Product Specification

Product Name: Z-Wave Cloud Module

Model Name: DSM-103

Revision History

Specification		Sect.	Update Description	By
Rev	**Date**			
1.0	2022-10-27		New version release	Li
1.1	2023-4-24		Fix the pin definition	C.H

1. Introduction

1.1. Purpose& Description

DSM-103 is a low-power embedded Z-WAVE module. It is composed of a highly integrated wireless chip EFR32ZG23A020F512GM40-C and some peripheral devices, and supports Z-WAVE and Z-WAVE long range protocols.

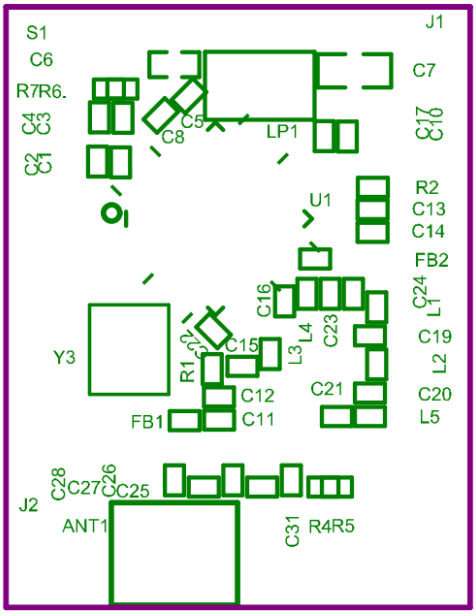
The product has two antenna connection methods. The default is IPEX socket connection method, and it can also be extended to the motherboard through the port. There are also two ways to connect to the motherboard. One is directly attached to the motherboard, and the other uses standard 1.27-pitch connectors and Motherboard connection supports global frequency bands.

1.2. Key Features

- Low Power Z-Wave Wireless SoC
- 32-bit ARM® Cortex®-M33 core with 78 MHz maximum operating frequency
- Up to 512 kB of flash and 64 kB of RAM
- Integrated sub-GHz PA with up to 20 dBm TX power
- Integrated LNA with RX Sensitivity as low as -109.8 dBm.
- Secure Element with Secure Vault

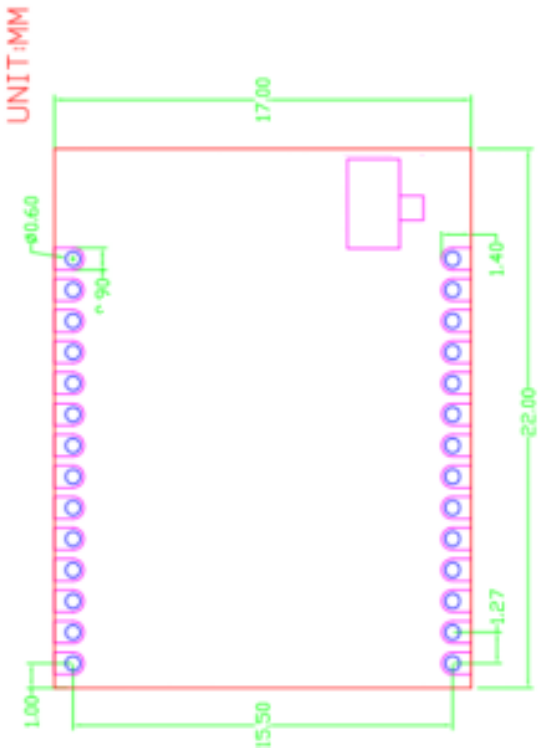
- 4.0 mA RX current at 908.42 MHz (9.6 kbps FSK)
- 4.0 mA RX current at 916 MHz (100 kbps GFSK)
- 9.8 mA TX current @ 0 dBm output power at 916 MHz
- 25.0 mA TX current @ 14 dBm output power at 916 MHz
- 85.5 mA TX current @ 20 dBm output power at 916 MHz
- 26 µA/MHz in Active Mode (EM0) at 39.0 MHz
- 1.5 µA EM2 DeepSleep current (64 kB RAM retention and RTC running from LFXO)
- 1.2 µA EM2 DeepSleep current (16 kB RAM retention and RTC running from LFRCO)

1.3. Appearance



1.4. Dimensions

DSM-103 has 2 columns of Pins (2* 14).The distance between each Pin is 1.27±0.1mm. Size: 17±0.35 mm (W) x 22±0.35 mm (L) x 2.8±0.15 mm (H).



1.5. Interface Pin definition

Pin Number	Symbol	IO Type	Function
1	GND	P	Power supply reference ground pin
2	ANT	RF	RF signal input/output port, which corresponds to ANT of IC
3	GND	P	Power supply reference ground pin
4	NC		Not connect
5	NC		Not connect
6	PD13	I/O	Corresponding to PD13 of IC
7	PD14	I/O	Corresponding to PD14 of IC
8	PD15	I/O	Corresponding to PD15 of IC
9	PB11	I/O	Corresponding to PB11 of IC
10	PB12	I/O	Corresponding to PB12 of IC
11	PB13	I/O	Corresponding to PB13 of IC
12	PB14	I/O	Corresponding to PB14 of IC
13	PB15	I/O	Corresponding to P15 of IC
14	NC		Not connect
15	NC		Not connect
16	NC		Not connect
17	PF3	I/O	Corresponding to PF3 of IC
18	PF2	I/O	Corresponding to PF2 of IC
19	NC		Not connect
20	GND	P	Power supply reference ground pin
21	VCC	P	Power supply pin (3.3V)
22	RX0	I	Corresponding to internal RXD0 of IC
23	TX0	O	Corresponding to internal TXD0 of IC
24	SWDIO	I/O	Corresponding to internal SWDIO of IC
25	SWCLK	I/O	Corresponding to internal SWCLK of IC
26	PC11	I/O	Corresponding to PC11 of IC
27	PC10	I/O	Corresponding to PC10 of IC
28	nRESET	I	Hardware reset pin, which is at a high level by default and is active at a low level

2. Electrical Characteristics

3.1 Absolute Maximum Ratings

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Storage temperature range	T_{STG}		-50	—	+150	℃
Voltage on any supply pin	V_{DDMAX}		-0.3	—	3.8	V
Junction temperature	T_{JMAX}	-G grade	—	—	+105	℃
		-I grade	—	—	+125	℃
Voltage ramp rate on any supply pin	$V_{DDRAMPMAX}$		—	—	1.0	V / μs
Voltage on HFXO pins	$V_{HFXOPIN}$		-0.3	—	1.2	V
DC voltage on any GPIO pin[1]	V_{DIGPIN}		-0.3	—	V_{IOVDD} + 0.3	V
DC voltage on RESETn pin[2]	V_{RESETn}		-0.3	—	3.8	V
Absolute voltage on Sub-GHz RF pins	$V_{MAXSUBG}$	SUBG_O pins	-0.3	—	1.2	V
		SUBG_I pins	-0.3	—	0.3	V
Total current into VDD power lines	I_{VDDMAX}	Source	—	—	200	mA
Total current into VSS ground lines	I_{VSSMAX}	Sink	—	—	200	mA
Current per I/O pin	I_{IOMAX}	Sink	—	—	50	mA
		Source	—	—	50	mA
Current for all I/O pins	$I_{IOALLMAX}$	Sink	—	—	200	mA
		Source	—	—	200	mA

