Mega System Technologies, Inc.

MST-WBM-08

Datasheet

V1.0

Revision History

Date	Version	Release notes
2021-10-27	V1.0	Official release.

This document provides the specifications for the MST-WBM-08 modules.

Contents

1. Module Overview

1.1. Features

MCU

- Xtensa® dual-core 32-bit LX6 microprocessor, up to 240 MHz
- 448 KB ROM for booting and core functions
- 520 KB SRAM for data and instructions
- 16 KB SRAM in RTC

Wi-Fi

- 802.11b/g/n
- Bit rate: 802.11n up to 150 Mbps
- A-MPDU and A-MSDU aggregation
- 0.4 *μs* guard interval support
- Center frequency range of operating channel: 2412 ~ 2484 MHz

Bluetooth®

- Bluetooth V4.2 BR/EDR and Bluetooth LE specification
- Class-1, class-2 and class-3 transmitter
- AFH
- CVSD and SBC

Hardware

- Interfaces: SD card, UART, SPI, SDIO, I2C, LED PWM, Motor PWM, I2S, IR, pulse counter, GPIO, capacitive touch sensor, ADC, DAC, Two-Wire Automotive Interface (TWAI®)
- 40 MHz crystal oscillator
- 4 MB SPI flash
- Operating voltage/Power supply: 3.0 ~ 3.6 V
- Operating temperature range: –40 ~ 85°C

Certification

- Bluetooth, RF certification: FCC/CE-RED
- Green certification: RoHS 2.0

1.2. Description

MST-WBM-08 is a powerful, generic Wi-Fi+BT+BLE MCU module that target a wide variety of applications, ranging from low-power sensor networks to the most demanding tasks, such as IOT, UPS remote monitoring and Remote switch control.

MST-WBM-08 comes with a 2.4GHz PCB antenna, π type matching circuit is reserved for antenna impedance matching. Except for the IO used to connect flash, other IO of the chip have been pulled to the pin of the module. The working voltage range of the module is 3.0V ~ 3.6V, and the working frequency range is 2400MHz~2483.5MHz. 40MHz passive crystal oscillator is used as clock source. The built-in 4 MB SPI flash is used to store the firmware and data of user applications.

At the core of the module is the MST-WBM-08. The CPU embedded is designed to be scalable and adaptive. There are two CPU cores that can be individually controlled, and the CPU clock frequency is adjustable from 80MHz to 240MHz. The chip also has a low-power co-processor that can be used instead of the CPU to save power while performing tasks that do not require much computing power, such as monitoring of peripherals. MST-WBM-08 integrates a rich set of peripherals, ranging from capacitive touch sensors, Hall sensors, SD card interface, Ethernet, high-speed SPI, UART, I²S and I²C.

The integration of Bluetooth®, Bluetooth LE and Wi-Fi ensures that a wide range of applications can be targeted, and that the module is all-around: using Wi-Fi allows a large physical range and direct connection to the Internet through a Wi-Fi router, while using Bluetooth allows the user to conveniently connect to the phone or broadcast low energy beacons for its detection. The sleep current of the MST-WBM-08 is less than 5 μA, making it suitable for battery powered and wearable electronics applications. The module supports a data rate of up to 150Mbps, and 20dBm output power at the antenna to ensure the widest physical range. As such the module does offer industry-leading specifications and the best performance for electronic integration, range, power consumption, and connectivity.

The operating system chosen for MST-WBM-08 is freeRTOS with LwIP; TLS 1.2 with hardware acceleration is built in as well. Secure (encrypted) over the air (OTA) upgrade is also supported, so that users can upgrade their products even after their release, at minimum cost and effort.

1.3. Applications

- Generic Low-power IoT Sensor Hub
- Generic Low-power IoT Data Loggers
- Cameras for Video Streaming
- Over-the-top (OTT) Devices
- Speech Recognition
- Image Recognition
- Mesh Network
- Home Automation
- Smart Building
- Industrial Automation
- Smart Agriculture
- Audio Applications
- Health Care Applications
- Wi-Fi-enabled Toys
- Wearable Electronics
- Retail & Catering Applications

