INSTALLATION AND OPERATION

# USER MANUAL

WWW.UNICORE.COM

# UM680

## Industrial-Grade Multi-GNSS Dual-Frequency High-Precision RTK Positioning Module

# Foreword

## Applicability

This document provides information about the product features, specifications and hardware design of the UM680 module.

### Target Readers

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

## Statement

### Legal Right Notice

This manual provides information and details on the products of Unicore Communication, Inc. (“Unicore”) referred to herein.



### Disclaimer

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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.

# Revision History

| Version | Revision History | Date |
| --- | --- | --- |
| R1.0 | First release. | May 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. | √ |

# Introduction

## 1.1 Overview

UM680 is an industrial-grade GNSS high-precision RTK positioning module developed by Unicore Communications. It is based on the multi-constellation, dual-frequency and high-performance GNSS SoC - UC6580I, and its manufacturing process conforms to IATF 16949.

UM680 can track signals of L1 + L5 from GPS/BDS/GLONASS[1]/Galileo/QZSS/NavIC[1], supporting multi-constellation joint positioning and single-constellation standalone positioning.


Figure 1-1 UM680 High-Precision Positioning Module

1. Only supported by specific firmware. ↩

## 1.2 Key Specifications

Table 1-1 Key Specifications

| | |
|---|---|
| **Power** | |
| Voltage | +2.7 V ~ +3.6 V DC |
| LNA Feed Power | +2.7 V ~ +3.3 V, < 100 mA |
| Power Consumption | 240 mW |
| **RF Input** | |

| | |
|---|---|
| Constellations | GPS/GLONASS[1]/BeiDou/Galileo/QZSS/NavIC[1] |
| Standing Wave Ratio | ≤ 2.5 |
| Input Impedance | 50 Ω |
| Antenna Gain | 15 dB ~ 30 dB |
| **Physical Characteristics** | |
| Package | 54 pin LGA |
| Dimensions | 22.0 mm × 17.0 mm × 2.6 mm |
| **Input / Output Data Interface** | |
| UART x 2 | LVTTL level;<br>Supported baud rate: 115200 bps ~ 921600 bps. |
| I2C x 1 | Reserved interface;<br>Address: 7 bit;<br>Operating in slave mode;<br>Maximum transfer rate: 400 Kbps. |
| SPI x 2 | Including an SPIM and an SPIS.<br>The maximum transfer rate of SPIM is 16 Mbps.<br>SPIS is reserved. It shares the pin 42~45 with UART and I2C.<br>The maximum transfer rate of SPIS is 4 Mbps. |
| **GNSS Performance** | |
| Frequencies | GPS: L1C/A, L5;<br>BDS: B1I, B1C[1], B2a;<br>Galileo: E1, E5a;<br>GLONASS: G1[1]<br>NavIC: L5[1]<br>QZSS: L1, L5<br>SBAS |
| Time to First Fix (TTFF) | Cold Start: 26 s<br>Hot Start: 2 s<br>Reacquisition: 2 s |

| | |
|---|---|
| Single Point Positioning Accuracy (RMS) | Horizontal: 1.5 m (open sky)<br>Vertical: 2.5 m (open sky) |
| RTK Positioning Accuracy (RMS) | Horizontal: 1 cm + 1 ppm (open sky)<br>Vertical: 2 cm + 1 ppm (open sky) |
| Velocity Accuracy (RMS)[2] | 0.05 m/s |
| Sensitivity | GNSS<br>Tracking: -162 dBm<br>Cold Start: -147 dBm<br>Hot Start: -157 dBm<br>Reacquisition: -158 dBm |
| GNSS Data Update Rate | 1 Hz / 5 Hz / 10 Hz |
| 1PPS Accuracy (RMS) | 20 ns |
| Data Format | NMEA 0183, Unicore Protocol, RTCM |
| **Environmental Specifications** | |
| Operating Temperature | -40 °C ~ +85 °C |
| Storage Temperature | -40 °C ~ +85 °C |
| Humidity | 95% No condensation |
| Vibration | GB/T 28046.3; ISO 16750.3 |
| Shock | GB/T 28046.3; ISO 16750.3 |

