Matter Module Specification
HM-MT5801

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1 Product Overview

The HM-MT5801 is a Matter over Wi-Fi wireless communication module based on the 2.4 GHz frequency band. It includes a highly integrated, high-performance, low-cost and low-power on-chip (SoC) ASR5822T, embedded 4 MB Flash, 352kB RAM, and rich peripheral resources to support 1x1 IEEE 802.11 b/g/n and BLE (Bluetooth Low Energy) 5.1 wireless communication protocols. The SoC is integrated with RF transceiver, 802.11 PHY + MAC, BLE PHY + MAC, ARM China STAR-MC1 processor, advanced peripheral interface, real-time counter (RTC) and power management circuit. The integrated RF and analog circuits contain T/R switches, RF balancing, power amplifier, low noise amplifier, and the entire power management module.

The HM-MT5801 Wi-Fi module has complete and self-contained 802.11 b/g/n WLAN network capabilities, either as a stand-alone IoT application (with Supplicant/Host AP/ Sniffer mode) and as a Slave mode (with an SDIO interface). Built-in speed buffers help improve system performance and optimize the storage system. It can be used as a Wi-Fi adapter simply via the SPI/UART/I2C interface. This module supports the standard IEEE802.11 b/g/n protocol, with the full TCP/IP protocol. Users can use the module to add networking features to existing devices, or to build independent network controllers.

The HM-MT5801 Wi-Fi module is equipped with IPEX antenna holder or external antenna interface, and supports Matter, Wi-Fi, BLE wireless communication technologies, which can be used for the development of Matter over Wi-Fi end device. Using the HM-MT5801 module helps users easily upgrade their existing wireless smart home devices to smart home devices that meet the Matter standard.

2 Module Features

- ARM China STAR-MC1 processor with 24 K Byte instruction cache
- Support Matter, Wi-Fi, Bluetooth Low Energy (BLE 5.1)
- On-chip integrated 4MB FLASH and 352KB RAM with built-in 64KB Boot ROM and 4Kbit OTP
- 2.4 GHz radio operation
- Security mechanism:

  • Security hardware security engine

  • AES/RSA/EC C/MAC/HMAC/SHA 1/SHA-224/SHA256/SHA512/D-H libraries

  • The True Random Number Generator (TRNG) / PRNG

  • Flash image integration for encryption / decryption

  • Dynamic encryption / decryption of application data

  • Ensemble eFuse OTP
- Wide selection of MCU peripheral devices
- Support for the internal RTC clock
- IEEE 802.11 Properties:

  • Built-in power amplifier (PA) with an internal power detector and closed-loop power calibration

  • Built-in T / R switch and RF balun, no off-chip matching network is required

  • Support for 802.11 b/g/n compatible WLAN

  • Support for 802.11e QoS enhancement (WMM)

  • Support for 802.11i (WPA / WPA2 PSK / WPA3 personal), Open/WEP/TKIP/ CCMP

  • Support power-saving mode
- Compliance with the ROHS / REACH / CA Prop 65 standards

3 Electrical Characteristics

Table 3-1 List of electrical parameters

Parameter	State	Minimum	Typical	Maximum	Unit
Module Model	HM-MT5801				
Package	Three rows of stamp holes				
Size	(20.3±0.10) x (15.3±0.10) x (2.60±0.10) With shield cover				mm
SPI Flash	Built-in 4MB				
Support Interface	UART/HSPI/I2C/I2S /GPIO/PWM				
I/O	Sixteen				
Serial Baud rate		300	115200	4608000	bps
Antenna	Onboard PCB antenna				
Spectrum Range	802.11 b/g/n	2412		2484	MHz
Channel Bandwidth	802.11 b/g/n		20		MHz
	802.11 n		40		MHz
Receiving Sensitivity	1 Mbps (FER≤8%) CCK		-98		dBm
	2 Mbps (FER≤8%) CCK		-94		dBm
	11 Mbps (FER≤8%) CCK		-89		dBm
	BPSK rate 1/2, 6 Mbps OFDM		-92.5		dBm
	64QAM rate 3/4, 54 Mbps OFDM		-76.5		dBm
	MCS0, BPSK rate 1/2		-92.5		dBm
	MCS7, 64QAM rate 5/6		-73		dBm
Maximum Transmit Power	1 Mbps CCK		20		dBm
	11 Mbps CCK		20		dBm
	6 Mbps OFDM		20		dBm
	54 Mbps OFDM		18		dBm
	HT20, MCS0		18		dBm
	HT20, MCS7		17.5		dBm
	HT40, MCS0		18		dBm
	HT40, MCS7		17.5		dBm
Maximum Input Level (FER ≤8%)	6 Mbps OFDM @ -70dBm		10		dBm
	54 Mbps OFDM		-8		dBm
	MCS0		10		dBm
	MCS7		-8		dBm
BLE Specification	Operating frequency range	2402	-	2480	MHz
	Maximum output	0	6	15	dBm