3. RF Features

This table is for devices with a output power rating of +20 dBm using the 915/920 MHz +20 dBm matching network as shown in the typical connections section. Unless otherwise indicated, typical conditions are: T_A = 25 ℃, VREGVDD = 3.3 V, AVDD = DVDD = IOVDD = RFVDD = 1.8 V powered from DCDC. PAVDD = 3.3V. Crystal frequency= 39.0 MHz. RFVDD and external PA supply paths filtered using ferrites. RF center frequency 916 MHz.

Sub-GHz RF Transmitter characteristics for 916 MHz Band

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
RF test frequency range	F_{RANGE}		902	—	928	MHz
Maximum TX Power	$POUT_{MAX}$	PAVDD = 3.3V, 20 dBm devices, +20 dBm match[1 2 3]	17.7	20	21.4	dBm
Minimum active TX Power	$POUT_{MIN}$		—	-20.6	—	dBm
Output power variation vs supply at $POUT_{MAX}$	$POUT_{VAR\_V}$	1.8 V < V_{PAVDD} < 3.8 V, T = 25 ℃	—	4.7	—	dB

Output power variation vs temperature, peak to peak	$POUT_{VAR\_T}$	T_A = -40 to +85 ℃ with PAVDD = 3.3 V	—	0.6	1.0	dB
Output power variation vs RF frequency	$POUT_{VAR\_F}$	PAVDD = 3.3 V, T_A = 25 ℃	—	0.5	0.9	dB
Spurious emissions of harmonics, Conducted measurement, Test Frequency = 916 MHz	$SPUR_{HARM\_FCC}$	In non-restricted bands, per FCC 47 CFR §15.247[4]	—	-58.3	-20	dBc
		In restricted bands, per FCC 47 CFR §15.205 & §15.209[5 6]	—	-50.2	-41.2	dBm
Unwanted signal emissions over frequency domain, Conducted measurement, Test Frequency = 916 MHz	$SPUR_{OOB\_FCC}$	In non-restricted bands, per FCC 47 CFR §15.247[4]	—	-60.0	-20	dBc
		In restricted bands (30-88 MHz),per FCC 47 CFR §15.205 & §15.209[5 6]	—	-62.7	-55.2	dBm
		In restricted bands (88-216 MHz), per FCC 47 CFR §15.205 & §15.209[5 6]	—	-60.7	-51.7	dBm
		In restricted bands (216-960 MHz), per FCC 47 CFR §15.205 & §15.209[5 6]	—	-61.1	-49.2	dBm
		In restricted bands (>960 MHz), per FCC 47 CFR §15.205 & §15.209[5 6]	—	-50.6	-41.2	dBm
Error Vector Magnitude, Offset at +20 dBm output power	EVM	Reference Signal is 100 kbps DSSS-OQPSK, continuous pseu- do random binary sequence. Modulated according to Z-Wave Long Range PHY/MAC Layer specification from the Z-Wave Alliance	—	0.3	20	%rms

Average Power spectral density limit	PSD_{AVG_20}	PSD per FCC Part 15.247, 100 kbps O-QPSK, Continuous PN9 sequence, Average method per ANSI C63.10-2020 11.10.3 AVGPSD-1	—	-3.1	+8	dBm/3kHz
Peak Power spectral density limit	PSD_{PEAK_20}	PSD per FCC Part 15.247, 100 kbps O-QPSK, Continuous PN9 sequence, Peak method per ANSI C63.10-2020 11.10.2 Method PKPSD	—	7.3	+8	dBm/3kHz

Note:

1. Supported transmit power levels are determined by the ordering part number (OPN). Transmit power ratings for all devices cov- ered in this datasheet can be found in the Max TX Power column of the Ordering Information Table.
2. The transmit power for the 902 MHz to 928 Band MHz is normally supports +20 dBm or higher when frequency hopping or DSSS is used. Only the +20 dBm devices are recommended with the +20 dBm match.
3. The 20 dBm match is optimized for best efficiency at maximum power. The maximum output power can go up to the maximum rating. Emissions are tested with the output power set to 20 dBm.
4. FCC Title 47 CFR Part 15 Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
5. FCC Title 47 CFR Part 15 Section 15.205 Restricted bands of operation.

FCC Title 47 CFR Part 15 Section 15.209 Radiated emission limits; general requirements.

3.1. Sub-GHz RF Transmitter characteristics for 916 MHz Band, +14 dBm

This table is for devices with a output power rating of +14 dBm using the 915/920 MHz 14 dBm matching network as shown in the typical connections section. Unless otherwise indicated, typical conditions are: T_A = 25 ℃, VREGVDD = 3.3 V, AVDD = DVDD = IOVDD = RFVDD = PAVDD = 1.8 V powered from DCDC. Crystal frequency= 39.0 MHz. RFVDD and external PA supply paths filtered using ferrites. RF center frequency 916 MHz.

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
RF test frequency range	F_{RANGE}		902	—	928	MHz
Maximum TX Power	$POUT_{MAX}$	PAVDD connected to DC-DC output, 14 dBm devices, 14 dBm match[1 2]	12.6	14.3	15.3	dBm
Minimum active TX Power	$POUT_{MIN}$		—	-22.7	—	dBm
Output power variation vs supply at $POUT_{MAX}$	$POUT_{VAR\_V}$	2.2 V < $V_{VREGVDD}$ < 3.8 V, PAVDD connected to DC-DC out- put, T = 25 ℃	—	0.01	—	dB
Output power variation vs temperature, peak to peak	$POUT_{VAR\_T}$	T_A = -40 to +85 ℃ with PAVDD connected to DC-DC output	—	0.6	0.9	dB
		T_A = -40 to +125 ℃ with PAVDD connected to DC-DC output	—	0.8	1.4	dB
Output power variation vs RF frequency	$POUT_{VAR\_F}$	PAVDD connected to DC-DC output, T = 25 ℃	—	0.6	0.9	dB
Spurious emissions of harmonics, Conducted measurement, Test Frequency = 916 MHz	$SPUR_{HARM\_FCC}$	In non-restricted bands, per FCC 47 CFR §15.247[3]	—	-67.6	-20	dBc
		In restricted bands, per FCC 47 CFR §15.205 & §15.209[4 5]	—	-53.5	-41.2	dBm
Unwanted signal emissions over frequency domain, Conducted measurement, Test Frequency = 916 MHz	$SPUR_{OOB\_FCC}$	In non-restricted bands, per FCC 47 CFR §15.247[3]	—	-68.0	-20	dBc
		In restricted bands (30-88 MHz),per FCC 47 CFR §15.205 & §15.209[4 5]	—	-68.3	-55.2	dBm

