INSTALLATION AND OPERATION

USER MANUAL

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UM680A

Automotive Grade GNSS High Precision RTK Positioning Module

Revision History

Version	Revision History	Date
R1.0	First release	Oct. 2024

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Foreword

This document describes the information of the hardware, package, specification and the use of Unicore UM680A module.

Target Readers

This document applies to technicians who are familiar with GNSS receivers.

Contents

1 Introduction

UM680A is an automotive-grade GNSS navigation and positioning module designed for intelligent driving field. It is based on the multi-system, dual-frequency and high-performance GNSS SoC - UC6580A, which conforms to the requirements of AEC-Q100, and the manufacturing process is in line with IATF 16949.

UM680A supports GPS/BeiDou/GLONASS*/Galileo/QZSS/NavIC* L1+L5 frequencies, providing centimeter-level RTK positioning. It has two sub-models, UM680A-12 and UM680A-13, of which UM680A-13 supports up to 105 °C. See Table 1-1 for more information.

Figure 1-1 UM680A High Precision Positioning Module

* Only supported by specific firmware.

1.1 Key Specifications

Table 1-1 Technical Specifications

Products	UM680A-12 Multi-system dual-frequency high precision RTK positioning module	UM680A-13 Multi-system dual-frequency high precision RTK positioning module
Illustration		
Dimension	22.0 mm × 17.0 mm × 2.6 mm	22.0 mm × 17.0 mm × 2.6 mm
Package	54 pin LGA	54 pin LGA
Working Temperature	-40 °C to +85 °C	-40 °C to +105 °C
Storage Temperature	-40 °C to +85 °C	-40 °C to +105 °C
RF Input		
Frequency	GPS: L1C/A+L5 BDS: B1I+B1C*+B2a Galileo: E1+E5a GLONASS: G1* NavIC: L5* QZSS: L1+L5 SBAS	GPS: L1C/A+L5 BDS: B1I+B1C*+B2a Galileo: E1+E5a GLONASS: G1* NavIC: L5* QZSS: L1+L5 SBAS
VSWR	≤ 2.5	≤ 2.5
Input Impedance	50 Ω	50 Ω
Antenna Gain	15 dB to 30 dB	15 dB to 30 dB
Interface		
UART[1]	×2	×2
I²C[2]	●	●

* Supported by specific firmware.

[1] TTL; baud rate: 115200 to 921600 bps.

[2] Reserved; address: 7 bit; working mode: slave; supports up to 400 Kbps.

Products	UM680A-12 Multi-system dual-frequency high precision RTK positioning module	UM680A-13 Multi-system dual-frequency high precision RTK positioning module
SPI[3]	●	●
PPS	×1	×1
EVENT	×1	×1
RESET_N	●	●
RTK_STAT	●	●
GNSS Antenna	×1	×1
Performance		
TTFF	Cold start: 26 s Hot start: 2 s Reacquisition: 2 s	Cold start: 26 s Hot start: 2 s Reacquisition: 2 s
Single Point Positioning Accuracy (RMS)	Horizontal: 1.5 m (open sky) Vertical: 2.5 m (open sky)	Horizontal: 1.5 m (open sky) Vertical: 2.5 m (open sky)
RTK Positioning Accuracy (RMS)	Horizontal: 1 cm + 1ppm (open sky) Vertical: 2 cm + 1ppm (open sky)	Horizontal: 1 cm + 1ppm (open sky) Vertical: 2 cm + 1ppm (open sky)
Velocity Accuracy (RMS)[4]	0.05 m/s	0.05 m/s
Sensitivity	Tracking: -162 dbm Cold start: -147 dbm Hot start: -157 dbm Reacquisition: -158 dbm	Tracking: -162 dbm Cold start: -147 dbm Hot start: -157 dbm Reacquisition: -158 dbm
Data Update Rate	1 Hz/5 Hz/10 Hz	1 Hz/5 Hz/10 Hz
1PPS Accuracy (RMS)	20 ns	20 ns

[3] Reserved; alternate function of Pin 42 to 45; working mode: slave; supports up to 4 Mbps.

