User Guide for RMWIFI

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1. Section1:

1.1 Summary:

RMWIFI-M3 based on RMWIFI-M5 module provides a quick, easy and cost effective way to add Wi-Fi capabilities for RAE Systems products, such as AreaRAE2, MutIRAE2, and RAE-Hub etc.

The module combined 802.11 MAC, security, PHY functions, FLASH SRAM, and external antenna connectors, provides a Wi-Fi radio for end customers. It also integrates TCP/IP stack and other related network stacks such as DHCP client, DHCP server and web server etc. It can be used to connect to Ethernet conveniently and transfer data to network server like ProRAE Guardian directly.

1.2 Key Features:

- 46 * 26 mm (Length * Width) with M3 40-PINs interface
- RCS protocol API for application interface
- DSSS modulation for 1 and 2Mbps, CCK modulation for 5.5 and 11Mbps
- Compatible with IEEE 802.11 b
- UART interface, SPI interface, I2C interface, one ADC channel, several GPIOs
- Low power consumption
- RoHS compliant, certified lead- and halogen-free

2. Section2:

2.1 **Overview**:

RMWIFI-M3 operates in the unlicensed 2.4 radio bands IEEE 802.11b, which supports Direct Sequence Spread Spectrum (DSSS) 1 Mb/s and 2 Mb/s data rates, and Complementary Code Keyed (CCK) 5.5 Mb/s and 11 Mb/s data rates. RMWIFI-M3 is based on RMWIFI-M5 module, which contains GS1011 WIFI system-on-chip. The GS1011 have fully integrated RF Transceiver, low power PA and application processor. Both TX and RX chain in the module incorporate internal power control loops.

RMWIFI-M3 carries onboard single supply monitor for 1.8V voltage supply with optional module controlled external regulator enable control pin (DC_DC_CNTL).

2.2 **Pin Definition**:



Connector Pin	Pin Name	Description	I/O
1	GND	Ground	
3	RESET	Active-low system reset	I/O
5	UART_TX	UART transmit output	0
7	UART_RX	UART transmit input	
9	I2C_DATA	PU data signal for an external I2C device	I/O
11	I2C_CLK	PU clk signal for an external I2C device	I/O
13, 15, 17	NA		
19	WakeUp	WakeUp the Module	I
21, 23, 25, 27, 29	NA		
31	SPI_MISO	Slave SPI master in slave out	I/O

		line	
33	SPI_MOSI	Slave SPI master out slave in	I/O
		line	
35	SPI_CLK	Slave SPI clock line	
37	SPI_CS	Slave SPI chip select line	
39	VCC	Digital voltage supply	
2, 4	GND	Ground	
6, 8	NA		
10	UART_RTS	RTS input (Request To Send)	I
		for UART hardware flow	
		control	
12	UART_CTS	CTS output (Clear To Send)	0
		for UART hardware flow	
		control	
14	LED1	LED indicate control PIN	0
16	LED2	LED indicate control PIN	0
18	WIFIPRO ⁽¹⁾	Enable/Disable into boot load	
20, 22, 24	NA		
26	VCC	Digital voltage supply	
28	ADC	ADC input	
30, 32, 34, 36, 38	NA		
40	VCC	Digital voltage supply	

Note (1): If WIFIPRO is high during boot, the WLAN will wait for Flash download via SPI or UART.

3. Section3:

3.1 Voltage:

Power supply for the RMWIFI-M3 module will be provided by the host power pins.

Symbol	Min	Тур	Мах	Unit
VCC	3.0	3.3	3.6	V

3.2 Current Consumption:

Condition: 25deg.C. The default voltage is 3.3V.

