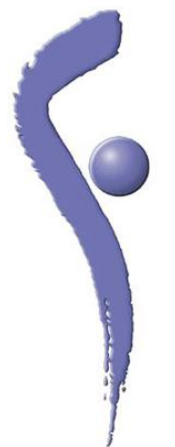


MMRW User Manual

Product Name	MM Chip Reader / Writer module [13.56MHz]
Product Number	MMRW-MD-H01



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

Contents

1	Introduction	3
2	Usage Important Points	3
3	Key features	3
4	Reader/writer module package content.	4
5	Connections	5
6	Function and use	5
7	Hardware	6
7.1	Carrier oscillation circuit, ASK modulator circuit, transmission output circuit	6
7.2	RF receiving circuit	7
7.3	Microprocessor.	8
7.4	Microprocessor's pin assignment	9
7.5	RF antenna	9
8	Firmware	10
9	Firmware Writing Procedures	11
9.1	Firmware writing application start-up and installation	11
9.2	Firmware writing	11
10	Product general specification	14
11	Annexes	15
11.1	Schematics	15
11.2	List of components	16
11.3	Antenna layout	17
12	FCC STATEMENT	17

1 Introduction

This MMRW-MD-H01 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-H01 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]

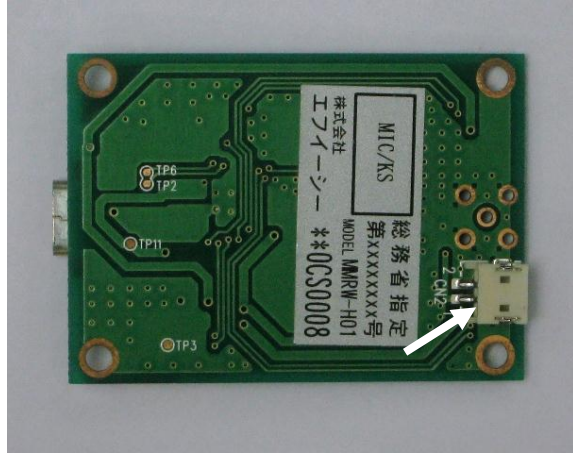
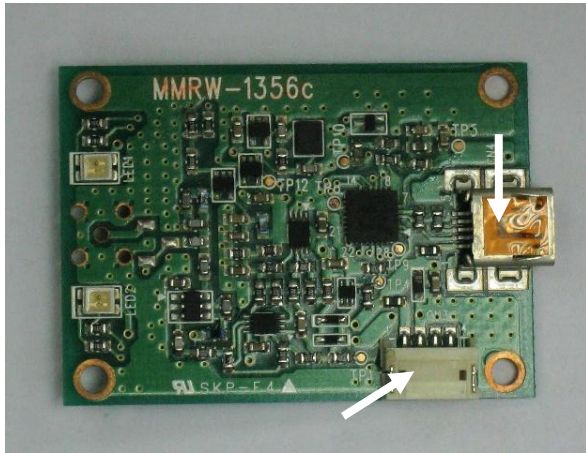
- 1) This product is designed for general use and should not be utilized with application such as medical appliances related to human life or in space satellite environment which requires high reliability. Our company will not be responsible for any accidents caused from the said events, such as personal 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: 25mW
- Operation voltage: 5VDC

4 Reader/writer module package content

[RFID reader / writer board: MMRW-MD-H01]



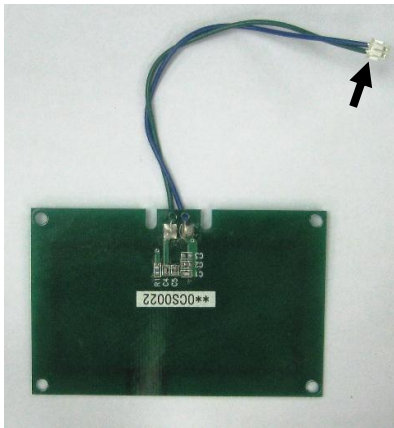
USB (Mini B)

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: MMATH-4570]



[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.