[4] 68% at 30 m/s for dynamic operation, open sky

Products	UM680A-12 Multi-system dual-frequency high precision RTK positioning module	UM680A-13 Multi-system dual-frequency high precision RTK positioning module
Data Format	NMEA 0183 Unicore Protocol RTCM	NMEA 0183 Unicore Protocol RTCM
Electrical Specifications		
Voltage	2.7 V to 3.6 V, Typ.: 3.3 V	2.7 V to 3.6 V, Typ.: 3.3 V
LNA Feed Power	2.7 V to 3.3 V, <100 mA	2.7 V to 3.3 V, <100 mA
Power Consumption	240 mW	240 mW
Environmental Specifications		
Humidity	95% No condensation	95% No condensation
Vibration	GB/T 28046.3; ISO 16750.3	GB/T 28046.3; ISO 16750.3
Shock	GB/T 28046.3; ISO 16750.3	GB/T 28046.3; ISO 16750.3

1.2 Block Diagram

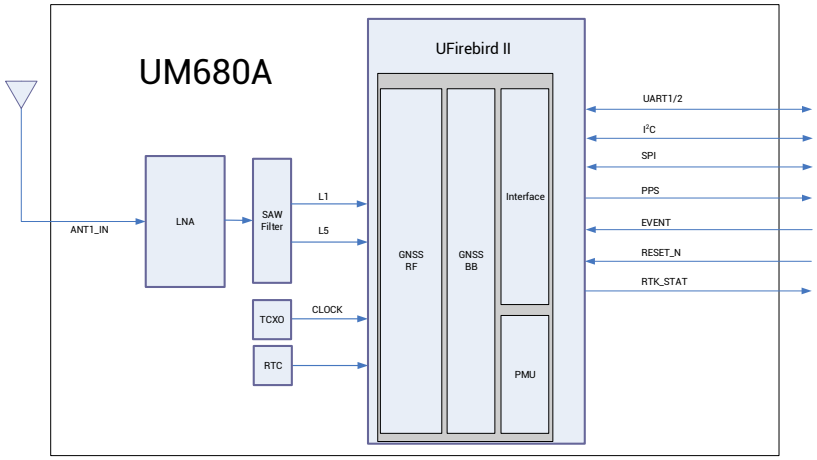


Figure 1-2 UM680A Block Diagram

1. RF Part

The receiver gets filtered and enhanced GNSS signals 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 UFirebird II chip.

2. UFirebird II SoC (UC6580A)

UFirebird II is the new generation RF-baseband and high-precision algorithm integrated GNSS SoC developed by Unicore. It adopts 22 nm technology and low power

consumption design, supporting multi-path mitigation, anti-jamming and high precision GNSS joint positioning. The chip is especially suitable for the application scenarios which are sensitive to power and size.

3. Interfaces

UM680A has interfaces such as UART, I²C*, SPI*, PPS, EVENT, RTK_STAT and RESET_N.

There are two UARTs. UART1 is the master serial port, supporting data transmission and firmware upgrade, and the I/O signal type is LVTTL. The baud rate can be configured by users. UART2 is a backup port and only supports data transmission; it cannot be used for firmware upgrade.

* I²C and SPI are reserved interfaces.

2 Hardware

2.1 Pin Definition

See Figure 2-1 for the definition of UM680A-12/UM680A-13.

