GigaDevice Semiconductor Inc.

GD32VW553-MINI

Wi-Fi Single Band 1x1 802.11b/g/n/ax + BLE 5.2

IoT Combo Module

Datasheet

Revision 1.0

(DEC. 2024)

Website: www.GD32MCU.com

Table of Contents

Table of Contents 2
List of Figures 3
List of Tables 4
1. General Features 5
2. General description 6
3. Block diagram 7
4. Pin definition 8
4.1. Pinouts 8
4.2. Pin definitions 8
5. Wireless radio characteristics 11
5.1. Wi-Fi characteristics 11
5.2. Bluetooth LE characteristics 12
6. Electrical Characteristics 13
6.1. Absolute maximum ratings 13
6.2. Operating conditions 13
6.3. Power consumption 13
7. Size information 15
7.1. Physical dimensions 15
7.2. Layout recommendation 16
7.3. Dimensions of external antenna connector 17
8. Peripheral circuit reference design 18
9. Requirements for antenna placement 19
10. Recommended reflow profile 20
11. Package 21
11.1. Reel 21
12. Moisture sensitivity 22
13. Revision history 23

List of Figures

Figure 3-1. Block diagram 7
Figure 4-1. Pinouts from top view 8
Figure 7-1. Physical dimensions of MINI-I 15
Figure 7-2. Physical dimensions of MINI-E 15
Figure 7-3. Layout recommendation of MINI-I 16
Figure 7-4. Layout recommendation of MINI-E 16
Figure 7-5. Dimensions of IPEX connector 17
Figure 8-1. Reference design 18
Figure 9-1. Recommended Placement 19
Figure 10-1. Recommended reflow profile 20
Figure 11-1. Reel detail 21

List of Tables

Table 2-1. Description of module types 6
Table 4-1. Pin definitions 8
Table 5-1. Wi-Fi characteristics 11
Table 5-2. BLE characteristics 12
Table 6-1. Absolute maximum ratings 13
Table 6-2. Operating conditions 13
Table 6-3. Power consumption (1)(2)(3) 13
Table 8-1. Boot mode selection 18
Table 10-1. Reflow process and condition 20
Table 13-1. Revision history 23

1. General Features

- Built-in QFN32 GD32VW553 chip, RISC-V 32-bit processor up to 160 MHz
- Built-in 4096 KB on-chip Flash memory and 320KB (288 KB + 32KB Shared) SRAM memory
- 802.11b/g/n/ax compatible
- 802.11i (WPA, WPA2, WPA3). Open, shared key, and pair-wise key authentication services
- Single antenna 1x1 stream in 20MHz channels
- Support of 802.11ax MCS up to MCS9 with a Max PHY rate of 114.7Mbps
- Bluetooth LE 5.2
- Support of BLE High-Speed 2M PHY and Long-Range modes (125 kbps, 500 kbps).
- Peripheral interfaces: 20 GPIOs, support of ADC, PWM, UART, I2C, SPI
- Onboard PCB antenna for GD32VW553-MINI-IMKx, and external IPEX connector for the GD32VW553-MINI-EMKx
- Operating voltage: 3.0V ~ 3.6V
- Operating temperature: -40 ~ 85℃ for grade 6 and -40 ~ 105℃ for grade 7

2. General description

The GD32VW553-MINI series modules are highly integrated 2.4GHz Wi-Fi and BLE modules, they are optimized modules designed for a broad array of smart devices for Internet of Things (IoT) applications especially in areas such as industrial control, motor drives, user interface, power monitor and alarm systems, consumer and handheld equipment, gaming and GPS, E-bike, optical module and so on.
The GD32VW553-MINI series modules are currently available in four types, based on different antenna type and operating temperature.

