INSTALLATION AND OPERATION

USER MANUAL

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UM980

BDS/GPS/GLONASS/Galileo/QZSS

All-constellation Multi-frequency

High Precision RTK Positioning Module

Revision History

Version	Revision History	Date
R1.0	First release	2022-08
R1.1	• If hot start is not used, V_BCKP should be connected to VCC; • Update the IO threshold in Table 2-5; • Add section 3.1: UM980 minimal design; • Update the recommended thickness of the stencil in Chapter 4	2022-10-20

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Should you purchase our product and encounter any inconsistency, please contact us or our local authorized distributor for the most up-to-date version of this manual along with any addenda or corrigenda.

Foreword

This document describes the information of the hardware, package, specification and the use of Unicore UM980 modules.

Target Readers

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

Contents

1 Introduction 1
1.1 Key Features 2
1.2 Key Specifications 2
1.3 Block Diagram 5
2 Hardware 6
2.1 Dimensions 6
2.2 Pin Definition 8
2.3 Electrical Specifications 12
2.3.1 Absolute Maximum Ratings 12
2.3.2 Operating Conditions 12
2.3.3 IO Threshold 13
2.3.4 Antenna Feature 13
3 Hardware Design 14
3.1 UM980 Minimal Design 14
3.2 Antenna Feed Design 14
3.3 Grounding and Heat Dissipation 16
3.4 Power-on and Power-off 16
4 Production Requirement 17
5 Packaging 18
5.1 Label Description 18
5.2 Product Packaging 18

1 Introduction

UM980 is a new generation of GNSS high precision RTK positioning module from Unicore. It supports all constellations and all frequencies, and can simultaneously track BDS B1I/B2I/B3I/B1C/B2a/B2b*, GPS L1/L2/L5, GLONASS G1/G2/G3*, Galileo E1/E5a/E5b/E6*, QZSS L1/L2/L5, and SBAS. The module is mainly used in surveying and mapping, precise agriculture, UAVs, and autonomous robots.

UM980 is based on NebulasIV™, a GNSS SoC which integrates the RF-baseband and high precision algorithm. Besides, the SoC integrates a dual-core CPU, a high speed floating point processor and an RTK co-processor with 22 nm low power design, and it supports 1408 super channels. All these above enable stronger signal processing.

With the built-in JamShield adaptive anti-jamming technology, UM980 can fulfill a strengthening RTK engine solution of multi-mode multi-frequency, 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.

Furthermore, UM980 supports abundant interfaces such as UART, I²C*, SPI*, as well as 1PPS, EVENT, CAN*, which meets the customers' needs in different applications.

Figure 1-1 UM980 Module

* B2b, G3 and E6 are supported by specific firmware

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

1.1 Key Features

- Based on the new generation GNSS SoC -NebulasⅣ™, with RF-baseband and high precision algorithm integrated
- 17 mm × 22 mm × 2.6 mm, surface-mount device
- Supports all-constellation multi-frequency on-chip RTK positioning solution
- Supports BDS B1I/B2I/B3I/B1C/B2a/B2b* + GPS L1/L2/L5 + GLONASS G1/G2/G3* + Galileo E1/E5a/E5b/E6* + QZSS L1/L2/L5 + SBAS
- All-constellation multi-frequency RTK engine and advanced RTK processing technology
- Instantaneous RTK initialization technology
- Independent tracking of different frequencies, and 60 dB narrowband anti-jamming technology

1.2 Key Specifications

Table 1-1 Technical Specifications

Basic Information	
Channels	1408 channels, based on NebulasIV™
Constellations	BDS/GPS/GLONASS/Galileo/QZSS
Frequencies	BDS: B1I, B2I, B3I, B1C, B2a, B2b[1] GPS: L1 C/A, L1C[1], L2P (Y), L2C, L5 GLONASS: G1, G2, G3[1] Galileo: E1, E5a, E5b, E6[1] QZSS: L1, L2, L5
Power	
Voltage	+3.0 V ~ +3.6 V DC
Power Consumption	480 mW (Typical)