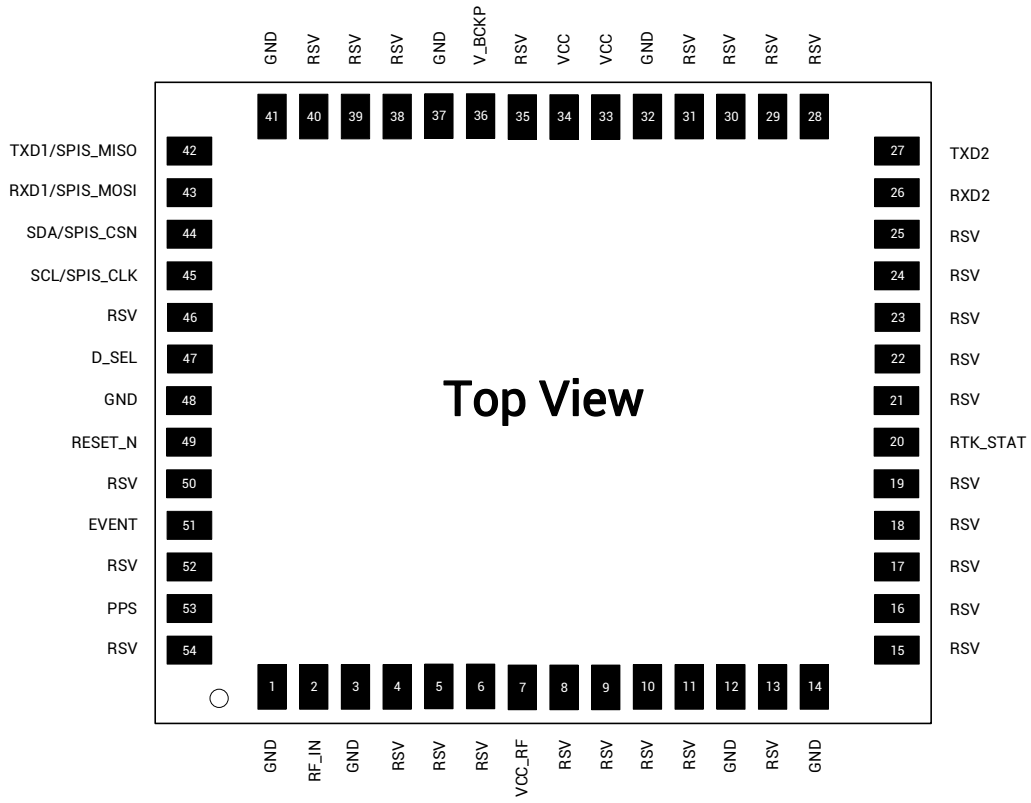


Figure 2-1 UM680A-12/UM680A-13 Pin Definition

Table 2-1 UM680A-12/UM680A-13 Pin Definition

No.	Pin	I/O	Description
1	GND	—	Ground
2	RF_IN	I	GNSS antenna signal input
3	GND	—	Ground
4	RSV	—	Reserved; leave floating
5	RSV	—	Reserved; leave floating
6	RSV	—	Reserved; leave floating
7	VCC_RF[5]	O	Antenna feed output

[5] Not recommended to use VCC_RF to feed the antenna (VCC_RF has not been optimized for anti-lightning strike and anti-surge due to the compact size of the module).

No.	Pin	I/O	Description
8	RSV	—	Reserved; leave floating
9	RSV	—	Reserved; leave floating
10	RSV	—	Reserved; leave floating
11	RSV	—	Reserved; leave floating
12	GND	—	Ground
13	RSV	—	Reserved; leave floating
14	GND	—	Ground
15	RSV	—	Reserved; leave floating
16	RSV	—	Reserved; leave floating
17	RSV	—	Reserved; leave floating
18	RSV	—	Reserved; leave floating
19	RSV	—	Reserved; leave floating
20	RTK_STAT	O	RTK positioning indicator: active high; outputs high for RTK fixed solution, and low for other status.
21	RSV	—	Reserved; leave floating
22	RSV	—	Reserved; leave floating
23	RSV	—	Reserved; leave floating
24	RSV	—	Reserved; leave floating
25	RSV	—	Reserved; leave floating
26	RXD2	I	UART2 input, LVTTL level
27	TXD2	O	UART2 output, LVTTL level
28	RSV	—	Reserved; leave floating
29	RSV	—	Reserved; leave floating
30	RSV	—	Reserved; leave floating
31	RSV	—	Reserved; leave floating
32	GND	—	Ground
33	VCC	I	Power supply (+3.3 V)
34	VCC	I	Power supply (+3.3 V)
35	RSV	—	Reserved; leave floating