1. Only supported by specific firmware. ↩

2. 68% at 30 m/s for dynamic operation, open sky. ↩

# 1.3 Block Diagram

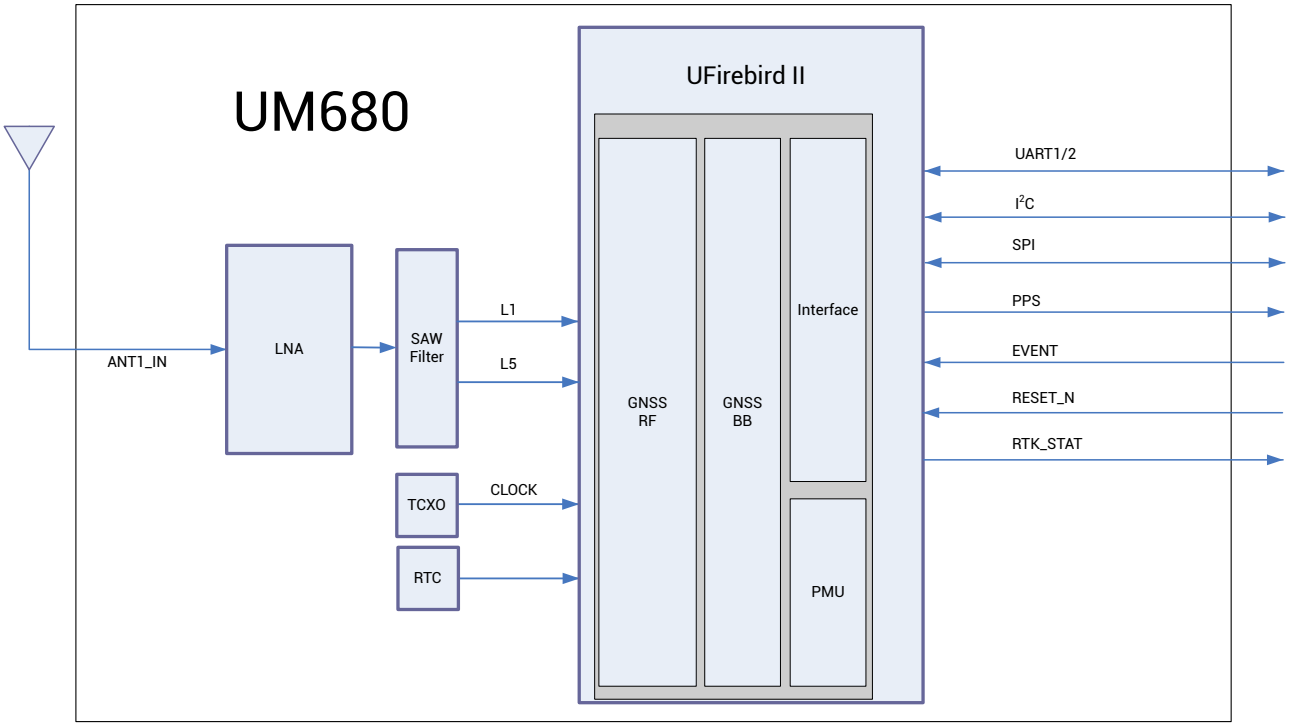



Figure 1-2 Block Diagram

### 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 SoC.

### 2. UFirebird II SoC (UC6580I)

UFirebird II is Unicore's new generation SoC which integrates RF, baseband and high-precision algorithm. It adopts 22 nm technology with low power consumption, supporting multi-path mitigation, anti-jamming and high-precision GNSS joint positioning. The chip can track L1+L5 or L1+L2 signals and is suitable for applications which require low power and compact size.

### 3. Interfaces

UM680 has interfaces such as UART, I2C[1], SPI[1], PPS, EVENT, RTK_STAT and RESET_N.

UART1 is the primary serial port, supporting data transfer 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 transfer. It cannot be used for firmware upgrade.