[1] B2b, L1C, G3 and E6 are supported by specific firmware

Performance				
Positioning Accuracy	Single Point Positioning[2] (RMS)	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		
Observation Accuracy (RMS)	BDS	GPS	GLONASS	Galileo
B1I/B1C/L1C[1]/L1 C/A/G1/E1 Pseudorange	10 cm	10 cm	10 cm	10 cm
B1I/B1C/L1C[1]/L1 C/A/G1/E1 Carrier Phase	1 mm	1 mm	1 mm	1 mm
B3I/L2P(Y)/L2C/G2 Pseudorange	10 cm	10 cm	10 cm	10 cm
B3I/L2P(Y)/L2C/G2 Carrier Phase	1 mm	1 mm	1 mm	1 mm
B2I/B2a/B2b[1]/L5/E5a/E5b Pseudorange	10 cm	10 cm	10 cm	10 cm
B2I/B2a/B2b[1]/L5/E5a/E5b Carrier Phase	1 mm	1 mm	1 mm	1 mm
Time Pulse Accuracy (RMS)	20 ns			
Velocity Accuracy[4] (RMS)	0.03 m/s			
Time to First Fix[5] (TTFF)	Cold Start < 30 s			

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

[5] -130dBm @ more than 12 available satellites

	Warm Start < 20 s
	Hot Start < 5 s
Initialization Time[2]	< 5 s (Typical)
Initialization Reliability[2]	> 99.9%
Data Update Rate	50 Hz[6] Positioning
Differential Data	RTCM 3.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	GJB150.16A-2009, MIL-STD-810F
Shock	GJB150.18A-2009, MIL-STD-810F
Functional Ports	
UART × 3	
I^2C* × 1	
SPI* × 1	Slave
CAN* × 1	Shared with UART3