2. Block Diagram

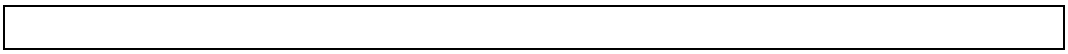

Figure 1: MST-WBM-08 Block Diagram

3. Pin Definitions

3.1. Pin Layout

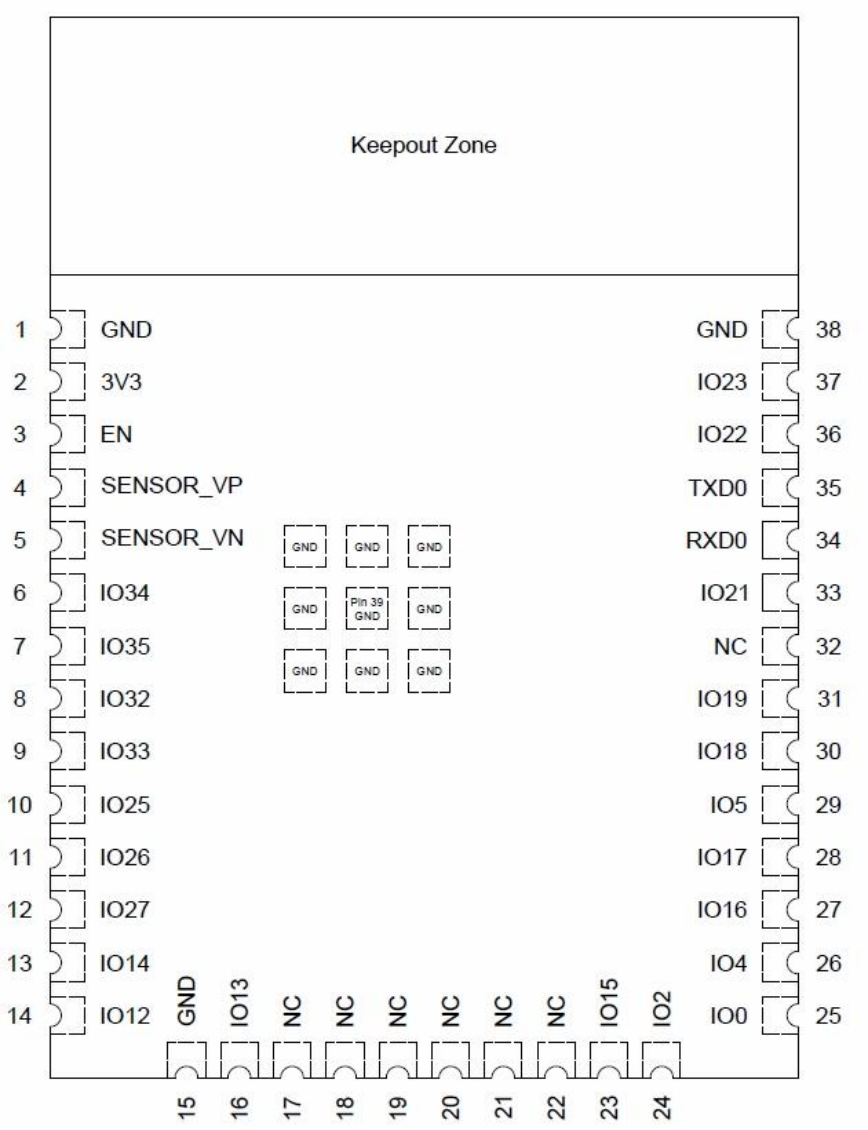

Figure 2: Pin Layout of MST-WBM-08 (Top View)

3.2. Pin Description

The module has 38 pins. See pin definitions in Table 1.

Table 1: Pin Definitions

Name	No.	Type	Function
GND	1	P	Ground
3V3	2	P	Power supply
EN	3	I	High: On; enables the chip Low: Off; the chip powers off Note: Do not leave the pin floating.
SENSOR_VP	4	I	GPIO36, ADC1_CH0, RTC_GPIO0
SENSOR_VN	5	I	GPIO39, ADC1_CH3, RTC_GPIO3
IO34	6	I	GPIO34, ADC1_CH6, RTC_GPIO4
IO35	7	I	GPIO35, ADC1_CH7, RTC_GPIO5
IO32	8	I/O	GPIO32, XTAL_32K_P (32.768 kHz crystal oscillator input), ADC1_CH4, TOUCH9, RTC_GPIO9
IO33	9	I/O	GPIO33, XTAL_32K_N (32.768 kHz crystal oscillator output), ADC1_CH5, TOUCH8, RTC_GPIO8
IO25	10	I/O	GPIO25, DAC_1, ADC2_CH8, RTC_GPIO6, EMAC_RXD0
IO26	11	I/O	GPIO26, DAC_2, ADC2_CH9, RTC_GPIO7, EMAC_RXD1
IO27	12	I/O	GPIO27, ADC2_CH7, TOUCH7, RTC_GPIO17, EMAC_RX_DV
IO14	13	I/O	GPIO14, ADC2_CH6, TOUCH6, RTC_GPIO16, MTMS, HSPICLK, HS2_CLK, SD_CLK, EMAC_TXD2
IO12	14	I/O	GPIO12, ADC2_CH5, TOUCH5, RTC_GPIO15, MTDI, HSPIQ, HS2_DATA2, SD_DATA2, EMAC_TXD3
GND	15	P	Ground
IO13	16	I/O	GPIO13, ADC2_CH4, TOUCH4, RTC_GPIO14, MTCK, HSPID, HS2_DATA3, SD_DATA3, EMAC_RX_ER
NC	17	-	-