1. I2C and SPI are reserved interfaces. ↩

# Hardware

## 2.1 Pin Definition

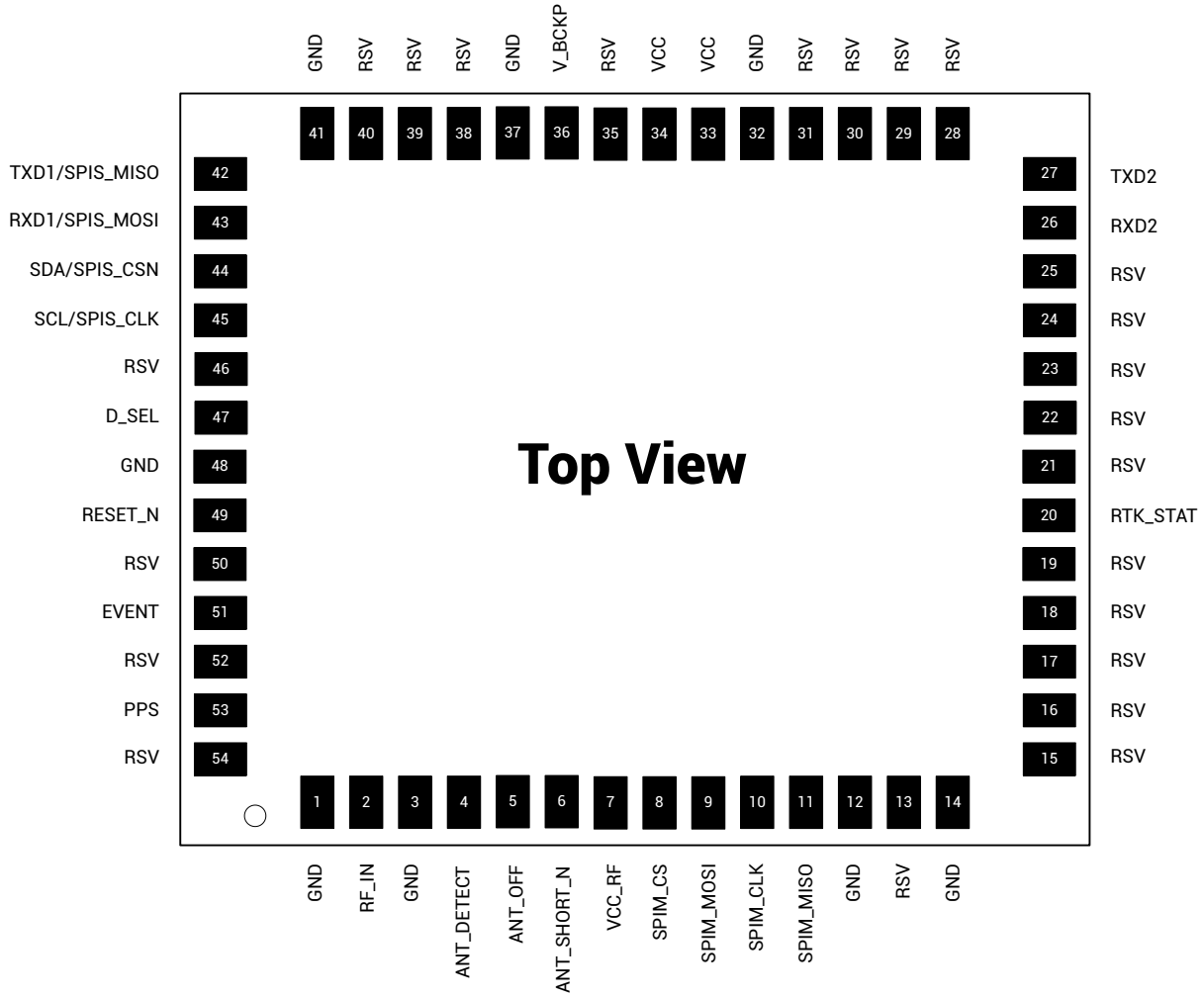



Figure 2-1 UM680 Pin Definition

Table 2-1 UM680 Pin Definition

| No. | Pin | I/O | Description |
|---|---|---|---|
| 1 | GND | — | Ground |
| 2 | RF_IN | I | GNSS antenna signal input |

| No. | Pin | I/O | Description |
|---|---|---|---|
| 3 | GND | — | Ground |
| 4 | ANT_DETECT | I | Active antenna detection. Active high.<br>High = antenna detected;<br>Low = antenna not detected. |
| 5 | ANT_OFF | O | Disable external antenna power supply. Active high.<br>High = disable external antenna;<br>Low = enable external antenna. |
| 6 | ANT_SHORT_N | I | Active antenna short detection. Active low.<br>Low = antenna short circuit;<br>High = antenna power status normal. |
| 7 | VCC_RF[1] | O | Power supply for external antenna |
| 8 | SPIM_CS | — | SPI master chip select |
| 9 | SPIM_MOSI | O | Master Out/Slave In of SPI master |
| 10 | SPIM_CLK | — | SPI master clock |
| 11 | SPIM_MISO | I | Master In/Slave Out of SPI master |
| 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.<br>High = RTK fix;<br>Low = other status. |
| 21 | RSV | — | Reserved; leave floating |

| No. | Pin | I/O | Description |
|---|---|---|---|
| 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 |
| 36 | V_BCKP | I | When the main power supply VCC is cut off, V_BCKP supplies power to RTC and relevant registers.<br>Supply voltage: 2.0 V to 3.6 V.<br>The operating current of V_BCKP is less than 10 μA at 25 °C when VCC is cut off.<br>If the hot start function is not used, 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 |

| No. | Pin | I/O | Description |
|---|---|---|---|
| 42 | TXD1/SPIS_MISO | O | UART1 output (D_SEL=VCC or floating);<br>Master In/Slave Out of SPI slave (D_SEL=GND) |
| 43 | RXD1/SPIS_MOSI | I | UART1 input (D_SEL=VCC or floating);<br>Master Out/Slave In of SPI slave (D_SEL=GND) |
| 44 | SDA/SPIS_CSN | — | I2C data (D_SEL=VCC or floating);<br>SPI slave chip select (D_SEL=GND) |
| 45 | SCL/SPIS_CLK | — | I2C clock (D_SEL=VCC or floating);<br>SPI slave clock (D_SEL=GND) |
| 46 | RSV | — | Reserved; leave floating |
| 47 | D_SEL | I | Interface select pin.<br>Use pin 42 to 45 as an SPI slave when D_SEL = GND,<br>as UART1 and I2C 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 |

1. Not recommended to use VCC_RF to supply power to the antenna (VCC_RF has not been optimized for the anti-lightning strike and anti-surge due to the compact size of the module). ↩