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

[6] Supports 50 Hz after firmware upgrade

1.3 Block Diagram

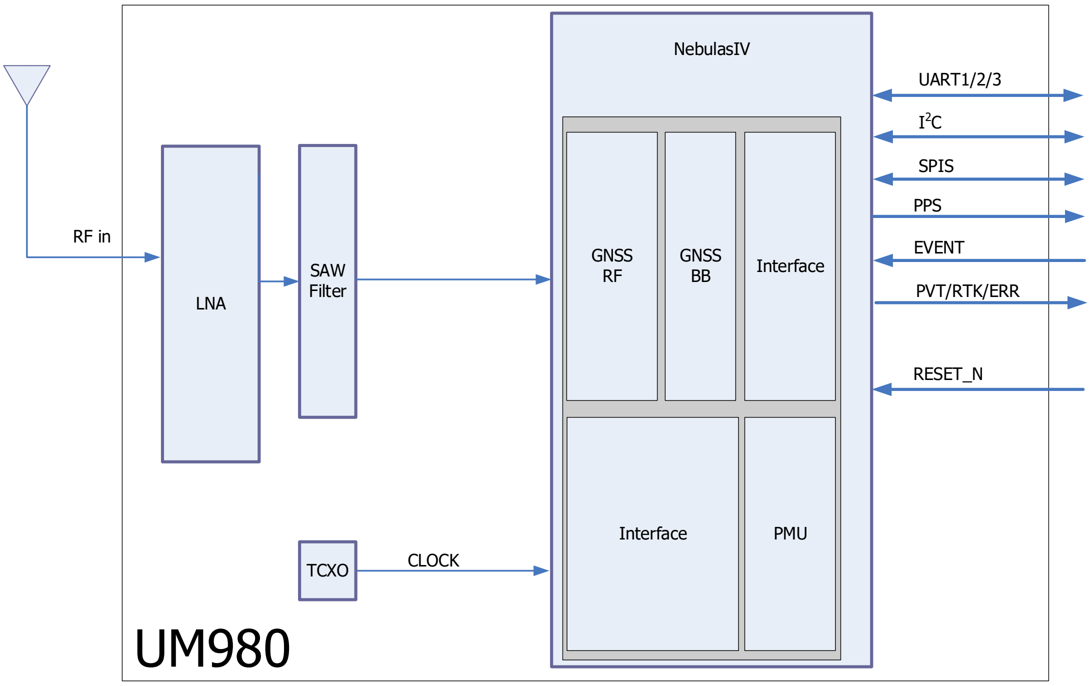


Figure 1-2 UM980 Block Diagram

- **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 UNICORECOMM's new generation high precision GNSS SoC with 22 nm low power design, supporting all constellations all frequencies and 1408 super channels. 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 UM980 include UART, I^2C*, SPI*, CAN*, PPS, EVENT, RTK_STAT, PVT_STAT, ERR_STAT, RESET_N, etc.