4 Module Function Description

Through a simple interface design to integrate the HM-MT5801 module into Smart Home end devices (such as lighting, switches, plugs, door locks, curtain motors, doorbells, thermostats, and other end devices), the original end device can be upgraded to Matter devices that meet the Matter standard specifications. Users can scan the QR code of the Matter device through the Smart Home App such as Apple Home App. After several simple steps, the users can easily commission the Matter device through BLE, to add it to the existing Matter network. The Matter devices developed based on the HM-MT5801 module can be seamlessly added to the Smart Home ecosystems such as Apple Homekit, Amazon Alexa, Google Home, and Samsung SmartThings, greatly simplifying the customer product development cycle, accelerating the product launch, and effectively improving the user experiences.

5 Module Application Example

It is very simple to develop Matter products using HOPERF's Matter module. It is mainly divided into two working methods: one is to connect a MCU through the UART. The MCU and Matter module communicate through the serial port protocol, which can well distinguish the Matter firmware functions and product functions. The module application diagram is shown in Figure 5.1; The second is the SoC method, that is, both Matter firmware functions and product functions are implemented by the SoC on the module.

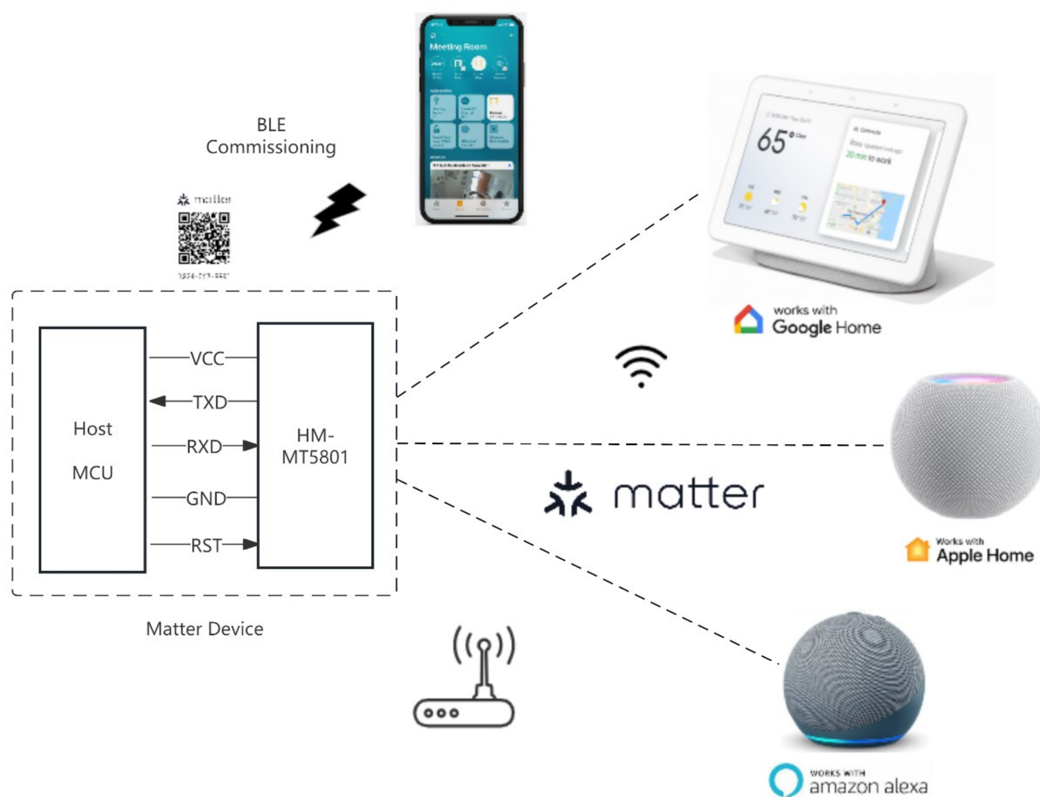

Figure 5.1 One of the application example for the module

