INSTALLATION AND OPERATION

USER MANUAL

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UM980C

GPS/BDS/GLONASS/Galileo/QZSS

All-Constellation Multi-Frequency High-Precision RTK Positioning Module

(L-Band & CLAS Supported)

Revision History

Version	Revision History	Date
R1.0	First release.	Sept. 2025
R1.1	Updated vibration and shock test standards to GB/T 28046.3, ISO 16750-3	Dec. 2025

Document Status

Releases	Status Descriptions	Current Status
Primary	This is a pre-release version with target specifications that are subject to revision.	
Alpha release	This is an alpha release version, which has been preliminarily tested and verified. The content may undergo minor modifications based on user feedback and further testing.	
Production release	The document contains the complete and final specifications.	√

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Foreword

This document describes the information of the hardware, package, specification and the use of Unicore UM980C modules.

Target Readers

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

Contents

1 Introduction

UM980C is Unicore's new-generation GNSS high-precision RTK positioning module. It can simultaneously track multiple frequencies of all systems, including GPS, BDS, GLONASS, Galileo, QZSS, NavIC, SBAS and L-Band, supports QZSS L6 (CLAS) PPP-RTK solution, and supports TruePoint REACH Sat L-band-based PPP-AR service. The module is ideal for surveying and mapping, and precision agriculture.

UM980C is developed based on the GNSS SoC – NebulasIV™, which integrates RF-baseband and high-precision algorithm. Additionally, it integrates dual CPUs, a high-speed floating-point processor and an RTK co-processor, with 22 nm low-power design and 1408 super channels, to deliver stronger signal processing performance.

With the built-in adaptive anti-jamming technology — JamShield, UM980C enhances RTK engine solution on multiple modes and frequencies, which significantly improves RTK initialization speed, measurement accuracy and reliability even in challenging environments such as urban canyons and tree shades.

Furthermore, UM980C supports various interfaces for different purposes, including UART, I²C*, SPI*, 1PPS, EVENT and CAN*, to meet specific requirements in different applications.

Figure 1-1 UM980C Module

* I²C, SPI and CAN are supported on specific firmware or hardware.

1.1 Key Features

- Based on Unicore's new-generation GNSS SoC NebulasIV™ which integrates RF-baseband and high-precision algorithm
- All-constellation, multi-frequency RTK engine and advanced RTK processing technology
- 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, E6-HAS and QZSS L6E (MADOCA) PPP services
- Supports QZSS L6D (CLAS) PPP-RTK solution
- Supports TruePoint REACH Sat L-band-Based PPP-AR service[1]

1.2 Key Specifications

Table 1-1 Technical Specifications

Basic Information	
Channels	1408 channels, based on NebulasIV™
Constellations	GPS/BDS/GLONASS/Galileo/QZSS
Frequencies	GPS: L1C/A, L1C, L2C, L2P(Y), L5 BDS: B1I, B2I, B3I, B1C, B2a, B2b GLONASS: G1, G2, G3 Galileo: E1, E5a, E5b, E6 QZSS: L1C/A, L1C, L2C, L5, L6 NavIC: L5 SBAS: L1C/A L-Band
Power	

[1] This is a paid service.

Voltage	+3.0 V ~ +3.6 V DC			
Power Consumption	480 mW (typical)			
Performance				
Positioning Accuracy	Single Point Positioning (RMS)[2]	Horizontal: 1.5 m		
		Vertical: 2.5 m		
	DGPS (RMS)[2,3]	Horizontal: 0.4 m		
		Vertical: 0.8 m		
	RTK (RMS) [2,3]	Horizontal: 0.8 cm + 1 ppm		
		Vertical: 1.5 cm + 1 ppm		
	PPP (RMS)[4]	Horizontal: 5 cm @ 20 min		
		Vertical: 10 cm @ 20 min		
	PPP-AR (RMS)[4]	Horizontal: 3 cm @ 5 min		
		Vertical: 6 cm @ 5 min		
	CLAS (RMS)[4]	Horizontal: 5 cm @ 1 min		
		Vertical: 10 cm @ 1 min		
Observation Accuracy (RMS)	GPS	BDS	GLONASS	Galileo
B1I/B1C/L1 C/A/G1/E1 Pseudorange	10 cm	10 cm	10 cm	10 cm
B1I/B1C/L1 C/A/G1/E1 Carrier Phase	1 mm	1 mm	1 mm	1 mm
B3I/L2C/L2P/G2/E6/L6 Pseudorange	10 cm	10 cm	10 cm	10 cm
B3I/L2C/L2P/G2/E6/L6 Carrier Phase	1 mm	1 mm	1 mm	1 mm

[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.