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

2 Hardware

2.1 Dimensions

Table 2-1 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

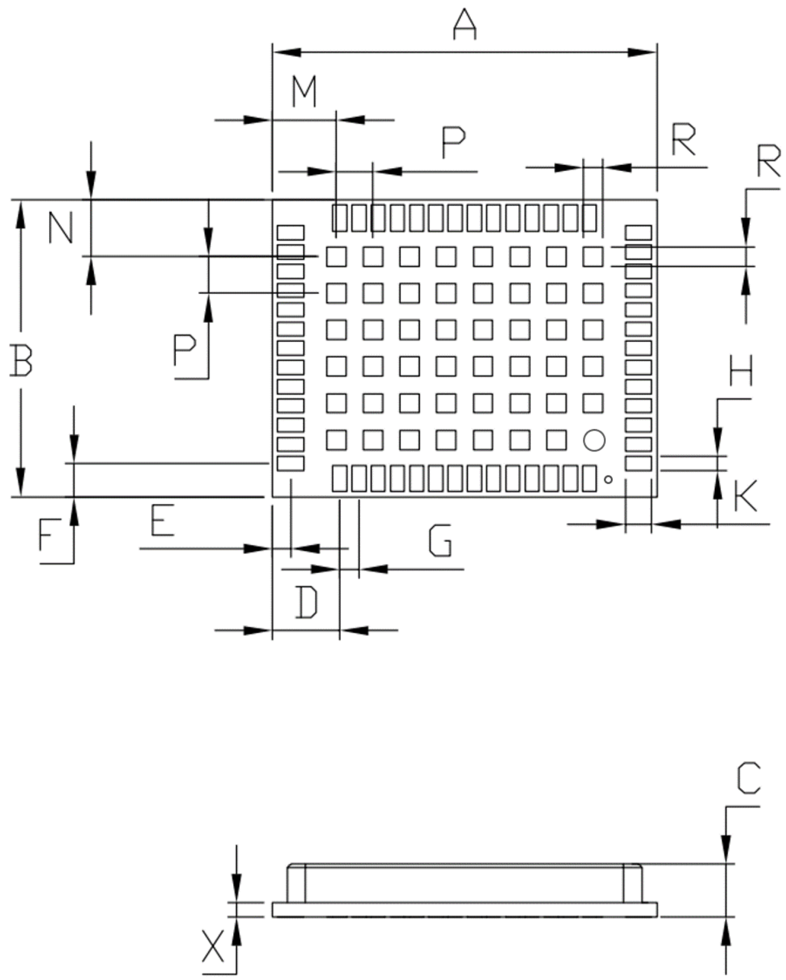


Figure 2-1 UM980 Mechanical Dimensions

2.2 Pin Definition

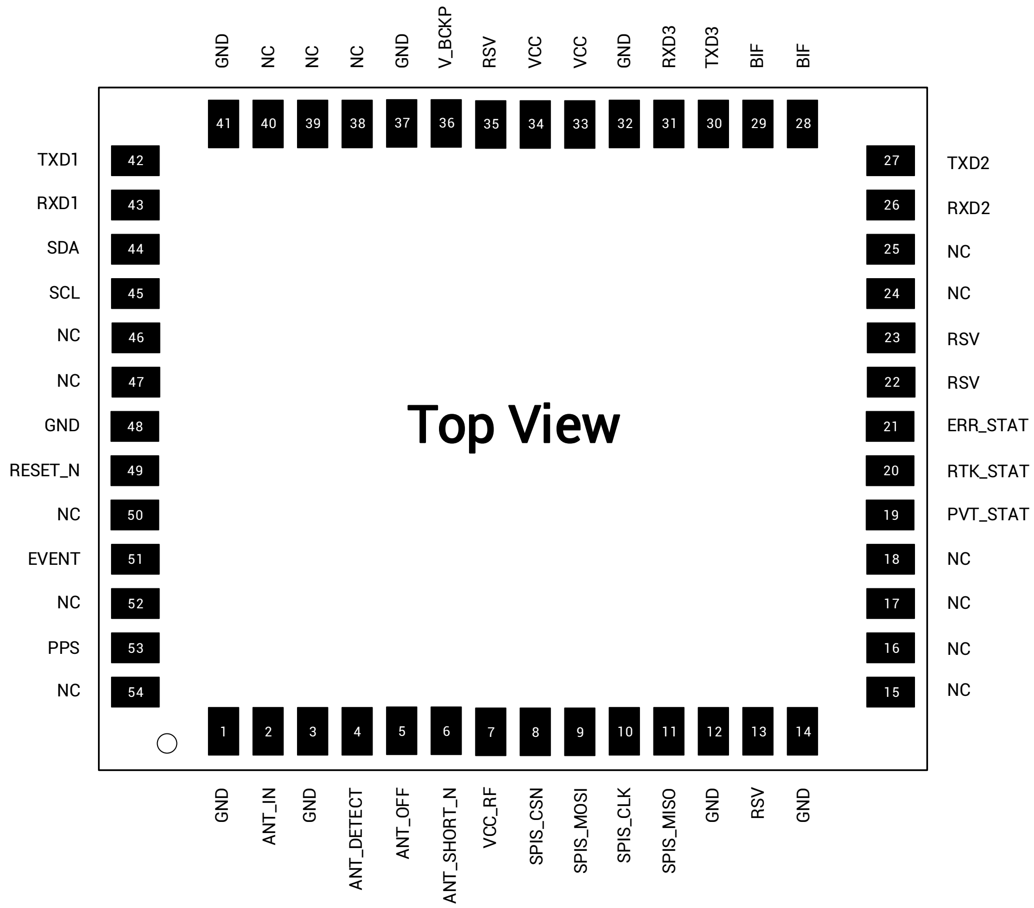


Figure 2-2 UM980 Pin Definition

Table 2-2 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
5	ANT_OFF	O	Disable external LNA
6	ANT_SHORT_N	I	Antenna short circuit detection; active low

No.	Pin	I/O	Description
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
14	GND	—	Ground
15	NC	—	No connection inside
16	NC	—	No connection inside
17	NC	—	No connection inside
18	NC	—	No connection inside
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 with 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, recommended to be floating

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

No.	Pin	I/O	Description
23	RSV	—	Reserved, recommended to be floating
24	NC	—	No connection inside
25	NC	—	No connection inside
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 be peripheral I/O, 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 be peripheral I/O, but can be floating
30	TXD3	O	COM3 output, can be used as CAN TXD, LVTTL level
31	RXD3	I	COM3 input, can be used as CAN RXD, LVTTL level
32	GND	—	Ground
33	VCC	I	Power supply
34	VCC	I	Power supply
35	RSV	—	Reserved
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