		In restricted bands (88-216 MHz), per FCC 47 CFR §15.205 & §15.209[4 5]	—	-68.3	-51.7	dBm
		In restricted bands (216-960 MHz), per FCC 47 CFR §15.205 & §15.209[4 5]	—	-68.1	-49.2	dBm
		In restricted bands (>960 MHz), per FCC 47 CFR §15.205 & §15.209[4 5]	—	-56.4	-41.2	dBm
Error Vector Magnitude, Off- set at +14 dBm output power	EVM	Reference Signal is 100 kbps DSSS-OQPSK, continuous pseu- do random binary sequence. Modulated according to Z-Wave Long Range PHY/MAC Layer specification from the Z-Wave Alli- ance	—	0.4	20	%rms
Average Power spectral den- sity limit	PSD_{AVG_14}	PSD per FCC Part 15.247, 100 kbps O-QPSK, Continuous PN9 sequence, Average method per ANSI C63.10-2020 11.10.3 AVGPSD-1	—	-8.7	+8	dB m/ 3kH z
Peak Power spectral density limit	PSD_{PEAK_14}	PSD per FCC Part 15.247, 100 kbps O-QPSK, Continuous PN9 sequence, Peak method per ANSI C63.10-2020 11.10.2 Method PKPSD	—	1.4	+8	dB m/ 3kH z

Note:

1. Supported transmit power levels are determined by the ordering part number (OPN). Transmit power ratings for all devices cov- ered in this datasheet can be found in the Max TX Power column of the Ordering Information Table.
2. The 14 dBm match is optimized for best efficiency at 14 dBm. The maximum output power can go up to the maximum rating. Emissions are tested with the output power set to 14 dBm.
3. FCC Title 47 CFR Part 15 Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
4. FCC Title 47 CFR Part 15 Section 15.205 Restricted bands of operation.

FCC Title 47 CFR Part 15 Section 15.209 Radiated emission limits; general requirements.

3.2. 916 MHz Band 0 dBm RF Transmitter CharacteristicsSub-GHz RF Receiver Characteristics for 916 MHz Band

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
RF test frequency range	F_{RANGE}		902	—	928	MHz
Maximum TX Power	$POUT_{MAX}$	PAVDD connected to DC-DC out- put, 14 dBm devices, +14 dBm match[1] [2] for operation mode un- der FCC 15.249	-1.9	0.4	2.0	dBm
Minimum active TX Power	$POUT_{MIN}$		—	-22.7	—	dBm
Output power variation vs supply at $POUT_{MAX}$	$POUT_{VAR\_V}$	2.2 V < $V_{VREGVDD}$ < 3.8 V, PAVDD connected to DC-DC out- put, T = 25 ℃	—	0.01	—	dB
Output power variation vs temperature, peak to peak	$POUT_{VAR\_T}$	T_A = -40 to +85 ℃ with PAVDD connected to DC-DC output	—	1.2	1.9	dB
		T_A = -40 to +125 ℃ with PAVDD connected to DC-DC output	—	1.5	2.4	dB
Output power variation vs RF frequency	$POUT_{VAR\_F}$	PAVDD connected to DC-DC out- put, T = 25 ℃	—	0.6	0.9	dB
Spurious emissions of har- monics at 0 dBm output pow- er, Conducted measurement, 0dBm match, Test Frequen- cy = 908.4 MHz	$SPUR_{HARM\_FCC}$	Per FCC 47 CFR §15.205 & §15.209[3] [4]	—	-52.8	-41.2	dBm
Spurious emissions out-of- band at 0 dBm output power, Conducted measurement, 0dBm match, Test Frequen- cy = 908.4 MHz	$SPUR_{OOB\_FCC}$	(30-88 MHz),per FCC 47 CFR §15.205 & §15.209[3] [4]	—	-79.4	-55.2	dBm
		(88-216 MHz), per FCC 47 CFR §15.205 & §15.209[3] [4]	—	-76.6	-51.7	dBm
		(216-960 MHz), per FCC 47 CFR §15.205 & §15.209[3] [4]	—	-69.5	-49.2	dBm
		(>960 MHz), per FCC 47 CFR §15.205 & §15.209[3] [4]	—	-70.7	-41.2	dBm

Note:

1. Supported transmit power levels are determined by the ordering part number (OPN). Transmit power ratings for all devices cov- ered in this datasheet can be found in the Max TX Power column of the Ordering Information Table.
2. The 14 dBm match is optimized for best efficiency at 14 dBm. The maximum output power can go up to the maximum rating. All parameters are tested with the output power set to 0 dBm.
3. FCC Title 47 CFR Part 15 Section 15.205 Restricted bands of operation.
4. FCC Title 47 CFR Part 15 Section 15.209 Radiated emission limits; general requirements.

power set to 10 dBm.

3. Specific regional requirements for this band normally limit the maximum Tx power in this band to 10 dBm or less. Only the 14 dBm part numbers are reccomended for this band.
4. Conducted measurement per EN 300-220-1 v3.1.1 5.9.3.3.1
5. Spurious emission limits per EN 300-220-1 v3.1.1 5.9.2
6. FCC emissions are specificed at a power level of 10 dBm conducted. A lower power setting may be required to meet the FCC limit specified in μV at 3m.
7. FCC Title 47 CFR Part 15 Section 15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz.
8. FCC Title 47 CFR Part 15 Section 15.205 Restricted bands of operation.
   FCC Title 47 CFR Part 15 Section 15.209 Radiated emission limits; general requirements.

RF Receiver Characteristics

916 MHz Band RF Receiver Characteristics for Z-Wave

Unless otherwise indicated, typical conditions are: T_A = 25 ℃, VREGVDD = 3.3 V, AVDD = DVDD = IOVDD = RFVDD = PAVDD = 1.8 V powered from DCDC. Crystal frequency= 39.0 MHz. RFVDD and external PA supply paths filtered using ferrites. RF center frequency 916 MHz.