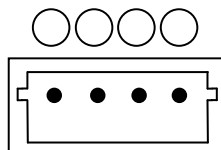
5 Connections

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 Carrier oscillation circuit, ASK modulator circuit, transmission output circuit

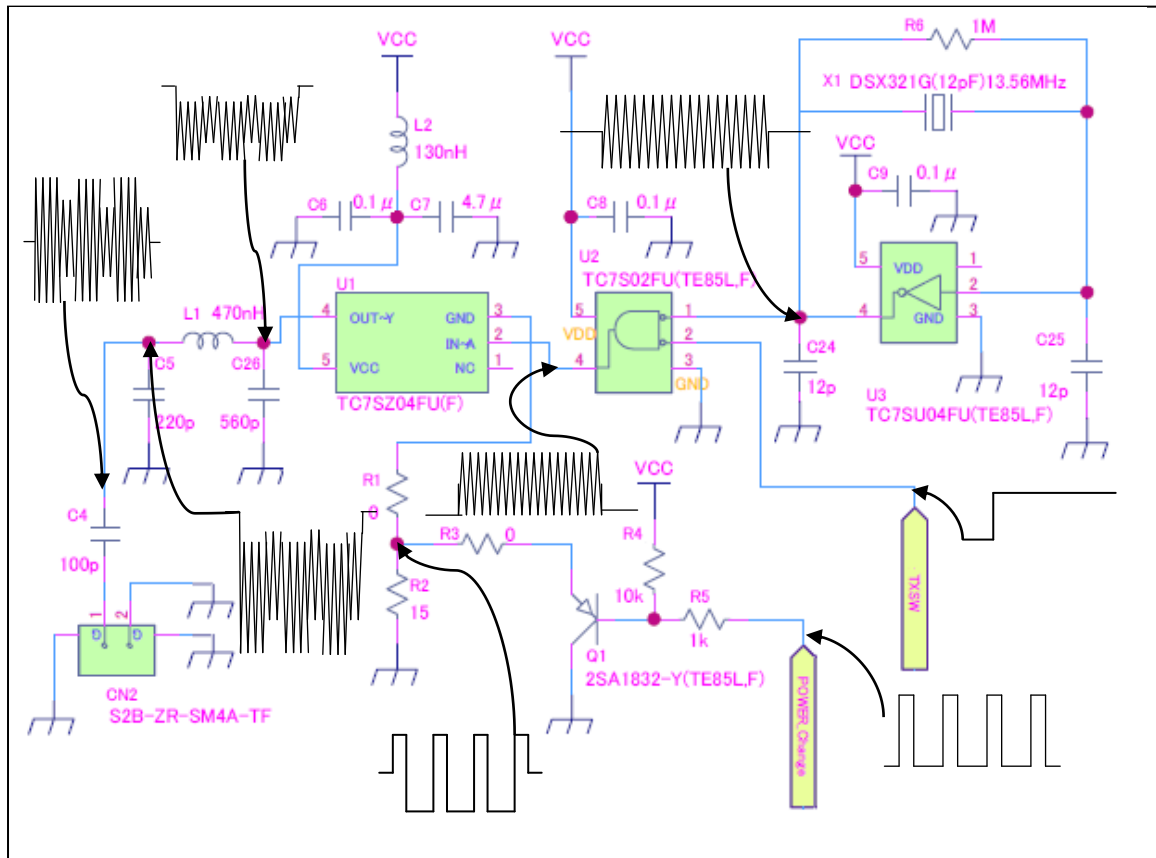


Fig. 1 shows carrier oscillation circuit, ASK modulator circuit and transmission output circuit. 13.56MHz carrier (waveform ①) from U9 oscillation circuit is input to gate 1 of gate IC U2TC7S02. As for Gate2, on/off of the sending can be done by the waveform ② from U8-11P. U2 output (waveform ③) is input to inverter IC U1 TC7SZ04. U1 is a transmitting circuit, and Q1 is ASK modulator circuit. Tx data (waveform⑦) is input to Q1 transistor base, and ASK modulation Signal (waveform④) is output from U1. It is adjusted with R2 to 10% modulation. Waveform ④ becomes waveform ⑤ by the resonance in L1, C5, and C26 resonance circuit. DC component of U1 is removed by passing C4 and waveform ⑥ is output from CN2.