# 2.2 Electrical Specifications

## 2.2.1 Absolute Maximum Ratings

**Table 2-2 Absolute Maximum Ratings**

| Parameter | Min. | Max. | Unit | Remark |
|---|---|---|---|---|
| Power Supply (VCC) | -0.2 | 3.6 | V | Main power supply |
| Backup Battery (V_BCKP) | -0.2 | 3.6 | V | Backup power supply for RTC |
| Digital Pin Voltage | -0.2 | 3.6 | V | Voltage at digital IO pins |
| Antenna RF Input Power (RF_IN) | — | -3 | dBm | Maximum input power of antenna |
| Storage Temperature ($T_{STG}$) | -40 | +85 | °C | |
| 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 Voltage | VCC | 2.7 | 3.3 | 3.6 | V | |
| Ripple Voltage | Vp-p | | | 50 | mV | |
| Peak Current | Iccp | | | 200 | mA | VCC = 3.0 V |
| Average Tracking Current[1] | $I_{ACQ}$ | 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 | |

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|---|
| 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 | |

1. Since the product has capacitors inside, inrush current occurs during power-on. Please evaluate in the actual environment in order to check the effect of the supply voltage drop caused by inrush current in the system. This reference value is tested from the samples after cold start, and the actual value may vary depending on the factors including firmware version, external circuit, number of the satellites tracked, signal strength, type and time of start, duration, and test conditions. ↩

## 2.3 Dimensions

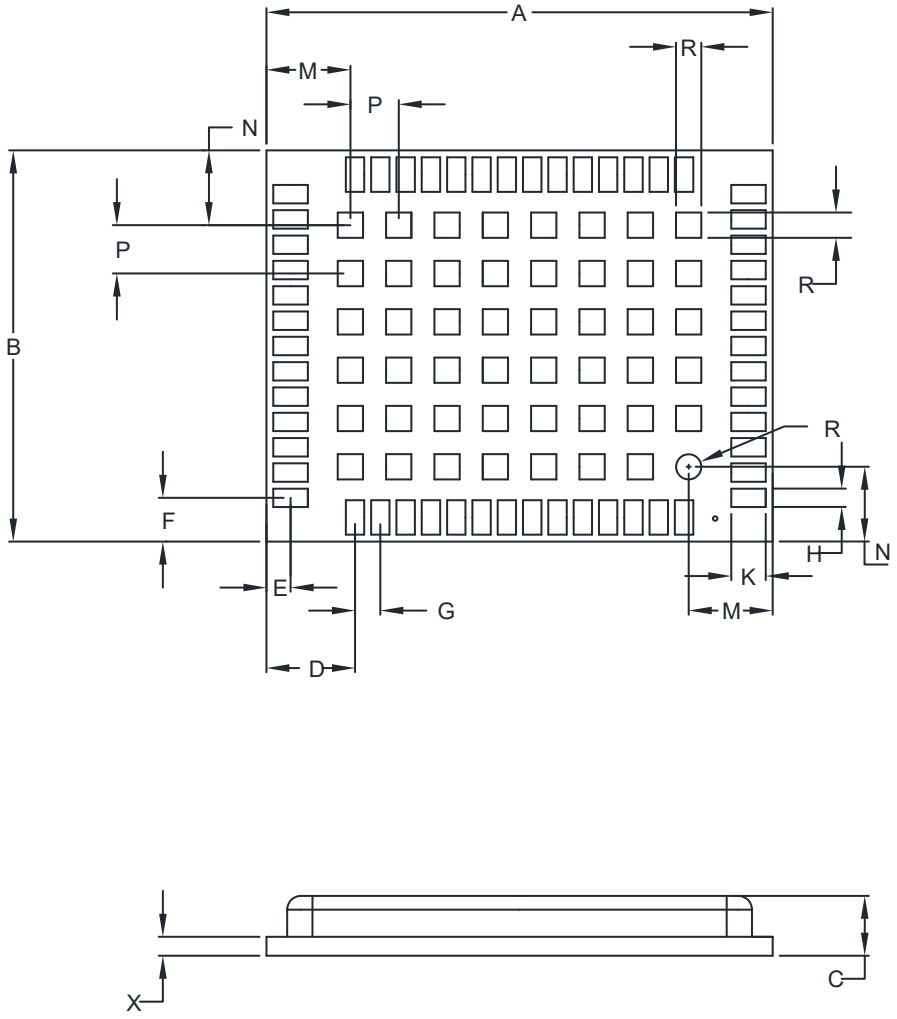



Figure 2-2 UM680 Mechanical Dimensions

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 |

| Symbol | Min. (mm) | Typ. (mm) | Max. (mm) |
|---|---|---|---|
| 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 |

