INSTALLATION AND OPERATION

USER MANUAL

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UM670A-03

Automotive-Grade Multi-Constellation Dual-Frequency GNSS Navigation and Positioning Module

Revision History

Version	Revision History	Date
R1.0	First release	Jul. 2025

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Foreword

This document describes the information of the hardware, package, specification and the use of Unicore UM670A-03 module.

Target Readers

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

Contents

1 Introduction

UM670A-03 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.

UM670A-03 supports GPS/BDS/GLONASS*/Galileo/QZSS/NavIC* and L1 + L5 frequencies, with the functions of raw data output and single point positioning. See Table 1-1 for the detailed specifications.

Figure 1-1 UM670A-03 Positioning Module

* Supported by the specific firmware.

1.1 Key Specifications

Table 1-1 Key Specifications

Basic Information		
Channel	96 channels, based on UFirebird II	
Constellation	GPS/BDS/GLONASS*/Galileo/QZSS/NavIC*	
Frequency	GPS: L1C/A + L5; BDS: B1I + B2a; Galileo: E1 + E5a; GLONASS*: G1 QZSS: L1 + L5 NavIC*: L5	
Power		
Voltage	+2.7 V to 3.6 V DC; Typical: 3.3 V	
Power Consumption	150 mW (Typical)	
Performance		
Time to First Fix (TTFF)	Cold Start: 26 s Hot Start: 2 s Reacquisition: 2 s	
Positioning Accuracy (RMS)	Horizontal: 1.5 m (open sky) Vertical: 2.5 m (open sky)	
Velocity Accuracy (RMS)[1]	0.05 m/s	
Sensitivity		GNSS
	Tracking	-162 dBm
	Cold Start	-147 dBm
	Hot Start	-157 dBm
	Reacquisition	-158 dBm
Data Update	1 Hz/5 Hz/10 Hz	
1PPS Accuracy (RMS)	20 ns	
Data Format	NMEA 0183, Unicore Protocol, RTCM	

* Supported by specific firmware.

[1] 68% at 30 m/s for dynamic operation, open sky.

RF Input	
VSWR	≤ 2.5
Input Impedance	50 Ω
Antenna Gain	15 dB ~ 30 dB
Physical Specifications	
Dimensions	22.0 mm × 17.0 mm × 2.6 mm
Package	54 pin LGA
Environmental Specifications	
Operating Temperature	-40 °C to +105 °C
Storage Temperature	-40 °C to +105 °C
Humidity	95% no condensation
Vibration	GB/T 28046.3, ISO 16750.3
Shock	GB/T 28046.3, ISO 16750.3
Functional Ports	
UART × 2	LVTTL; baud rate supports 115200 to 921600 bps
I^2C^* × 1	Address: 7 bits; works in slave mode; supports up to 400 kbps
SPI* × 1	Alternate function of pin 42 to 45; works in slave mode; supports up to 4 Mbps
PPS × 1	LVTTL

* I^2C and SPI are reserved interfaces.

1.2 Block Diagram

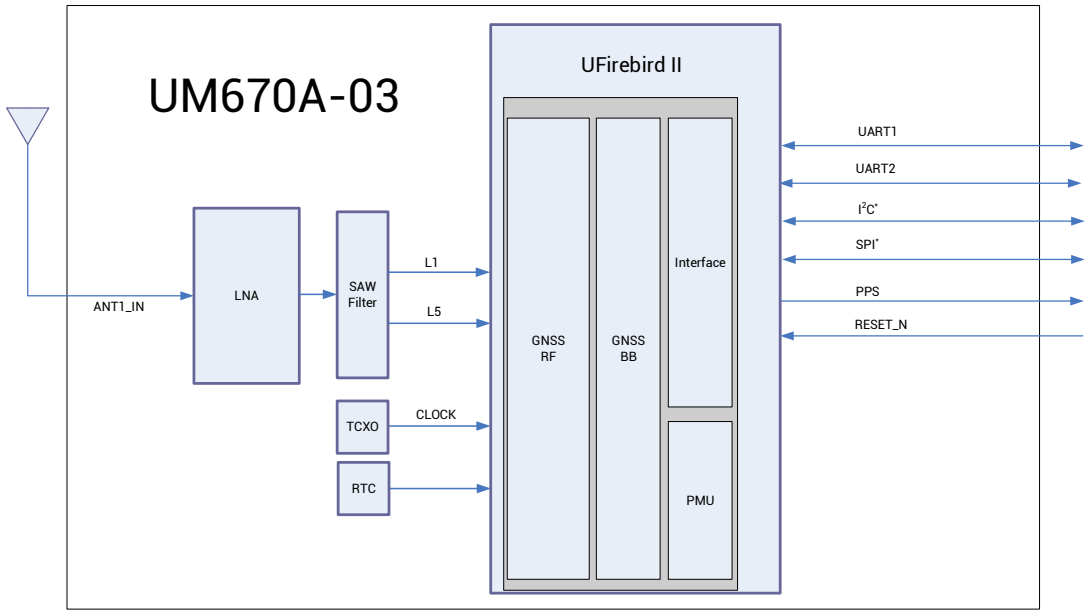


Figure 1-2 UM670A-03 Block Diagram

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 (UC6580A)

