



unicorecomm UM960L All Constellation Multi Frequency High Precision RTK Positioning Module User Manual

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Revision History

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Foreword

This document describes the information of the hardware, package, specification and the use of Unicore UM960L modules.

Target Readers

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

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Introduction

UM960L is a new generation of GNSS high precision positioning RTK module from Unicore. It supports all constellations and multiple frequencies, and can simultaneously track GPS L1/L2/L5 + BDS B1I/B2I/B3I + GLONASS L1/L2+Galileo E1/E5a/E5b + QZSS L1/L2/L5. The module is mainly used in geological hazard monitoring, deformation monitoring, and high precision GIS.

UM960L is based on NebulasIVTM, a GNSS SoC which integrates RF-baseband and high precision algorithms. Besides, the SoC integrates a 2 GHz dual CPU, a high speed floating point processor and a RTK co-processor with 22 nm low power design, and it supports 1408 super channels. All these above enable stronger signal processing.

UM960L features a compact size of 16.0 mm × 12.2 mm. It adopts SMT pads, supports standard pick-and-place, and supports fully automated integration of reflow soldering.

Furthermore, UM960L supports interfaces such as UART, I2C, which meets the customers' needs in different applications.

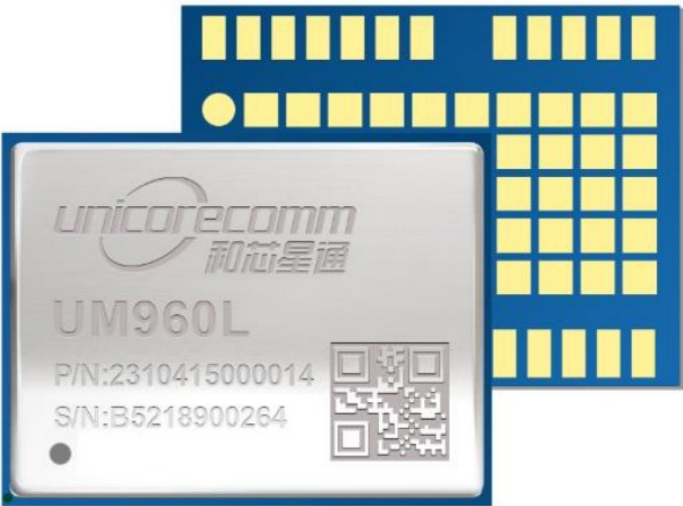


Figure 1-1 UM960L Module

Reserved interface, not supported currently.

Key Features

- High precision, compact size and low power consumption
- Based on the new generation GNSS SoC -NebulasIVTM, with RF-baseband and high precision algorithms integrated
- 16.0 mm × 12.2 mm × 2.4 mm, surface-mount device
- Supports all-constellation multi-frequency on-chip RTK positioning solution
- Supports GPS L1/L2/L5 + BDS B1I/B2I/B3I + GLONASS L1/L2 + Galileo E1/E5b/E5a + QZSS L1/L2/L5
- All constellations and multiple frequencies RTK engine, and advanced RTK processing technology
- Independent track of each frequency, and 60 dB narrowband anti-jamming

Key Specifications

Table 1-1 Technical Specifications

Basic Information

| | |
|----------------|---|
| Channels | 1408 channels, based on NebulasIVTM |
| Constellations | GPS/BDS/GLONASS/Galileo/QZSS |
| Frequency | GPS: L1C/A, L2P(W), L2C, L5 BDS: B1I, B2I, B3I GLONASS: L1C/A, L2C/AGalileo: E1, E5b, E5a QZSS: L1, L2, L5 |

Power

| | |
|-------------------|---------------------|
| Voltage | +3.0 V to +3.6 V DC |
| Power Consumption | 410 mW Typical |