Table 4.19. 916 MHz Band RF Receiver Characteristics for Z-Wave

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
RF test frequency range	F_{RANGE}		902	—	928	MHz
Max usable input level, 1% FER	SAT_{100K}	Desired is reference 100 kbps GFSK signal[1]	—	—	10.0	dBm
Sensitivity	SENS	Desired is reference 9.6 kbps 2FSK signal[2], 1% FER, frequency = 908.42 MHz, T ≤ 85 °C	—	-109.3	—	dBm
		Desired is reference 40 kbps 2FSK signal[3], 1% FER, frequency = 908.4 MHz, T ≤ 85 °C	—	-109.7	—	dBm
		Desired is reference 100 kbps GFSK signal[1], 1% FER, frequen- cy = 916 MHz, T ≤ 85 ℃	—	-108.1	—	dBm
		Desired is reference 100 kbps O- QPSK signal[4], 1% FER, frequen- cy = 912 MHz, T ≤ 85 ℃	—	-109.8	—	dBm
Image rejection, Interferer is CW at image frequency	C/I_{IMAGE}	Desired is reference 9.6 kbps 2FSK signal[2] at 3dB above sensi- tivity level, 1% FER, frequency = 908.42 MHz	—	50.7	—	dB
		Desired is reference 40 kbps 2FSK signal[3] at 3dB above sensi- tivity level, 1% FER, frequency = 908.4 MHz	—	50.9	—	dB
		Desired is 100 kbps GFSK signal[1] at 3dB above sensitivity level, 1% FER, frequency = 916 MHz	—	49.6	—	dB
		Desired is reference 100 kbps O- QPSK signal[4], 1% FER, frequen- cy = 912 MHz	—	53.3	—	dB
Blocking selectivity, 1% FER. Desired is 9.6 kbps 2FSK signal[2] at 3dB above sensi- tivity level, frequency = 908.42 MHz	$C/I_{BLOCKER\_9p6}$	Interferer CW at Desired ±1 MHz	—	58.7	—	dB
		Interferer CW at Desired ±2 MHz	—	63.5	—	dB
		Interferer CW at Desired ±5 MHz	—	73.0	—	dB
		Interferer CW at Desired ± 10 MHz	—	79.0	—	dB
		Interferer CW at Desired ± 100 MHz	—	82.5	—	dB

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Blocking selectivity, 1% FER. Desired is 40 kbps 2FSK signal[3] at 3dB above sensitivity level, frequency = 908.4 MHz	$C/I_{BLOCKER\_40}$	Interferer CW at Desired ±1 MHz	—	59.3	—	dB
		Interferer CW at Desired ±2 MHz	—	63.7	—	dB
		Interferer CW at Desired ±5 MHz	—	73.6	—	dB
		Interferer CW at Desired ±10 MHz	—	79.4	—	dB
		Interferer CW at Desired ±100 MHz	—	82.1	—	dB
Blocking selectivity, 1% FER. Desired is 100 kbps GFSK signal[1] at 3dB above sensitivity level, frequency = 916 MHz	$C/I_{BLOCKER\_100}$	Interferer CW at Desired ±1 MHz	—	49.6	—	dB
		Interferer CW at Desired ±2 MHz	—	63.1	—	dB
		Interferer CW at Desired ±5 MHz	—	72.3	—	dB
		Interferer CW at Desired ±10 MHz	—	78.0	—	dB
		Interferer CW at Desired ±100 MHz	—	80.3	—	dB
Blocking selectivity, 1% FER. Desired is reference 100 kbps O-QPSK signal[4], 1% FER, frequency = 912 MHz, P_in = -89 dBm	$C/BLOCK\_ER_{OQPSK}$	Interferer CW at Desired ±2 MHz	—	58.4	—	dB
		Interferer CW at Desired ±5 MHz	—	72.2	—	dB
		Interferer CW at Desired ±10 MHz	—	78.9	—	dB
		Interferer CW at Desired ±100 MHz	—	84.3	—	dB
Intermod selectivity, 1% FER. CW interferers at 400 kHz and 800 kHz offsets	C/I_{IM}	Desired is 100 kbps GFSK signal[1] at 3dB above sensitivity level	—	43.4	—	dB
Upper limit of input power range over which RSSI resolution is maintained	$RSSI_{MAX}$		—	—	10.0	dBm
Lower limit of input power range over which RSSI resolution is maintained	$RSSI_{MIN}$		-90.0	—	—	dBm
RSSI resolution	$RSSI_{RES}$	Over $RSSI_{MIN}$ to $RSSI_{MAX}$ range	—	0.25	—	dB
Max spurious emissions during active receive mode, per FCC Part 15.109(a)	$SPUR_{RX\_FCC}$	216-960 MHz	—	-81.7	-49.2	dBm
		Above 960 MHz	—	-78.7	-41.2	dBm

Note:

1. Definition of reference signal is 100 kbps 2GFSK, BT=0.6, Δf = 58 kHz, NRZ, '0' = F_center + Δf/2, '1' = F_center - Δf/2
2. Definition of reference signal is 9.6 kbps 2FSK, Δf = 40 kHz, Manchester, '0' = Transition from (F_center + Δf/2), '1' = Transition from (F_center - Δf/2)
3. Definition of reference signal is 40 kbps 2FSK, Δf = 40 kHz, NRZ, '0' = F_center + Δf/2, '1' = F_center - Δf/2
4. Definition of reference signal is 100 kbps O-QPSK, 800 kcps chip rate, 8x spreading factor, 32 bit chip length, 4 bits per symbol

915 MHz Band RF Receiver Characteristics

Band is 902 to 928 MHz. Unless otherwise indicated, typical conditions are: T_A = 25 ℃, VREGVDD = 3.3 V, AVDD = DVDD = IOVDD = RFVDD = PAVDD = 1.8 V powered from DCDC. Crystal frequency= 39.0 MHz. RFVDD and external PA supply paths filtered using ferrites. RF center frequency 915 MHz.

Table 4.20. 915 MHz Band RF Receiver Characteristics

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
RF test frequency range	F_{RANGE}		902	—	928	MHz
Max usable input level, 0.1% BER	SAT_{2M}	Desired is reference 2 Mbps 2GFSK signal[1]	—	—	10	dBm
Sensitivity	SENS	Desired is reference 4.8 kbps OOK signal, PER<20%[2]	—	-113.1	—	dBm
		Desired is reference 50 kbps 2FSK signal, Δf = ± 25 kHz, PER<10%[3]	—	-110.1	—	dBm
		Desired is reference 50 kbps 2FSK signal, Δf = ± 25 kHz, PER<10% with FEC[4]	—	-114.2	—	dBm
		Desired is reference 150 kbps 2FSK signal, Δf = ± 37.5 kHz, PER<10%[5]	—	-107.5	—	dBm
		Desired is reference 2 Mbps 2GFSK signal, Δf = ± 500 kHz, BER<0.1%[1]	—	-96.9	—	dBm
		Desired is reference 4.8 kbps O-QPSK signal, spreading factor=8, PER<1%[6]	—	-125.8	—	dBm
		Desired is reference 250 kbps O-QPSK DSSS signal, PER<1%[7]	—	-103.5	—	dBm
		Desired is reference 120 kbps OOK signal[8], PER<20%	—	-102.6	—	dBm
Adjacent channel selectivity, Interferer is CW at ±1 ×channel-spacing	C/I_1	Desired is reference 4.8 kbps OOK signal[2] at 3dB above sensi- tivity level	—	49.6	—	dB
		Desired is reference 50 kbps 2FSK signal[3] at 3dB above sensi- tivity level	—	44.1	—	dB
		Desired is reference 150 kbps 2FSK signal[5] at 3dB above sensi- tivity level	—	43.8	—	dB
		Desired is reference 250 kbps O-QPSK DSSS signal[7] at 3dB above sensitivity level	—	46.6	—	dB