7.2 RF receiving circuit

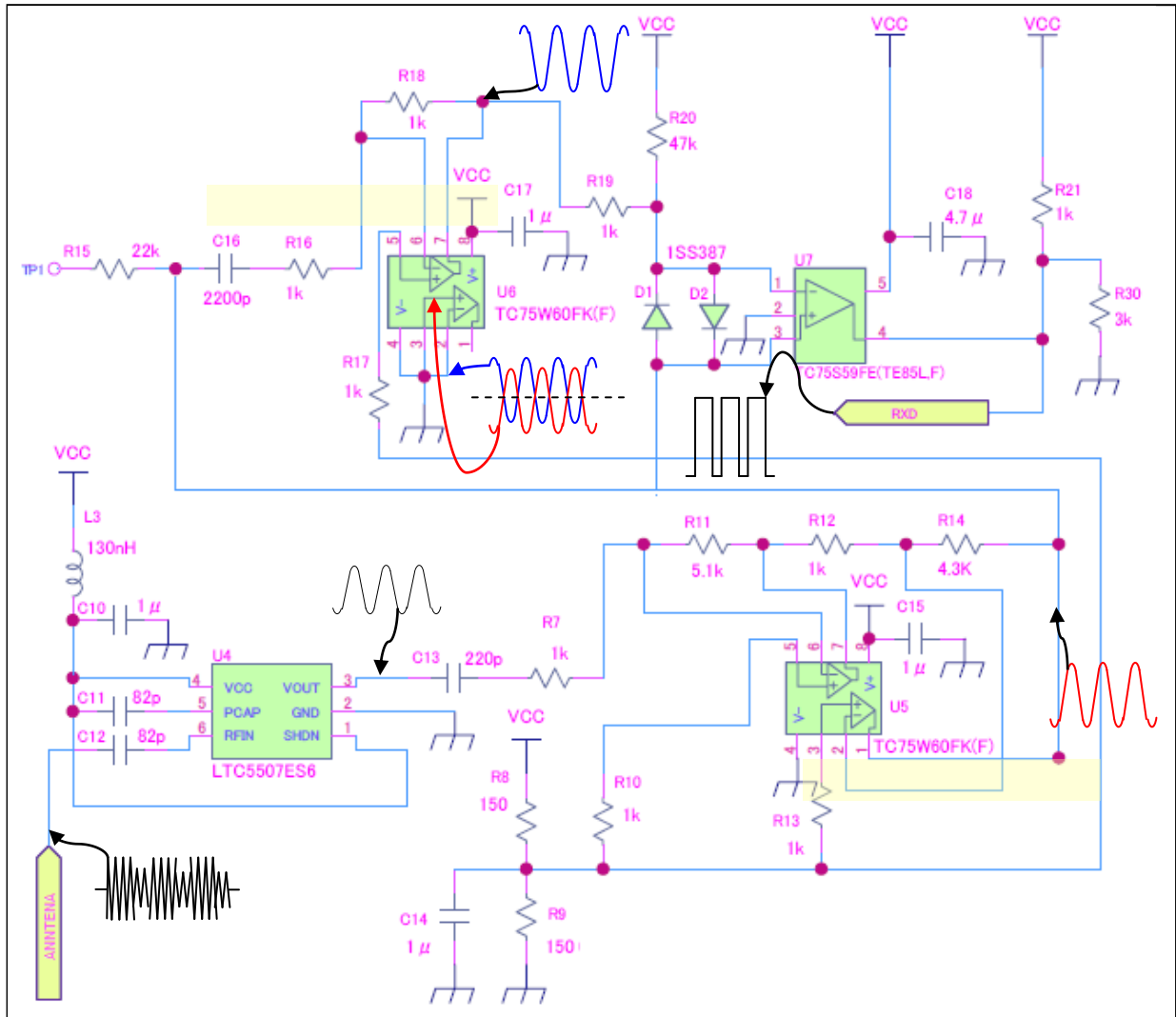


Fig 2 shows receiving circuit / comparator circuit. Career signal (waveform ⑧) input from U4-6pin outputs career wave (waveform ③) with U4 LTC5507 high frequency amplifier/detect IC. Career wave is amplified by U5 / U6 operational amplifier TC75W60, and outputs waveform ⑩, ⑪. Waveform ⑩ is input to U7 Comparator TC75S59 non inverting input. Other waveform ⑪ inputs to U7 inverting input, and outputs Rx data (waveform ⑬) to U8-1pin and 2pin.

