INSTALLATION AND OPERATION

USER MANUAL

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UMD980

BDS High-Precision

RTK Positioning Module

Revision History

Version	Revision History	Date
R1.1	First release	Sept. 2024
R1.2	Updated **3.5 Recommended Footprint on the PCB.** Updated the stencil thickness suggestion in **4 Production Requirements.**	Mar. 2025
R1.3	Updated vibration and shock test standards to GB/T 28046.3, ISO 16750-3	Dec. 2025

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Foreword

This document describes the information of the hardware, package, specification and the use of Unicore UMD980 modules.

Target Readers

This document applies to technicians who possess the expertise on GNSS receivers.

Contents

1 Introduction

UMD980 is a new generation of BDS high precision RTK positioning module from Unicore. It tracks the BDS frequencies including B1I, B2I, B3I, B1C, B2a, and B2b. The module is mainly used in surveying and mapping and precision agriculture.

UMD980 is based on the SoC chipset – UCD9810 that integrates the RF-baseband and high-precision algorithms. UCD9810 integrates a built-in dual-core CPU, a high speed floating point processor and an RTK co-processor with 22 nm low-power technique. All these above enable stronger signal processing capability.

With the built-in adaptive, anti-jamming JamShield technology, UMD980 can fulfill a strengthening RTK engine solution of all the BDS frequencies, which ensures a good performance on RTK initialization speed, measurement accuracy and reliability even in the most challenging environments such as urban canyons and tree shades.

UMD980 supports sufficient communication interfaces such as UART, I²C*, SPI*, as well as 1PPS, EVENT, CAN*, which meets customers' needs in different applications.

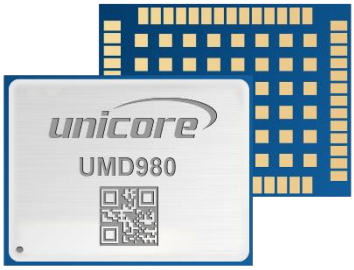


Figure 1-1 UMD980 Module

* I²C, SPI, CAN: reserved interfaces, not supported currently

1.1 Key Features

- Surface-mount package with dimensions of 17.0 mm x 22.0 mm x 2.6 mm
- BDS all-frequency on-board RTK positioning
- Instantaneous RTK initialization technology
- 60 dB narrowband anti-jamming and jamming detection
- Heading2 technology to provide orientation information
- STANDALONE single-station high-precision positioning technology
- Supports B2b-PPP and BDS SBAS[1]

1.2 Technical Specifications

Table 1-1 Technical Specifications

Basic Information		
Chipset	UCD9810	
Frequencies	BDS: B1I, B2I, B3I, B1C, B2a, B2b	
Power		
Voltage	+3.0 V ~ +3.6 V DC	
Power Consumption	480 mW (Typical)	
Performance		
Positioning Accuracy	Single-Point Positioning[2] (RMS)	Horizontal: 1.5 m
		Vertical: 2.5 m
	DGPS (RMS)[2,3]	Horizontal: 0.4 m

[1] BDS SBAS is supported on specific firmware.

[2] Test results may be biased due to atmospheric conditions, baseline length, GNSS antenna type, multipath, number of visible satellites, and satellite geometry

[3] The measurement uses a 1 km baseline and a receiver with good antenna performance, regardless of possible errors of antenna phase center offset

		Vertical: 0.8 m
	RTK (RMS)[2,3]	Horizontal: 0.8 cm + 1 ppm
		Vertical: 1.5 cm + 1 ppm
	PPP (RMS)[4]	Horizontal: 10 cm
		Vertical: 15 cm
Observation Accuracy (RMS)	Raw Data Pseudo Range: 10cm	
	Raw Data Carrier Phase: 1mm	
Time Pulse Accuracy (RMS)	20 ns	
Velocity Accuracy[5] (RMS)	0.03 m/s	
Time to First Fix[6] (TTFF)	Cold Start < 12 s	
	Hot Start < 4 s	
Initialization Time[2]	< 5 s (Typical)	
Initialization Reliability[2]	> 99.9%	
Data Update Rate[7]	50 Hz (RTK + Raw Data)	
Differential Data	RTCM 3.X	
Data Format	NMEA-0183, Unicore	
Physical Characteristics		
Package	54 pin LGA	
Dimensions	22.0 mm × 17.0 mm × 2.6 mm	
Weight	1.88 g ± 0.03 g	

[4] After 20 minutes of convergence under open sky without jamming

[5] Open sky, unobstructed scene, 99% @ static

[6] -130dBm @ more than 8 available satellites

[7] Supports 50 Hz data output rate in specific mode

Environmental Specifications	
Operating Temperature	-40 °C ~ +85 °C
Storage Temperature	-55 °C ~ +95 °C
Humidity	95% No condensation
Vibration	GB/T 28046.3, ISO 16750-3
Shock	GB/T 28046.3, ISO 16750-3
Functional Ports	
UART × 3	× 3
I^2C*	× 1
SPI*	× 1, Slave
CAN*	× 1, Shared with UART3