Performance

| | | | | |
|---------------------------------|--------------------------------|-------|----------------------------|---------|
| Positioning Accuracy | Single Point Positioning (RMS) | | Horizontal: 1.5 m | |
| | | | Vertical: 2.5 m | |
| | DGPS (RMS) | | Horizontal: 0.4 m | |
| | | | Vertical: 0.8 m | |
| | RTK (RMS) | | Horizontal: 0.8 cm + 1 ppm | |
| | | | Vertical: 1.5 cm + 1 ppm | |
| Observation Accuracy RMS | BDS | GPS | GLONASS | Galileo |
| B1I/ L1C/A /G1/E1 Pseudorange | 10 cm | 10 cm | 10 cm | 10 cm |
| B1I/ L1C/A /G1/E1 Carrier Phase | 1 mm | 1 mm | 1 mm | 1 mm |
| B2I/L2P/G2/E5b Pseudorange | 10 cm | 10 cm | 10 cm | 10 cm |
| B2I/L2P/G2/E5b Carrier Phase | 1 mm | 1 mm | 1 mm | 1 mm |
| Time Accuracy (RMS) | 20 ns | | | |
| Velocity Accuracy (RMS) | 0.03 m/s | | | |
| Time to First Fix (TTFF) | Cold Start < 30 s | | | |
| Initialization Time | < 5 s (Typical) | | | |
| Initialization Reliability | > 99.9% | | | |
| Data Update Rate | 5 Hz Positioning | | | |
| Differential Data | RTCM 3.0, 3.2, 3.3 | | | |
| Data Format | NMEA-0183; Unicore | | | |

Physical Specifications

| | |
|------------|----------------------------|
| Package | 24 pin LGA |
| Dimensions | 16.0 mm × 12.2 mm × 2.4 mm |

Environmental Specifications

| | |
|-----------------------|-------------------------------|
| Operating Temperature | -40 ° C to +85 ° C |
| Storage Temperature | -55 ° C to +95 ° C |
| Humidity | 95% No condensation |
| Vibration | GJB150.16A-2009; MIL-STD-810F |
| Shock | GJB150.18A-2009; MIL-STD-810F |

Functional Ports

- UART x 3
- I2C x 1

Interfaces

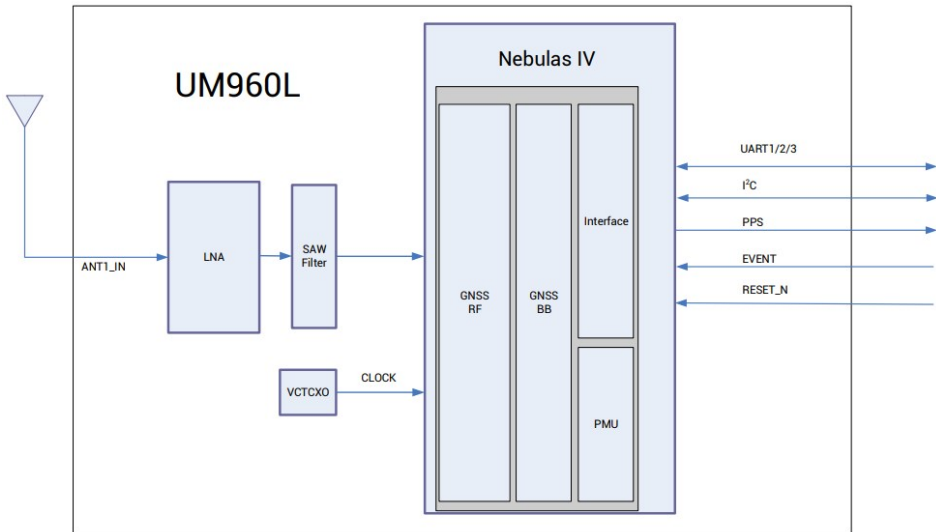


Figure 1-2 UM960L Block Diagram

• 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 signal, and converts IF analog signal into digital signals required for NebulasIVTM chip.

• NebulasIVTM SoC

NebulasIVTM is UNICORECOMM's new generation high precision GNSS SoC with 22 nm low power design, supporting all constellations, multiple frequencies and 1408 super channels. It integrates a 2 GHz dual CPU, a

high speed floating point processor and an RTK co-processor, which can fulfill the high precision baseband processing and RTK positioning independently.