7.3 Microprocessor

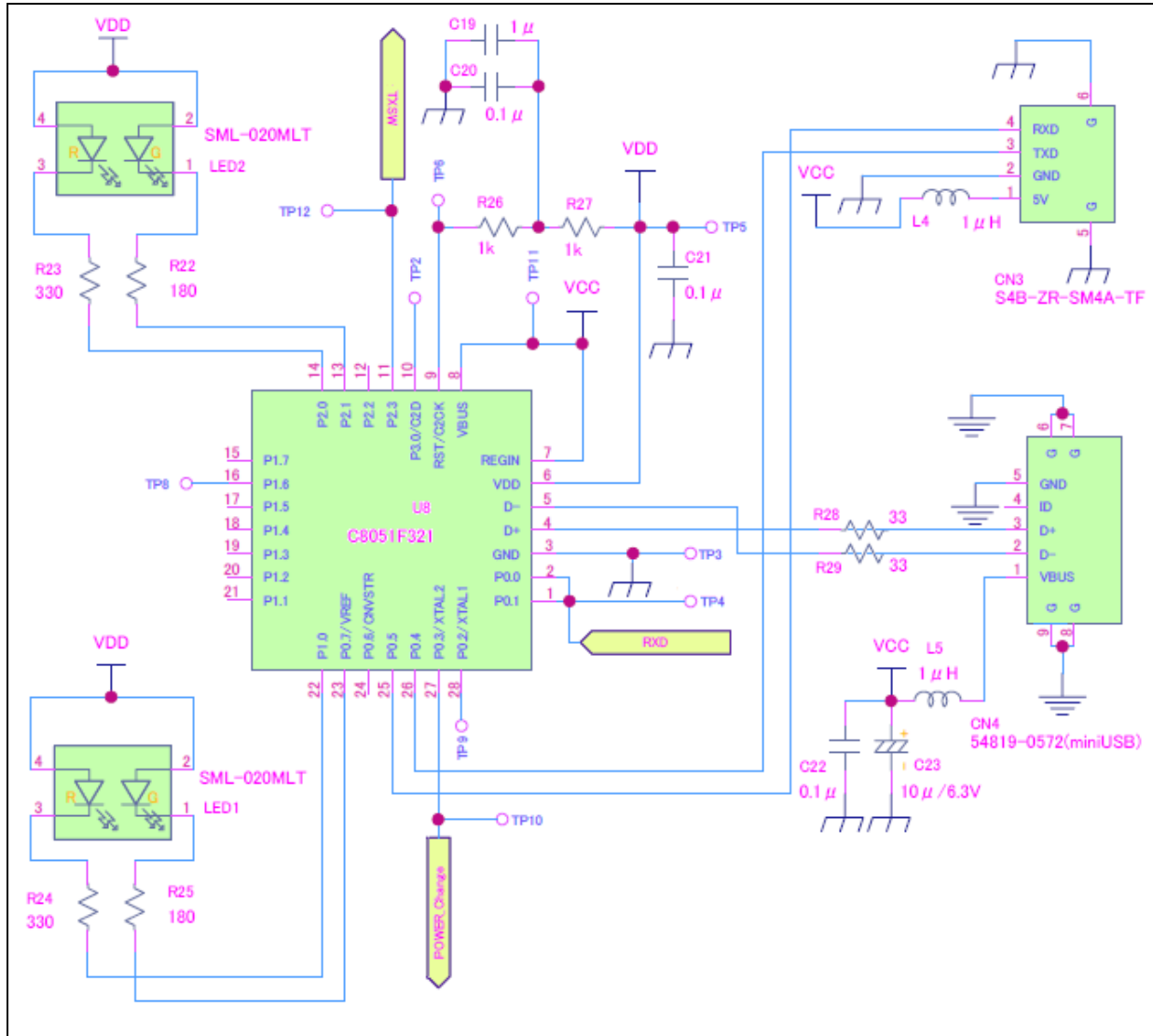


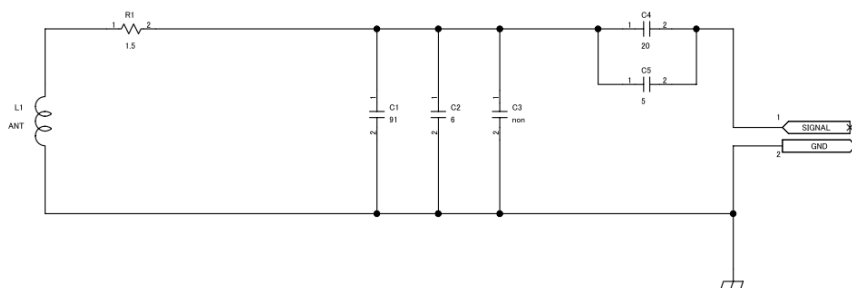
Fig3 composition of the LED drive, USB interface, serial data interface, and power reset circuit that centers on the U8 C8051F321 microprocessor. The crystal oscillator is unnecessary, because the clock generator is built into U8 internally. Moreover, 3.3V voltage regulator and USB driver are built into 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. R26, R27, C19, and C20 are for reset time constant. CN3 is USB interface connector, and C4 is a connector for the serial interface. CN4-1Pin must use 5V when you use the serial interface connector.

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						
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						
16	P1.6	DEBUG0	O	push-pull	-	-	Debug port
17	P1.5						
18	P1.4						
19	P1.3						
20	P1.2						
21	P1.1						
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						
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

MMATH-4570 is 50Ω antenna connected with MMRW-MD-H01. Antenna size is 45 x 70mm.