No.	Pin	I/O	Description
36	V_BCKP	I	When the main power supply VCC is cut off, V_BCKP supplies power to RTC and relevant register. Supply voltage: 2.0 V to 3.6 V, and the working current is less than 10 μA at 25 °C. If you do not use the hot start function, connect V_BCKP to VCC or a standalone power source. Do NOT connect it to ground or leave it floating.
37	GND	—	Ground
38	RSV	—	Reserved; leave floating
39	RSV	—	Reserved; leave floating
40	RSV	—	Reserved; leave floating
41	GND	—	Ground
42	TXD1/SPIS_MISO	O	UART1 output (D_SEL=VCC or floating); Master In/Slave Out of SPI slave (D_SEL=GND)
43	RXD1/SPIS_MOSI	I	UART1 input (D_SEL=VCC or floating); Master Out/Slave In of SPI slave (D_SEL=GND)
44	SDA/SPIS_CSN	I	I^2C data (D_SEL=VCC or floating); SPI slave chip select (D_SEL=GND)
45	SCL/SPIS_CLK	I	I^2C clock (D_SEL=VCC or floating); SPI slave clock (D_SEL=GND)
46	RSV	—	Reserved; leave floating
47	D_SEL	I	Interface select pin; Use pin 42 to 45 as a SPI slave when D_SEL = GND, as UART1 and I^2C When D_SEL=VCC or floating
48	GND	—	Ground
49	RESET_N	I	System reset; active low; the active time should be no less than 5 ms
50	RSV	—	Reserved; leave floating
51	EVENT	I	Event mark input with adjustable frequency and polarity
52	RSV	—	Reserved; leave floating
53	PPS	O	Pulse per second with adjustable pulse width and polarity
54	RSV	—	Reserved; leave floating

2.2 Electrical Specifications

2.2.1 Absolute Maximum Ratings

Table 2-2 Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Remark
Power Supply	VCC	-0.2	3.6	V	
Backup Battery	V_BCKP	-0.2	3.6	V	
Digital Pin Voltage		-0.2	3.6	V	
Antenna RF Input Power	RF_IN	-	-3	dBm	
Storage Temperature	T_{STG}	-40	+85	°C	UM680A-12
	T_{STG}	-40	+105	°C	UM680A-13
Reflow Soldering Temperature	T_{SLDR}	-	+245	°C	

2.2.2 Operational Conditions

Table 2-3 Operational Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Power Supply	VCC	2.7	3.3	3.6	V	
VCC Ripple	Vp-p			50	mV	
Peak Current	Iccp			200	mA	VCC = 3.0 V
Average Tracking Current[6]	I_{ACQ}	70	80	100	mA	VCC = 3.0 V
Low Level Input Voltage	V_{IL}	-0.3		0.2 × VCC	V	
High Level Input Voltage	V_{IH}	0.7 × VCC		3.6	V	
Low Level Output Voltage	V_{OL}	0		0.4	V	I_{out} = -2 mA
High Level Output Voltage	V_{OH}	VCC – 0.4		VCC	V	I_{out} = 2 mA
Antenna Gain	G_{ANT}	15	20	30	dB	