No.	Pin	I/O	Description
			connect it to ground or leave it floating.
37	GND	—	Ground
38	NC	—	No connection inside
39	NC	—	No connection inside
40	NC	—	No connection inside
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
47	NC	—	No connection inside
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
51	EVENT	I	Event mark input, with adjustable frequency and polarity
52	NC	—	No connection inside
53	PPS	O	Pulse per second, with adjustable pulse width and polarity
54	NC	—	No connection inside

2.3 Electrical Specifications

2.3.1 Absolute Maximum Ratings

Table 2-3 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
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

2.3.2 Operating Conditions

Table 2-4 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	

[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.

2.3.3 IO Threshold

Table 2-5 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 Output Voltage	V_{out_high}	VCC - 0.45		VCC	V	I_{out} = 2 mA

2.3.4 Antenna Feature

Table 2-6 Antenna Feature

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

3 Hardware Design

3.1 UM980 Minimal Design

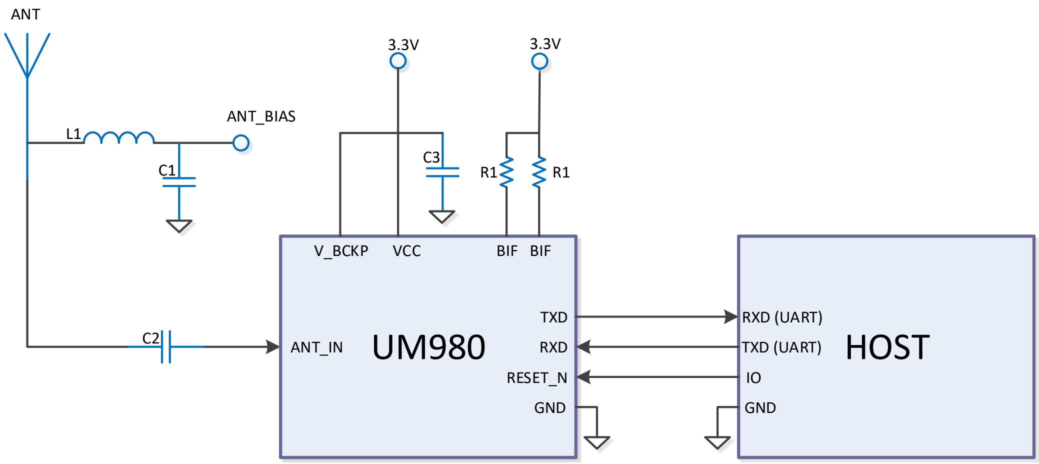


Figure 3-1 UM980 Minimal Design

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 inductance should be no less than 30 μF

R1: 10 kΩ resistor is recommended

3.2 Antenna Feed Design

UM980 just supports feeding the antenna from the external of the module rather than from the internal. 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.