R1 = 1.5 Ω

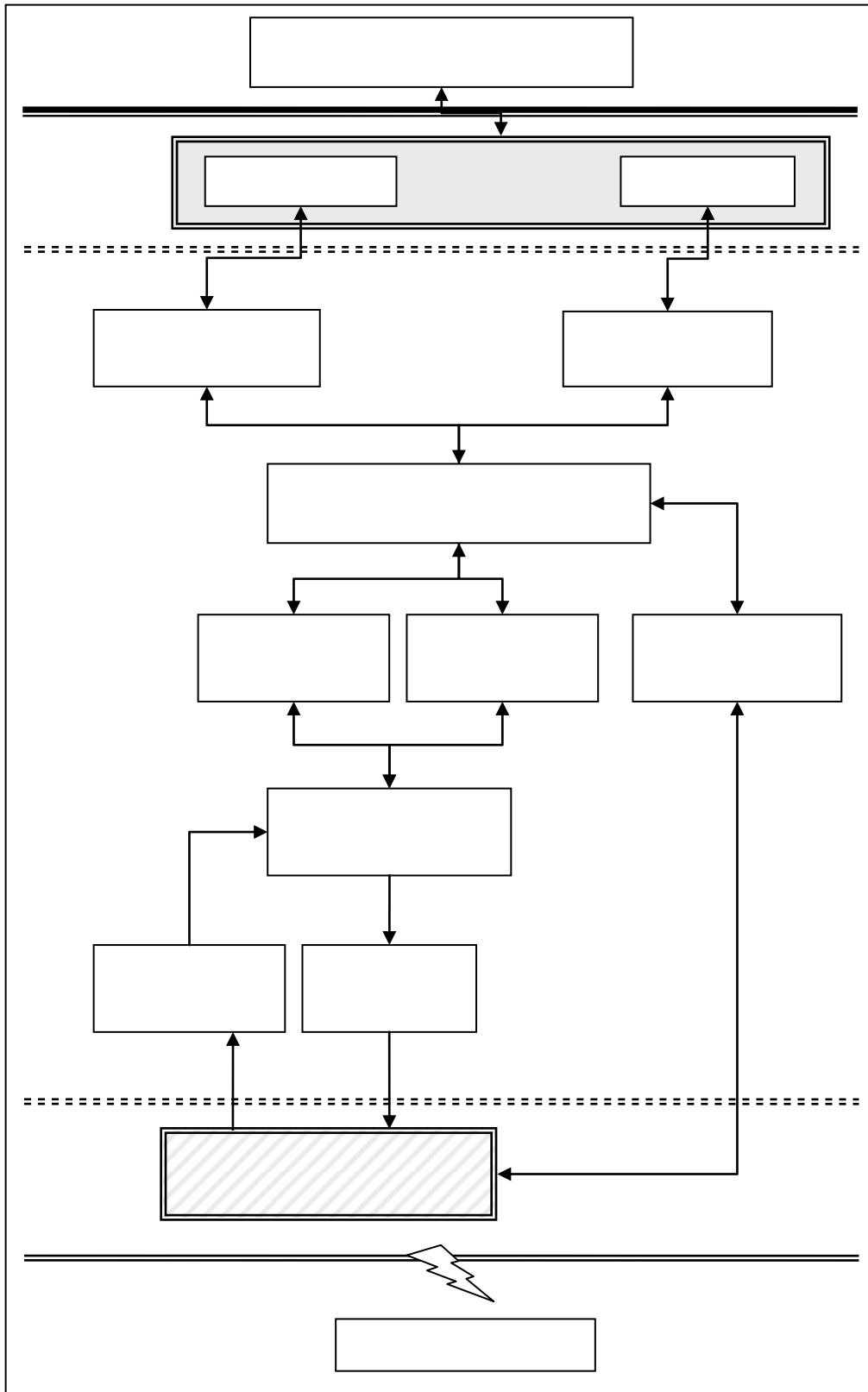
C1 = 91pF

C2 = 6pF

C4 = 20pF

C5 = 5pF

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 “mmrw135r.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.

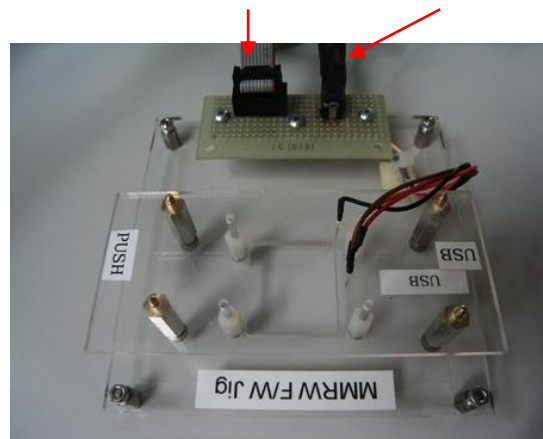
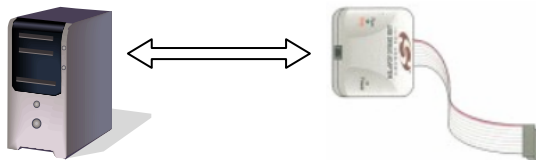
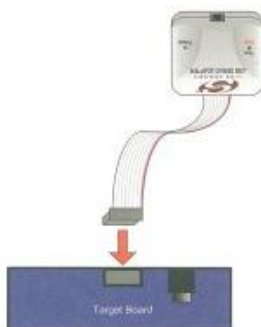
<http://www.silabs.com/products/mcu/Pages/SoftwareDownloads.aspx>

“Start” → “Silicon Laboratories” → Select and start “Silicon Laboratories IDE”.

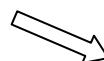
9.2 Firmware writing

- (1) Firmware file (MMRW-135ver01.00.OMF) is saved in any folder in the PC used for firmware writing.