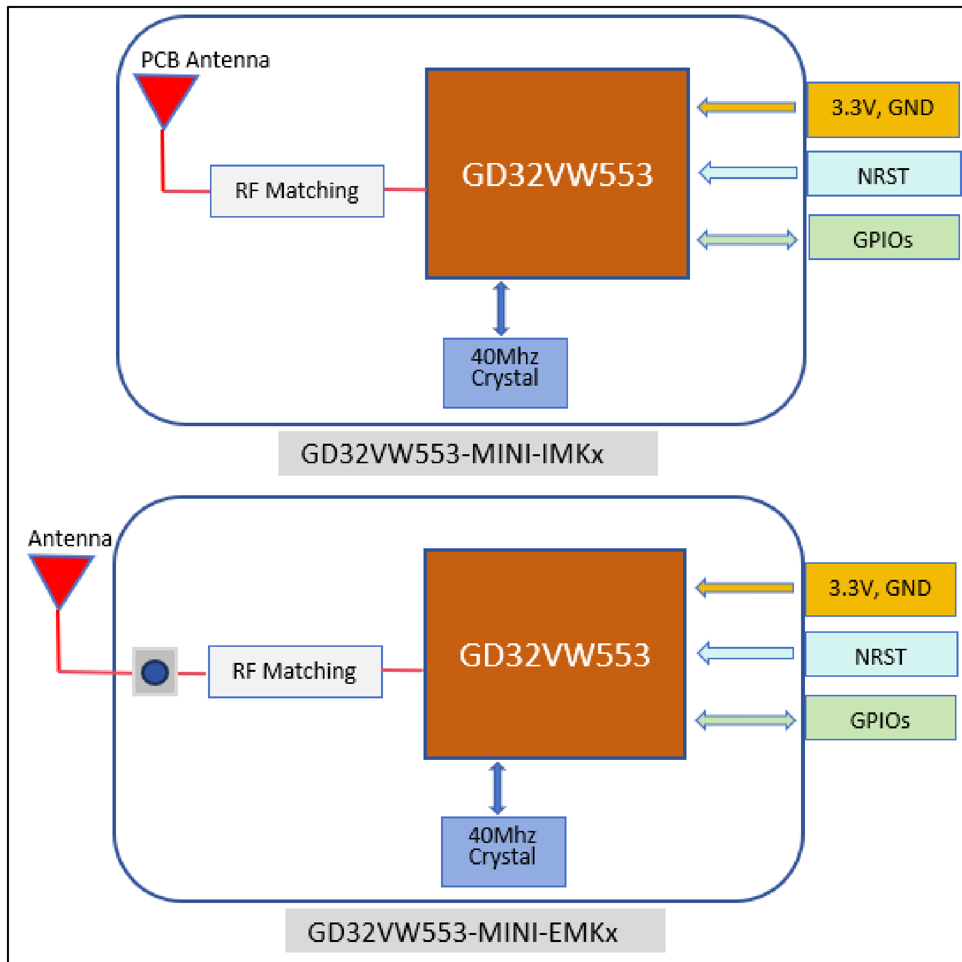
Table 2-1. Description of module types

Module Part Number	Flash	Operating Temperature	Antenna Type	Module Size(mm)
GD32VW553-MINI-IMK6	4MB	-40 ~ 85℃	Onboard	15 x 12.4 x 2.4
GD32VW553-MINI-IMK7		-40 ~ 105℃	Onboard	15 x 12.4 x 2.4
GD32VW553-MINI-EMK6		-40 ~ 85℃	External	9.5 x 12.4 x 2.4
GD32VW553-MINI-EMK7		-40 ~ 105℃	External	9.5 x 12.4 x 2.4

3. Block diagram

An onboard PCB antenna is used for GD32VW553-MINI-IMKx, while an external antenna with an IPEX connector is used for GD32VW553-MINI-EMKx.

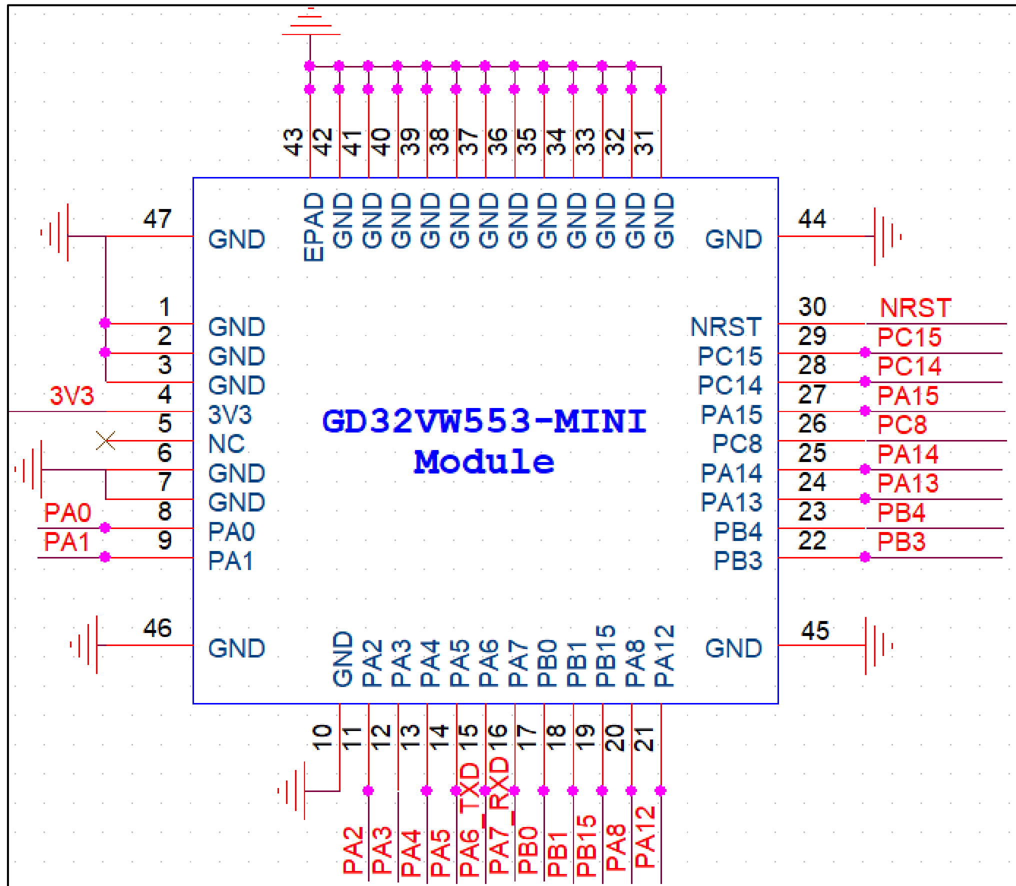
Figure 3-1. Block diagram



4. Pin definition

4.1. Pinouts

Figure 4-1. Pinouts from top view



4.2. Pin definitions

Table 4-1. Pin definitions

NO.	Name	Type	Function Description
1,2,3,6,7, 10,31~47	GND	P	GND
4	3V3	P	3.3V(+/-0.3)
5	NC	---	Not connect
8	PA0	I/O	Default: PA0 Alternate: USART0_TX, TIMER1_CH0, TIMER1_ETI, SPI_MOSI, UART1_CTS, TIMER0_ETI, EVENTOUT Additional: ADC_IN0, WAKEUP0, RTC_TAMP1