Name	No.	Type	Function
NC	18	-	-
NC	19	-	-
NC	20	-	-
NC	21	-	-
NC	22	-	-
IO15	23	I/O	GPIO15, ADC2_CH3, TOUCH3, MTDO, HSPICS0, RTC_GPIO13, HS2_CMD, SD_CMD, EMAC_RXD3
IO2	24	I/O	GPIO2, ADC2_CH2, TOUCH2, RTC_GPIO12, HSPIWP, HS2_DATA0, SD_DATA0
IO0	25	I/O	GPIO0, ADC2_CH1, TOUCH1, RTC_GPIO11, CLK_OUT1, EMAC_TX_CLK
IO4	26	I/O	GPIO4, ADC2_CH0, TOUCH0, RTC_GPIO10, HSPIHD, HS2_DATA1, SD_DATA1, EMAC_TX_ER
IO16	27	I/O	GPIO16, HS1_DATA4, U2RXD, EMAC_CLK_OUT
IO17	28	I/O	GPIO17, HS1_DATA5, U2TXD, EMAC_CLK_OUT_180
IO5	29	I/O	GPIO5, VSPICS0, HS1_DATA6, EMAC_RX_CLK
IO18	30	I/O	GPIO18, VSPICLK, HS1_DATA7
IO19	31	I/O	GPIO19, VSPIQ, U0CTS, EMAC_TXD0
NC	32	-	-
IO21	33	I/O	GPIO21, VSPIHD, EMAC_TX_EN
RXD0	34	I/O	GPIO3, U0RXD, CLK_OUT2
TXD0	35	I/O	GPIO1, U0TXD, CLK_OUT3, EMAC_RXD2
IO22	36	I/O	GPIO22, VSPIWP, U0RTS, EMAC_TXD1
IO23	37	I/O	GPIO23, VSPID, HS1_STROBE
GND	38	P	Ground

4. Electrical Characteristics

4.1. Absolute Maximum Ratings

Stresses beyond the absolute maximum ratings listed in the table below may cause permanent damage to the device. These are stress ratings only, and do not refer to the functional operation of the device that should follow the recommended operating conditions.

Table 2: Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDD33	Power supply voltage	－0.3	3.6	V
T_{STORE}	Storage temperature	－40	85	°C

4.2. Recommended Operating Conditions

Table 3: Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VDD33	Power supply voltage	3.0	3.3	3.6	V
I_{VDD}	Current delivered by external power supply	0.5	–	–	A
T	Operating temperature	-40	–	85	°C
Humidity	Humidity condition	–	85	–	%RH

4.3. DC Characteristics (3.3 V, 25 °C)

Table 4: DC Characteristics (3.3 V, 25 °C)

Symbol	Parameter	Min	Typ	Max	Unit
C_{IN}	Pin capacitance	-	2	-	pF
V_{IH}	High-level input voltage	0.75×VDD	-	VDD+0.3	V
V_{IL}	Low-level input voltage	-0.3	-	0.25×VDD	V
I_{IH}	High-level input current	-	-	50	nA
I_{IL}	Low-level input current	-	-	50	nA
V_{OH}	High-level output voltage	0.8×VDD	-	-	V
V_{OL}	Low-level output voltage	-	-	0.1×VDD	V
I_{OH}	High-level source current (VDD = 3.3 V, VOH >= 2.64 V, output drive strength set to the maximum)	VDD3P3_CPU power domain	-	40	mA
		VDD3P3_RTC power domain	-	40	mA
		VDD_SDIO power domain	-	20	mA
I_{OL}	Low-level sink current (VDD = 3.3 V, VOL = 0.495 V, output drive strength set to the maximum)	-	28	-	mA
R_{PU}	Resistance of internal pull-up resistor	-	45	-	kΩ
R_{PD}	Resistance of internal pull-down resistor	-	45	-	kΩ
V_{IL_nRST}	Low-level input voltage of CHIP_PU to power off the chip	-	-	0.6	V

4.4. Current Consumption Characteristics

With the use of advanced power-management technologies, MST-WBM-08 can switch between different power modes.