[6] 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 2-4 Dimensions

Symbol	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

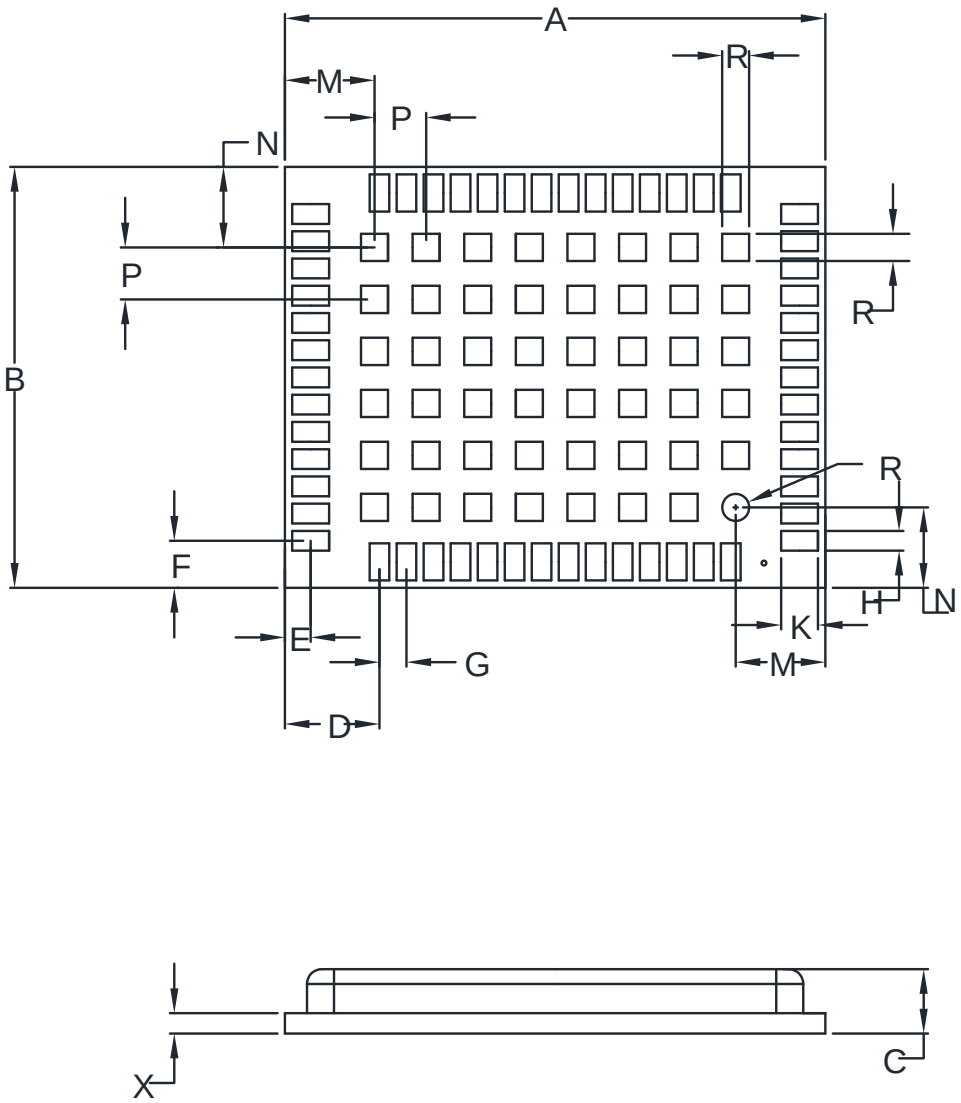


Figure 2-2 UM680A Mechanical Dimensions

3 Hardware Design

3.1 Recommended Minimal Design

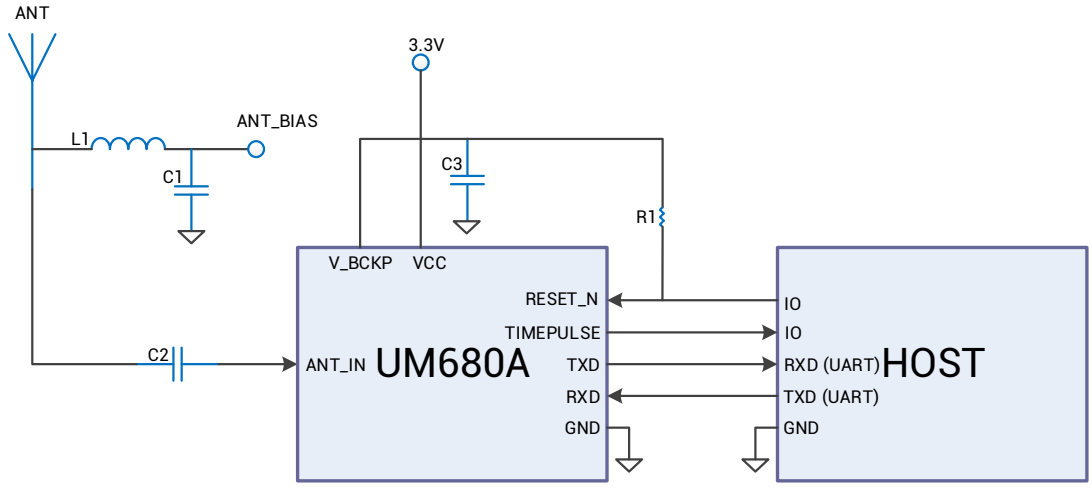


Figure 3-1 UM680A Minimal Design

Remarks:

- 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: Several 10 μF + 100 nF capacitors connected in parallel is recommended
- R1: 10 kΩ resistor is recommended; pull up

3.2 Antenna Feed Design

UM680A supports feeding the antennal 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.