# Hardware Design

## 3.1 Recommended Minimal Design

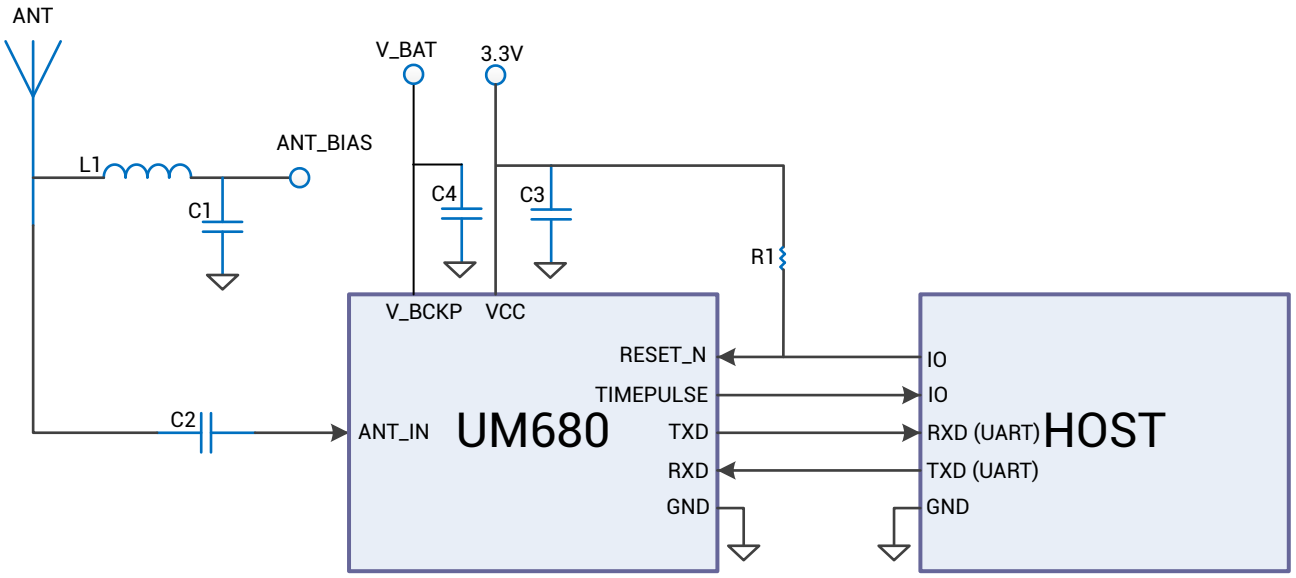



Figure 3-1 Recommended Minimal Design

**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.
- C4: 100 nF capacitor is recommended.
- R1: 10 kΩ resistor is recommended; pull up

## 3.2 Antenna Bias

UM680 does not support internal power supply to the antenna and requires external power supply. It is recommended to use components with high power and that can withstand high voltage. Gas discharge tubes, varistors, TVS tubes and other high-power protective components may also be used in the power supply circuit to further protect the module from lightning strikes and surges.

**Caution**

The antenna bias (ANT_BIAS) and the module's main power supply (VCC) should use separate power rails to reduce the risk of damage to the module. If ANT_BIAS and 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.

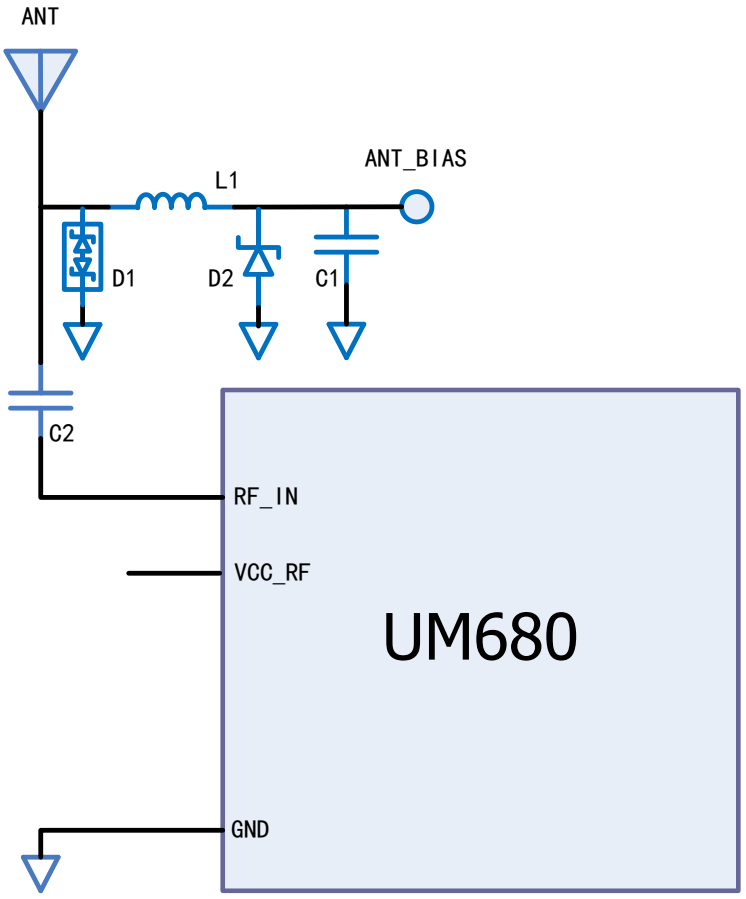



Figure 3-2 UM680 Reference Design for Antenna Bias

Remarks:

- L1: feed inductor, 68nH RF inductor in 0603 package is recommended.
- C1: decoupling capacitor, two capacitors of 100nF/100pF connected in parallel are recommended.
- C2: DC blocking capacitor, 100pF capacitor is recommended.
- VCC_RF is not recommended to be used as ANT_BIAS to supply power to 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 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 Antenna Detection Design

UM680 supports the detection of antenna open circuit and short circuit, and it will cut the antenna power supply when a short circuit happens. The antenna detection circuit is connected to the pins of ANT_DETECT, ANT_SHORT_N and ANT_OFF, and the voltage level of the three pins can be used to judge the antenna status.