- **1PPS**

UM960L outputs 1 PPS with adjustable pulse width and polarity.

- **Event**

UM960L provides 1 Event Mark Input with adjustable frequency and polarity.

- **Reset (RESET_N)**

Active LOW, and the active time should be no less than 5 ms.

Hardware

Dimensions

Table 2-1 Dimensions

| Symbol | Min. (mm) | Typ. (mm) | Max. (mm) |
|--------|-----------|-----------|-----------|
| A | 15.80 | 16.00 | 16.50 |
| B | 12.00 | 12.20 | 12.70 |
| C | 2.20 | 2.40 | 2.60 |
| D | 0.90 | 1.00 | 1.10 |
| E | 0.20 | 0.30 | 0.40 |
| F | 1.40 | 1.50 | 1.60 |
| G | 1.00 | 1.10 | 1.20 |
| H | 0.70 | 0.80 | 0.90 |
| N | 2.90 | 3.00 | 3.10 |
| P | 1.30 | 1.40 | 1.50 |
| R | 0.99 | 1.00 | 1.10 |
| X | 0.72 | 0.82 | 0.92 |
| φ | 0.99 | 1.00 | 1.10 |

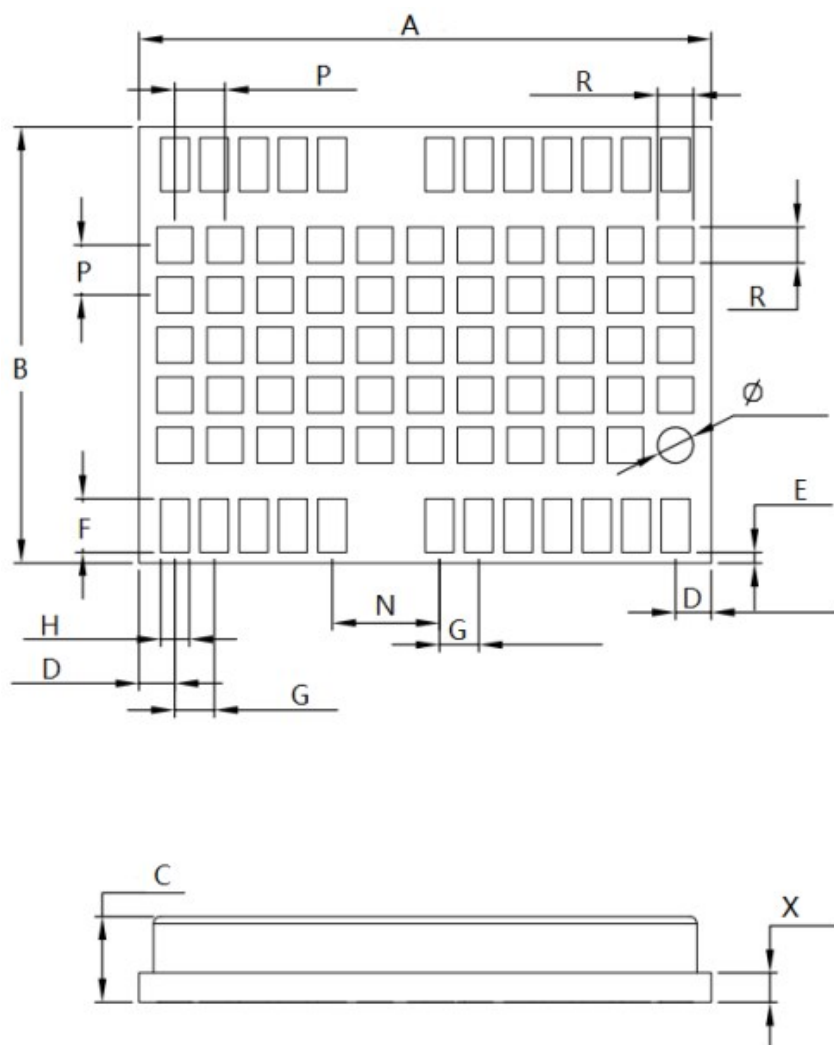


Figure 2-1 UM960L Mechanical Dimensions

Pin Definition

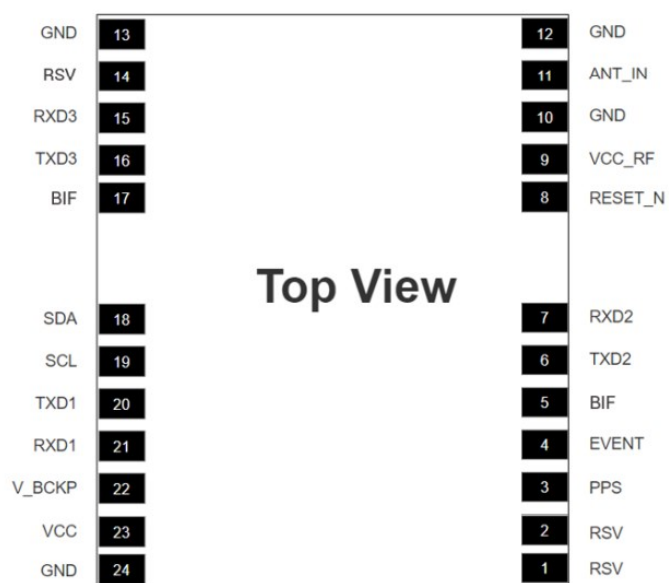


Figure 2-2 UM960L Pin Definition

Table 2-2 Pin Definition

| No. | Pin | I/O | Description |
|-----|---------|-----|--|
| 1 | RSV | — | Reserved, must be floating; cannot connect ground or power supply or peripheral I/O |
| 2 | RSV | — | Reserved, must be floating; cannot connect ground or power supply or peripheral I/O |
| 3 | PPS | O | Pulse per second |
| 4 | EVENT | I | Event Mark |