Item	Condition	Min	Nom	Мах	Unit
Receive	RX		108		mA
Transmit	Tx power setting: P=0 Single carrier		145		mA
Sleep			200		uA

3.3 I/O DC Specification:

Parameter	Symbol	Min	Мах	Unit
Input Low Voltage	V _{IL}		0.25*VCC	V
Input High Voltage	V _{IH}	0.8*VCC		V
Output Low Voltage	V _{OL}		0.4	V
Output High Voltage	V _{OH}	0.8*VCC		V

3.4 Mechanical Drawing:



4. How to program RMWIFI:

4.1 Hardware interface setup:

Configure the back side of the EVB as following picture:



Configure the front side of EVB as following picture:



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4.2 Program software interface introduction: Programming RMWIFI modem needs three *.bin files which including WLAN bin, APP bin1 and APP bin2, please see following picture for detail:



4.3 Running application firmware

After upgrading RMWIFI modem firmware successfully, configure the back side of the EVB as following picture:



Then power-off and power on the EVB, RMWIFI modem application firmware will run and output information as following picture via

EVB's RS232 interface:

👠 SSCOM3.2 (作者:聂小猛(丁丁), 主页http://ww	w.mcu51.com, Email: mcu52@163 💶 🗖 🗙
RAE WIFI APP FW Version: V1.13 APP FW build date: Oct 20 2014 14:06:13	
module cullent mode is initiasticitude.	
	V
打开文件文件名	发送文件 保存窗口 清除窗口 □ ਮधх显示
串口号 COM14 💌 🛞 <u>关闭串口</u> 帮助	WWW. MCU51.COM 扩展
波特率 115200 · DTR RTS	欢迎使用专业串口调试工具SSCOM ! 作者:再小注(丁丁)
数据位 8 □ 定时发送 1000 ms/次	最新版本下载地址:
	http://www.mcu51.com/download/sscom.rar 短期時期中心的時期後日
校验位 None ▼ 子付串输入框:	
流控制 None 10 41 00 06 14 24 00 II II	ru // vec mAc address
www.mcu51.com S:0 R:124 COM	114已打开 115200bps 8 1 CTS=1 DSR=0 RLSD=0 //

5. Initialization:

5.1 Get module type:

Host command:

7B 41 00 06 74 2E 00 FF FF 7D

RMWIFI response:

7B 41 00 07 75 2E 00 00 3F F3 7D

Example communication sequence:

A SSCOM3.2 (作者:聂小猛()	「丁),主页http://ww	w.mcu51.com, E	mail: mcu52@163	
7B 41 00 07 75 2E 00 00 3F	F3 7D			
				-
打开文件文件名		发送文件 保ィ	「「「「」」「「「「」」」	HEX显示
串口号 COM14 💌 🍥 关	和串口 都助	WWW. A	ICU51 .COM	扩展
波特率 115200 ▼ DTR 数据位 8 ▼ □ 定时援 停止位 1 ▼ HEX发) 校验位 None ▼ 字符串输 流控制 None ▼ 7b 41 00	□ RTS 送 1000 ms/次 送 □ 发送新行 入框: 发送 06 74 2e 00 ff ff 7	欢迎使用专业串(作者: 哥小猛(T 最新版本下载地) http://www.mcu5 欢迎提出您的建词 7d	□调试工具SSCOM ! 「〒) け: il.com/download/ssc ☆!	om.rar
www.mcu51.com S:12	R:11 COM	14已打开 115200	ops 8 1 CTS=1 DSR=0	RLSD=0

Note:

In order to make it easy when using COMM tools to communicate with RMWIFI, the CRC field of host command is replaced by FF FF.

5.2 Get MAC address:

Host command:

7B 41 00 06 74 08 00 FF FF 7D

RMWIFI response:

7B 41 00 0C 75 08 00 00 12 9F 00 07 11 60 7F 7D

Example communication sequence:

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6. Scan and associate with AP:

6.1 Scan network:

1. Send scan command

Host command:

7B 41 00 0A 74 0F 00 FF FF 00 00 FF FF 7D

RMWIFI response:

7B 41 00 0A 75 0F 00 00 00 04 4C 58 3F 7D

Example communication sequence:

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www	w.mc	cu5	1.co	m	5:16	5			R	:14				со	M1	42:	打开	11	520	0bp	s 8	1	CTS	=10	SR=	=0 R	LSD:	=0 //

2. Get scan status and AP number found:

Host command:

7B 41 00 06 74 10 00 FF FF 7D

RMWIFI response:

7B 41 00 08 75 10 00 00 01 29 0D 7D

Example communication sequence:

A SSCOM3.2 (作者:聂小猛(丁	丁),主页http://ww	w.mcu51.com, Email: n	ncu52@163 💶 🗙
7B 41 00 08 75 10 00 00 01 :	29 OD 7D		A
			_
		发送文件 保存窗口	清除窗口 ▼ HEX显示
串口号 COM14 💌 🛞 <u>关</u> 演	<u> 串口 「帮助 </u>	WWW. MCU5	1.COM <u>扩展</u>
波特率 115200 ▼ □ DTR	RTS	欢迎使用专业串口调试	_具SSCOM !
数据位 8 ▼ □ 定时发	送 1000 ms/次	作者: 暴小猫() 最新版本下载地址:	
停止位 1 🔽 🔽 HEX发送	↓ □ 发送新行	http://www.mcu51.com/	download/sscom.rar
校验位 None 💌 字符串输入	、框: 发送)	欢迎提出您的建议!	
流控制 None 🔽 7b 41 00	06 74 10 00 ff ff 1	74	
www.mcu51.com S:10	R:12 COM	14已打开 115200bps 8 1	CTS=1DSR=0RLSD=0

3. Get scanned AP information according to AP index:

Host command:

7B 41 00 07 74 11 00 00 FF FF 7D

RMWIFI response:



6.2 Set password:

Example:

If one AP uses WPA/WPA2, and the password is rec-wireless1

Host command:

7B 41 00 15 74 12 00 03 00 72 65 63 2D 77 69 72 65 6C 65 73 73 31

FF FF 7D

RMWIFI response:

7B 41 00 06 75 12 00 73 96 7D

Example communication sequence:

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🏬 SSCOM3.2 (作者:聂小猛(丁丁), 主页)	http://www.mcu51.com,	Email: mcu52@163	
7B 41 00 06 75 12 00 73 96 7D	-	_	
 打开文件 文件名	发送文件 [1	保存窗口 清除窗口 🔽	HEX显示
串口号 COM4 ▼ ⑧ <u>关闭串口</u>	帮助 WWW	. MCU51.COM	扩展
波特率 115200 ▼ □ DTR BTS 数据位 8 ▼ □ 定时发送 1000 停止位 1 ▼ HEX发送 支援 校验位 None ▼ - 76串输入框: □ 流控制 None ▼ - 00 15 74 12 00 03	S 次迎使用专业 作者: 聂小猛 最新版本下载: http://www.mu 发法	串口调试<u>工</u>具SSCOM ! (丁丁) 她帅: cu51.com/download/ssc(津议 ! 72 65 6C 65 73 73 31	om.rar ff ff 7d
www.mcu51.com S:25 R:10	COM4已打开 11520	0bps 8 1 CTS=0 DSR=0	RLSD=0

6.3 Associate with AP:

Example:

The AP SSID that the module wants to associate with is

gainspandemo.

Host command:

7B 41 00 12 74 13 00 67 61 69 6E 73 70 61 6E 64 65 6D 6F FF FF

7D

RMWIFI response:

7B 41 00 07 75 13 00 02 17 F0 7D

7B 41 00 07 75 13 00 00 18 70 7D

The Wi-Fi module will response two commands, first command

responses immediately after it receives the associate command

and indicates it's doing. The second response command will delay

for seconds and indicates whether it associates with AP successfully. Check the red byte of the response command, 0x00 indicates that it has associated with AP successfully. Example communication sequence:

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w	ww.r	ncu5	1.co	m	S:22	2			R	:22				со	M4	2打	Ŧ	115	5200)bps	8 1		TS=	0 DSF	R=0	RLSD=	0 //

7. How to communicate using TCP:

7.1 Connect to TCP server:

1. Use the socket test tool, create a TCP server as following picture, the TCP listen port is 9723:

Kercules SETUP utility by HW-group.com	_ 🗆 🗵
UDP Setup Serial TCP Client TCP Server UDP Test Mode About	
Received data	Server status 1010 9723 X Close TEA authorization
Sent data	1: 01020304 3: 090A080C 2: 05060708 4: 0D0E0F10
	Client connection status
	Clients count: 0
Send	
Image: Provided and the second sec	Send WWW.HW-group.com Hercules SETUP stility Version 3.2.8