9	PA1	I/O	Default: PA1 Alternate: USART0_RX, TIMER1_CH1, SPI_MISO, UART1_RTS, EVENTOUT Additional: ADC_IN1
11	PA2	I/O	Default: PA2 Alternate: USART0_CTS, TIMER1_CH2, I2C0_SCL, SPI_SCK, TIMER0_CH0, UART1_TX, EVENTOUT Additional: ADC_IN2
12	PA3	I/O	Default: PA3 Alternate: USART0_RTS, TIMER1_CH3, I2C0_SDA, SPI_NSS, TIMER0_CH0_ON, UART1_RX, RTC_OUT, EVENTOUT Additional: ADC_IN3
13	PA4	I/O	Default: PA4 Alternate: UART1_TX, SPI_MOSI, QSPI_SCK, SPI_NSS, TIMER0_CH1, EVENTOUT Additional: ADC_IN4
14	PA5	I/O	Default: PA5 Alternate: UART1_RX, TIMER2_ETI, QSPI_CSN, SPI_MISO, SPI_SCK, TIMER0_CH1_ON , EVENTOUT Additional: ADC_IN5
15	PA6_ TXD	I/O	Default: UART2_TX Alternate: TIMER2_CH0, QSPI_IO0, I2C1_SCL, SPI_MISO, SPI_SCK, TIMER0_CH1, TIMER1_CH1, EVENTOUT Additional: ADC_IN6
16	PA7_ RXD	I/O	Default: UART2_RX Alternate: I2C1_SDA , TIMER0_CH0_ON, TIMER2_CH1, QSPI_IO1, SPI_NSS, SPI_MOSI, TIMER0_CH1_ON, TIMER1_CH2, EVENTOUT Additional: ADC_IN7, WAKUP2
17	PB0	I/O	Default:PB0 Alternate:TIMER0_CH1_ON,TIMER0_CH0, TIMER0_CH2, UART1_TX, I2C0_SCL, TIMER2_ETI, TIMER16_CH0, UART2_CTS, TIMER0_BRKIN, EVENTOUT Additional: ADC_IN8
18	PB1	I/O	Default: PB1 Alternate: TIMER0_CH2_ON, TIMER0_CH0_ON, TIMER2_CH2, UART1_RX, I2C0_SDA, TIMER16_CH0_ON, UART2_RTS, EVENTOUT Additional: BOOT1
19	PB15	I/O	Default: PB15 Alternate: RTC_REFIN, TIMER0_CH2_ON, TIMER2_CH0, I2C0_SCL, I2C1_SCL, UART1_TX,

			USART0_TX, IFRP_OUT , EVENTOUT
20	PA8	I/O	Default: PA8 Alternate: CK_OUT0, TIMER0_CH0, USART0_RX, UART1_RX, I2C0_SDA, I2C1_SDA, USART0_CK, TIMER15_CH0, RTC_OUT, TIMER0_CH2_ON , EVENTOUT
21	PA12	I/O	Default: PA12 Alternate: TIMER0_ETI, TIMER0_CH3, QSPI_IO1, SPI_NSS, USART0_CK, TIMER1_CH2, TIMER16_CH0_ON, EVENTOUT Additional: WKUP3
22	PB3	I/O	Default: JTDO, PB3 Alternate: TIMER1_CH1, QSPI_IO2, USART0_RX, UART1_RX, TIMER15_BRKIN, EVENTOUT
23	PB4	I/O	Default: NJTRST, PB4 Alternate: TIMER1_CH0, TIMER1_ETI, QSPI_IO3, USART0_TX, UART1_TX, EVENTOUT
24	PA13	I/O	Default: JTMS, PA13 Alternate: I2C0_SMBA, I2C1_SCL, USART0_CTS, UART1_CTS, EVENTOUT
25	PA14	I/O	Default: JTCK, PA14 Alternate: I2C1_SMBA, I2C1_SDA, USART0_RTS, UART1_RTS, EVENTOUT
26	PC8	I/O	Default: PC8 Alternate: TIMER2_CH2, I2C0_SDA, I2C1_SDA, USART0_TX, UART1_TX, EVENTOUT Additional: BOOT0
27	PA15	I/O	Default: JTDI, PA15 Alternate: TIMER1_CH0, TIMER1_ETI, I2C0_SCL, I2C1_SCL, USART0_RX, UART1_RX, EVENTOUT Additional: WKUP1
28	PC14	I/O	Default: PC14 Alternate: EVENTOUT Additional: OSC32IN
29	PC15	I/O	Default: PC15 Alternate: IFRP_OUT, EVENTOUT Additional: OSC32OUT
30	NRST	I	Default: NRST

