INSTALLATION AND OPERATION

USER MANUAL

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UM960

GPS/BDS/GLONASS/Galileo/QZSS All-constellation Multi-frequency High Precision RTK Positioning Module

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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 UM960 modules.

Target Readers

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

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1 Introduction

UM960 is a new generation of GNSS high precision positioning RTK module from Unicore. It supports all constellations and multiple frequencies, and can simultaneously track BDS B1I/B2I/B3I + GPS L1/L2/L5 + GLONASS L1/L2+Galileo E1/E5a/E5b + QZSS L1/L2/L5 + SBAS. The module is mainly used in UAVs, lawn mower, handheld device, high precision GIS, precise agriculture, and intelligent drive.

UM960 is based on NebulasIV™, a GNSS SoC which integrates RF-baseband and high precision algorithm. Besides, the SoC integrates a 2 GHz dual CPU, a high speed floating point processor and an RTK co-processor with 22 nm low power design, and it supports 1408 super channels and realizes 20 Hz RTK positioning output. All these above enable stronger signal processing.

UM960 features a compact size of 16.0 mm × 12.2 mm. It adopts SMT pads, supports standard pick-and-place and fully automated integration of reflow soldering.

Furthermore, UM960 supports interfaces such as UART, I²C*, which meets the customers' needs in different applications.

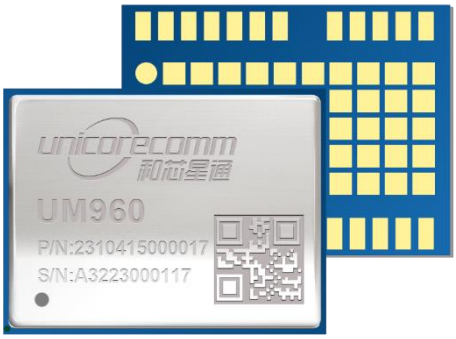


Figure 1-1 UM960 Module

* Reserved interface, not supported currently.

1.1 Key Features

- High precision, compact size and low power consumption
- Based on the new generation GNSS SoC -NebulasIV™, with RF-baseband and high precision algorithm integrated
- 16.0 mm × 12.2 mm × 2.6 mm, surface-mount device
- Supports all-constellation multi-frequency on-chip RTK positioning solution
- Supports BDS B1I/B2I/B3I + GPS L1/L2/L5 + GLONASS L1/L2 + Galileo E1/E5b/E5a + QZSS L1/L2/L5 + SBAS
- All constellations and multiple frequencies RTK engine, and advanced RTK processing technology
- Independent track of each frequency, and 60 dB narrowband anti-jamming
- Advanced function of jamming detection

1.2 Key Specifications

Table 1-1 Technical Specifications

Basic Information		
Channels	1408 channels, based on NebulasIV™	
Constellations	GPS/BDS/GLONASS/Galileo/QZSS	
Frequency	GPS: L1C/A, L2P(W), L2C, L5 BDS: B1I, B2I, B3I GLONASS: L1C/A, L2C/A Galileo: E1, E5b, E5a QZSS: L1, L2, L5	
Power		
Voltage	+3.0 V~ +3.6 V DC	
Power Consumption	440 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
B3I/L5/E5a Pseudorange	10 cm	10 cm	10 cm	10 cm
B3I/L5/E5a 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	20 Hz Positioning			
Differential Data	RTCM 2.3, RTCM3.x, CMR			
Data Format	NMEA-0183; Unicore			
Physical Specifications				
Package	24 pin LGA			
Dimensions	16.0 mm × 12.2 mm × 2.6 mm			
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 x 3				
I^2C^* x 1				

* Reserved interface, not supported currently.