| 5 | 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 or peripheral I/O, but can be floating. |
| 6 | TXD2 | O | UART2 transmitting data |
| 7 | RXD2 | I | UART2 receiving data |
| 8 | RESET_N | I | System resetActive Low |
| 9 | VCC_RF1 | O | External LNA power supply |
| 10 | GND | — | Ground |
| 11 | ANT_IN | I | GNSS antenna signal input |
| 12 | GND | — | Ground |
| 13 | GND | — | Ground |
| 14 | RSV | — | Reserved, must be floating; cannot connect ground or power supply or peripheral I/O |
| 15 | RXD3 | I | UART3 receiving data |
| 16 | TXD3 | O | UART3 transmitting data |
| 17 | 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 or peripheral I/O, but can be floating. |
| 18 | SDA | I/O | I2C data |
| 19 | SCL | I/O | I2C clock |

| | | | |
|----|---------|---|--|
| 20 | TXD1 | O | UART1 transmitting data |
| 21 | RXD1 | I | UART1 receiving data |
| 22 | V_BCKP2 | I | When the main power supply VCC is cut off, V_BCKP supplies power to RTC and relevant register. Level requirements: 2.0 V ~ 3.6 V, and the working current is less than 60 μ A 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. |
| 23 | VCC | I | Supply voltage |
| 24 | GND | — | Ground |

1. Not recommended to take VCC_RF as ANT_BIAS to feed the antenna. See section 3.1 for more details.
2. Not supported currently, and keep this pin floating.