[4] Under open sky and without jamming.

B2I/B2a/B2b/L5/E5a/E5b Pseudorange	10 cm	10 cm	10 cm	10 cm
B2I/B2a/B2b/L5/E5a/E5b Carrier Phase	1 mm	1 mm	1 mm	1 mm
Time Pulse Accuracy (RMS)	20 ns			
Velocity Accuracy (RMS)[5]	0.03 m/s			
Sensitivity	Acquisition: -148 dBm			
	Tracking: -160 dBm			
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	Up to 50 Hz RTK positioning data output			
Differential Data	RTCM V3.X			
Data Format	NMEA-0183, Unicore			
Physical Characteristics				
Package	54 pin LGA			
Dimensions	22 mm × 17 mm × 2.6 mm			
Weight	1.88 g ± 0.03 g			
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			

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

[6] -130dBm @ more than 12 available satellites

I²C*	× 1
SPI*	× 1, Slave
CAN*	× 1, Shared with UART3

1.3 Block Diagram

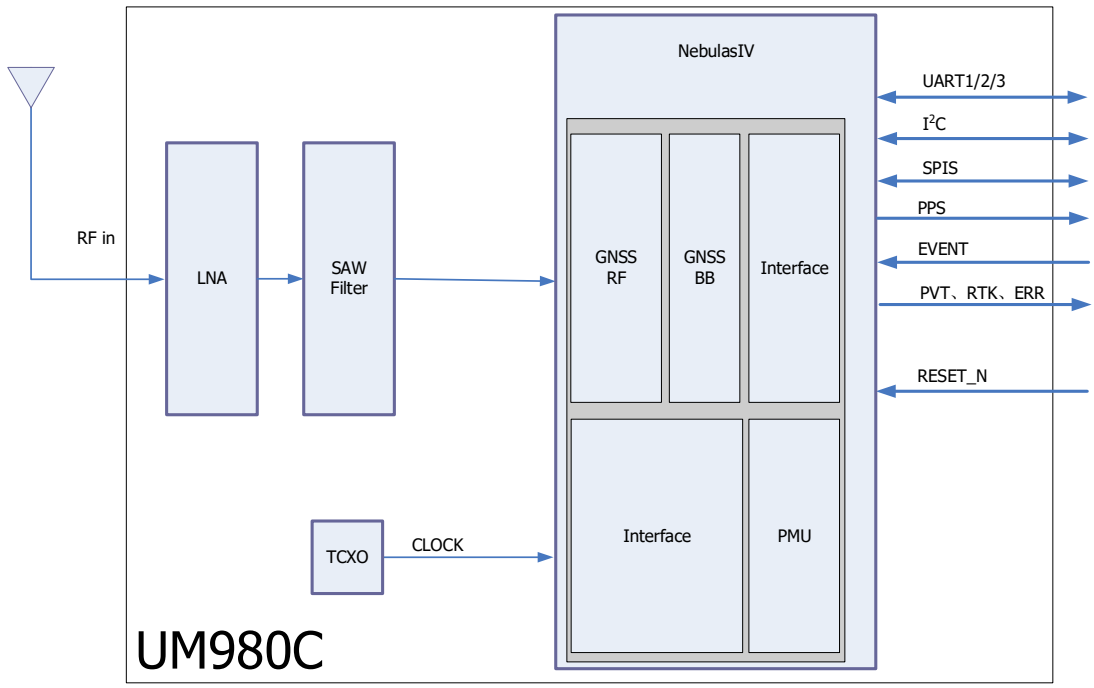


Figure 1-2 UM980C Block Diagram

- **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 NebulasIV™ chip (UC9810).

- **NebulasIV™ SoC (UC9810)**

NebulasIV™ (UC9810) is Unicore's new-generation high-precision GNSS SoC with 22 nm low power design, supporting all constellations and multiple frequencies with 1408 super channels. It integrates dual CPUs, a high-speed floating-point processor and an RTK co-processor, which can fulfill high-precision baseband processing and RTK positioning on a single SoC.

- **External Interfaces**

The external interfaces of UM980C include UART, I²C*, SPI*, CAN*, PPS, EVENT, RTK_STAT, PVT_STAT, ERR_STAT, RESET_N, etc.