* I^2C, SPI, CAN: reserved interfaces, not supported currently

1.3 Block Diagram

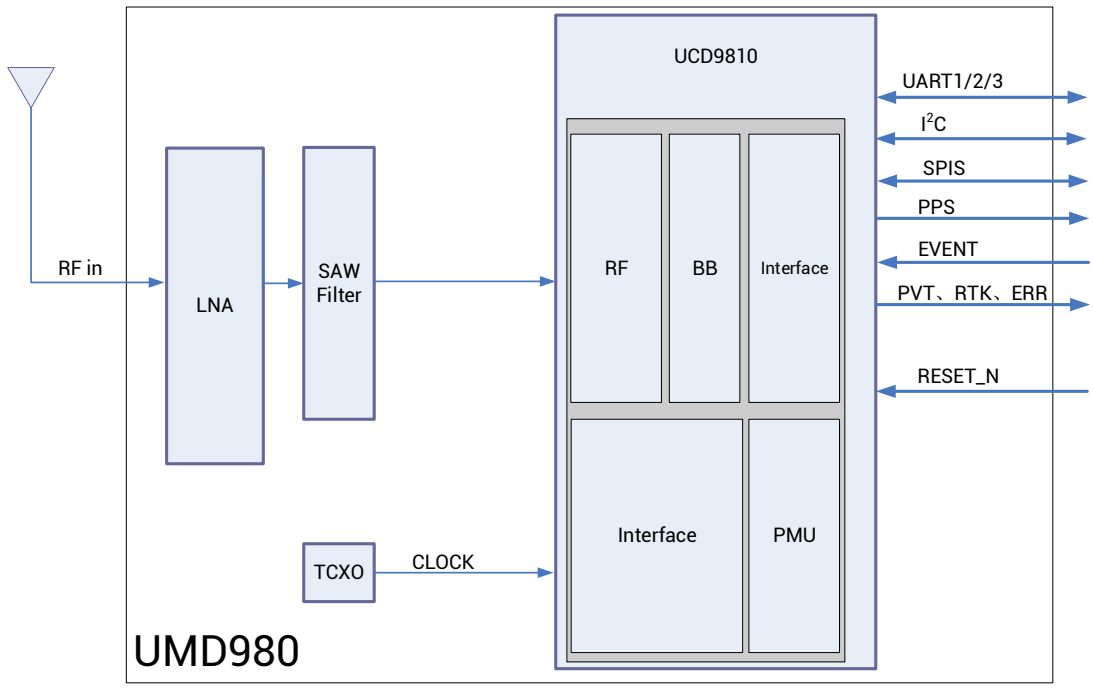


Figure 1-2 UMD980 Block Diagram

- **RF Part**

The receiver gets filtered and enhanced GNSS signal from the antenna via a coaxial cable. The RF part converts the RF input signals into the IF signals, and converts IF analog signals into digital signals required for the chipset UCD9810.

- **UCD9810**

UCD9810 is Unicore's new generation, BDS all -frequency high-precision SoC with 22 nm low-power technique. It integrates a dual-core CPU, a high speed floating point processor and an RTK co-processor, which can fulfill the high-precision baseband processing and RTK positioning independently.

- **External Interfaces**

The external interfaces of UMD980 include UART, I2C*, SPI*, CAN*, PPS, EVENT, RTK_STAT, PVT_STAT, ERR_STAT, RESET_N, etc.