1.3 Interfaces

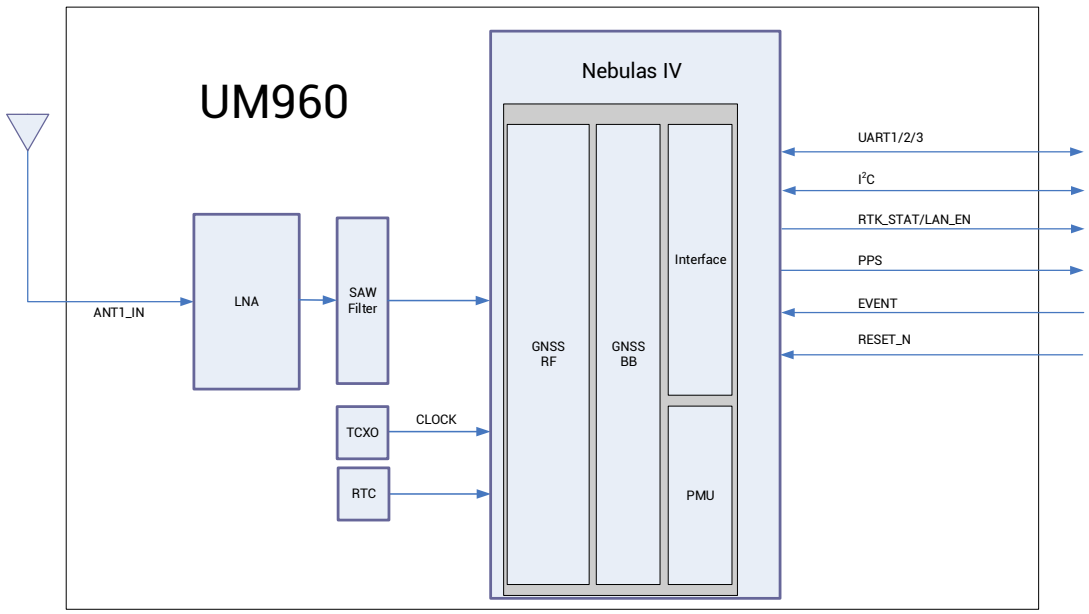


Figure 1-2 UM960 Block Diagram

- 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 NebulasIV chip.

- NebulasIV SoC

NebulasIV 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

UM960 outputs 1 PPS with adjustable pulse width and polarity.

- Event

UM960 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.

2 Hardware

2.1 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	2.40	2.60	2.80
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
J	3.20	3.30	3.40
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