Electrical Specifications

Absolute Maximum Ratings

Table 2-3 Absolute Maximum Ratings

| Parameter | Symbol | Min. | Max. | Unit |
|---------------------------------------|--------------------|------|------|------|
| Power Supply (VCC) | VCC | -0.3 | 3.6 | V |
| Voltage Input | V _{in} | -0.3 | 3.6 | V |
| GNSS Antenna Signal Input | ANT_IN | -0.3 | 6 | V |
| RF Input Power Consumption of Antenna | 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 |

Operational Conditions

Table 2-4 Operational Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|------------------------------|--------|------|---------|------|------|-------------|
| Power Supply (VCC) | VCC | 3.0 | 3.3 | 3.6 | V | |
| Maximum Ripple Voltage | Vrpp | 0 | | 50 | mV | |
| Working Current ³ | Iopr | | 109 | 218 | 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 | Topr | -40 | | 85 | °C | |
| Power Consumption | P | | 410 | | mW | |

IO Threshold

Table 2-5 IO Threshold

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|--------------------------|-----------|------------|------|-----------|------|------------|
| Low Level InputVoltage | Vin_low | 0 | | VCC × 0.2 | V | |
| High Level InputVoltage | Vin_high | VCC × 0.7 | | VCC + 0.2 | V | |
| Low Level OutputVoltage | Vout_low | 0 | | 0.45 | V | Iout= 4 mA |
| High Level OutputVoltage | Vout_high | VCC – 0.45 | | VCC | V | Iout =4 mA |

Antenna Feature

Table 2-6 Antenna Feature

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|--------------------|--------|------|------|------|------|-----------|
| Optimum Input Gain | Gant | 18 | 30 | 36 | dB | |

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.

Hardware Design

Antenna Feed Design

UM960L just supports feeding the antennal from the outside of the module rather than 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 lighting strike and surge.

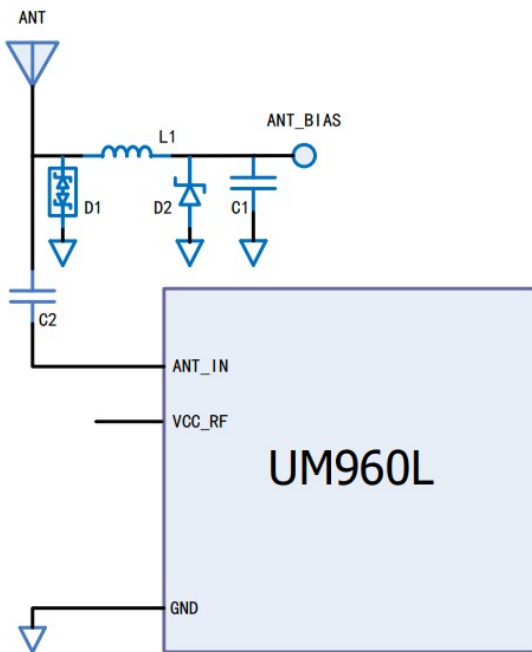


Figure 3-1 UM960L External Antenna Feed Reference Circuit

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 take VCC_RF as ANT_BIAS to feed the antenna (VCC_RF is not optimized for the anti-lighting 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 voltage

Grounding and Heat Dissipation

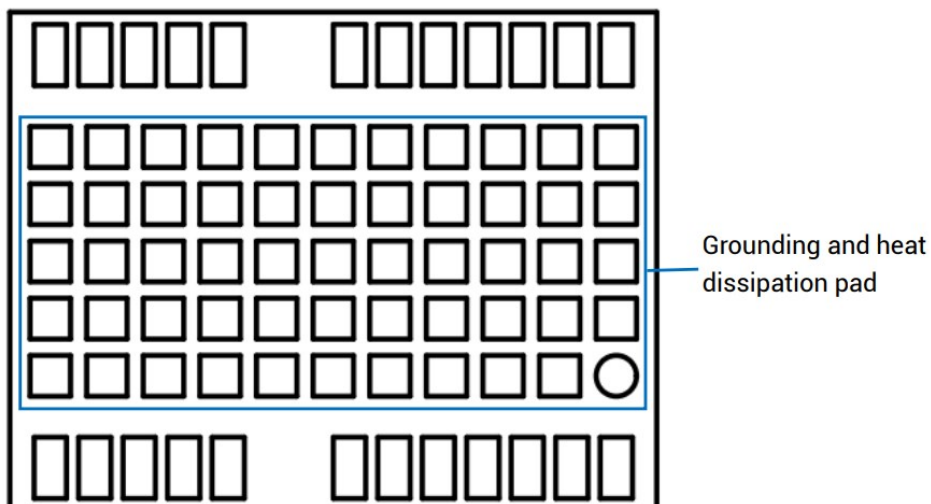


Figure 3-2 Grounding and Heat Dissipation Pad

The 55 pads in the rectangle in Figure 3-2 are for grounding and heat dissipation.