2 Hardware

2.1 Pin Definition

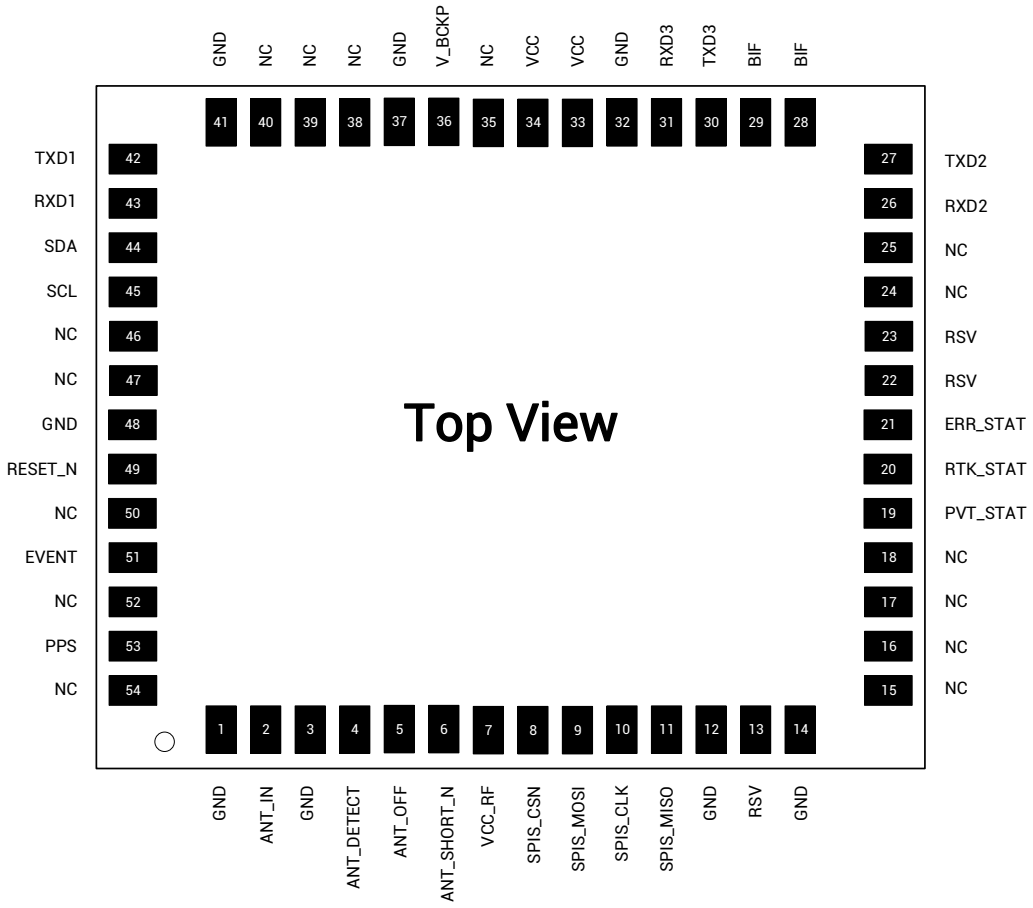


Figure 2-1 UMD980 Pin Definition

Table 2-1 Pin Description

No.	Pins	I/O	Descriptions
1	GND	—	Ground
2	ANT_IN	I	GNSS antenna signal input
3	GND	—	Ground
4	ANT_DETECT	I	Antenna signal detection
5	ANT_OFF	O	Disable external LNA

No.	Pins	I/O	Descriptions
6	ANT_SHORT_N	I	Antenna short circuit detection; active low
7	VCC_RF[8]	O	External LNA power supply
8	SPIS_CSN	I	Chip select pin for SPI slave
9	SPIS_MOSI	I	Master Out / Slave In. This pin is used to receive data in slave mode.
10	SPIS_CLK	I	Clock input pin for SPI slave
11	SPIS_MISO	O	Master In / Slave Out. This pin is used to transmit data in slave mode.
12	GND	—	Ground
13	RSV	—	Reserved; must be floating
14	GND	—	Ground
15	NC	—	No connection inside; leave floating
16	NC	—	No connection inside; leave floating
17	NC	—	No connection inside; leave floating
18	NC	—	No connection inside; leave floating
19	PVT_STAT	O	PVT status: active high; outputs high when positioning and low when not positioning
20	RTK_STAT	O	RTK status: active high; outputs high for RTK fixed solution and low for other positioning status or no positioning

[8] Not recommended to take VCC_RF as ANT_BIAS to feed the antenna. See section 3.2 for more details.

No.	Pins	I/O	Descriptions
21	ERR_STAT	O	Error status: active high; outputs high when failing self-test, and low when passing self-test
22	RSV	—	Reserved, must be floating
23	RSV	—	Reserved, must be floating
24	NC	—	No connection inside; leave floating
25	NC	—	No connection inside; leave floating
26	RXD2	I	COM2 input, LVTTL level
27	TXD2	O	COM2 output, LVTTL level
28	BIF	—	Built-in function; recommended to add a through-hole testing point and a 10 kΩ pull-up resistor; cannot connect ground or power supply, and cannot input/output data, but can be floating
29	BIF	—	Built-in function; recommended to add a through-hole testing point and a 10 kΩ pull-up resistor; cannot connect ground or power supply, and cannot input/output data, but can be floating
30	TXD3	O	COM3 output, which can be used as CAN TXD, LVTTL level
31	RXD3	I	COM3 input, which can be used as CAN RXD, LVTTL level
32	GND	—	Ground
33	VCC	I	Power supply
34	VCC	I	Power supply
35	NC	—	No connection inside; leave floating

No.	Pins	I/O	Descriptions
36	V_BCKP	I	When the main power supply VCC is cut off, V_BCKP supplies power to RTC and relevant register. Level requirement: 2.0 V ~ 3.6 V, and the working current should be less than 60 μA at 25 °C. If you do not use the hot start function, connect V_BCKP to VCC, Do NOT connect it to ground or leave it floating.
37	GND	—	Ground
38	NC	—	No connection inside; leave floating
39	NC	—	No connection inside; leave floating
40	NC	—	No connection inside; leave floating
41	GND	—	Ground
42	TXD1	O	COM1 output, LVTTL level
43	RXD1	I	COM1 input, LVTTL level
44	SDA	I/O	I^2C data
45	SCL	I/O	I^2C clock
46	NC	—	No connection inside; leave floating
47	NC	—	No connection inside; leave floating
48	GND	—	Ground
49	RESET_N	I	System reset; active Low. The active time should be no less than 5 ms.
50	NC	—	No connection inside; leave floating
51	EVENT	I	Event mark input, with adjustable frequency and polarity