5. Wireless radio characteristics

5.1. Wi-Fi characteristics

Table 5-1. Wi-Fi characteristics

Features	Description		
WLAN Standard	IEEE 802.11 b/g/n/ax		
Range of frequency	2412 MHz ~ 2484 MHz		
channels	2.4GHz：Channel 1 ~ 14		
Transmitter characteristics	**Rate**	**Typical value**	**Unit**
Output Power (Pass 802.11 Mask & EVM spec.)	802.11b /1Mbps	23.4	dBm
	802.11b /11Mbps	23.4	
	802.11g /6Mbps	22.3	
	802.11g /54Mbps	20.1	
	802.11n, HT20 /MCS0	20.5	
	802.11n, HT20 /MCS7	19.5	
	802.11ax, HE20 /MCS0	21.2	
	802.11ax, HE20 /MCS9	17.6	
Receiver characteristics	**Rate**	**Typical value**	**Unit**
Sensitivity (Pass 802.11 PER spec.)	802.11b /1Mbps	-100.1	dBm
	802.11b /11Mbps	-92.0	
	802.11g /6Mbps	-95.6	
	802.11g /54Mbps	-79.0	
	802.11n, HT20 /MCS0	-95.5	
	802.11n, HT20 /MCS7	-76.5	
	802.11ax, HE20 /MCS0	-95.4	
	802.11ax, HE20 /MCS9	-69.8	
Maximum input Level (Pass 802.11 PER spec.)	802.11b /1Mbps	10	dBm
	802.11b /11Mbps	10	
	802.11g /6Mbps	10	
	802.11g /54Mbps	0.4	
	802.11n, HT20 /MCS0	10	
	802.11n, HT20 /MCS7	-1.1	
	802.11ax, HE20 /MCS0	10	
	802.11ax, HE20 /MCS9	-5.0	
Adjacent Channel Rejection (Pass 802.11 spec.)	802.11b /1Mbps	45.3	dB
	802.11b /11Mbps	45.3	
	802.11g /6Mbps	29.5	

	802.11g /54Mbps	10.3	
	802.11n, HT20 /MCS0	27.8	
	802.11n, HT20 /MCS7	9	
	802.11ax, HE20 /MCS0	24.3	
	802.11ax, HE20 /MCS9	-1.8	

5.2. Bluetooth LE characteristics

Table 5-2. BLE characteristics

Features	**Description**	
Bluetooth LE Specification	Bluetooth LE V5.2	
Host interface	UART	
Range of frequency	2402 MHz ~ 2480 MHz	
channels	40	
Transmitter characteristics		
Transmitter Power Range	-24.0 ~ 15.0 dBm	
Receiver characteristics	**Rate**	**Typical Value (dBm)**
Receiver Sensitivity (@ PER=30.8%.)	LE 1Mbps	-101.2
	LE 2Mbps	-98.0
	LE 125Kbps	-108.2
	LE 500Kbps	-102.3
Receiver Maximum input Level (@ PER=30.8%.)	LE 1Mbps	10
	LE 2Mbps	10
	LE 125Kbps	10
	LE 500Kbps	10

6. Electrical Characteristics

6.1. Absolute maximum ratings

Table 6-1. Absolute maximum ratings

Symbol	MIN	MAX	Unit
Supply Voltage	-0.3	3.6	V
Storage Temperature	-40	125	deg.C

6.2. Operating conditions

Table 6-2. Operating conditions

Symbol	MIN	TYP	MAX	Unit
Supply Voltage	3.0	3.3	3.6	V
Operating Temperature (grade 6 module)	-40	25	85	deg.C
Operating Temperature (grade 7 module)	-40	25	105	deg.C

6.3. Power consumption

Table 6-3. Power consumption (1)(2)(3)

Power Mode	Description	Typical value	Unit
Wi-Fi Active	Tx 802.11b, 1Mbps, Pout = 18dBm	323.8	mA
	Tx 802.11b /11Mbps, Pout = 17dBm	311.5	
	Tx 802.11g /6Mbps, Pout = 18dBm	328.8	
	Tx 802.11g /54Mbps, Pout = 15dBm	298.0	
	Tx 802.11n, HT20 /MCS0, Pout = 18dBm	328.3	
	Tx 802.11n, HT20 /MCS7, Pout = 14dBm	286.2	
	Tx 802.11ax, HE20 /MCS0, Pout = 18dBm	330.5	
	Tx 802.11ax, HE20 /MCS9, Pout = 12dBm	270.3	
	Rx 802.11b, 1Mbps, Pin = -90dBm	99.2	
	Rx 802.11b /11Mbps, Pin = -80dBm	99.8	
	Rx 802.11g /6Mbps, Pin = -80dBm	100.8	
	Rx 802.11g /54Mbps, Pin = -70dBm	103.0	
	Rx 802.11n, HT20 /MCS0, Pin = -75dBm	101.0	
	Rx 802.11n, HT20 /MCS7, Pin = -65dBm	102.5	
	Rx 802.11ax, HE20 /MCS0, Pin = -75dBm	101.2	
	Rx 802.11ax, HE20 /MCS9, Pin = -60dBm	109.7	
BLE Active	Tx LE 1Mbps, Pout = -24dBm	124.1	mA

	Tx LE 1Mbps, Pout = 0dBm	134.3	
	Tx LE 1Mbps, Pout = 15dBm	246.8	
	Rx LE 1Mbps, Pin = -80dBm	93.8	
Wi-Fi Sleep	MCU in Run mode	39.5	mA
Mild Sleep	DTIM=1	1.8	mA
	DTIM=3	561.0	uA
	DTIM=10	457.0	uA

(1) DC Power = 3.3 V, HXTAL = 40 MHz
(2) Continuous Tx, Duty cycle = 100%.
(3) The DTIM power consumption is equal to the average power consumption of multiple beacon intervals.

