1608 56pF	1	C26
〃	1608 100pF	8	C12,30,34,39,44,69,78,80
〃	1608 180pF	1	C6
〃	1608 1000pF	6	C15,52,58,61,62,79
〃	1608 0.1μF	14	C4,5,11,13,16,19,20,21,22,
			C24,25,27,49,73
〃	1608 1μF	17	C3,7,8,9,17,18,23,29,32,35,
			C40,43,45,46,48,54,76
〃	1608 2.2μF	1	C81
〃	2125 2.2μF	2	C14,57
Trimming Capacitor	Surface Mount	1	C77
〃	3216 10μF	1	C28
Chip Coil	1608 2.7nH	1	L5
〃	1608 4.7nH	1	L7
〃	1608 10nH	3	L1,2,6
〃	1608 15nH	2	L3,4
Transistor	Surface Mount	2	Q1,Q4
〃	Surface Mount	1	Q2
〃	Surface Mount	1	Q3
Diode	Surface Mount	3	D2,3,4,
Zener Diode	Surface Mount	1	D1
LED	Surface Mount	2	LED1,2
Connector	Surface Mount	1	CN1
〃	Surface Mount	1	CN2
Mini USB Connector	Surface Mount	1	CN3
Coaxial Connector	Surface Mount	1	CN4
Shield Case A	Component Side	1	
Shield Case B	Solder Side	1	
R/F Substrate (Four-layered)	58 x 33 x 1mm	1	
S/No. Sticker	4 x 19mm	1	

MMATU-OCA

Part Name	Specification	Qty	Part No.
Antenna Substrate	7.6x9.64x1.6mm	1	RoHS compliance
Capacitor	1.5pF	1	C1
Connector	U.FL receptacle	1	CN1(RS:426-5469)

11.3 Antenna layout



12 FCC STATEMENT

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.