2 Hardware

2.1 Pin Definition

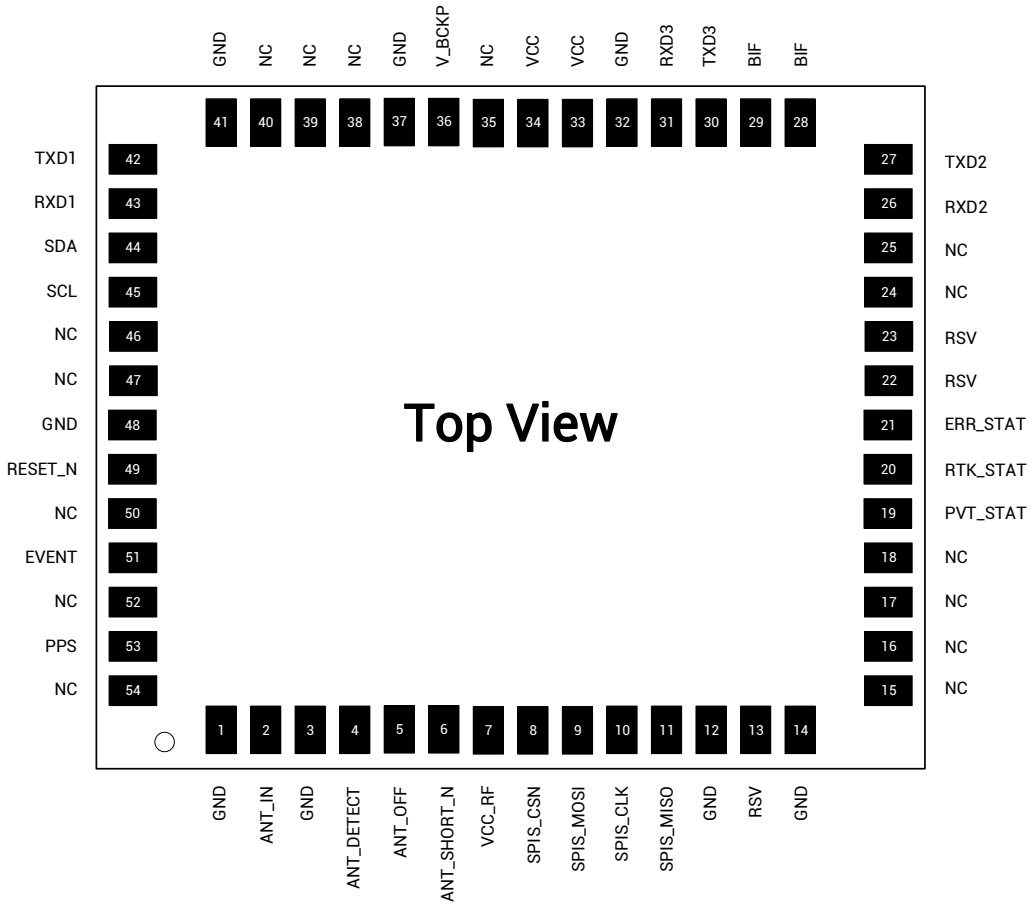


Figure 2-1 UM980C Pin Definition

Table 2-1 Pin Description

No.	Pin	I/O	Description
1	GND	—	Ground
2	ANT_IN	I	GNSS antenna signal input
3	GND	—	Ground
4	ANT_DETECT	I	Antenna signal detection

No.	Pin	I/O	Description
5	ANT_OFF	O	Disable external LNA
6	ANT_SHORT_N	I	Antenna short circuit detection; active low
7	VCC_RF[7]	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
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

[7] Not recommended to take VCC_RF as ANT_BIAS to feed the antenna. See 3.2 Antenna Bias for more details.