7. Size information

7.1. Physical dimensions

Figure 7-1. Physical dimensions of MINI-I

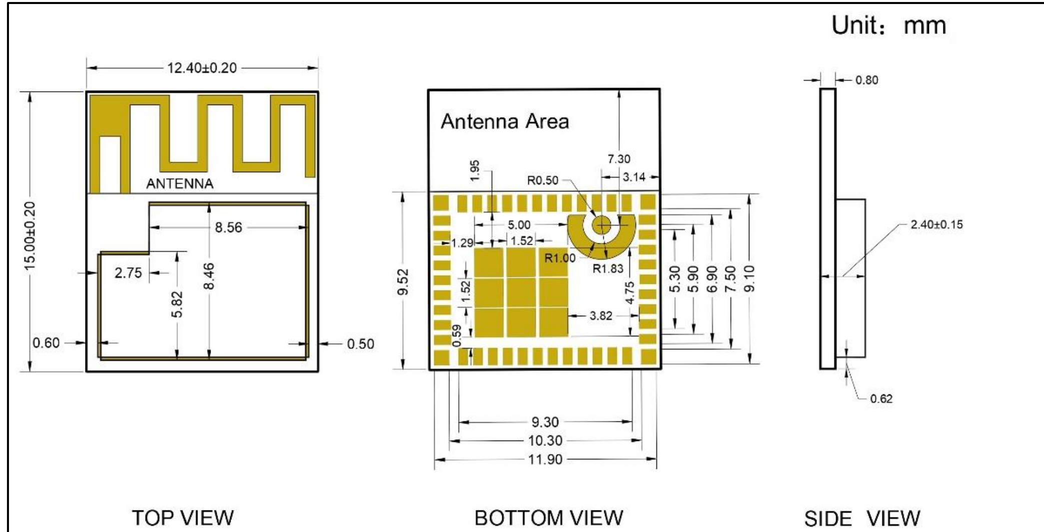
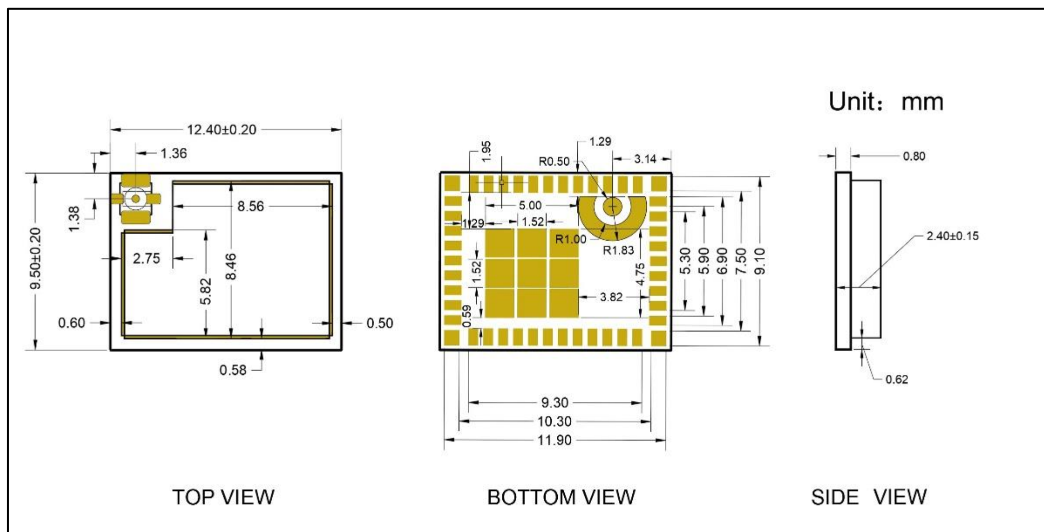