4.4.1. Current Consumption Depending on RF Modes

Table 5: Current Consumption Depending on RF Modes

Work mode	Description		Average (mA)	Peak (mA)
Active (RF working)	TX	802.11b, 20 MHz, 1 Mbps, @19.5 dBm	239	379
		802.11g, 20 MHz, 54 Mbps, @15 dBm	190	276
		802.11n, 20 MHz, MCS7, @13 dBm	183	258
		802.11n, 40 MHz, MCS7, @13 dBm	165	211
	RX	802.11b/g/n	112	112
		802.11n, 40 MHz	118	118

Note:

- The current consumption measurements are taken with a 3.3 V supply at 25 °C of ambient temperature at the RF port. All transmitters' measurements are based on a 50% duty cycle.
- The current consumption figures for in RX mode are for cases when the peripherals are disabled and the CPU idle.

4.5. Wi-Fi RF Characteristics

4.5.1. Wi-Fi RF Standards

Table 6: Wi-Fi RF Standards

Name		Description
Center frequency range of operating channel *note*		2412 ~ 2462 MHz
Wi-Fi wireless standard		IEEE 802.11b/g/n
Data rate	20 MHz	11b: 1, 2, 5.5 and 11 Mbps 11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps 11n: MCS0-7, 72.2 Mbps (Max)
	40 MHz	11n: MCS0-7, 150 Mbps (Max)
Antenna type		PCB antenna

Note:

Device should operate in the center frequency range allocated by regional regulatory authorities. Target center frequency range is configurable by software.

4.5.2. Transmitter Characteristics

Table 6: Transmitter Characteristics

Parameter	Rate	Typ	Unit
TX Power *note*	11b, 1 Mbps	<11	dBm
	11b, 11 Mbps	<11	
	11g, 6 Mbps	<13	
	11g, 54 Mbps	<13	
	11n, HT20, MCS0	<13	
	11n, HT20, MCS7	<13	
	11n, HT40, MCS0	<13	
	11n, HT40, MCS7	<13	

Note:

Target TX power is configurable based on device or certification requirements.

4.5.3. Receiver Characteristics

Table 7: Receiver Characteristics

Parameter	Rate	Typ	Unit
RX Sensitivity	1 Mbps	-97	dBm
	2 Mbps	-94	
	5.5 Mbps	-92	
	11 Mbps	-88	
	6 Mbps	-93	
	9 Mbps	-91	
	12 Mbps	-89	
	18 Mbps	-87	
	24 Mbps	-84	
	36 Mbps	-80	
	48 Mbps	-77	
	54 Mbps	-75	
	11n, HT20, MCS0	-92	
	11n, HT20, MCS1	-88	
	11n, HT20, MCS2	-86	
	11n, HT20, MCS3	-83	
	11n, HT20, MCS4	-80	
	11n, HT20, MCS5	-76	
	11n, HT20, MCS6	-74	
	11n, HT20, MCS7	-72	
	11n, HT40, MCS0	-89	
	11n, HT40, MCS1	-85	
	11n, HT40, MCS2	-83	
	11n, HT40, MCS3	-80	
	11n, HT40, MCS4	-76	
	11n, HT40, MCS5	-72	
	11n, HT40, MCS6	-71	
	11n, HT40, MCS7	-69	

Parameter	Rate	Typ	Unit
RX Maximum Input Level	11b, 1 Mbps	5	dBm
	11b, 11 Mbps	5	
	11g, 6 Mbps	0	
	11g, 54 Mbps	-8	
	11n, HT20, MCS0	0	
	11n, HT20, MCS7	-8	
	11n, HT40, MCS0	0	
	11n, HT40, MCS7	-8	
Adjacent Channel Rejection	11b, 11 Mbps	35	dB
	11g, 6 Mbps	27	
	11g, 54 Mbps	13	
	11n, HT20, MCS0	27	
	11n, HT20, MCS7	12	
	11n, HT40, MCS0	16	
	11n, HT40, MCS7	7	

4.6. Bluetooth Radio

4.6.1. Receiver – Basic Data Rate

Table 8: Receiver Characteristics – Basic Data Rate

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity @0.1% BER	-	-90	-89	-88	dBm
Maximum received signal @0.1% BER	-	0	-	-	dBm
Co-channel C/I	-	-	+7	-	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	-	-	-6	dB
	F = F0 - 1 MHz	-	-	-6	dB
	F = F0 + 2 MHz	-	-	-25	dB
	F = F0 - 2 MHz	-	-	-33	dB
	F = F0 + 3 MHz	-	-	-25	dB
	F = F0 - 3 MHz	-	-	-45	dB
Out-of-band blocking performance	30 MHz ~ 2000 MHz	-10	-	-	dBm
	2000 MHz ~ 2400 MHz	-27	-	-	dBm
	2500 MHz ~ 3000 MHz	-27	-	-	dBm
	3000 MHz ~ 12.5 GHz	-10	-	-	dBm
Intermodulation	-	-36	-	-	dBm