> **Note**
>
> Refer to *UM680 Series_Hardware Reference Design* for the details of the antenna detection circuit.

## 3.4 Power-on and Power-off

VCC

- The VCC initial level when powered on needs to be less than 0.4 V.
- The VCC ramp when powered on needs to be monotonic, without plateaus.
- The voltages of undershoot and ringing need to be within 5% of VCC.
- VCC power-on waveform: The time interval from 10% rising to 90% needs to 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 needs to be larger than 500 ms.

V_BCKP

- The V_BCKP initial level when powered on needs to be less than 0.4 V.
- The V_BCKP ramp when powered on needs to be monotonic, without plateaus.
- The voltages of undershoot and ringing need to be within 5% of V_BCKP.
- V_BCKP power-on waveform: The time interval from 10% rising to 90% needs to 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 needs to be larger than 500 ms.

## 3.5 Grounding and Heat Dissipation

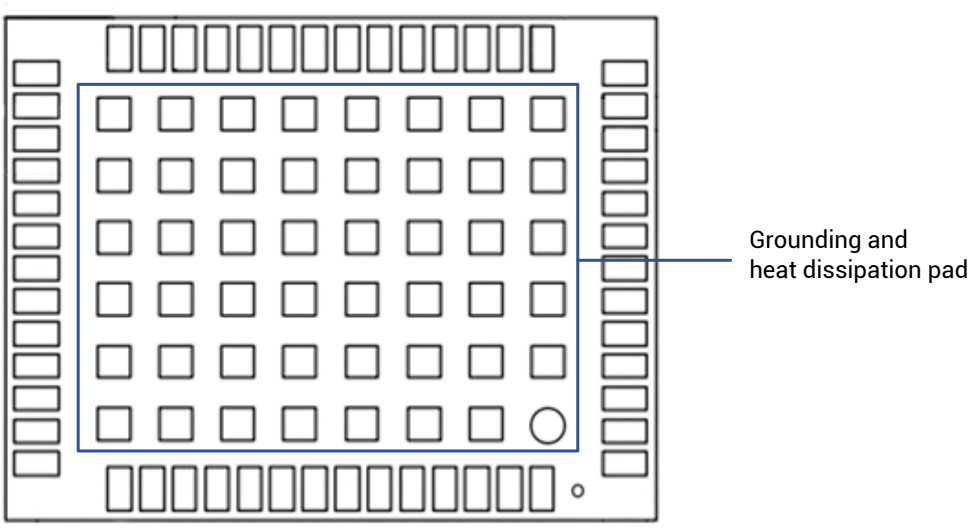



Figure 3-3 Grounding and Heat Dissipation Pad

The 48 pads in the rectangle area in **Figure 3-3** are used 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.

# 3.6 Recommended Footprint on the PCB

The dimensions of UM680'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 Dimensions.

> **Note**
>
> 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.

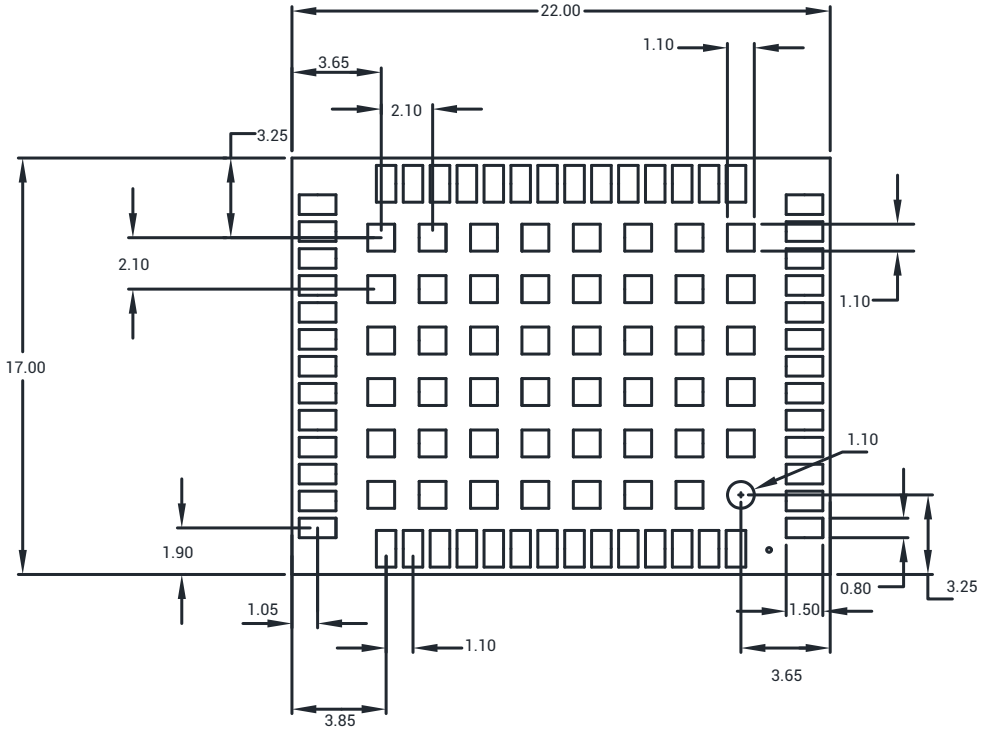



Figure 3-4 Recommended Footprint (Unit: mm)