No.	Pins	I/O	Descriptions
52	NC	—	No connection inside; leave floating
53	PPS	O	Pulse per second, with adjustable pulse width and polarity
54	NC	—	No connection inside; leave floating

2.2 Electrical Specifications

2.2.1 Absolute Maximum Ratings

Table 2-2 Absolute Maximum Ratings

Parameters	Symbols	Min.	Max.	Unit
Power Supply Voltage	VCC	-0.3	3.6	V
Input Voltage	V_{in}	-0.3	3.6	V
GNSS Antenna Signal Input	ANT_IN	-0.3	6	V
Antenna RF Input Power	ANT_IN input power	/	+10	dBm
External LNA Power Supply	VCC_RF	-0.3	3.6	V
VCC_RF Output Current	ICC_RF	/	100	mA
Storage Temperature	T_{stg}	-55	95	°C

2.2.2 Operating Conditions

Table 2-3 Operating Conditions

Parameters	Symbols	Min.	Typ.	Max.	Unit	Conditions
Power Supply Voltage[9]	VCC	3.0	3.3	3.6	V	/
Maximum VCC Ripple	V_{rpp}	0	/	50	mV	/

[9] The voltage range of VCC (3.0 V ~ 3.6 V) has already included the ripple voltage.

Parameters	Symbols	Min.	Typ.	Max.	Unit	Conditions
Working Current[10]	I_{opr}	/	145	180	mA	VCC=3.3 V
VCC_RF Output Voltage	VCC_RF	/	VCC-0.1	/	V	/
VCC_RF Output Current	ICC_RF	/	/	50	mA	/
Operating Temperature	T_{opr}	-40	/	85	°C	/
Power Consumption	P	/	480	/	mW	/

2.2.3 IO Thresholds

Table 2-4 IO Thresholds

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Low Level Input Voltage	V_{in_low}	0	/	0.6	V	/
High Level Input Voltage	V_{in_high}	VCC × 0.7	/	VCC + 0.2	V	/
Low Level Output Voltage	V_{out_low}	0	/	0.45	V	I_{out} = 2 mA
High Level Output Voltage	V_{out_high}	VCC - 0.45	/	VCC	V	I_{out} = 2 mA

2.2.4 Antenna Features

Table 2-5 Antenna Features

Parameters	Symbols	Min.	Typ.	Max.	Unit	Conditions
Optimum Input Gain	G_{ant}	18	30	36	dB	/

[10] Since the product has capacitors inside, inrush current occurs during power-on. You should evaluate in the actual environment in order to check the effect of the supply voltage drop caused by inrush current in the system.

2.3 Dimensions

Table 2-6 Dimensions

Parameters	Min. (mm)	Typ. (mm)	Max. (mm)
A	21.80	22.00	22.50
B	16.80	17.00	17.50
C	2.40	2.60	2.80
D	3.75	3.85	3.95
E	0.95	1.05	1.15
F	1.80	1.90	2.00
G	1.00	1.10	1.20
H	0.70	0.80	0.90
K	1.40	1.50	1.60
M	3.55	3.65	3.75
N	3.15	3.25	3.35
P	2.00	2.10	2.20
R	1.00	1.10	1.20
X	0.72	0.82	0.92