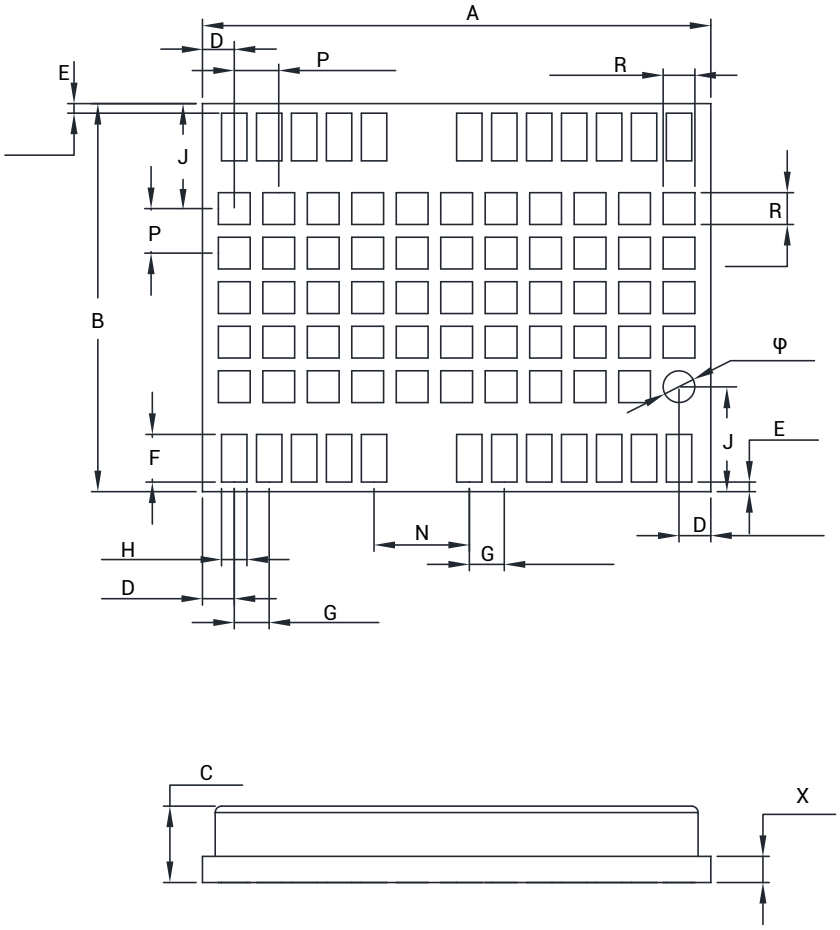


Figure 2-1 UM960 Mechanical Dimensions

2.2 Pin Definition

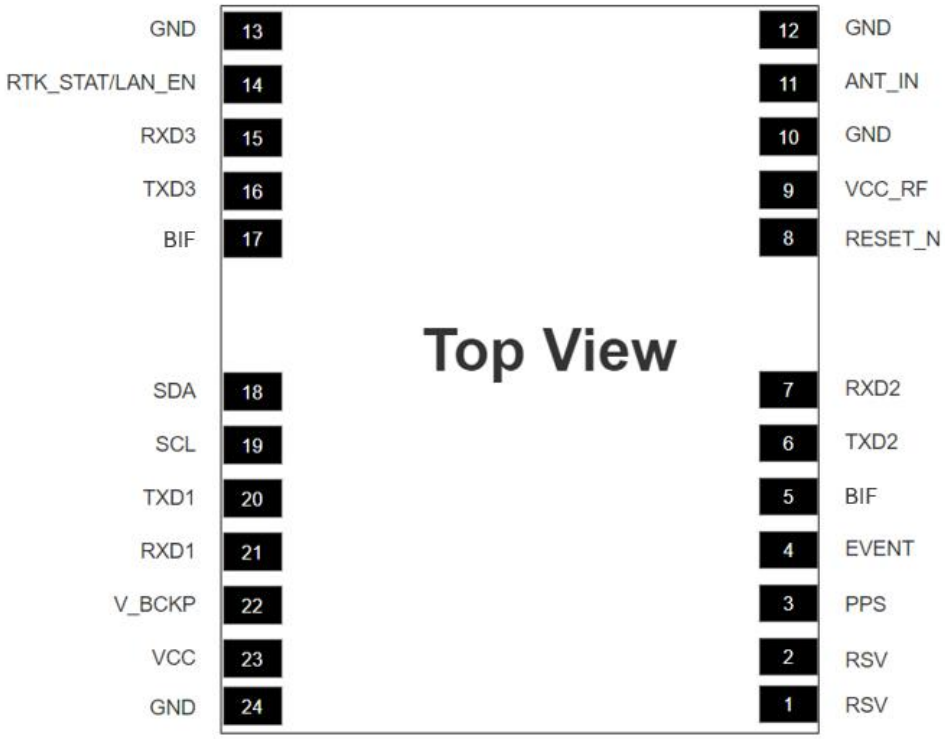


Figure 2-2 UM960 Pin Definition

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	RSV	—	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	COM 2 transmitting data
7	RXD2	I	COM 2 receiving data
8	RESET_N	I	System reset Active Low

No.	Pin	I/O	Description
9	VCC_RF[1]	O	External LNA power supply
10	GND	—	Ground
11	ANT_IN	I	GNSS antenna signal input
12	GND	—	Ground
13	GND	—	Ground
14	RTK_STAT/LAN_EN	O	RTK_STAT: High level, RTK Fix; Low level, RTK No Fix LAN_EN: High level, enable external LNA; Low level, disable external LNA; **Note: The pin function is configured by protocol. The default is RTK_STAT.**
15	RXD3	I	COM 3 receiving data
16	TXD3	O	COM 3 transmitting data
17	RSV	—	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	I^2C data
19	SCL	I/O	I^2C clock
20	TXD1	O	COM 1 transmitting data
21	RXD1	I	COM 1 receiving data
22	V_BCKP	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 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.
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.

2.3 Electrical Specifications

2.3.1 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

2.3.2 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	V_{rpp}	0		50	mV	
Working Current[2]	I_{opr}		133	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	T_{opr}	-40		85	°C	
Power Consumption	P		440		mW	

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		VCC × 0.2	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}= 4 mA
High Level Output Voltage	V_{out_high}	VCC - 0.45		VCC	V	I_{out} =4 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	

[2] 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.

3 Hardware Design

3.1 Antenna Feed Design

UM960 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.