4.6.2. Transmitter – Basic Data Rate

Table 9: Transmitter Characteristics – Basic Data Rate

Parameter	Conditions	Min	Typ	Max	Unit
RF transmit power *note*	-	-	0	-	dBm
Gain control step	-	-	3	-	dB
RF power control range	-	-12	-	+9	dBm
+20 dB bandwidth	-	-	0.9	-	MHz

Parameter	Conditions	Min	Typ	Max	Unit
Adjacent channel transmit power	F = F0 ± 2 MHz	-	-55	-	dBm
	F = F0 ± 3 MHz	-	-55	-	dBm
	F = F0 ± > 3 MHz	-	-59	-	dBm
$\Delta f 1_{avg}$	-	-	-	155	kHz
$\Delta f 2_{max}$	-	127	-	-	kHz
$\Delta f 2_{avg}/\Delta f 1_{avg}$	-	-	0.92	-	-
ICFT	-	-	-7	-	kHz
Drift rate	-	-	0.7	-	kHz/50 μs
Drift (DH1)	-	-	6	-	kHz
Drift (DH5)	-	-	6	-	kHz

Note:

There are a total of eight power levels from 0 to 7, and the transmit power ranges from –12 dBm to 9 dBm. When the power level rises by 1, the transmit power increases by 3 dB. Power level 4 is used by default and the corresponding transmit power is 0 dBm.

4.6.3. Receiver – Enhanced Data Rate

Table 10: Receiver Characteristics – Enhanced Data Rate

Parameter	Conditions	Min	Typ	Max	Unit
π/4 DQPSK					
Sensitivity @0.01% BER	-	-90	-89	-88	dBm
Maximum received signal @0.01% BER	-	-	0	-	dBm
Co-channel C/I	-	-	11	-	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	-	-7	-	dB
	F = F0 - 1 MHz	-	-7	-	dB
	F = F0 + 2 MHz	-	-25	-	dB
	F = F0 - 2 MHz	-	-35	-	dB
	F = F0 + 3 MHz	-	-25	-	dB
	F = F0 - 3 MHz	-	-45	-	dB

Parameter	Conditions	Min	Typ	Max	Unit
8DPSK					
Sensitivity @0.01% BER	-	-84	-83	-82	dBm
Maximum received signal @0.01% BER	-	-	-5	-	dBm
C/I c-channel	-	-	18	-	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	-	2	-	dB
	F = F0 - 1 MHz	-	2	-	dB
	F = F0 + 2 MHz	-	-25	-	dB
	F = F0 - 2 MHz	-	-25	-	dB
	F = F0 + 3 MHz	-	-25	-	dB
	F = F0 - 3 MHz	-	-38	-	dB

4.6.4. Transmitter – Enhanced Data Rate

Table 11: Transmitter Characteristics – Enhanced Data Rate

Parameter	Conditions	Min	Typ	Max	Unit
RF transmit power (see note under Table 9)	-	-	0	-	dBm
Gain control step	-	-	3	-	dB
RF power control range	-	-12	-	+9	dBm
π/4 DQPSK max w0	-	-	-0.72	-	kHz
π/4 DQPSK max wi	-	-	-6	-	kHz
π/4 DQPSK max |wi + w0|	-	-	-7.42	-	kHz
8DPSK max wi	-	-	-9.6	-	kHz
8DPSK max |wi + w0|	-	-	-10	-	kHz
π/4 DQPSK modulation accuracy	RMS DEVM	-	4.28	-	%
	99% DEVM	-	100	-	%
	Peak DEVM	-	13.3	-	%
8 DPSK modulation accuracy	RMS DEVM	-	5.8	-	%
	99% DEVM	-	100	-	%
	Peak DEVM	-	14	-	%

Parameter	Conditions	Min	Typ	Max	Unit
In-band spurious emissions	F = F0 ± 1 MHz	-	-46	-	dBm
	F = F0 ± 2 MHz	-	-44	-	dBm
	F = F0 ± 3 MHz	-	-49	-	dBm
	F = F0 +/- > 3 MHz	-	-	-53	dBm
EDR differential phase coding	-	-	100	-	%