No.	Pin	I/O	Description
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
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

No.	Pin	I/O	Description
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
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

Parameter	Symbol	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

Parameter	Symbol	Min.	Max.	Unit
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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Power Supply Voltage[8]	VCC	3.0	3.3	3.6	V	
Maximum VCC Ripple	V_{rpp}	0		50	mV	
Working Current[9]	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 Threshold

Table 2-4 IO Threshold

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
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	V_{out_high}	VCC -		VCC	V	I_{out} = 2 mA

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

[9] 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.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Output Voltage		0.45				

2.2.4 Antenna Feature

Table 2-5 Antenna Feature

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Optimum Input Gain	G_{ant}	18	30	36	dB	

2.3 Dimensions

Table 2-6 Dimensions

Parameter	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

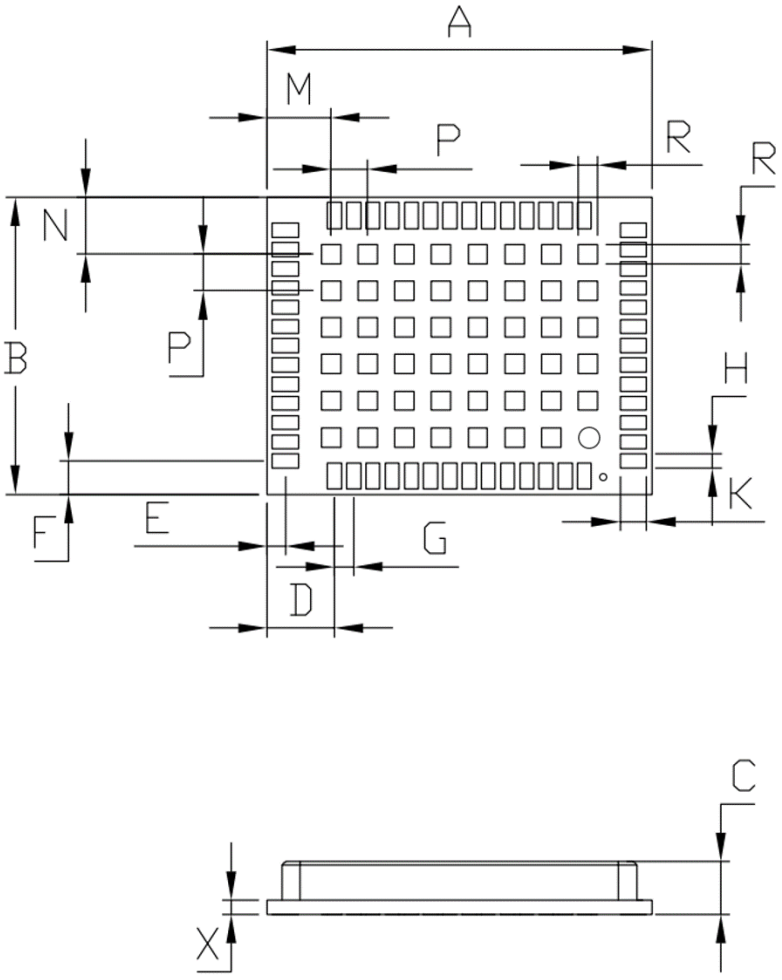


Figure 2-2 UM980C Mechanical Dimensions

3 Hardware Design

3.1 Recommended Minimal Design

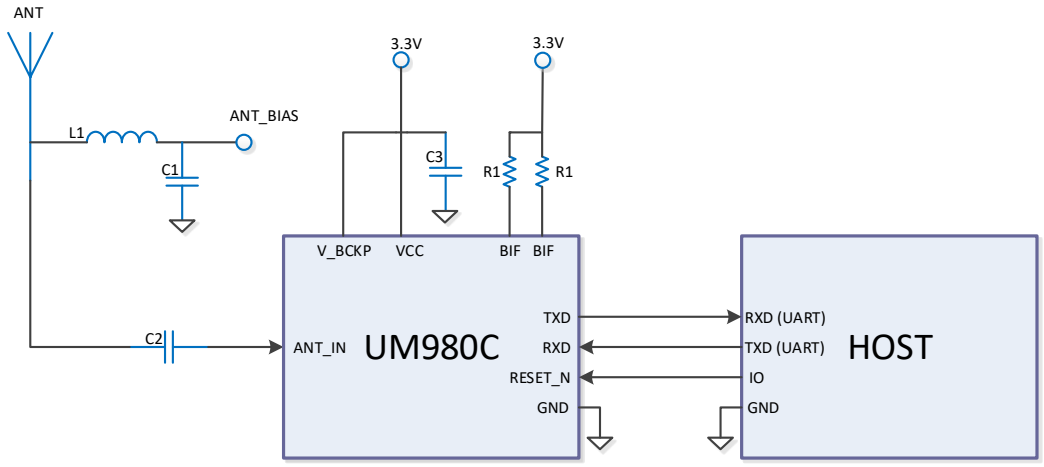


Figure 3-1 Recommended Minimal Design

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 Bias

UM980C does not support internal power supply to the antenna and requires external power supply. In order to protect the module from lightning strikes and surges, it is recommended to use devices with high voltage and high power capabilities. Gas discharge tubes, varistors, TVS tubes and other high-power protective devices may also be used in the power supply circuit to further protect the module from lightning strikes and surges.