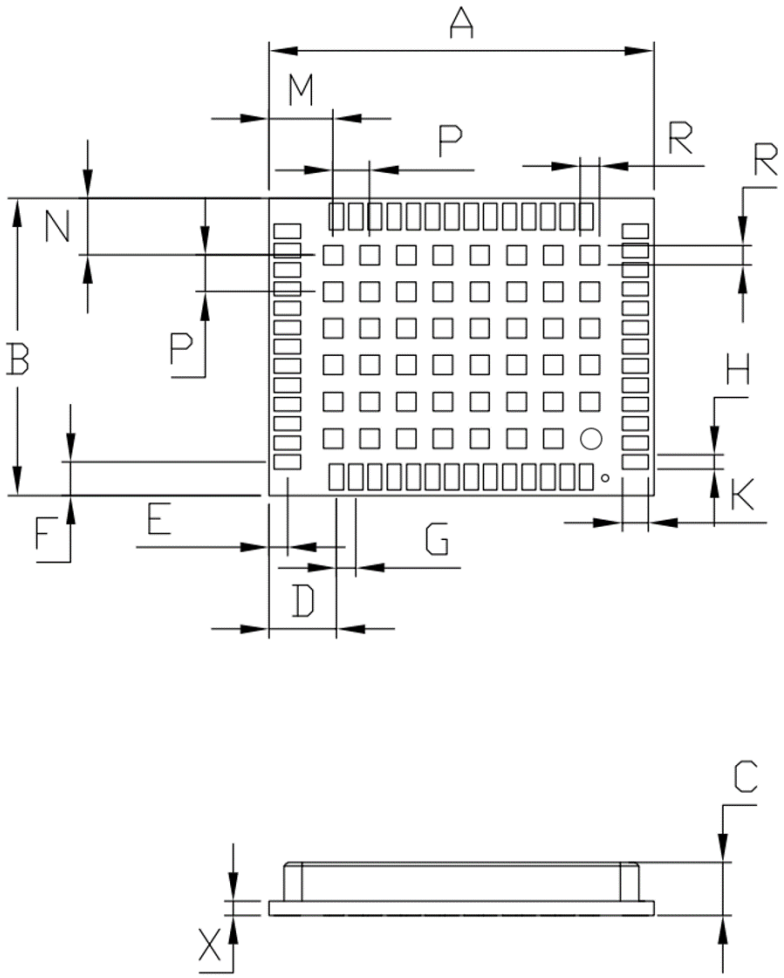


Figure 2-2 UMD980 Dimensions

3 Hardware Design

3.1 Recommended Minimal Design

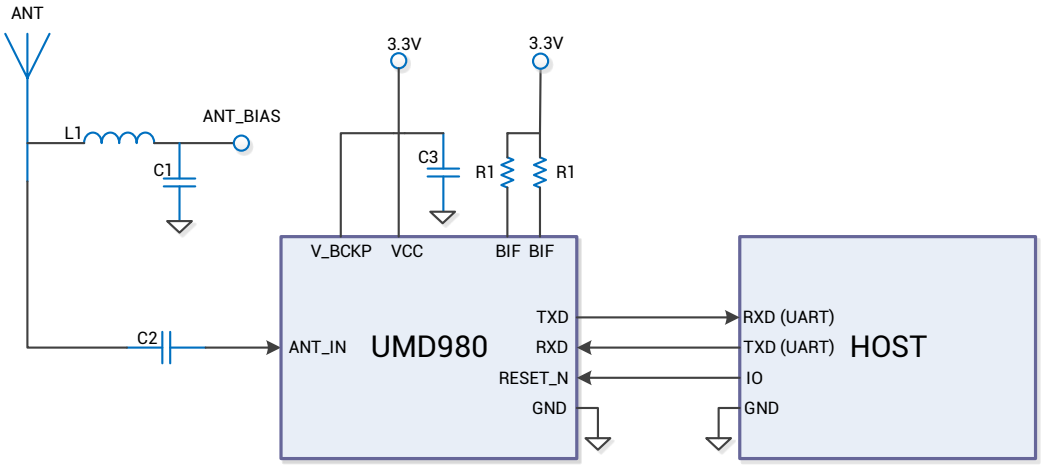


Figure 3-1 Recommended Minimal Design

L1: 68 nH RF inductor in 0603 package is recommended.

C1: 100 nF + 100 pF capacitors connected in parallel is recommended.

C2: 100 pF capacitor is recommended.

C3: N * 10 μF + 1 * 100 nF capacitors connected in parallel is recommended, and the total capacitance should be no less than 30 μF.

R1: 10 kΩ resistor is recommended.

3.2 Antenna Feed Design

UMD980 just supports feeding the antenna from the outside of the module rather than from the inside. It is recommended to use devices with high power and that can withstand high voltage. Gas discharge tube, varistor, TVS tube and other high-power protective devices may also be used in the power supply circuit to further protect the module from lightning strike and surge.

⚠ If the antenna feed supply ANT_BIAS and the module's main supply VCC use the same power rail, the ESD, surge and overvoltage from the antenna will have an effect on VCC, which may cause damage to the module. Therefore, it is recommended to design an independent power rail for the ANT_BIAS to reduce the possibility of module damage.

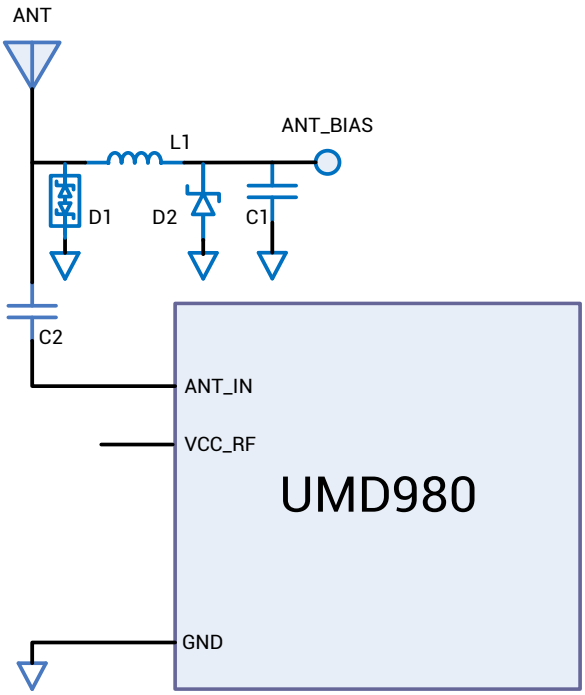


Figure 3-2 UMD980 External Antenna Feed Reference Circuit

Notes:

- L1: feed inductor, 68 nH RF inductor in 0603 package is recommended
- C1: decoupling capacitor, recommended to connect two capacitors of