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Alternate channel selectivity, Interferer is CW at ±2 × channel-spacing	C/I_2	Desired is reference 4.8 kbps OOK signal[2] at 3dB above sensi- tivity level	—	64.0	—	dB
		Desired is reference 50 kbps 2FSK signal[3] at 3dB above sensi- tivity level	—	51.5	—	dB
		Desired is reference 150 kbps 2FSK signal[5] at 3dB above sensi- tivity level	—	57.7	—	dB
		Desired is reference 250 kbps O-QPSK DSSS signal[7] at 3dB above sensitivity level	—	50.7	—	dB
Image rejection, Interferer is CW at image frequency	C/I_{IMAGE}	Desired is reference 4.8 kbps OOK signal[2] at 3dB above sensi- tivity level	—	43.0	—	dB
		Desired is reference 50 kbps 2FSK signal[3] at 3dB above sensi- tivity level	—	44.0	—	dB
		Desired is reference 150 kbps 2FSK signal[5] at 3dB above sensi- tivity level	—	44.5	—	dB
		Desired is reference 250 kbps O-QPSK DSSS signal[7] at 3dB above sensitivity level	—	52.3	—	dB
Blocking selectivity, PER < 10%. Desired is 50 kbps 2GFSK signal at 3dB above sensitivity level	$C/I_{BLOCKER}$	Interferer CW at Desired ±1 MHz	—	63.9	—	dB
		Interferer CW at Desired ±2 MHz	—	71.3	—	dB
		Interferer CW at Desired ±10 MHz	—	81.4	—	dB
Intermod selectivity, PER < 10%. CW interferers at 400 kHz and 800 kHz offsets	C/I_{IM}	Desired is reference 50 kbps 2GFSK signal[3] at 3dB above sen- sitivity level	—	48.2	—	dB
Upper limit of input power range over which RSSI reso- lution is maintained	$RSSI_{MAX}$		—	—	10.0	dBm
Lower limit of input power range over which RSSI reso- lution is maintained	$RSSI_{MIN}$		-97.0	—	—	dBm
RSSI resolution	$RSSI_{RES}$	Over $RSSI_{MIN}$ to $RSSI_{MAX}$ range	—	0.25	—	dB
Max spurious emissions dur- ing active receive mode, per FCC Part 15.109(a)	$SPUR_{RX\_FCC}$	216-960 MHz	—	-81.7	-49.2	dBm
		Above 960 MHz	—	-78.7	-41.2	dBm

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Alternate channel selectivity, Interferer is CW at ±2 × channel-spacing	C/I_2	Desired is reference 2.4 kbps 2GFSK signal[2] at 3dB above sensitivity level	—	-44.4	—	dBm
		Desired is reference 38.4 kbps 2GFSK signal[3] at 3dB above sensitivity level	—	37.9	—	dB
		Desired is reference 50 kbps 2FSK signal[4] at 3dB above sensi- tivity level	—	42.8	—	dB
		Desired is reference 100 kbps 2FSK signal[5] at 3dB above sensi- tivity level	—	51.2	—	dB
		Desired is reference 100 kbps O-QPSK DSSS signal [7] at 3dB above sensitivity level	—	65.7	—	dB
Image rejection, Interferer is CW at image frequency	C/I_{IMAGE}	Desired is reference 2.4 kbps 2GFSK signal[2] at 3dB above sensitivity level	—	-51.0	—	dBm
		Desired is reference 38.4 kbps 2GFSK signal[3] at 3dB above sensitivity level	—	38.0	—	dB
		Desired is reference 50 kbps 2FSK signal[4] at 3dB above sensi- tivity level	—	43.7	—	dB
		Desired is reference 100 kbps 2FSK signal[5] at 3dB above sensi- tivity level	—	44.9	—	dB
		Desired is reference 100 kbps O-QPSK DSSS signal [7] at 3dB above sensitivity level	—	50.3	—	dB
Blocking selectivity, 0.1% BER. Desired is 2.4 kbps 2GFSK signal[2] at 3 dB above sensitivity level	$C/I_{BLOCKER\_24}$	Interferer CW at Desired ±2 MHz	—	-17.0	—	dBm
		Interferer CW at Desired ±10 MHz	—	-6.7	—	dBm
		Interferer CW at Desired ±43.4 MHz	—	-4.5	—	dBm
Blocking selectivity, 10% PER. Desired is 50 kbps 2GFSK signal[4] at 3 dB above sensitivity level	$C/I_{BLOCKER\_50}$	Interferer CW at Desired ±1 MHz	—	65.5	—	dB
		Interferer CW at Desired ±2 MHz	—	72.3	—	dB
		Interferer CW at Desired ±10 MHz	—	80.8	—	dB
Upper limit of input power range over which RSSI resolution is maintained	$RSSI_{MAX}$		—	—	10	dBm

Lower limit of input power range over which RSSI resolution is maintained	$RSSI_{MIN}$		-103	—	—	dBm
RSSI resolution	$RSSI_{RES}$	Over $RSSI_{MIN}$ to $RSSI_{MAX}$ range	—	0.25	—	dB

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Max spurious emissions during active receive mode	$SPUR_{RX}$	30 MHz to 1 GHz	—	-81.7	-57	dBm
		1 GHz to 12 GHz	—	-71.7	-47	dBm

Note:

1. Definition of reference signal is 500 kbps 2GMSK, BT = 0.5, mi = 0.5, BER<0.1%, RX channel BW = 753.320 kHz. Crystal toler- ance = 0 ppm.
2. Definition of reference signal is 2.4 kbps 2GFSK, BT = 0.5, mi = 1.0, BER<0.1%, RX channel BW = 10 kHz, channel spacing = 25 kHz.
3. Definition of reference signal is 38.4 kbps 2GFSK, BT = 0.5, mi = 1.04, BER<0.1%, RX channel BW = 74.809 kHz, channel spac- ing = 100 kHz. Crystal tolerance = 0 ppm.
4. Definition of reference signal is 50 kbps 2FSK, BT = 2, mi = 0.5, PER<10%, Channel Spacing = 100 kHz, Data Whitening, no FEC. Per Wi-SUN FAN PHY 1.0 standard mode #1a.
5. Definition of reference signal is 100 kbps 2FSK, BT = 2, mi = 0.5, PER<10%, Channel Spacing = 200 kHz, Data Whitening, no FEC. Per Wi-SUN FAN PHY 1.0 standard mode #2a.
6. The modulation bandwidth may not be suitable for regional regulatory requirements in this band. Crystal tolerance = 0 ppm.
7. Definition of reference signal is O-QPSK DSSS per IEEE802.15.4, Data rate = 100 kbps, 4 bit to 16 chip PN sequence mapping, PER<1%, Channel Spacing = 2 MHz, payload length=20 octets.