Figure 7-2. Physical dimensions of MINI-E



7.2. Layout recommendation

Figure 7-3. Layout recommendation of MINI-I

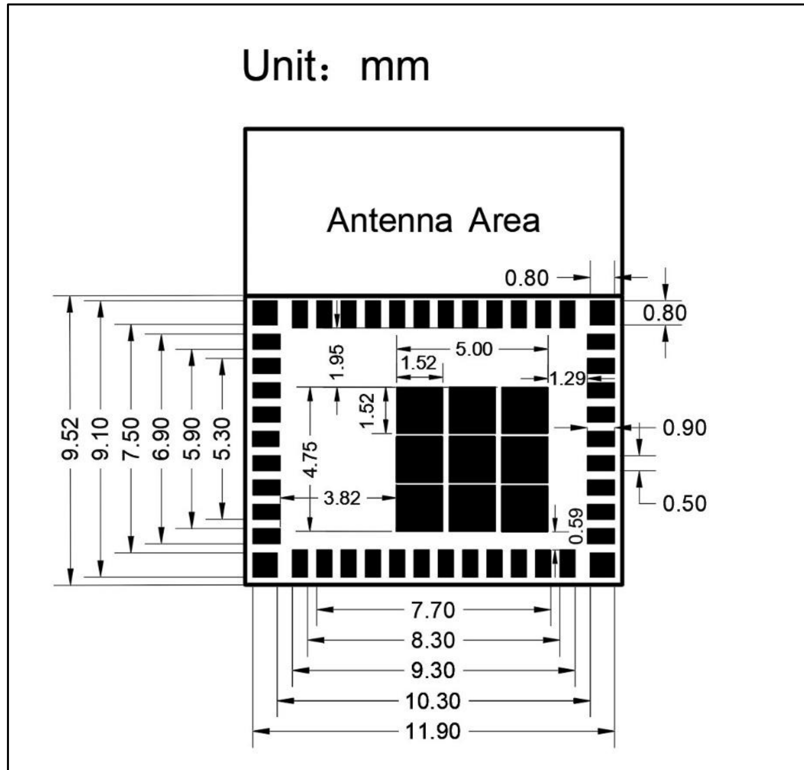
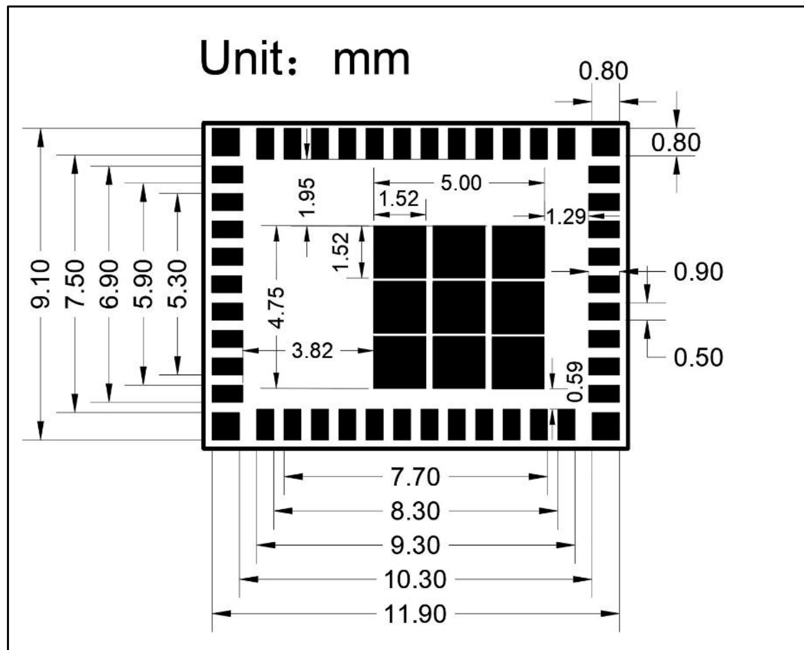
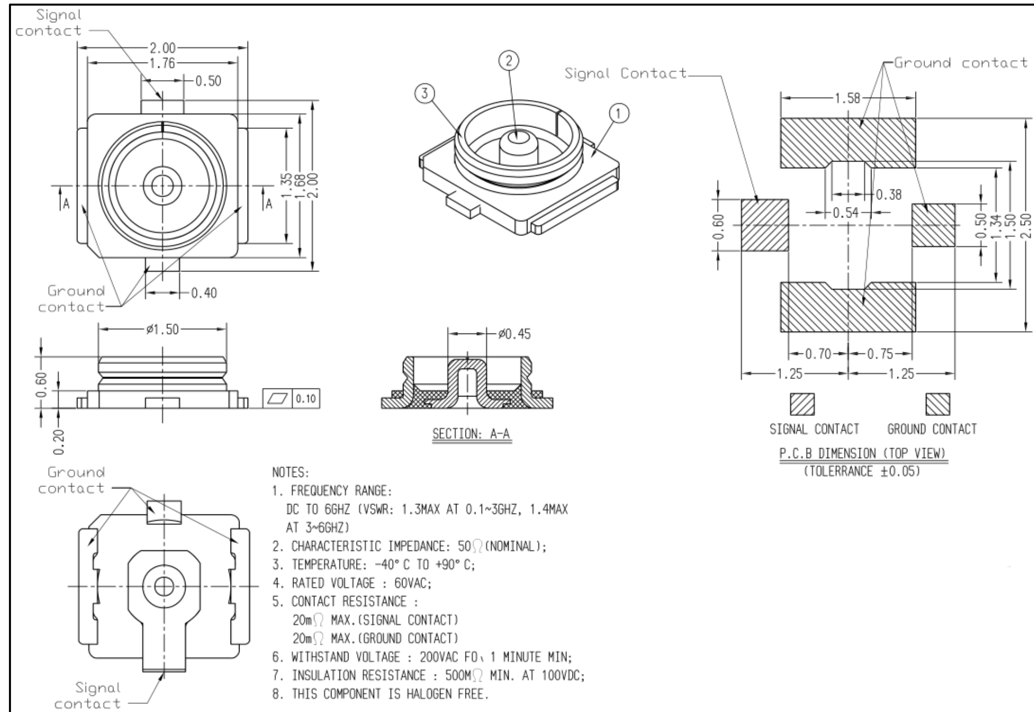