⚠ If the antenna bias (ANT_BIAS) and the module's main power supply (VCC) use the same power rail, the ESD, surge and overvoltage generated at the antenna will be directly applied to 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 risk of damage to the module.

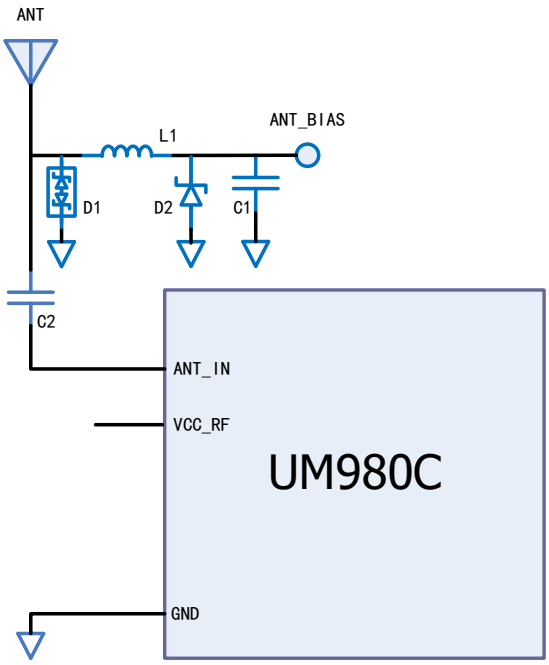


Figure 3-2 UM980C Reference Design for Antenna Bias

Notes:

- L1: feed inductor, 68 nH RF inductor in 0603 package is recommended.
- C1: decoupling capacitor, two capacitors of 100 nF/100 pF connected in parallel are recommended.
- C2: DC blocking capacitor, 100 pF capacitor is recommended.
- It is not recommended to use VCC_RF as ANT_BIAS to supply the antenna (VCC_RF

has not been optimized for anti-lightning strikes, anti-surges and over current protection due to the compact size of the module).

- D1: ESD diode, choose one that supports high-frequency signals (above 2000 MHz).
- D2: TVS diode, choose one with appropriate clamping specifications according to the supply voltage and the 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

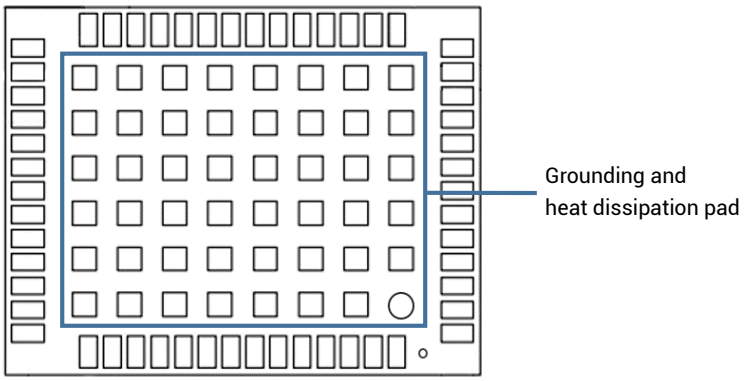


Figure 3-3 Grounding and Heat Dissipation Pad (Bottom View)

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

3.5 Recommended Footprint on the PCB

The dimensions of UM980C'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.