433 MHz Band RF Receiver Characteristics

Band is 433.05 MHz to 434.79 MHz. Unless otherwise indicated, typical conditions are: T_A = 25 ℃, VREGVDD = 3.3 V, AVDD = DVDD = IOVDD = RFVDD = PAVDD = 1.8 V powered from DCDC. Crystal frequency= 39.0 MHz. RFVDD and external PA supply paths fil- tered using ferrites. RF center frequency 433.92 MHz.

Table 4.23. 433 MHz Band RF Receiver Characteristics

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
RF test frequency range	F_{RANGE}		433	—	434.79	MHz
Max usable input level, 0.1% BER	SAT_{100k}	Desired is reference 100 kbps 2GFSK signal, BER<0.1%[1]	—	—	10	dBm
Sensitivity	SENS	Desired is reference 2.4 kbps 2GFSK signal, Δf = ± 1.2 kHz, BER<0.1%[2]	—	-126.9	—	dBm
		Desired is reference 4.8 kbps OOK signal, PER<20%[3]	—	-114.2	—	dBm
		Desired is reference 100 kbps 2GFSK signal, Δf = ± 50 kHz, BER<0.1%[1]	—	-110.7	—	dBm
		Desired is reference 50 kbps 2GFSK signal, Δf = ± 25 kHz, BER<0.1%[4]	—	-113.8	—	dBm
		Desired is reference 50 kbps 4GFSK signal, Δf_o = ±25 kHz, Δf_i = ±8.33 kHz, PER<1%[5]	—	-112.1	—	dBm
		Desired is reference 460 MHz 4.8 kbps 2FSK signal, Δf = ± 2.4 kHz, PER<10%[6]	—	-122.5	—	dBm
Adjacent channel selectivity, Interferer is CW at ±1 × channel-spacing	C/I_1	Desired is reference 4.8 kbps OOK signal[3] at 3dB above sensi- tivity level	—	54.7	—	dB
		Desired is reference 2.4 kbps 2GFSK signal[2] at 3dB above sen- sitivity level	—	63.9	—	dB
Alternate channel selectivity, Interferer is CW at ±2 × channel-spacing	C/I_2	Desired is reference 4.8 kbps OOK signal[3] at 3dB above sensi- tivity level	—	67.5	—	dB
		Desired is reference 2.4 kbps 2GFSK signal[2] at 3dB above sen- sitivity level	—	63.9	—	dB
Image rejection, Interferer is CW at image frequency	C/I_{IMAGE}	Desired is reference 4.8 kbps OOK signal[3] at 3dB above sensi- tivity level	—	49.6	—	dB
		Desired is reference 2.4 kbps 2GFSK signal[2] at 3dB above sen- sitivity level	—	73.9	—	dB

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit

Blocking selectivity, 0.1% BER. Desired is 2.4 kbps 2GFSK signal[2] at 3dB above sensitivity level	$C/I_{BLOCKER}$	Interferer CW at Desired ±1 MHz	—	84.1	—	dB
		Interferer CW at Desired ±2 MHz	—	90.6	—	dB
		Interferer CW at Desired ±10 MHz	—	95.8	—	dB
Intermod selectivity, 0.1% BER. CW interferers at 12.5 kHz and 25 kHz offsets	C/I_{IM}	Desired is reference 2.4 kbps 2GFSK signal[2] at 3dB above sensitivity level	—	56.1	—	dB
Upper limit of input power range over which RSSI resolution is maintained	$RSSI_{MAX}$		—	—	10	dBm
Lower limit of input power range over which RSSI resolution is maintained	$RSSI_{MIN}$		-111.0	—	—	dBm
RSSI resolution	$RSSI_{RES}$	Over $RSSI_{MIN}$ to $RSSI_{MAX}$ range	—	0.25	—	dB
Max spurious emissions during active receive mode, per FCC Part 15.109(a)	$SPUR_{RX\_FCC}$	216-960 MHz	—	-81.0	-49.2	dBm
		Above 960 MHz	—	-79.4	-41.2	dBm
Max spurious emissions during active receive mode, per ETSI 300-220 Section 8.6	$SPUR_{RX\_ETSI}$	Below 1000 MHz	—	-81.4	-57	dBm
		Above 1000 MHz	—	-72.2	-47	dBm
Max spurious emissions during active receive mode, per ARIB STD T67 Section 3.3(5)	$SPUR_{RX\_ARIB}$	Below 710 MHz, RBW=100kHz	—	-84.8	-54	dBm

Note:

1. Definition of reference signal is 100 kbps 2GFSK, BT = 0.5, mi = 1.0, BER<0.1%, RX channel BW = 200 kHz, Crystal tolerance = 0 ppm.
2. Definition of reference signal is 2.4 kbps 2GFSK, BT = 0.5, mi = 1.0, BER<0.1%, Channel Spacing = 12.5 kHz, RX channel BW = 4.8 kHz.
3. Definition of reference signal is 4.8 kbps Manchester-encoded OOK, RX channel BW = 350 kHz, channel spacing = 500 kHz.
4. Definition of reference signal is 50 kbps 2GFSK, BT = 0.5, mi = 1.0, BER<0.1%, RX channel BW = 100 kHz, Crystal tolerance = 0 ppm.
5. Definition of reference signal is 50 kbps 4GFSK, BT = 1.0, mi = 0.66, PER<1%, RX channel BW = 74.98 kHz, Crystal tolerance = 0 ppm.
6. Definition of reference signal is 4.8 kbps 2FSK, BT = 2, mi = 1.0, PER<10%, Channel Spacing = 12.5 kHz, Data Whitening, no FEC, 460 MHz center frequency. Per IEEE 802.15.4g 450 MHz band, mode 2.