6 Module Interfaces

6.1 Module Footprint

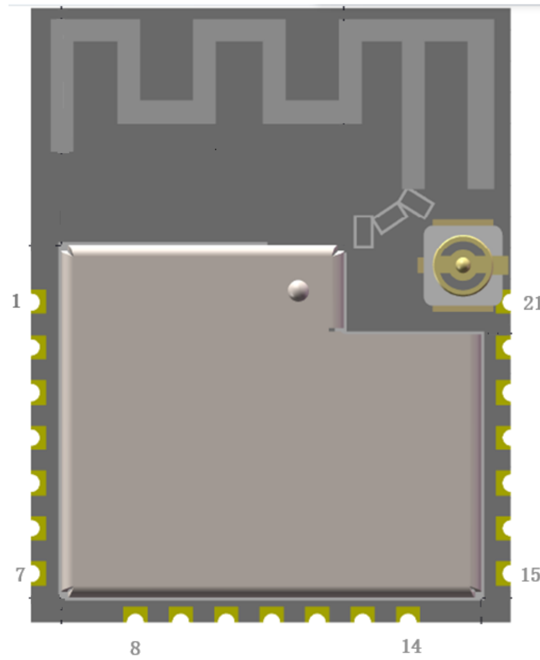

Figure 6.1 Top View

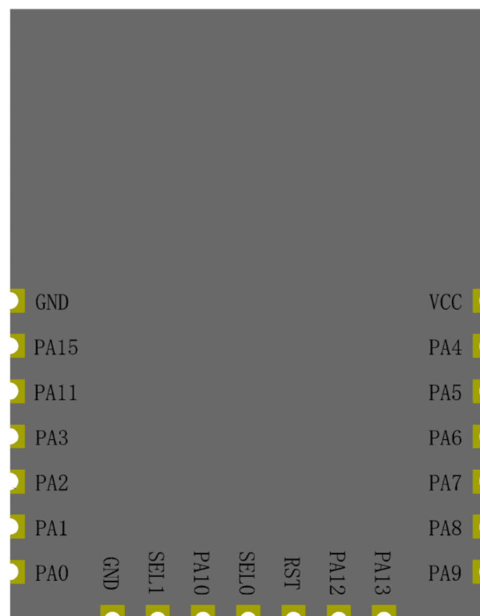

Figure 6.2 Bottom View

6.2 Pin Definition

Table 6.1 HM-MT5801 Module Pin Definitions

Pin No.	Pin Name	Type	Description
1	VCC	DV	Power supply is 3.3V
2	PA4	I/O	GPIO
3	PA5	I/O	GPIO
4	PA6	I/O	GPIO
5	PA7	I/O	GPIO
6	PA8	I/O	GPIO
7	PA9	I/O	GPIO
8	PA13	I/O	GPIO
9	PA12	I/O	GPIO
10	RST	I/O	Reset, active low
11	SEL0	D I	Mode select
12	PA10	I/O	GPIO
13	SEL1	DI	Burn state control foot: pull up into burning mode, default internal pull down
14	GND	DG	Ground
15	PA0	I/O	GPIO
16	PA1	I/O	GPIO
17	PA2	I/O	GPIO
18	PA3	I/O	GPIO
19	PA11	I/O	GPIO
20	PA15	I/O	GPIO
21	GND	DG	Ground

The SEL pin mode description:

There are two dedicated SEL0, SEL1 pins, which configure some special startup modes when power up, as shown in table 6.2. Precautions about the SEL pin configuration:

1. All IO ports have pull-down resistance configuration, if you need to put 0 as long as suspended, if the need for the configuration pin or the IO port function can also be suspended.
2. After the power reset on the chip, the high and low levels on the two pins are automatically detected to enter the corresponding mode and remain in this mode. When the external configuration pin state changes, the chip must be power cycle or the external reset to take effect.

Table 6.2 Description of the SEL pin mode

Mode Name	MODE_SEL1	MODE_SEL0 PAD_SEL
Boot with Flash	0	0
Boot with UART	1	0
GPIO download Flash	1	1