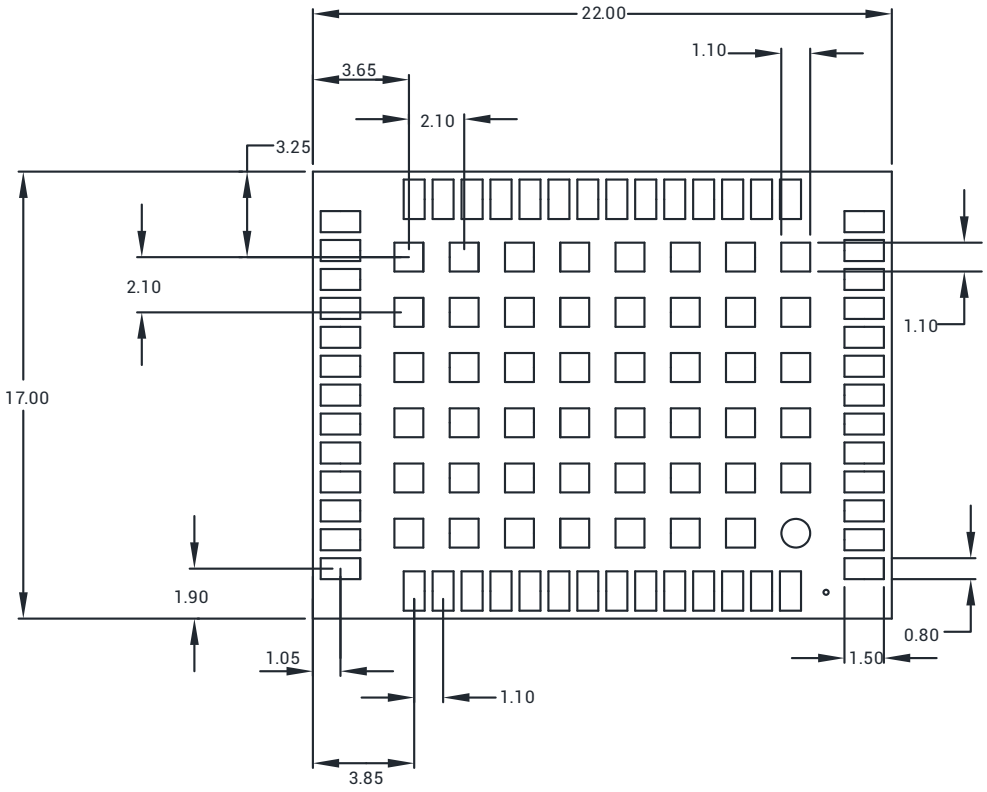


Figure 3-4 Recommended Footprint (Unit: mm)

4 Production Requirements

Recommended soldering temperature curve is as follows:

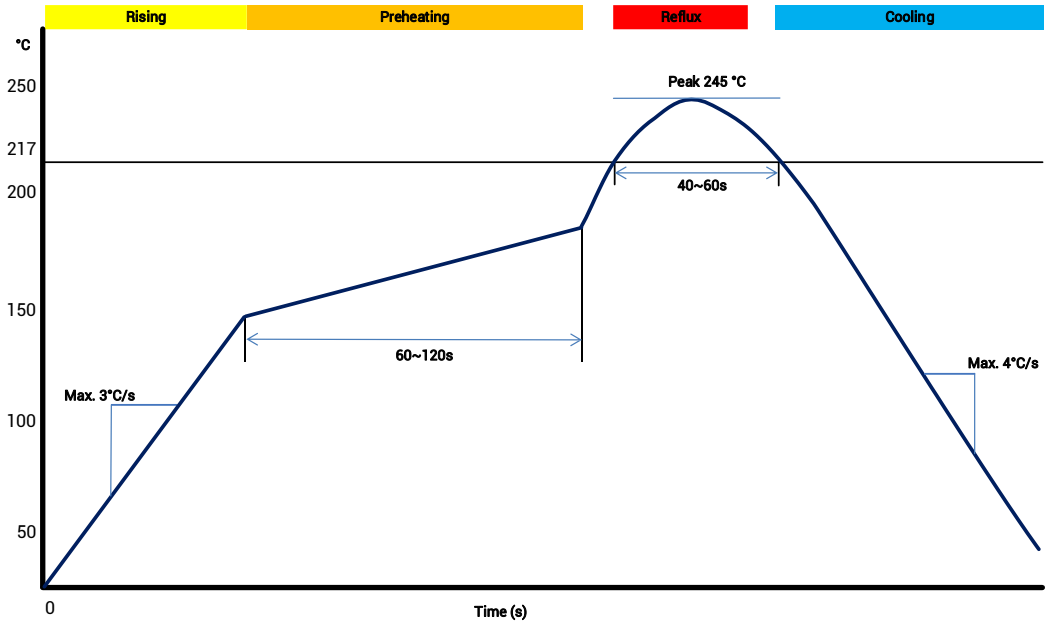


Figure 4-1 Soldering Temperature (Lead-free)