2. Connect to the TCP server:

Host command:

7B 41 00 0c 74 1A 00 c0 a8 01 86 25 fb ff ff 7d

RMWIFI response:

7B 41 00 07 75 1A 00 00 AC 70 7D

Example communication sequence:

┃ <mark>┃ 55COM3.2 (作者:聂小猛(丁丁),</mark> 主页http://www.mcu51.com, Email: mcu52@163	<u>_ ×</u>
7B 41 00 07 75 1A 00 00 AC 70 7D	*
	HEX显示
串口号 COM4 👤 🛞 <u>关闭串口</u> 帮助 W/W/W. MCU51.COM	扩展
波特率 115200 ▼ □ DTR □ RTS 欢迎使用专业串口调试工具SSCOM !	
数据位 8 ▼ □ 定时发送 1000 ms/次 最新版本下载地址	
停止位 1 ▼ HEX发送 □ 发送新行 http://www.mcu51.com/download/ssc	m.rar
校验位 None ▼ 字符串输入框: □□	
流控制 None 🔽 7B 41 00 0C 74 1A 00 C0 A8 01 86 25 FB FF FF 7D	
www.mcu51.com S:16 R:11 COM4已打开 115200bps 8 1 CTS=0 DSR=0	RLSD=0

The socket test tools will inform that one client has connected to it:

Kercules SETUP utility by HW-group.com	
UDP Setup Serial TCP Client TCP Server UDP Test Mode About	
Received data	Server status
	Port 9723 X Close
	TEA authorization TEA key 1: 01020304 2: 05060708 4: 0D0E0F10
Sent data	Client authorization
	Client connection status
	4:23:28 PM: 192.168.1.99 Client co
	Clients count: 0
Send	
hello, world HEX Cursor decode Server settings HEX Decimal Decimal Decoder Input Redirect to UDP	Send Www.HW-group.com Hercules SETUP utility Version 3.2.8

7.2 Receive data packet from server:

From the socket test tools side, send data packet to RMWIFI as

following picture:

🔆 Hercules SETUP utility by HW-group.com	
UDP Setup Serial TCP Client TCP Server UDP Test Mode About	
Received data	Server status
	Port
	9723 X Close
	TEA authorization
	TEA key
	1: 01020304 3: 090A0B0C
	2: 05060708 4: 0D0E0F10
Sent data	Client authorization
Hello, World!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	Client connection status
	Clients count: 0
Send	
Hello, World!!!!!!!!!!!	Send HWgroup
Cursor decode	www.HW-group.com
HEX Decimal Decoder Input	Hercules SETUP utility
	Version 3.2.8

The RMWIFI will receive the data packet from TCP server:

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71	3 41	00	25	75	21	00	00	48	65	6C	6C	6F	2C	20	57	6F	72	6C	64	21	21	21	21	21	21	21	21	21 📩
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wv	vw.n	ncu5	1.co	m	S:1				R	:41				со	M5	己打	ſŦ	115	5200)bps	8	1	CTS	=0 [DSR	=0 F	RLSD	=0 //

7.3 Send data packet to server:

Send the same data packet back to TCP server:

Host command:

7B 41 00 26 74 20 00 00 00 48 65 6C 6C 6F 2C 20 57 6F 72 6C 64 21

RMWIFI response:

7B 41 00 07 75 20 00 00 E4 73 7D

Example communication sequence:



The socket test tool side will receive the data packet as following picture which is the same data packet as it sends out:

Honeywell

🛞 Hercules SETUP utility by HW-group.com	<u> </u>
UDP Setup Serial TCP Client TCP Server UDP Test Mode About	
Received data	Server status
Hello, World!!!!!!!!!!!!!!	Port 9723 Close
	TEA authorization TEA key 1: 01020304 3: 090A0B0C 2: 05060708 4: 0D0E0F10
Sent data	Client authorization
	Client connection status 4:23:28 PM: 192.168.1.99 Client co Clients count: 0
_ Send	
Hello, World!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!	Send WWV.HW-group.com Hercules SETUP utility Version 3.2.8

Note:

During doing the test, please make sure the host PC running the socket test tools connects to the same AP as Wi-Fi module associate with.