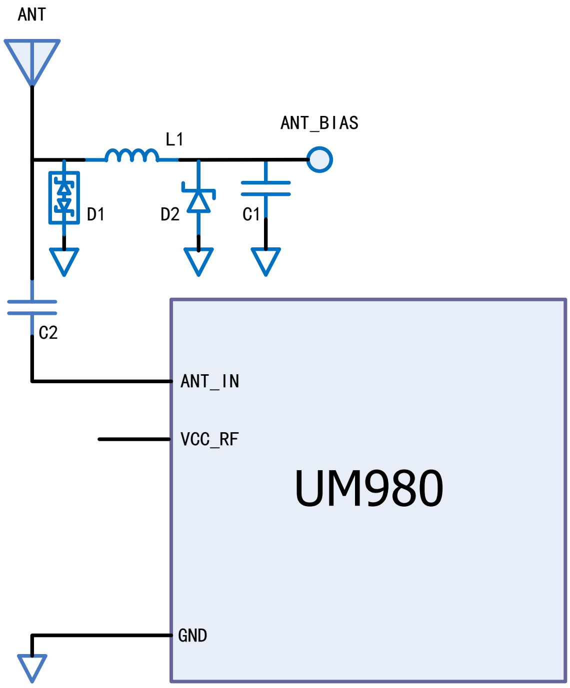


Figure 3-2 UM980 External Antenna Feed Reference Circuit

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 voltage

3.3 Grounding and Heat Dissipation

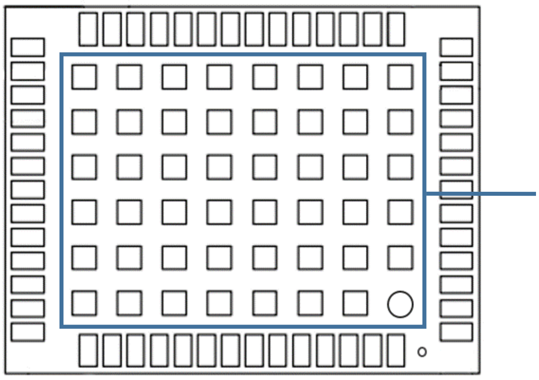


Figure 3-3 Grounding and Heat Dissipation Pad (Bottom View)

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.

3.4 Power-on and Power-off

VCC

The VCC initial level when power-on should be less than 0.4 V and has good monotonicity. The voltages of undershoot and ringing should be within 5% VCC.

VCC power-on waveform: The time interval from 10% rising to 90% must be within 100 us ~1 ms.

Power-on time interval: The time interval between the VCC < 0.4 V (after power-off) 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 and has good monotonicity. The voltages of undershoot and ringing should be within 5% V_BCKP.

V_BCKP power-on waveform: The time interval from 10% rising to 90% must be within 100 us ~1 ms.

Power-on time interval: The time interval between the V_BCKP < 0.4 V (after power-off) to the next power-on must be larger than 500 ms.

4 Production Requirement

Recommended soldering temperature curve is as follows:

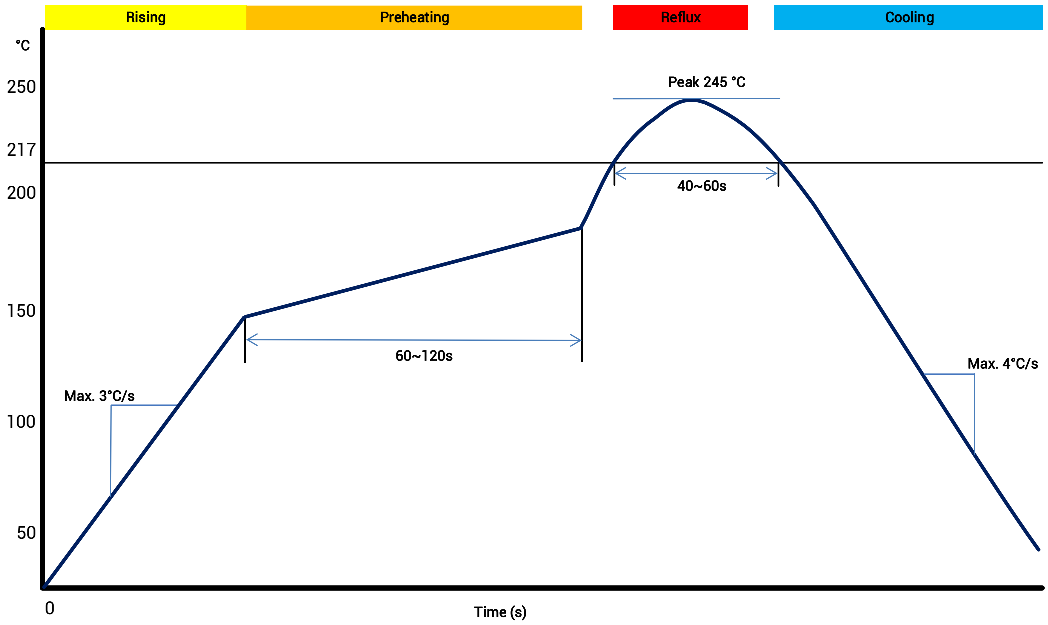


Figure 4-1 Soldering Temperature (Lead-free)

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 opening of the stencil needs to meet your design requirement and comply with the examine standards. The thickness of the stencil is recommended to be 0.15mm.