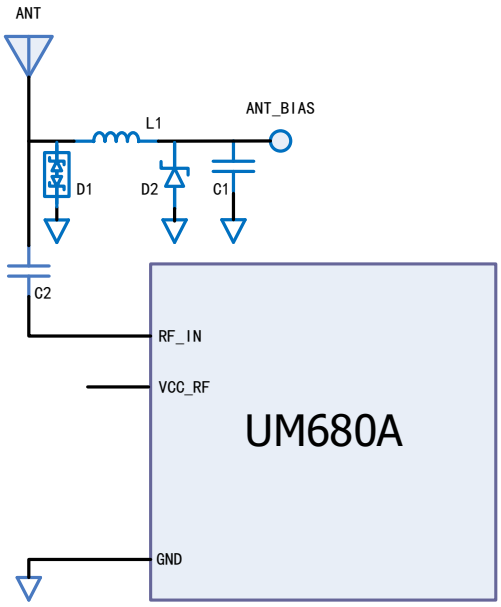


Figure 3-2 UM680A External Antenna Feed Reference Circuit

Remarks:

- L1: feed inductor, 68nH RF inductor in 0603 package is recommended;
- C1: decoupling capacitor, it is recommended to connect two capacitors of 100nF/100pF in parallel;
- C2: DC blocking capacitor, recommended 100pF capacitor;
- Not recommended to use VCC_RF as ANT_BIAS to feed the antenna (VCC_RF has not been optimized for the anti-lightning strike and anti-surge 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.
- VCC power-on waveform: The time interval from 10% rising to 90% must be within 100 μs to 10 ms.
- 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.
- V_BCKP power-on waveform: The time interval from 10% rising to 90% must be within 100 μs to 10 ms.
- 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

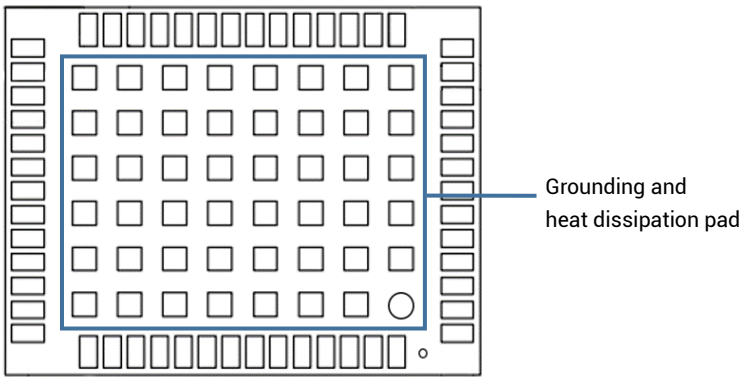


Figure 3-3 Grounding and Heat Dissipation Pad

The 48 pads in the rectangle in Figure 3-3 are for grounding and heat dissipation. In the PCB design, it is recommended to connect them to a large sized ground to strengthen the heat dissipation.

3.5 Recommended PCB Package Design

See the following figure for the recommended PCB package design of the module UM680A.