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
RF synthesizer frequency range	f_{RANGE}	742 - 970 MHz	742	—	970	MHz
		557 - 727 MHz	557	—	727	MHz
		372 - 557 MHz	372	—	557	MHz
		223 - 372 MHz	223	—	372	MHz
		110 - 223 MHz	110	—	223	MHz
LO tuning frequency resolu- tion with 39.0 MHz crystal	f_{RES}	742 - 970 MHz	—	—	24.8	Hz
		557 - 727 MHz	—	—	18.6	Hz
		372 - 557 MHz	—	—	12.4	Hz
		223 - 372 MHz	—	—	7.4	Hz
		110 - 223 MHz	—	—	5.0	Hz
Frequency deviation resolu- tion with 39.0 MHz crystal	df_{RES}	742 - 970 MHz	—	—	24.8	Hz
		557 - 727 MHz	—	—	18.6	Hz
		372 - 557 MHz	—	—	12.4	Hz
		223 - 372 MHz	—	—	7.4	Hz
		110 - 223 MHz	—	—	5.0	Hz
Maximum frequency devia- tion with 39.0 MHz crystal	df_{MAX}	742 - 970 MHz	—	—	617	kHz
		557 - 727 MHz	—	—	463	kHz
		372 - 557 MHz	—	—	308	kHz
		223 - 372 MHz	—	—	185	kHz
		110 - 223 MHz	—	—	116	kHz

4. Antenna

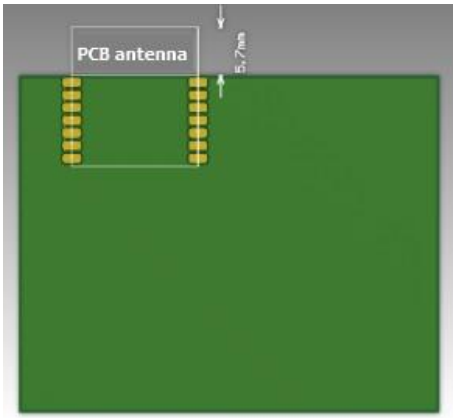
4.1. Antenna type

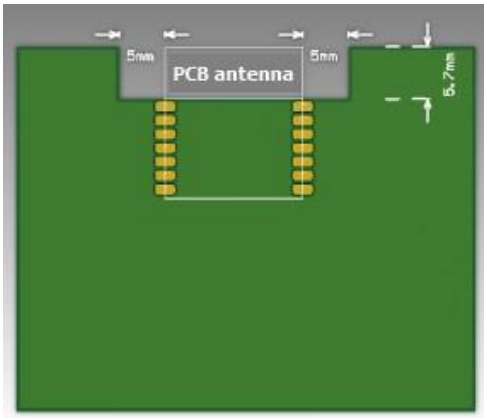
uses an onboard PCB antenna or Ipex antenna.

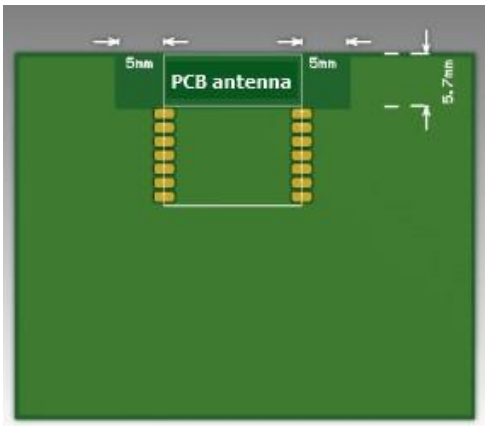
4.2. Antenna interference reduction

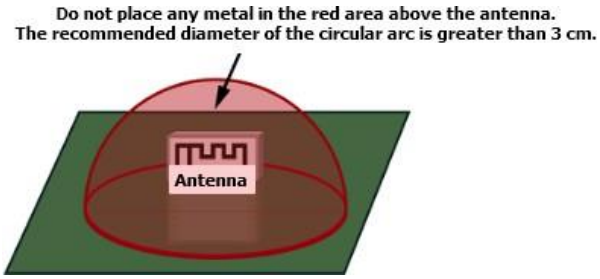
To ensure optimal Z-WAVE performance when the module uses an onboard PCB antenna, it is recommended that the antenna be at least 5 mm away from other metal parts.

To prevent an adverse impact on the antenna radiation performance, avoid copper or traces along the antenna area on the PCB.









5. Firmware

5.1. Docking support

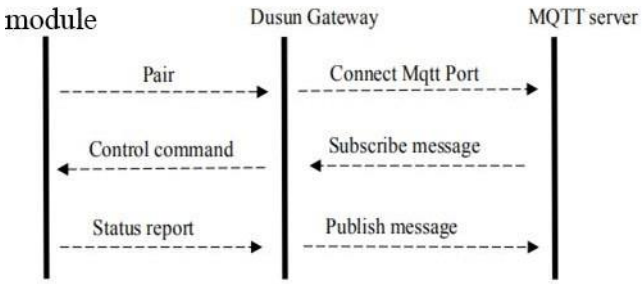
A. API

Support customized various product solutions. and provide related API documents and support. Customers can pair the device to the gateway (Dusun gateway or Private gateway)according to the API description and standard protocol.

API content includes reading sensor data, controlling device switches, changing device configuration, OTA, etc.

B. MQTT

It can provide the erminal device customization + Dusun gateway overall solution, and can provide the MQTT protocol for the gateway to connect to the customer platform. Customers can easily deploy the entire system and view the status and data of the terminal equipment at any time.



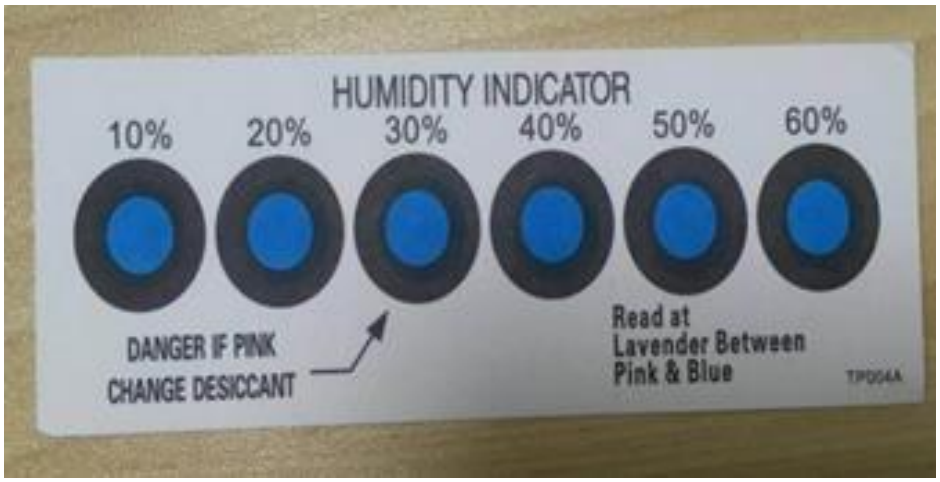
5.2. Product list

Product Name	Wireless Devices	Firmware version
DSM-103-1	Temperature &humidity sensor	DSM-103_T&H sensor.bin
DSM-103-2	Door/window sensor	DSM-103_Beacon.bin
DSM-103-3	PIR	DSM-103_ PIR.bin
DSM-103-4	Leakage	DSM-103_Leakage.bin
DSM-103-5	Plug	DSM-103-Plug.bin
DSM-103-6	Switch(3 gang)	DSM-103-Switch.bin
DSM-103-7	Smoke	DSM-103-Smoke.bin
DSM-103-8	Emergency button	DSM-103-SOS button.bin
DSM-103-9	RGB lighting	DSM-103-lighting.bin
DSM-103-10	Strip(4 gang)	DSM-103-Strip.bin