4.7. Bluetooth LE Radio

4.7.1. Receiver

Table 12: Receiver Characteristics – BLE

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity @30.8% PER	-	-94	-93	-92	dBm
Maximum received signal @30.8% PER	-	0	-	-	dBm
Co-channel C/I	-	-	+10	-	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	-	-5	-	dB
	F = F0 - 1 MHz	-	-5	-	dB
	F = F0 + 2 MHz	-	-25	-	dB
	F = F0 - 2 MHz	-	-35	-	dB
	F = F0 + 3 MHz	-	-25	-	dB
	F = F0 - 3 MHz	-	-45	-	dB
Out-of-band blocking performance	30 MHz ~ 2000 MHz	-10	-	-	dBm
	2000 MHz ~ 2400 MHz	-27	-	-	dBm
	2500 MHz ~ 3000 MHz	-27	-	-	dBm
	3000 MHz ~ 12.5 GHz	-10	-	-	dBm
Intermodulation	-	-36	-	-	dBm

4.7.2. Transmitter

Table 13: Transmitter Characteristics – BLE

Parameter	Conditions	Min	Typ	Max	Unit
RF transmit power (see note under Table 9)	-	-	0	-	dBm
Gain control step	-	-	3	-	dB
Adjacent channel transmit power	F = F0 ± 2 MHz	-	-55	-	dBm
	F = F0 ± 3 MHz	-	-57	-	dBm
	F = F0 ± > 3 MHz	-	-59	-	dBm
$\Delta f 1_{avg}$	-	-	-	265	kHz
$\Delta f 2_{max}$	-	210	-	-	kHz
$\Delta f 2_{avg}/\Delta f 1_{avg}$	-	-	+0.92	-	-
ICFT	-	-	-10	-	kHz
Drift rate	-	-	0.7	-	kHz/50 µs
Drift	-	-	2	-	kHz

5. Schematics

This is the reference design of the module.

Figure 3: MST-WBM-08 Schematics

6. Peripheral Schematics

This is the typical application circuit of the module connected with peripheral components (for example, power supply, antenna, reset button, JTAG interface, and UART interface).