Figure 7-4. Layout recommendation of MINI-E



7.3. Dimensions of external antenna connector

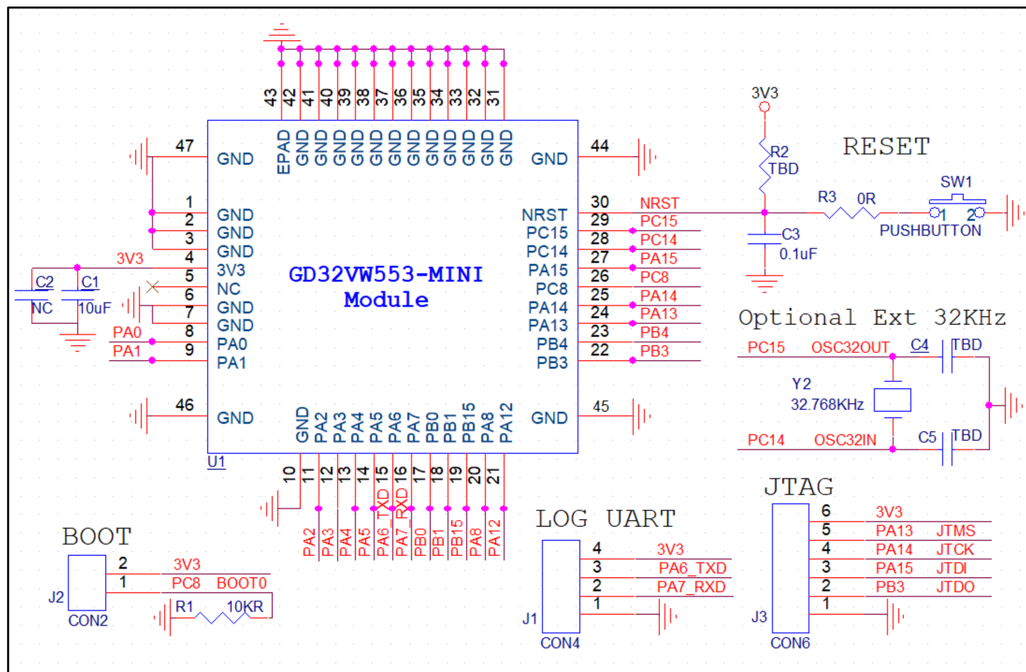
Figure 7-5. Dimensions of IPEX connector



8. Peripheral circuit reference design

Module pin NRST is the reset pin of the GD32VW553. The chip can operate only when NRST is pulled up. A 0.1uF filter capacitor and a 10K Ohm pull-up resistor have been placed in the module circuit. Besides, the log Uart and Jtag pins are recommended to be connected out.

Figure 8-1. Reference design



The power supply of 3.3V must provide a minimum of 500mA, with a capacitor of at least 10uF.

The selected pins for the boot mode are BOOT0 (PC8) and BOOT1 (PB1). Definitions of several modes are shown in the table below. Typically, flash boot mode is utilized, therefore BOOT0 needs to be pulled down on the motherboard.

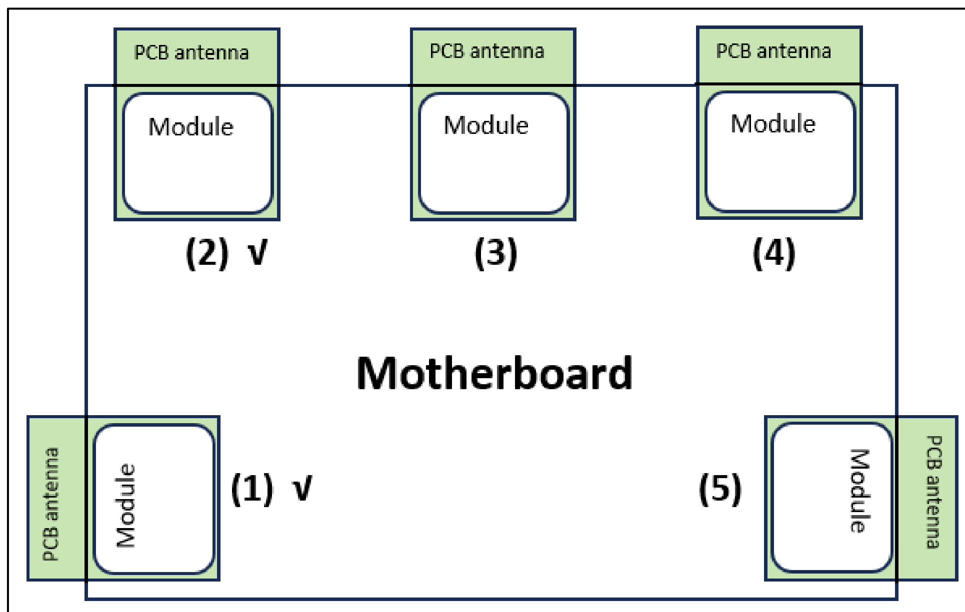
Table 8-1. Boot mode selection

BOOT1	BOOT0	Start-up Mode
X	0	Flash
0	1	Legacy Bootloader
1	1	SRAM

9. Requirements for antenna placement

If using the onboard PCB antenna, the antenna area of the module needs to extend away from the motherboard. The distance between the PCB of the motherboard and other metal devices must have a minimum clearance of 15mm. The area below and above the onboard antenna area is required to be kept away from metal devices, sensors, interference sources, and other materials that may cause signal interference.
The recommended placement of the module is shown below.

Figure 9-1. Recommended Placement



10. Recommended reflow profile

Product Model: SAC305YM102

Supplies: WTO

Process condition:

The 1st Ramp up speed: below 4℃.

The Preheat Time(A-B): 60-120S.

The 2nd Ramp up speed: below 4℃.

Peak Temperature: 235-250℃.