# Production Requirements

## 4.1 Clean

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

## 4.2 Soldering

The recommended soldering temperature curve (lead-free) is as follows:

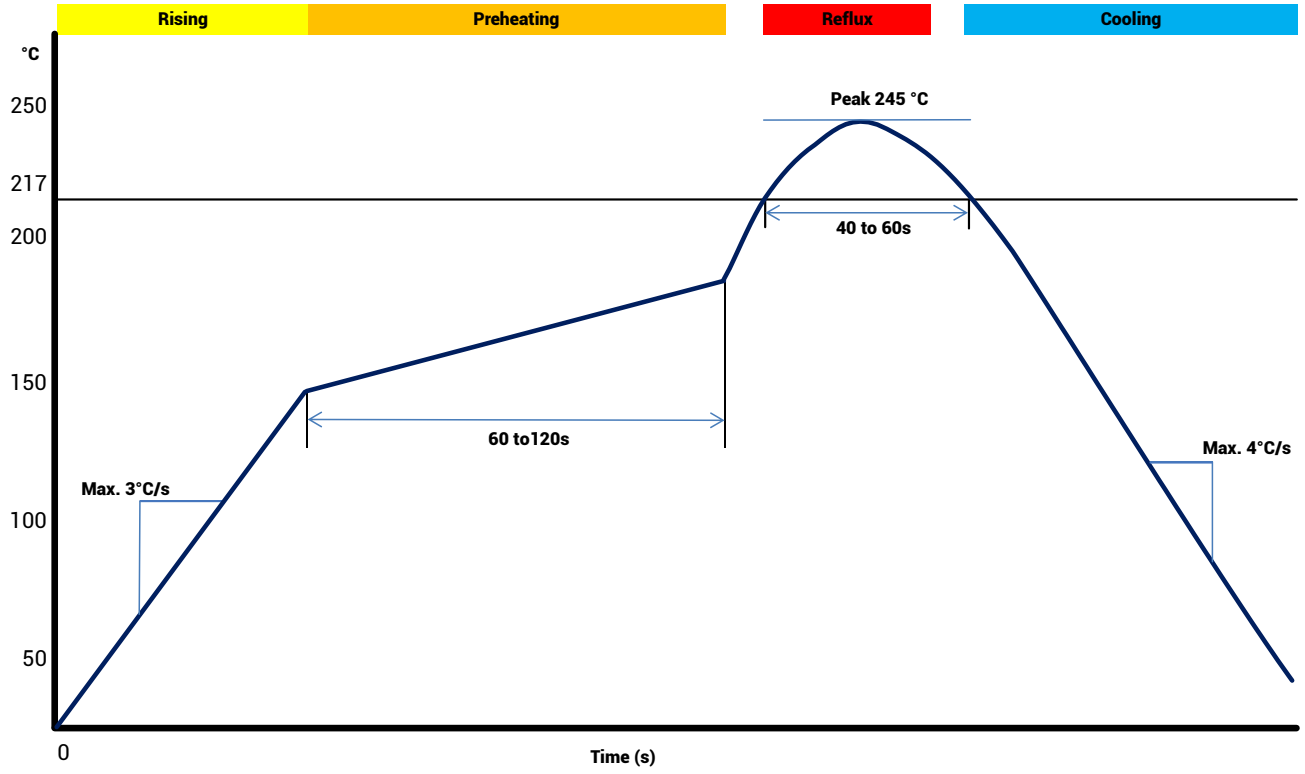



Figure 4-1 Soldering Temperature (Lead-free)

### 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

> **Note**
>
> In order to prevent the module falling off during soldering, do not solder it on the back of the board, and better not go through the 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 the solder paste.

## 4.3 Stencil

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 0.15 mm (not less than 0.12 mm).