7 Module Dimensions

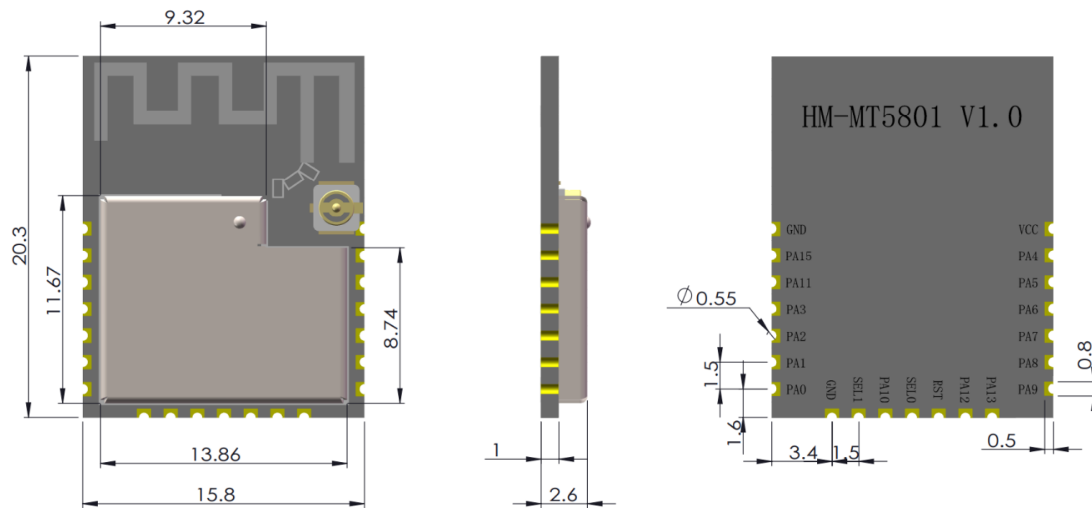

Figure 7.1 Module dimensions of HM-MT5801 with shield cover

8 Hardware Design Considerations

1. It is recommended to supply the module with DC voltage power supply as small as possible and the module should be reliably grounded; Please pay attention to the correct connection of the positive and negative poles of the power supply, if the reverse connection may cause permanent damage to the module;
2. Please check the power supply to ensure that exceeding the maximum value will cause permanent damage to the module; Please check the stability of the power supply and the voltage cannot fluctuate substantially and frequently;
3. When designing the power supply circuit for the module, it is recommended to keep more than 30% allowance, which is conducive to the long-term stable operation of the whole machine; The module should keep away from the parts with large electromagnetic interference such as power supply, transformer, and high-frequency wiring;
4. High-frequency digital routing, high-frequency analog wiring, and power wiring must avoid below the module, if have to go through the module, assuming that the module is welded in the Top Layer, Top Layer in the contact part of the module (all copper and good grounding), wiring must be close to the digital part of the module, and line in Bottom Layer;
5. Assuming that the module is welded or placed in Top Layer, it is wrong to walk at the Bottom Layer or other layers, which will affect the stray and receiving sensitivity of the module to different degrees;
6. Assuming that there are devices with large electromagnetic interference around the module will also greatly affect the performance of the module, according to the strength of the interference, it is recommended to stay away from the module, if the situation allows, appropriate isolation and shielding can be done;
7. Suppose that there is a wiring around the module with large electromagnetic interference (high-frequency digital, high-frequency simulation, power wiring) that will also greatly affect the performance of the module. According to the strength of

interference, it is recommended to stay away from the module, and appropriate isolation and shielding can be done;

8. If the communication line uses a 5V level, the level conversion circuit must be used;
9. Keep away from some TTLs with 2.4 GHz bands, such as USB 3.0;
10. Refer to the following figure for the module antenna layout:

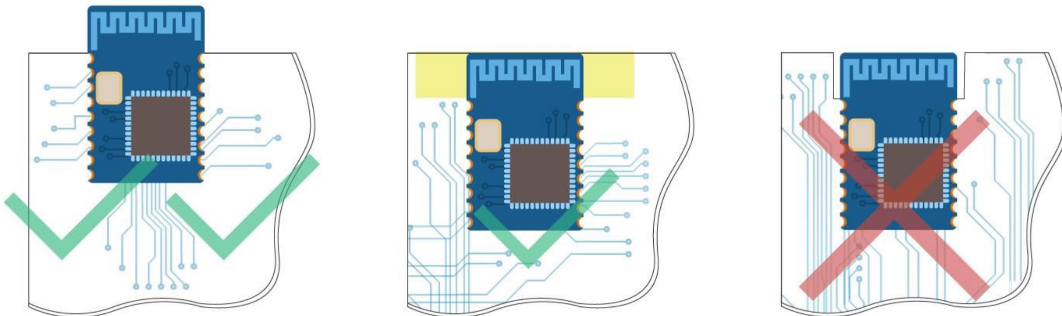

Figure 8.1 PCB routing recommendations

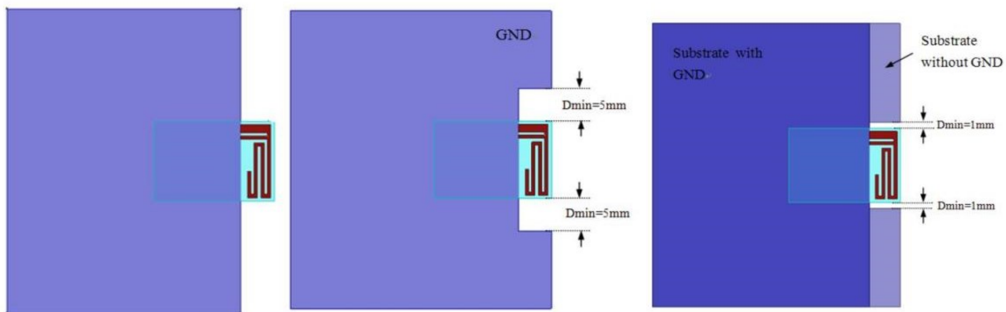

Figure 8.2 PCB layout recommendations

9 Frequently Asked Questions

9.1 An unsatisfactory transmission distance

1. When there is a linear communication obstacle, the communication distance will decay accordingly; Temperature, humidity, and same frequency interference will increase the communication packet loss rate; Poor ground absorbs and reflect radio waves, close to the ground;
2. The seawater has a strong ability to absorb radio waves, so the seaside test effect is poor;
3. There are metal objects near the antenna or placed in the metal shell, the signal attenuation will be very serious;
4. The power register setting is wrong and the air rate setting is too high (the higher the air rate, the closer the distance);
5. At room temperature, the power supply voltage is lower than the recommended value, and the lower the voltage, the lower the transmitting power;
6. The matching degree of the antenna and the module is poor, or the quality of the antenna itself is problematic.

9.2 Easy to damage —— abnormal damage

1. Please check the power supply to ensure that exceeding the maximum value will cause permanent damage to the module; Please check the stability of the power supply and the voltage cannot fluctuate substantially and frequently;
2. Please ensure the anti-static operation during the installation and use, and the high-frequency devices are electrostatic sensitive devices;
3. Please ensure that the humidity should not too high during the installation and use, and some components are humidity-sensitive devices; If there are no special requirements, it is not recommended to use them at too high or too low a temperature.

9.3 The BER rate is too high

1. Have the same frequency signal interference nearby, stay away from the interference source, or modify the frequency and channel to avoid the interference;
2. The power supply is not ideal and may also cause code jumble, be sure to ensure the reliability of the power supply;
3. The extension line, feeder quality is too poor or too long, and will also cause a high bit error rate.

10 Reflux Welding Conditions

1. Heating method: conventional convection or IR convection;
2. Number of allowable reflow welding: 2 times, based on the following reflow welding (conditions) (see the figure below);
3. Temperature curve: reflow welding should follow the following temperature curve (see the figure below);
4. Maximum temperature: 245°C.

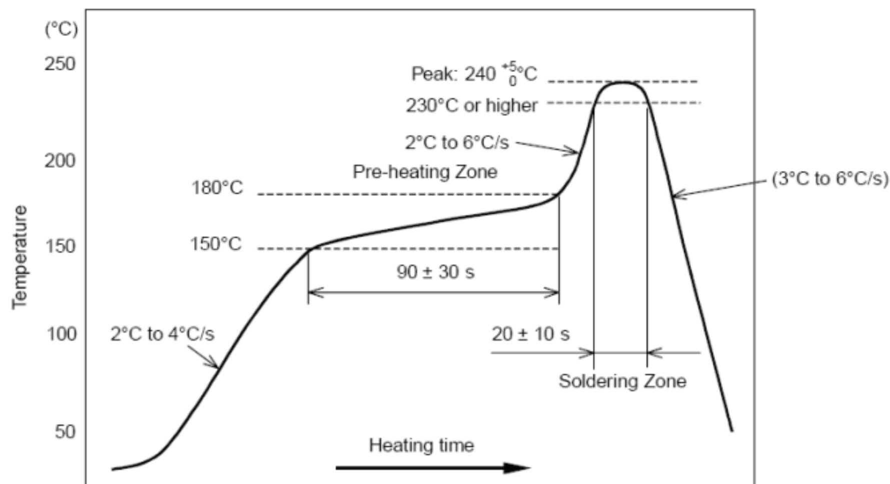

Figure 10.1 Welding heat resistance temperature curve of components (welding points)

11 Electrostatic Discharge Warning

The module is damaged due to static release and it is recommended that all modules be treated under the following 3 precautions:

1. Must follow the anti-static measures, can not hold the module.
2. The module must be placed in a placement area that can prevent static electricity.
3. The antistatic circuit at the high-voltage input or high-frequency input should be considered in the product design.

Electrostatics may result in subtle performance degradation to the entire device failure. Because very small parameter changes may cause the device to not meet the value limit of its certification requirements, the module will be more vulnerable to damage.

12 Document Change Record

Table 12.1 Document change record

Document version	Change description	Date updated
V1.0	First release	2024.03.01

13 Contact Information

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