In the PCB design, they must connect to a large sized ground to strengthen the heat dissipation.

Power-on and Power-off

VCC

- The VCC initial level when power-on is less than 0.4 V and it has good monotonicity. The voltages of undershoot and ringing are within 5% VCC.
- VCC power-on waveform: The time interval from 10% rising to 90% must be within 100 μ s to 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 is less than 0.4 V and it has good monotonicity. The voltages of undershoot and ringing are within 5% V_BCKP.
- V_BCKP power-on waveform: The time interval from 10% rising to 90% must be within 100 μ s to 1 ms.
- Power-on time interval: The time interval between the V_BCKP < 0.4 V (after poweroff) to the next power-on must be larger than 500 ms.

Production Requirement

Recommended soldering temperature curve is as follows:

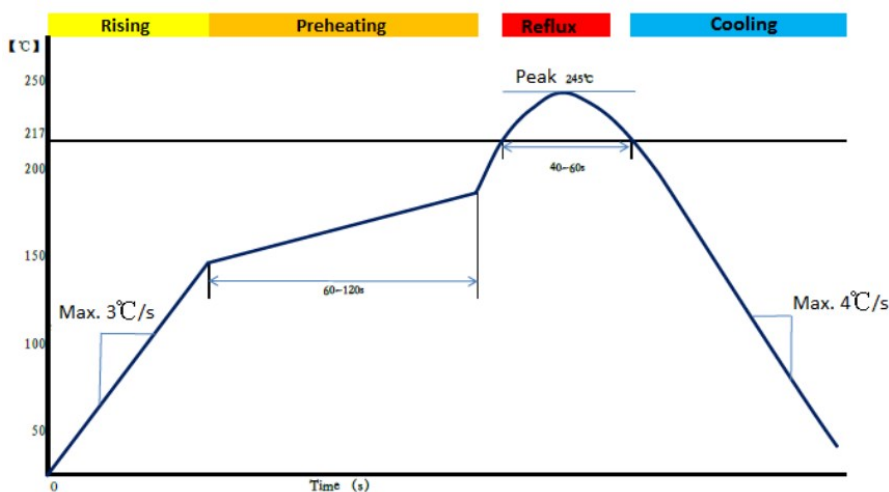


Figure 4-1 Soldering Temperature (Lead-free)

Temperature Rising Stage

- Rising slope: Max. 3 °C/s
- Rising temperature range: 50 °C 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, that is, 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.
- 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 to the examine standards. The thickness of the stencil is recommended to be 0.15 mm.

Packaging

Label Description



Figure 5-1 Label Description

Product Packaging

The UM960L 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 UM960L Package

Table 5-1 Package Description

| Item | Description |
|---------------|---|
| Module Number | 500 pieces/reel |
| Reel Size | Tray: 13"External diameter: 330 mm Internal diameter: 100 mm Width: 24 mmThickness : 2.0 mm |
| Carrier Tape | Space between (center-to-center distance): 20 mm |

The UM960L is rated at MSL level 3. Refer to the relevant IPC/JEDEC J-STD-033 standards for the package and operation requirements. You may access to the website www.jedec.org to get more information.

The shelf life of the UM960L module packaged in vacuum-sealed aluminum foil antistatic bags is one year.



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Documents / Resources



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UM960L, All Constellation Multi Frequency High Precision RTK Positioning Module, UM960L All Constellation Multi Frequency High Precision RTK Positioning Module, Multi Frequency High Precision RTK Positioning Module, High Precision RTK Positioning Module, RTK Positioning Module, Positioning Module, Module

References

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