  100 nF/100 pF in parallel
- C2: DC blocking capacitor, recommended 100 pF capacitor
- It is not recommended to take VCC_RF as ANT_BIAS to feed the antenna (VCC_RF is not optimized for anti-lightning strike, anti-surge and over current protection due to the compact size of the module)
- D1: ESD diode, choose the ESD protection device that supports high frequency signals (above 2000 MHz)
- D2: TVS diode, choose the TVS diode with appropriate clamping specification according to the requirement of feed voltage and antenna withstand voltage

3.3 Power-on and Power-off

VCC

- The VCC initial level when power-on should be less than 0.4 V.
- The VCC ramp when power-on should be monotonic, without plateaus.
- The voltages of undershoot and ringing should be within 5% VCC.
- Power-on time interval: The time interval between the power-off (VCC < 0.4 V) to the next power-on must be larger than 500 ms.

V_BCKP

- The V_BCKP initial level when power-on should be less than 0.4 V.
- The V_BCKP ramp when power-on should be monotonic, without plateaus.
- The voltages of undershoot and ringing should be within 5% V_BCKP.
- Power-on time interval: The time interval between the power-off (V_BCKP < 0.4 V) to the next power-on must be larger than 500 ms.

3.4 Grounding and Heat Dissipation

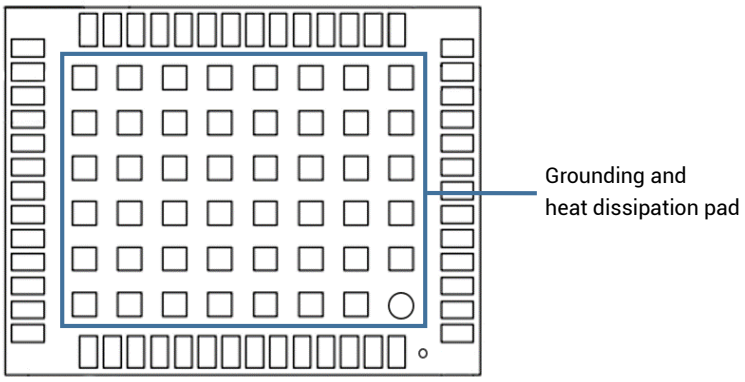


Figure 3-3 Grounding and Heat Dissipation Pad (Bottom View)

The 48 pads in the rectangle in Figure 3-3 are for grounding and heat dissipation. In the PCB design, the pads should be connected to a large sized ground to strengthen the heat dissipation.

3.5 Recommended Footprint on the PCB

The dimensions of UMD980's footprint on the PCB is recommended to be the same as that of the module's pads, as shown in **Figure 3-4 Recommended Footprint**. For more information about the module's dimensions, see **2.3 Dimensions**.

☞ For the convenience of hardware testing and debugging, proper test points can be added for the functional pins of the module.

☞ The dimensions of PCB pads can be optimized according to the specific production process to ensure manufacturability and reliability.

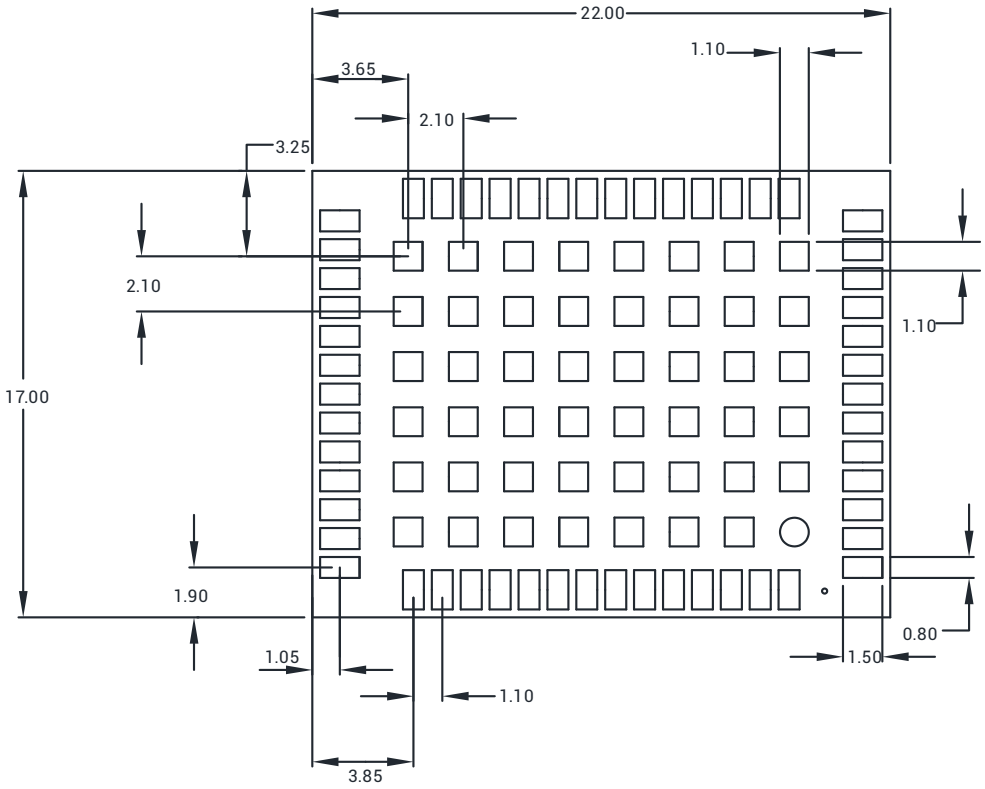


Figure 3-4 Recommended Footprint (Unit: mm)