8. How to communication using UDP:

Firstly, use socket tool to create UDP socket which listen on local port 4023, remote communication node IP: 192.168.1.99, port: 6000, see following picture for detail:

Kercules SETUP utility by HW-group.com	_ 🗆 🗵
UDP Setup Serial TCP Client TCP Server UDP Test Mode About	
Received data	UDP
UDP socket created	Module IP Port 192.168.1.99 6000
	Local port 4023 Close
	Server settings
	Server echo
Sent data	Redirect to TCP Server
	Redirect to TCP Client
	UDP broadcast
	File name:
	No file
	Load file Send
Send	
Hello, World!!!!!!!!!!!	Send HUgroup
│	Send www.HW-group.com Hercules SETUP utility
	Send Version 3.2.8

8.1 Receive data packet from UDP server:

 In order to receive data packet from remote using UDP protocol, communication via UDP, RMWIFI will need to listen on local port: 6000.

Host command:

7B 41 00 08 74 1D 00 17 70 FF FF 7D

RMWIFI_M3 response:

7B 41 00 07 75 1D 00 00 C3 F0 7D

Example communication sequence:

SSCOM3.2 (1	者:聂小猛(]	「丁), 主页htt	t <mark>p://</mark> www.	mcu51.con	n, Email: m	cu52@163	
7B 41 00 07 75 1	D 00 00 C3	FO 7D					*
							-
				4535 25 74			
<u>11#XH</u>]XH¥	á — — —			反法义件	1年仔囱口	□泊际囱凵□Ⅳ	HEX显示
串口号 COM4 👤	·」 🖲 İ	北口 _ 1	帮助	<i>ww</i> и	/. MCU5	1 .COM	扩展
波特案 115200 ▼		RTS	R/	迎使用专业	串口调试」	_具SSCOM !	
数据位 8 ▼	1 🗆 完时发	·¥ 1000 I	ms/次 们	E者: 裏小湖 Bocific チェガ	h(TT)		
停止位 1 ▼		.本 「 ¥ 「 发送報	新行 15	東新版24×1×1≤! ttn://www_r	արտոր։ ուս51 ւստ/	download/ssc	om rar
林验☆ None ▼	字符串输)	、框: 🖾 笼	送 2	抑提出您的	健议!		
流控制 None ▼	7B 41 00	08 74 1D 00	17 70 FF	FF 7D			
www.mcu51.com St	12	D-11	COM4	□±TII 1152	00bps 8 1		
provincuo 1.com p.	12	N.II	CONTE	20176 1122	0000001	010-00000	1230-0 //

2. Send data packet to RMWIFI as following:

Nercules SETUP utility by HW-group.com			
UDP Setup Serial TCP Client TCP Server UDP Test Mode About			
Received data			
UDP socket created Sent data Hello, World!!!!!!!!!!!!!!	UDP Module IP 192.168.1.39 Local port 4023 Server settings Server settings Server echo Redirect to TCP Server Redirect to TCP Client		
	UDP broadcast File name: No file Load file Send		
Hello, World!!!!!!!!!!!	Send H group		
│	Send www.HW-group.com Hercules SETUP utility		
E HEX	Send Version 3.2.8		

RMWIFI will receive data packet:



8.2 Send data packet to remote using UDP:

1. RMWIFI will need to create virtual connection to get a

connection ID.