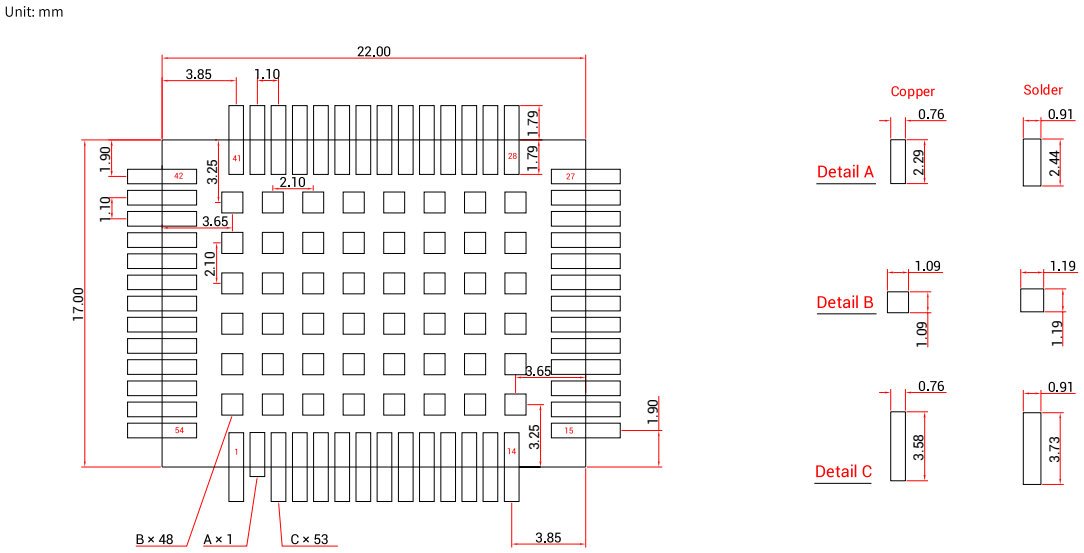


Figure 3-4 Recommended PCB Package Design

Remark:

For the convenience of testing, the soldering pads of the pins are designed long, exceeding the module border much more. For example:

- The pads denoted as detail C are 1.79 mm longer than the module border.
- The pad denoted as detail A is 0.50 mm longer than the module border. It is relatively short as it is an RF pin pad, so we hope the trace on the surface is as short as possible to reduce the impact of interference.

4 Production Requirement

4.1 Clean

Do NOT use alcohol or other organic solvents to clean the module, or it may lead to flux residues flooding into the shielding shell, causing mildew and other problems.

4.2 Soldering

Recommended soldering temperature curve is as follows:

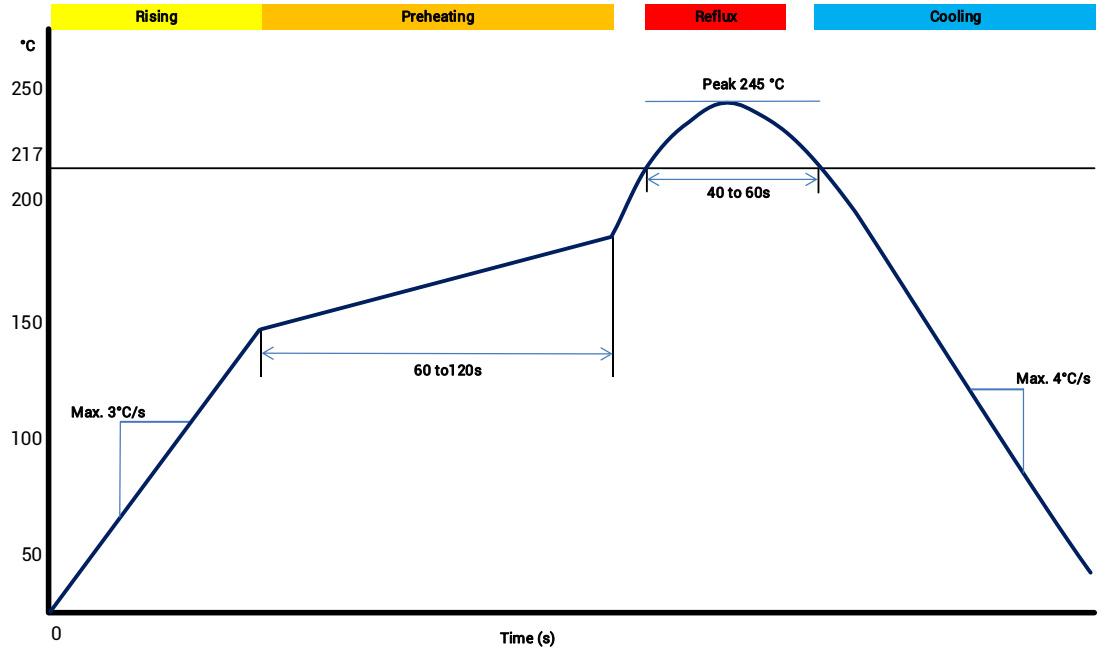


Figure 4-1 Soldering Temperature (Lead-free)

Temperature Rising Stage

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

Preheating Stage

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

Reflux Stage

- Over melting temperature (217 °C) time: 40 s to 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 better not 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.