- (2) “USB Debug Adaptor” and “5V-AC Adaptor” are connected to the “MMRW F/W JIG”, and this debug adaptor is connected to PC via USB cable.

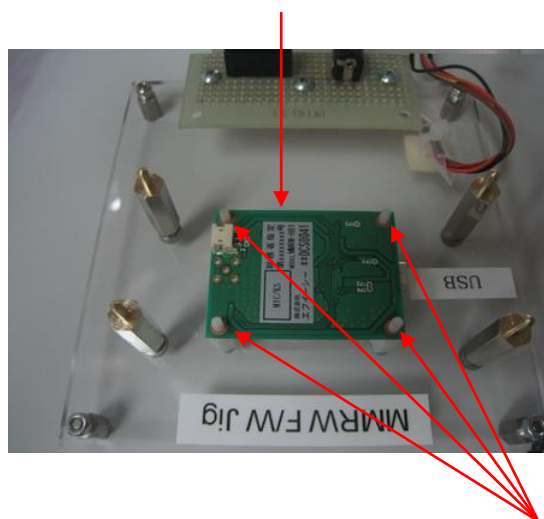
Connect USB Debug Adaptor to Target Board with JTAG/DEBUG cable



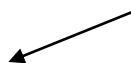
- (3) Silicon Laboratories IDE starts.
- (4) Set connection method for PC and connection substrate.
From the toolbar, select “Options” → “Connection Options”, then set USB debug adaptor to connector.



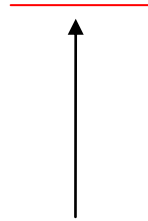
(5) MMRW Module is put onto “MMRW F/W JIG”.



(6) PC and module connect electronically.



- (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.



- (8) Writing firmware into microcontroller.