Figure 4: MST-WBM-08 Peripheral Schematics

7. Physical Dimensions and PCB Layout

7.1. Physical Dimensions

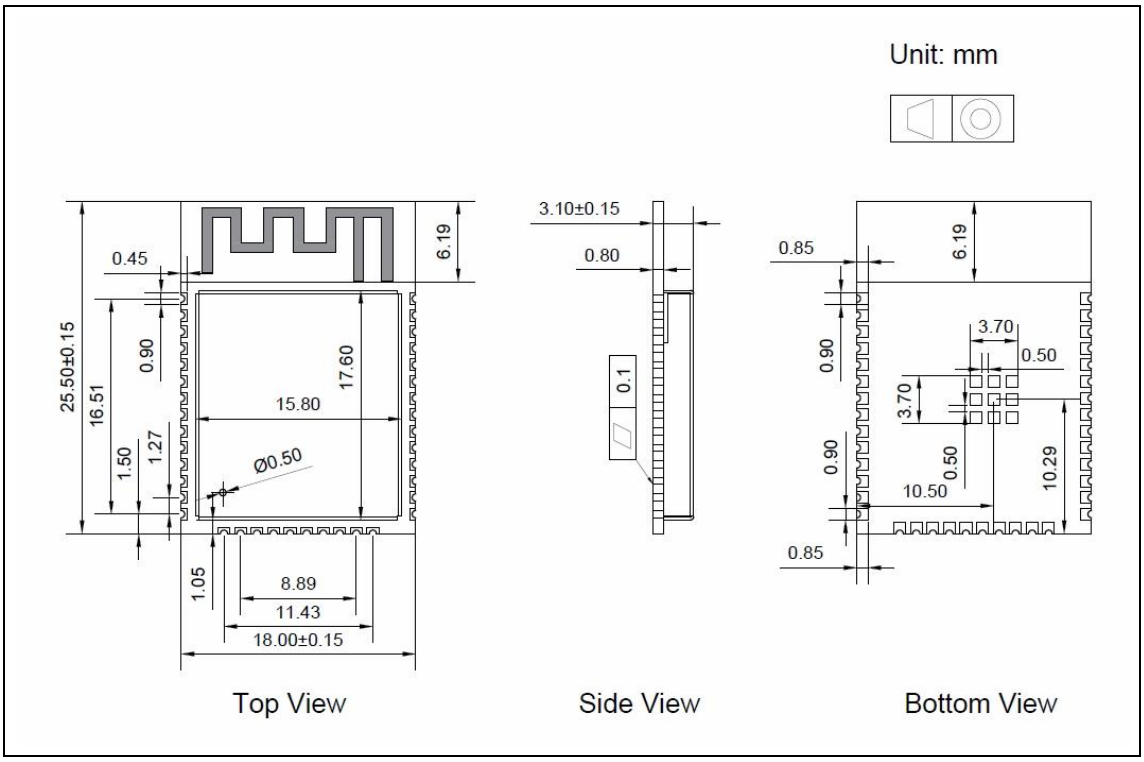

Figure 5: MST-WBM-08 Physical Dimensions

7.2. Recommended PCB Land Pattern

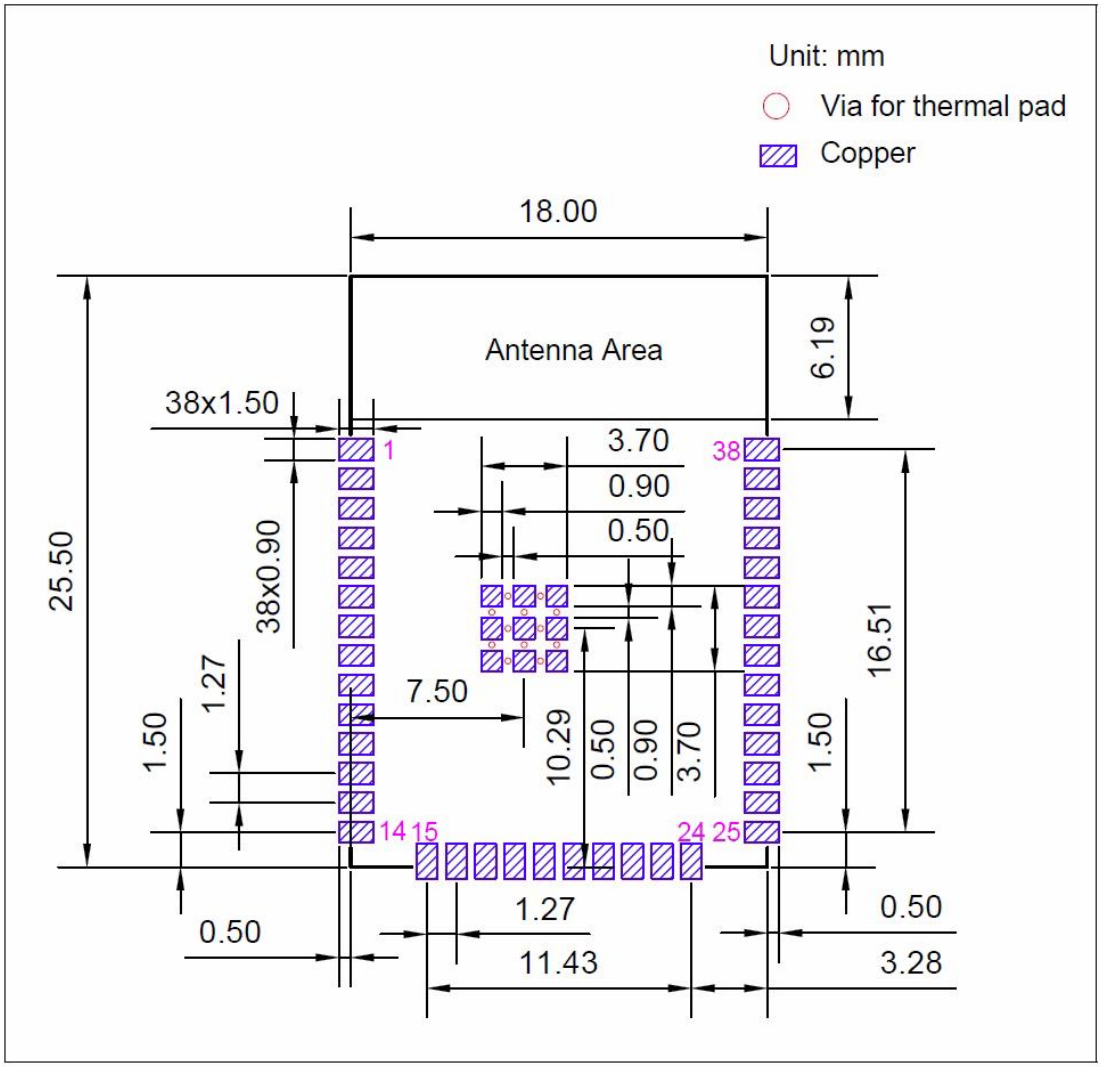

Figure 6: MST-WBM-08 Recommended PCB Land Pattern

8. Product Handling

8.1. Storage Condition

The products sealed in Moisture Barrier Bag (MBB) should be stored in a noncondensing atmospheric environment of < 40 °C/90% RH.

The module is rated at moisture sensitivity level (MSL) 3.

After unpacking, the module must be soldered within 168 hours with factory conditions 25±5 °C and 60% RH.

The module needs to be baked if the above conditions are not met.