4 Production Requirements

Recommended soldering temperature curve is as follows:

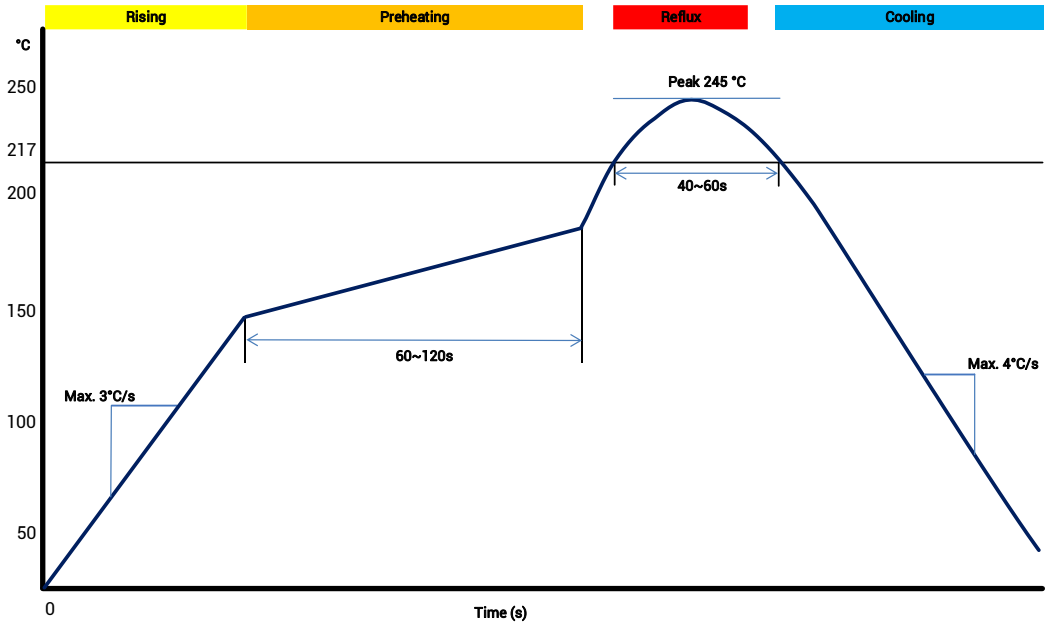


Figure 4-1 Soldering Temperature (Lead-free)

Temperature Rising Stage

- Rising slope: Max. 3 °C/s
- Rising temperature range: 50 °C ~ 150 °C

Preheating Stage

- Preheating time: 60s ~ 120 s
- Preheating temperature range: 150 °C ~ 180 °C

Reflux Stage

- Over melting temperature (217 °C) time: 40s ~ 60 s
- Peak temperature for soldering: no higher than 245 °C

Cooling Stage

Cooling slope: Max. 4 °C / s

- In order to prevent falling off during soldering of the module, do not solder it on the back of the board during design, and it is not recommended to go through soldering cycle twice.
- The setting of soldering temperature depends on many factors of the factory, such as board type, solder paste type, solder paste thickness etc. Please also refer to the relevant IPC standards and indicators of solder paste.
- Since the lead soldering temperature is relatively low, if using this method, please give priority to other components on the board.
- The apertures in the stencil need to meet the customer's own design requirements and inspection specifications. The thickness of the stencil is recommended to be 0.15mm (not less than 0.12 mm).

> ☞ The design of the stencil can be optimized according to the specific production process to ensure manufacturability and reliability.