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

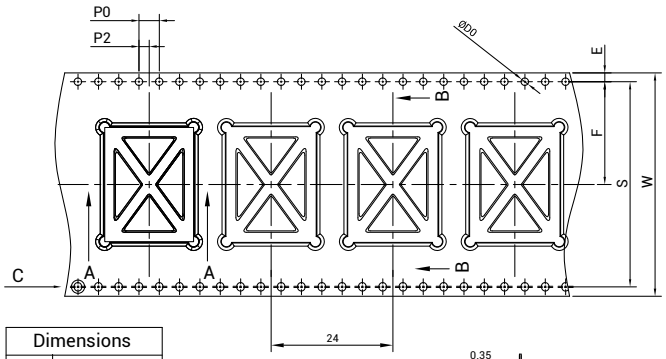
5.1 Label Description

Figure 5-1 Label Description

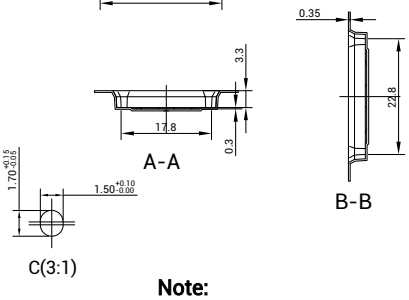
5.2 Product Packaging

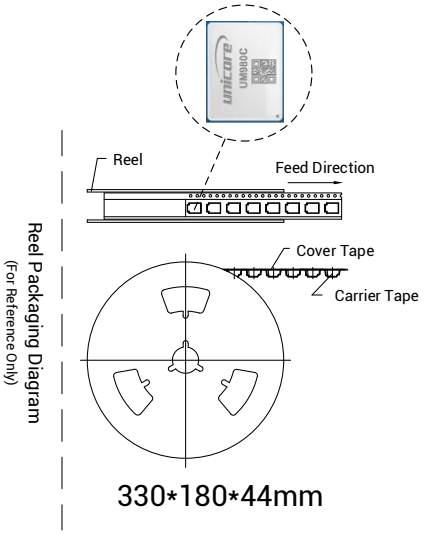
The UM980C module uses carrier tape and reel (suitable for mainstream surface mount devices), packaged in vacuum-sealed aluminum foil antistatic bags, with a desiccant inside to prevent moisture. When using reflow soldering process to solder modules, please strictly comply with IPC standard to conduct temperature and humidity control on the modules. As packaging materials such as the carrier tape can only withstand the temperature of 55 degrees Celsius, modules shall be removed from the package during baking.

Figure 5-2 UM980C Package



Dimensions	
E	1.75±0.10
F	20.20±0.10
S	40.40±0.10
P2	2.00±0.10
ØDo	$1.50 \pm {}^{0.10}_{0.00}$
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).

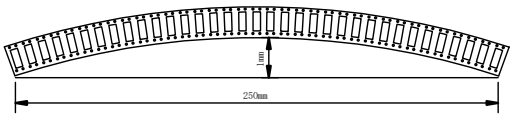


Figure 5-3 UM980C Reel Package Diagram

Table 5-1 Package Description

Item	Description
Module Number	250 pieces/reel
Reel Size	Tray: 13" External diameter: 330 ± 2 mm, Internal diameter: 180 ± 2mm, 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 UM980C 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.

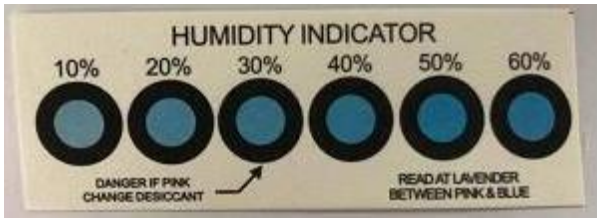


Figure 5-4 Normal Humidity Indication

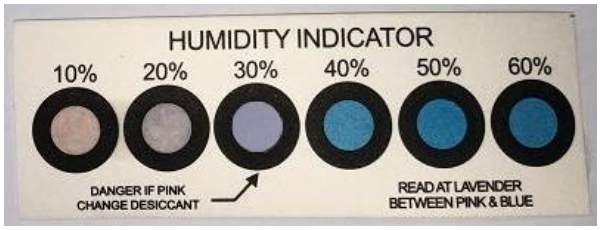


Figure 5-5 Abnormal Humidity Indication

The shelf life of the UM980C module packaged in vacuum-sealed aluminum foil antistatic bags is one year.

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