6. Production instruction

Use an SMT placement machine to mount components to the stamp hole module that Dusun produces within 24 hours after the module is unpacked and the firmware is burned. If not, vacuum pack the module again. Bake the module before mounting components to the module.

- SMT placement equipment: Reflow soldering machine
  Automated optical inspection (AOI) equipment Nozzle with a 6 mm to 8 mm diameter
- Baking equipment:
  Cabinet oven
  Anti-static heat-resistant trays Anti-static heat-resistant gloves
- Storage conditions for a delivered module are as follows:
  The moisture-proof bag is placed in an environment where the temperature is below 30℃ and the relative humidity is lower than 70%.
  The shelf life of a dry-packaged product is six months from the date when the product is packaged and sealed.
  The package contains a humidity indicator card (HIC).



- Bake a module based on HIC status as follows when you unpack the module package: If the 30%, 40%, and 50% circles are blue, bake the module for 2 consecutive hours. If the 30% circle is pink, bake the module for 4 consecutive hours.
  If the 30% and 40% circles are pink, bake the module for 6 consecutive hours.
  If the 30%, 40%, and 50% circles are pink, bake the module for 12 consecutive hours.
- Baking settings:
  Baking temperature: 125±5℃
  Alarm temperature: 130℃

SMT placement ready temperature after natural cooling: < 36℃

Number of drying times: 1

Rebaking condition: The module is not soldered within 12 hours after baking.

- Do not use SMT to process modules that have unpacked for over three months.

Electroless nickel immersion gold (ENIG) is used for the PCBs. If the solder pads are exposed to the air

for over three months, they will be oxidized severely and dry joints or solder skips may occur. Dusun is not liable for such problems and consequences.

- Before SMT placement, take electrostatic discharge (ESD) protective measures.

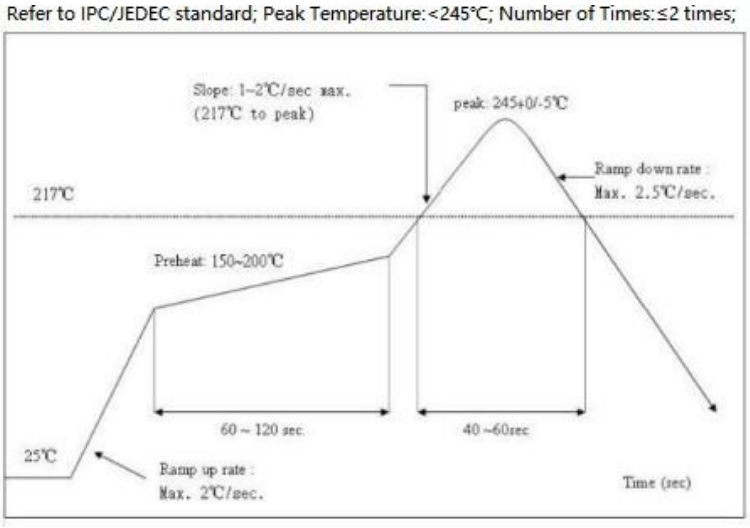
  To reduce the reflow defect rate, draw 10% of the products for visual inspection and AOI before first SMT placement to determine a proper oven temperature and component placement method. Draw 5 to 10 modules every hour from subsequent batches for visual inspection and AOI.

7. Recommended oven temperature curve

7.1. Reflow soldering temperature profile

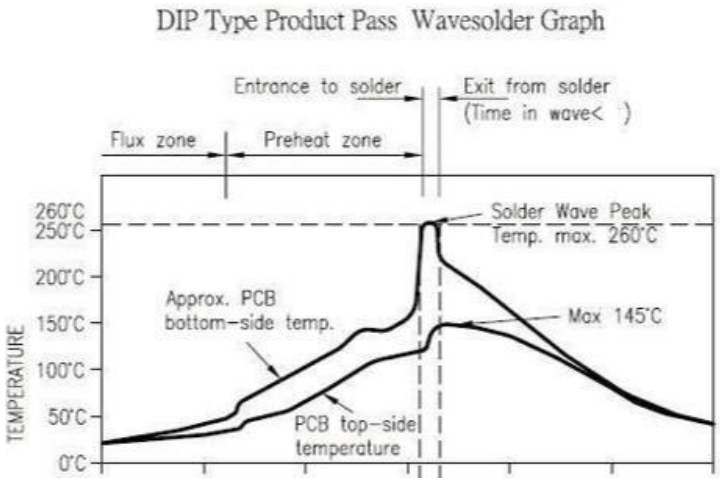
Perform SMT placement based on the following reflow oven temperature curve. The highest temperature is 245℃.

Based on the IPC/JEDEC standard, perform reflow soldering on a module at most twice.



7.2. Wave soldering temperature curve

Please refer to the recommended furnace temperature setting for wave soldering, the peak temperature is 260℃±5℃, and the wave soldering temperature curve is shown in the figure below:



8. Storage conditions

9. packing

Product type	MOQ	Packing method	Number of Modules in Each Reel Pack	Number of Reel Packs in Each Box
DSM-103	4000	Carrier tape and reel packing	1000	4

FCC Statement

FCC standards: FCC CFR Title 47 Part 15 Subpart C Section 15.249

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.

Any Changes or modifications 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 and used in accordance with the instructions,m ay 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.

FCC Radiation Exposure Statement

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.

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: 2AWWFDSGM-103 or Contains FCC ID: “2AWWFDSGM-103”

When the module is installed inside another device, the user manual of the host mustco ntain below warning statements;
1. 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.
(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 ClassB 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 correc t 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.
2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.
Any company of the host device which install this modular with modular approval should perform the test of radiated & conducted emission and spurious emission,etc. according to FCC part 15C :15.231 and 15.209 &
15.207 , 15B Class B requirement, only if the test result comply with FCC part 15C : 15.249 and 15.209 & 15.207 , 15B Class B requirement, then the host can be sold legally.