5 Packaging

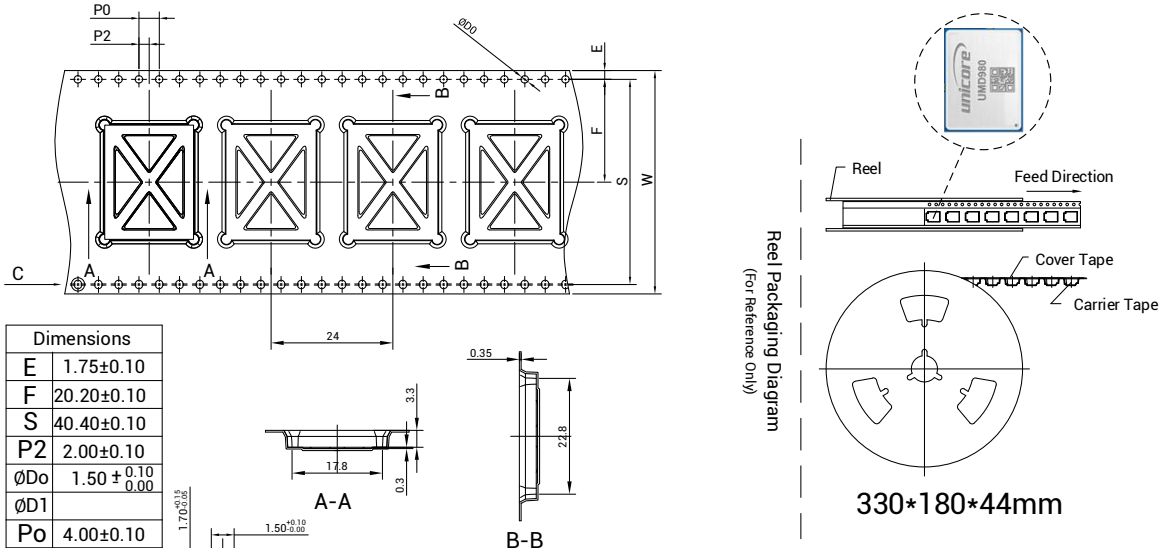
5.1 Label Descriptions

Figure 5-1 Label Descriptions

5.2 Product Packaging

The UMD980 module uses carrier tape and reel (suitable for mainstream surface mount devices), packaged in vacuum-sealed aluminum foil antistatic bags, with a desiccant inside to prevent moisture. When using reflow soldering process to solder modules, please strictly comply with IPC standard to conduct temperature and humidity control on the modules. As packaging materials such as the carrier tape can only withstand the temperature of 55 °C, modules shall be removed from the package during baking.

Figure 5-2 UMD980 Package



Dimensions	
E	1.75±0.10
F	20.20±0.10
S	40.40±0.10
P2	2.00±0.10
ØDo	1.50 ± 0.10 0.00
ØD1	
Po	4.00±0.10
10Po	40.00±0.20
W	44.00±0.30
P	24.00±0.10
Ao	17.80±0.10
B0	22.80±0.10
K0	3.30±0.10
t	0.35±0.05

Note:

1. The cumulative tolerance of 10 side holes should not exceed ±0.2 mm.
2. Material of the tape: Black antistatic PS (surface impedance 10^5-10^{11}) (surface static voltage <100 V), thickness: 0.35 mm.
3. Total length of the 13-inch reel package: 6.816 m (Length of the first part of empty packets: 0.408 m, length of packets containing modules: 6 m, length of the last part of empty packets: 0.408 m).
4. Total number of packets in the 13-inch reel package: 284 (Number of the first part of empty packets: 17; actual number of modules in the packets: 250; number of the last part of empty packets: 17).
5. All dimension designs are in accordance with EIA-481-C-2003.
6. The maximum bending degree of the carrier tape within the length of 250 mm should not exceed 1 mm (see the figure below).

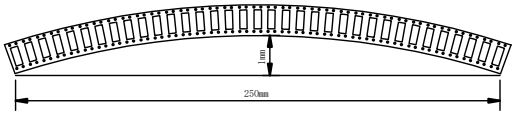


Figure 5-3 UMD980 Reel Package Diagram

Table 5-1 Package Descriptions

Items	Descriptions
Module Number	250 pieces/reel
Reel Sizes	Tray: 13" External diameter: 330 ± 2 mm, Internal diameter: 180 ± 2mm,

Items	Descriptions
	Width: 44.5 ± 0.5 mm Thickness: 2.0 ± 0.2 mm
Carrier Tape	Space between (center-to-center distance): 24 mm

Before surface mounting, make sure that the color of the 30% circle on the HUMIDITY INDICATOR is blue (see Figure 5-4). If the color of the 20% circle is pink and the color of the 30% circle is lavender (see Figure 5-5), you must bake the module until it turns to blue. The UMD980 is rated at MSL level 3. Please refer to the IPC/JEDEC J-STD-033 standards for the package and operation requirements. You may also access to the website www.jedec.org to get more information.

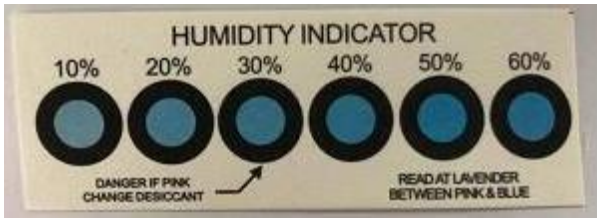


Figure 5-4 Normal Humidity Indication

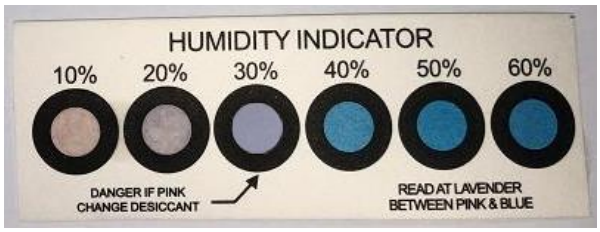


Figure 5-5 Abnormal Humidity Indication

The shelf life of the UMD980 module packaged in vacuum-sealed aluminum foil antistatic bags is ONE year.

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