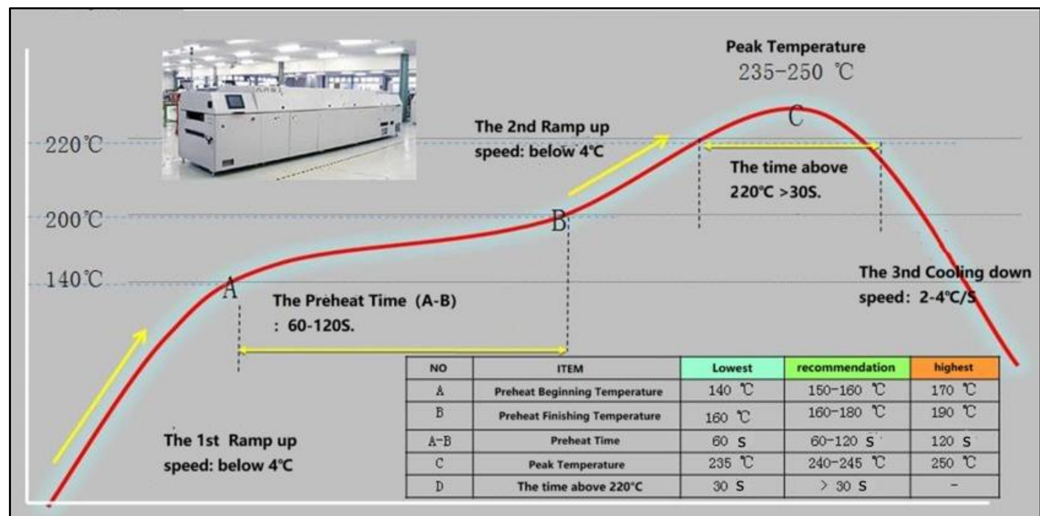
The time above 220℃: 30S.

The 3nd Cooling down speed: 2-4℃/S

Table 10-1. Reflow process and condition

No	Item	Min	Recommend	Max
A	Preheat Beginning Temperature	140℃	150-160℃	170℃
B	Preheat Finishing Temperature	160℃	160-180℃	190℃
A-B	Preheat Time	60S	60-120S	120S
C	Peak Temperature	235℃	240-245℃	250℃
D	The time above 220°C	30S	> 30S	-

Figure 10-1. Recommended reflow profile

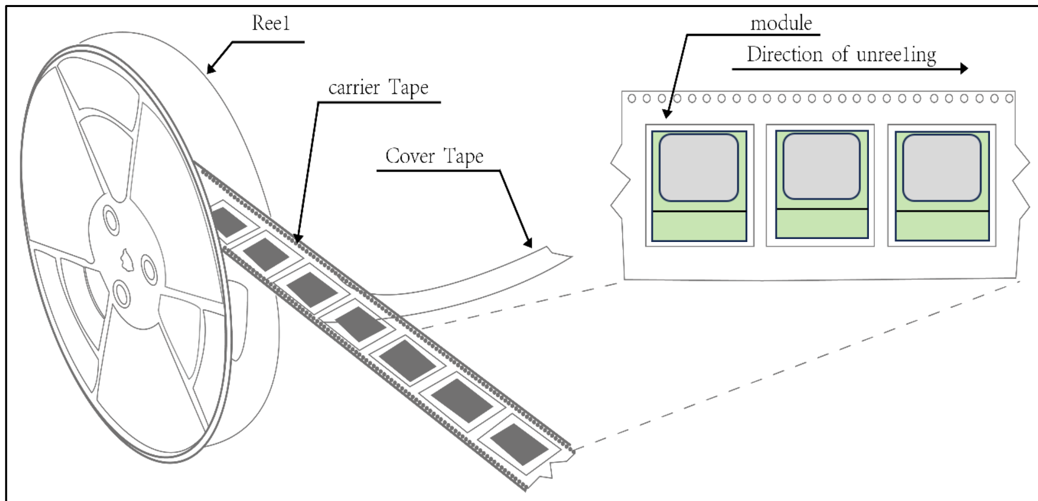


NO	ITEM	Lowest	recommendation	highest
A	Preheat Beginning Temperature	140 ℃	150-160 ℃	170 ℃
B	Preheat Finishing Temperature	160 ℃	160-180 ℃	190 ℃
A-B	Preheat Time	60 S	60-120 S	120 S
C	Peak Temperature	235 ℃	240-245 ℃	250 ℃
D	The time above 220°C	30 S	> 30 S	-

11. Package

11.1. Reel

Figure 11-1. Reel detail



12. Moisture sensitivity

The Module is a level 3 Moisture Sensitive Device, by the standard IPC/JEDEC J-STD-020. Special care must be provided to adhere to all of the requirements for using this class of component. Furthermore, the customer must allow for the following conditions:

a) Calculated shelf life in sealed bag: 12 months at <40°C and <90% relative humidity (RH).

b) Environmental condition during the production: 30°C / 60% RH according to IPC/JEDEC J-STD-033A paragraph 5.

c) The maximum time between the opening of the sealed bag and the reflow process allowed is 168 hours if “IPC/JEDEC J-STD-033A paragraph 5.2” is respected.

e) Baking is required if either conditions b) or c) are not respected.

f) Baking is required if the humidity indicator inside the bag indicates 10% RH or more.

13. Revision history

Table 13-1. Revision history

Revision No.	Description	Date
1.0	Initial Release	Dec.4th, 2024

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