8.2. ESD

- Human body model (HBM): 2000 V
- Charged-device model (CDM): 500 V
- Air discharge: 6000 V
- Contact discharge: 4000 V

8.3. Reflow Profile

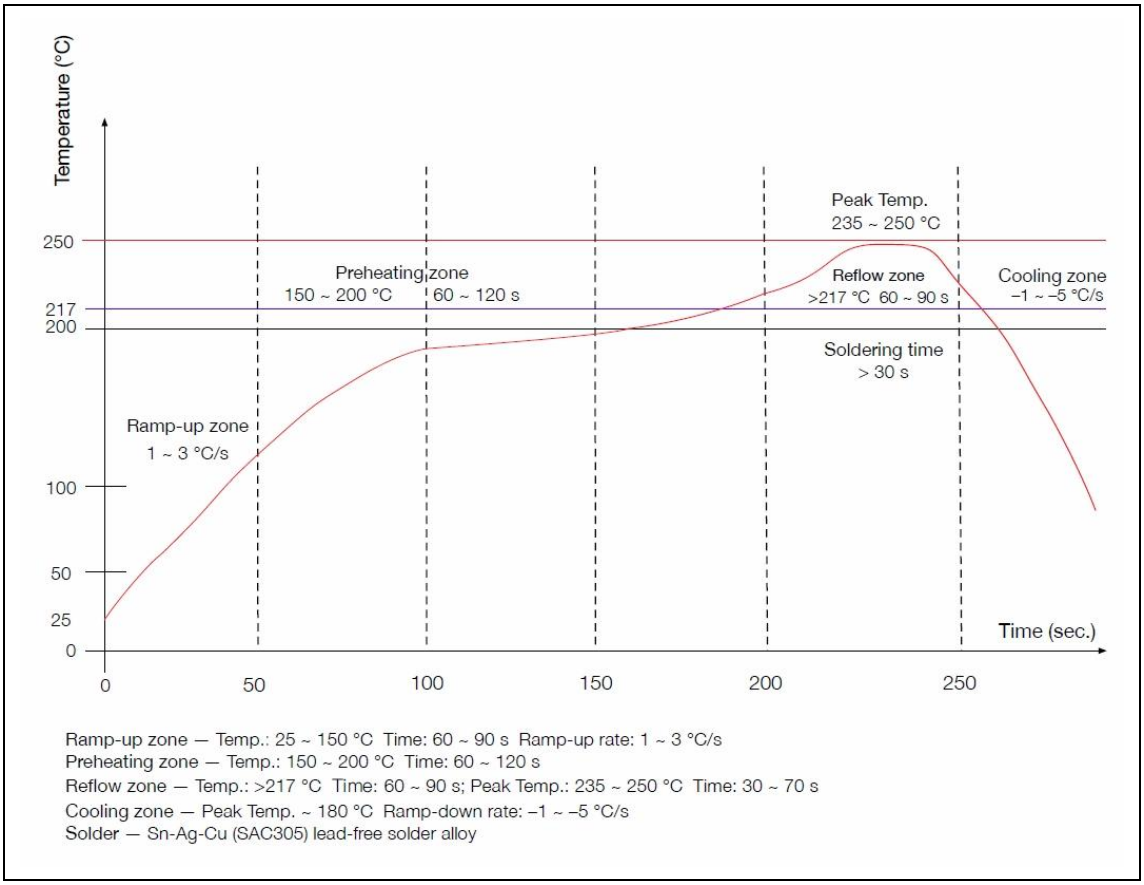

Figure 7: Reflow Profile

Note:

Solder the module in a single reflow.

FCC Statement

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.

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.

FCC Modular Usage Statement

The requirement for KDB 996369 D03:
2.2 List of applicable FCC rules
FCC CFR Title 47 Part 15 Subpart C Section 15.247
2.3 Summarize the specific operational use conditions
The module has been certified for Fix, Mobile, Portable applications. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
2.4 Limited module procedures
Not applicable
2.5 Trace antenna designs
Not applicable
2.6 RF exposure considerations
This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other

antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

2.7 Antennas

PCB antenna with antenna gain 3.4dBi, The antenna is permanently attached, can't be replaced.

2.8 Label and compliance information

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.

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

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 andused 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.

If the FCC identification number is not visible when the module is installed inside another device,

then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following:

"Contains Transmitter Module FCC ID: 2A3GV-MSTWBM08 Or Contains FCC ID: 2A3GV-MSTWBM08"

2.9 Information on test modes and additional testing requirements

The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247) list on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed when contains digital circuity.

2.10 Additional testing, Part 15 Subpart B disclaimer

When testing host product, the host manufacture should follow FCC KDB Publication 996369 D04 Module Integration Guide for testing the host products. The host manufacturer may operate their product during the measurements.