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

# Packaging

## 5.1 Label Description


Figure 5-1 Label Description

## 5.2 Ordering Information

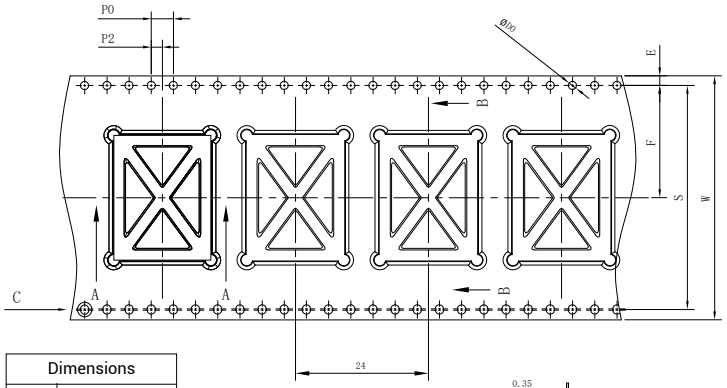
Table 5-1 Ordering Information

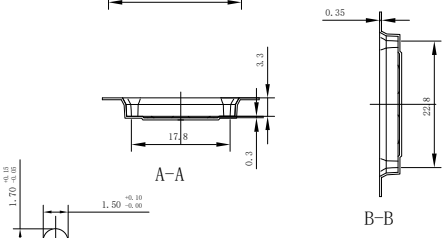
| Main Model | Sub-Model | Description |
|---|---|---|
| UM680 | 12 | Industrial grade;<br>L1+L5 dual-frequency RTK positioning module;<br>operating temperature: -40 °C to +85 °C;<br>supporting firmware upgrade;<br>22 mm x 17 mm; 250 pieces/reel |

## 5.3 Product Packaging

The UM680 module uses carrier tape and reel (suitable for mainstream surface mount devices), packaged in vacuum-sealed aluminum foil antistatic bags, with desiccant inside to prevent moisture. When using reflow soldering process to solder the modules, please strictly comply with IPC standard to conduct humidity control. As the packaging materials such as the carrier tape can only withstand the temperature of 55 °C, the modules shall be removed from the package during baking.


Figure 5-2 UM680 Package

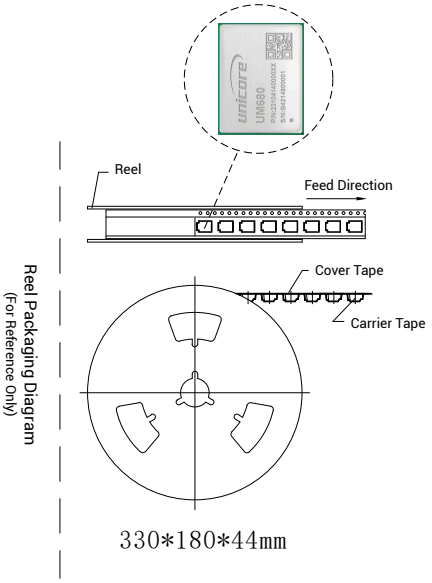






| Dimensions | |
|---|---|
| E | 1.75±0.10 |
| F | 20.20±0.10 |
| S | 40.40±0.10 |
| P2 | 2.00±0.10 |
| ØDo | 1.50 +0.10 0.00 |
| ØD1 | |
| Po | 4.00±0.10 |
| 10Po | 40.00±0.20 |
| W | 44.00±0.30 |
| P | 24.00±0.10 |
| Ao | 17.80±0.10 |
| BO | 22.80±0.10 |
| KO | 3.30±0.10 |
| t | 0.35±0.05 |




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).

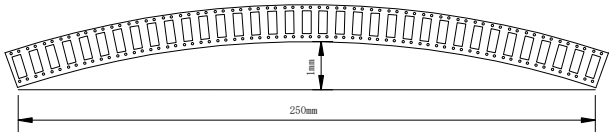



Figure 5-3 Reel Package Diagram

Table 5-2 Package Description

| Item | Description |
|---|---|
| **Module Number** | 250 pieces/reel |
| **Reel Size** | Tray: 13"<br>External diameter: 330 ± 2 mm<br>Internal diameter: 180 ± 2 mm<br>Width: 44.5 ± 0.5 mm<br>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**), it is necessary to bake the module until it turns to blue. When baking, please take the module out of the carrier tape and place it in a suitable tray.

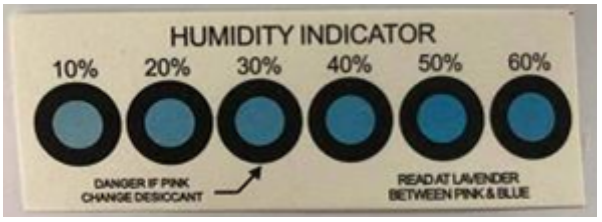



Figure 5-4 Normal Humidity Indication

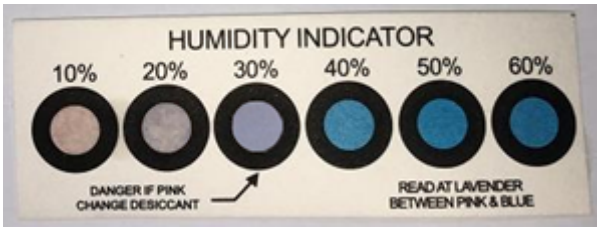



Figure 5-5 Abnormal Humidity Indication

The UM680 module is rated at MSL 3. Please refer to the IPC/JEDEC J-STD-033 standards for the package and operation requirements related to humidity. For more information, visit the website www.jedec.org.

The shelf life of the UM680 module packaged in vacuum-sealed aluminum foil antistatic bags is 1 year.

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