Get started with below shown window, select the folder where firmware file (MMRW-135ver01.00 OMF) is saved, click “Download” button and thereby firmware writing starts.



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



(9) PC and module electronically disconnected.



(10) MMRW module will detach from “MMRW F/W JIG”.

Before module is detached, PC and module MUST follow procedure (9) for release.

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-H01
Appearance diagram	45(D) x 33(W) x 8.65(H) mm (Excluding surface bump's presence) / Approximately 5g
Operation frequency	13.56MHz
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: $\pm 0.25V$) (USB bus power supply / external supply)
Current consumption	RF carrier ON: Approximately 120mA (Standard) RF carrier OFF: Approximately 80mA (Standard)
RF output	Approximately 25mW
Antenna output impedance	50 Ω
Temperature environment	Storage temperature range: -30°C~+80°C Operation temperature range: -10°C~+60°C Storage / operation humidity range: Below 90% RH (Non-condensation situation)
Anti-collision	Unsupported
RF output I/F	2pin-ZH Connector/Side type SM4

11.2 List of components

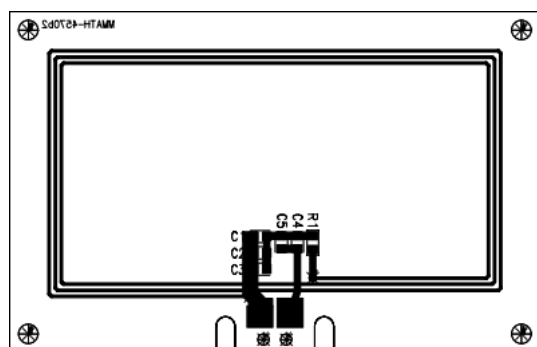
MMRW-MD-H01

Part Name	Specification	Qty	Part No.
L-MOS		1	U1
"		1	U2
"		1	U3
RF Power Detector		1	U4
Dual Operatinal Amplifier		2	U5,6
Comparator		1	U7
MCU	16KB	1	U8
Chip Resistor	1608 0Ω	2	R1,3
"	1608 15Ω	1	R2
"	1608 33Ω	2	R28,29
"	1608 150Ω	2	R8,9
"	1608 180Ω	2	R22,25
"	1608 330Ω	2	R23,24
"	1608 1KΩ	12	R5,7,10,12,13,16,17,18,19, R21,26,27
"	1608 3KΩ	1	R30
"	1608 4.3KΩ	1	R14
"	1608 5.1KΩ	1	R11
"	1608 10KΩ	1	R4
"	1608 22KΩ	1	R15
"	1608 47KΩ	1	R20
"	1608 1MΩ	1	R6
Chip Capacitor	1608 12pF	2	C24,25
"	1608 82pF	2	C11,12
"	1608 100pF	1	C4
"	1608 220pF	2	C5,C13
"	1608 560pF	1	C26
"	1608 2200pF	1	C16
"	1608 0.1μF	6	C6,8,9,20,21,22
"	1608 1μF	5	C10,14,15,17,19
"	1608 4.7μF	2	C7,18
Chip Tantalum Capacitor	6.3V 10μF	1	C23
Chip Coil	1608 130nH	2	L2,3
"	1680 470nH	1	L1
"	1608 1μH	2	L4,5
Transistor	Surface Mount	1	Q1
Diode	Surface Mount	2	D1,2
LED	Surface Mount	2	LED1,2
Crystal Oscillator	13.56MHz	1	X1
Connector	Surface Mount	1	CN2
"	Surface Mount	1	CN3
Mini USB Connector	Surface Mount	1	CN4
R/F Substrate(Two-Layered)	45 x 33 x 1mm	1	
S/No. Sticker	26 x 12.5mm	1	(Figure No.: D07011N-D1)

MMATH-4570

Part Name	Specification	Qty	Part No.
Resistance	1608 1.5Ω	1	R1
Capacitor	1608 91pF	1	C1
Capacitor	1608 6pF	1	C2
Capacitor	1608 20pF	1	C4
Capacitor	1608 5pF	1	C5
Housing	ZH 2pin	1	
Contact		2	
Heat-resistant vinyl wire	105mm	1	
Heat-resistant vinyl wire	105mm	1	
Antenna substrate	45mm x 70mm		
S/No. Sticker	4 x 19mm(Standard)		

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 UNDESIRE 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.