Host command:

7B 41 00 0C 74 1C 00 C0 A8 01 86 0F B7 FF FF 7D

RMWIFI response:

7B 41 00 07 75 1C 00 00 D4 70 7D

Example communication sequence:

1	<u>ss</u>	COI	43.2	2 (1E	者:温	小指	ŧП	Т),	主页http	://ww	w.mcu51.com	, Email: n	ncu52@163	
7	B 41	00	07	75-1	C 00	00	D4 7	0 7D						*
L														
L														
L														
L														
L														
L														
L														
L														
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L														~
	打开	文件	13	て件名	i i						发送文件	保存窗口	清除窗口 ▼	HEX显示
Ę	串口や	号 🖸	COM4	-] (关闭	串口		助	WWW	MCU5	1 .COM	扩展
	皮特≥	壑 1	152	00 🔻	1 г	DT	R	Г	RTS		欢迎使用专业	串口调试	[具SSCOM !	
123	数据	żΒ	;	•	Îг	定明	时发浪	ξ 1	000 m:	s/次	作者: - 呉小福 最新版本下载:	(T-T) ₩2+0F•		
1	亭止亻	<u>立</u> 1		•	1	HE	(发送	Ē	发送新	íī	http://www.m	cu51.com/	download/ssc	om.rar
1	交验(żΓ	lone	•] 字	符串	输入	框:	发送		欢迎提出您的	建议!		
11	<u> </u>	钊N	lone	•	7 B	41	00 0	IC 74	1C 00 e	0 98	01 86 Of B7 F1	F FF 7D		
w	ww.n	ncu5	1.co	m S:	16			R:11		COM	14已打开 11520	Obps 8 1	CTS=0 DSR=0	RLSD=0

2. Send data packet" Hello, World!!!!!!!!!!!!!!!! to remote:

Host command:

RMWIFI response:

7B 41 00 07 75 20 00 00 E4 73 7D

Example communication sequence:

🌓 55C0M3.2 (作者:聂小猛(丁丁), 主页http://ww	/w.mcu51.com, Emai	: mcu52@163	
7B 41 00 07 75 20 00 00 E4	73 7D			*
打开文件		<u></u>		HEX显示
串口号 COM4 👤 🍥 💢	闭串口 帮助	WWW. MCU	/51 .COM	扩展
波特率 115200 ▼ □ DTR	T RTS	欢迎使用专业串口调	试工具SSCOM !	
数据位 8 ▼ □ 定时2	发送 1000 ms/次	作者: 長小猛(TT) 最新版本下裁地址・		
停止位 1 ▼ ▼ HEX发	送 反送新行	http://www.mcu51.c	om/download/ssc	om.rar
校验位 None ▼ 字符串输	ì入框: 发送	欢迎提出您的建议!		
流控制 None ▼ 2 6C 64	21 21 21 21 21 21 21 21	1 21 21 21 21 21 21 21	21 21 21 21 21	ff ff 7D
www.mcu51.com S:49	R:11 CON	14已打开 115200bps 8	1 CTS=0 DSR=0	RLSD=0

Socket test tool will receive the data packet:

🔆 Hercules SETUP utility by HW-group.com	
UDP Setup Serial TCP Client TCP Server UDP Test Mode About	
Received data	_ UDB
UDP socket stated	ODF
OHello, World!!!!!!!!!!!!!!	Instant Fort Instant Fort Local port K 4023 K Server settings
	E Server eeke
, Sent data	
Hello, World!!!!!!!!!!!!!!!!!	Redirect to TCP Server Redirect to TCP Client
	UDP broadcast File name: No file Load file Send
_ Send	
Hello, Worldillillillilli	Send HUUgroup
	Send Hercules SETUP utility
	Send Version 3.2.8

9. Reference:

- 1. 904-E800-xxx RAE Wi-Fi communication Protocol.doc
- 2. Rev2 EVB board -Datasheet.docx

10. Caution:

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. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 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.

MPE Reminding

To satisfy FCC RF exposure requirements, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended.

Region Selection

Limited by local law regulations, version for North America does not have region selection option.

Information for the OEM Integrators

This device is intended for OEM integrators only. Please see the full grant of equipment document for restrictions.

Label Information to the End User by the OEM or Integrators

If the FCC ID of this module is not visible when it is installed inside another device, then the outside of the device into which the module is into which the module is installed must be label with "Contains FCC ID: SU3RMWIFI".

For detachable antennas:

This device is tested together with a PCB and a Pole antenna. The client can use an antenna with the same type of the two antennas, but must make sure that the maximum gain of PCB antenna is 0dBi and the maximum gain of Pole antenna is 1.5dBi.