5 Packaging

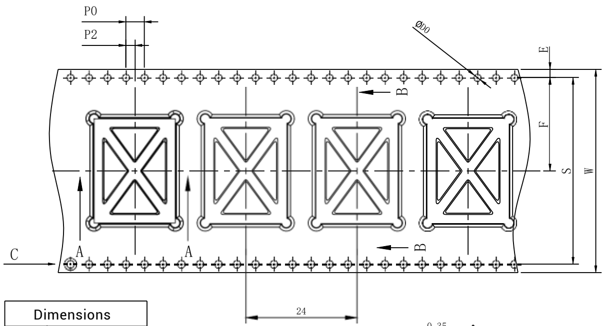
5.1 Label Description

Figure 5-1 Label Description

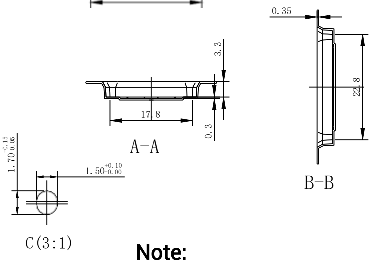
5.2 Product Packaging

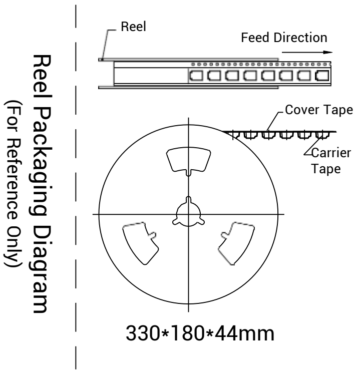
The UM980 module uses carrier tape and reel (suitable for mainstream surface mount devices), packaged in vacuum-sealed aluminum foil antistatic bags, with a desiccant inside to prevent moisture. When using reflow soldering process to solder modules, please strictly comply with IPC standard to conduct 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 UM980 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).

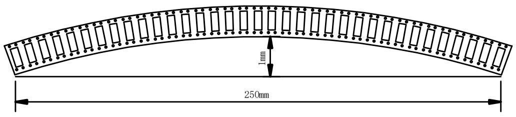


Figure 5-3 UM980 Reel Package Diagram

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 UM980 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.

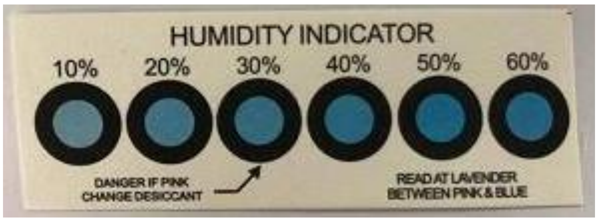


Figure 5-4 Normal Humidity Indication

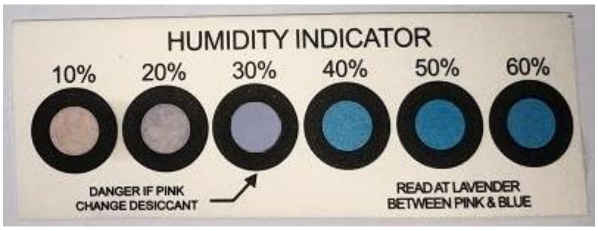


Figure 5-5 Abnormal Humidity Indication

The shelf life of the UM980 module packaged in vacuum-sealed aluminum foil antistatic bags is one year.

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