4.3 Stencil Thickness

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 0.15 mm.

5 Packaging

5.1 Label Description

Figure 5-1 Label Description

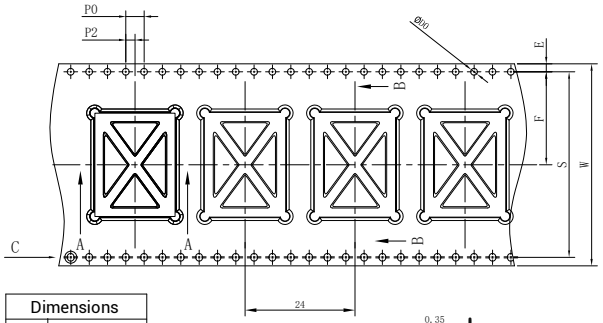
5.2 Ordering Information

Product Model	Sub-model	Description
UM680A	12	Automotive grade; dual-frequency RTK positioning module; operating temperature: -40 °C to +85 °C; supporting firmware upgrade; 22 mm x 17 mm; 250 pieces/reel
	13	Automotive grade; dual-frequency RTK positioning module; operating temperature: -40 °C to +105 °C; supporting firmware upgrade; 22 mm x 17 mm; 250 pieces/reel

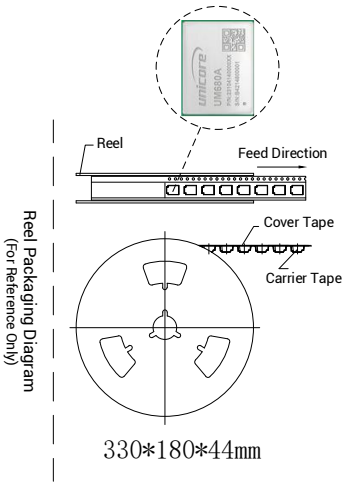
5.3 Product Packaging

The UM680A 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 humidity control. 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 UM680A 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
BO	22.80±0.10
KO	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).

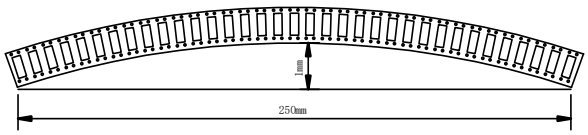


Figure 5-3 UM680A Reel Package Diagram

Table 5-1 Package Description

Item	Description
Module Number	250 pieces/reel
Reel Size	Tray: 13" External diameter: 330 ± 2 mm Internal diameter: 180 ± 2 mm 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 UM680A is rated at MSL level 3. Refer to the relevant IPC/JEDEC J-STD-033 standards for the package and operation requirements. Users may access to the website www.jedec.org to get more information.

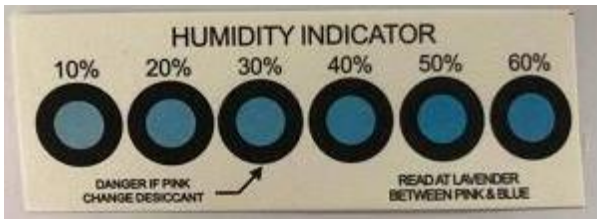


Figure 5-4 Normal Humidity Indication

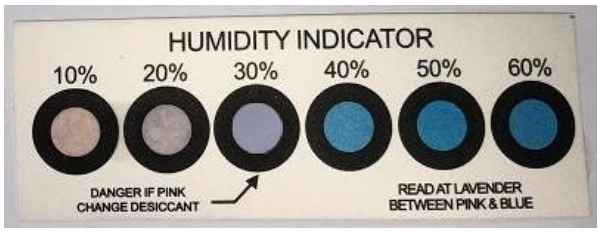


Figure 5-5 Abnormal Humidity Indication

The shelf life of the UM680A module packaged in vacuum-sealed aluminum foil antistatic bags is one year.

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