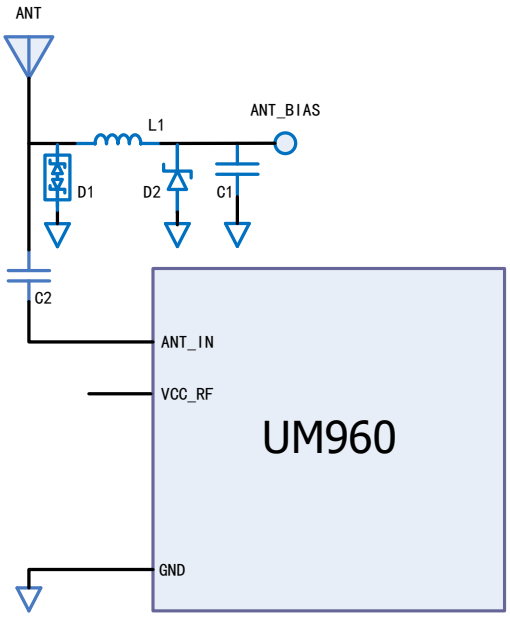


Figure 3-1 UM960 External Antenna Feed Reference Circuit

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

3.2 Grounding and Heat Dissipation

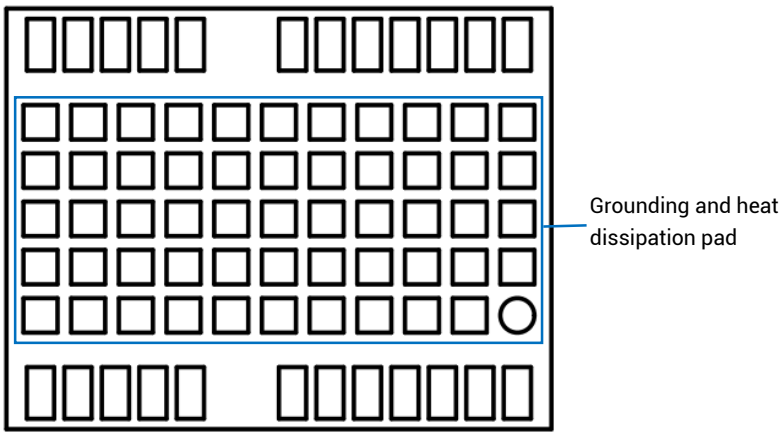


Figure 3-2 Grounding and Heat Dissipation Pad

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.

3.3 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 μs 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 μs to 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:

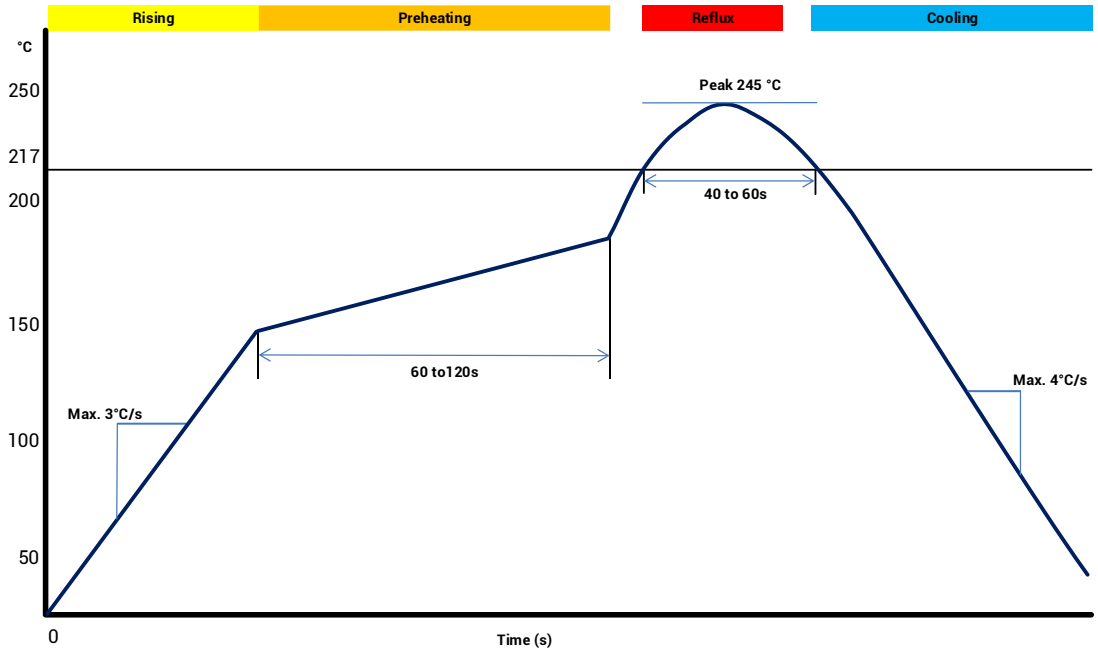


Figure 4-1 Soldering Temperature (Lead-free)

Temperature Rising Stage

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

5 Packaging

5.1 Label Description



Figure 5-1 Label Description

5.2 Product Packaging

The UM960 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 UM960 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 mm Thickness: 2.0 mm
Carrier Tape	Space between (center-to-center distance): 20 mm

The UM960 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 UM960 module packaged in vacuum-sealed aluminum foil antistatic bags is one year.

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