UFirebird II is the new generation RF-baseband and high-precision algorithm integrated 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

UM670A-03 has interfaces such as UART, I²C*, SPI*, PPS and RESET_N. The UART interface supports data transmission and firmware upgrade, and the I/O signal type is LVTTL. The baud rate of UART can be configured by users.

* I²C and SPI are reserved interfaces

2 Technical Specifications

2.1 Pin Definition

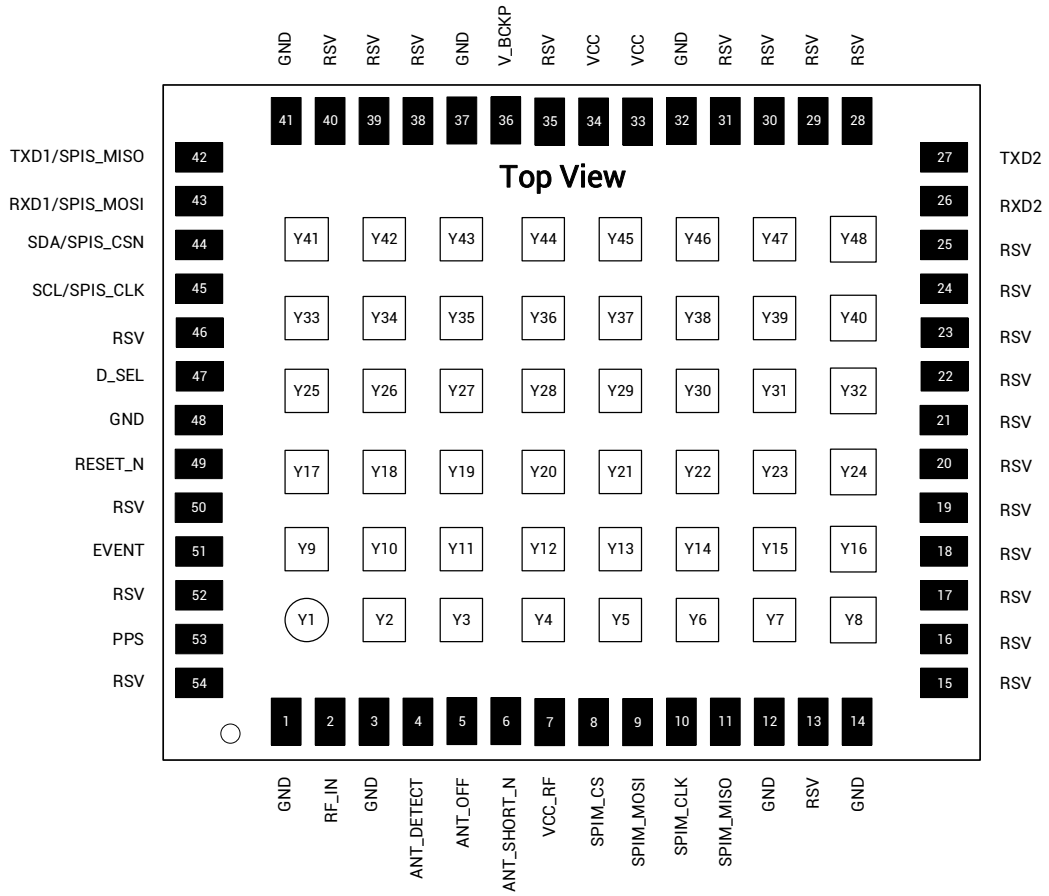


Figure 2-1 UM670A-03 Pin Definition

Table 2-1 Pin Definition

No.	Pin	I/O	Description
1	GND	—	Ground
2	RF_IN	I	GNSS antenna signal input
3	GND	—	Ground
4	ANT_DETECT*	I	Active antenna detection. Active high. High = antenna detected; Low = antenna not detected.
5	ANT_OFF*	O	Disable external antenna power supply. Active high. High = disable external antenna; Low = enable external antenna.

* Optional.

No.	Pin	I/O	Description
6	ANT_SHORT_N*	I	Active antenna short detection. Active low. Low = antenna short circuit; High = antenna power status normal.
7	VCC_RF[2]	O	Antenna power supply
8	SPIM_CS*	O	Chip select pin for SPI master
9	SPIM_MOSI*	O	Master Out / Slave In. This pin is used to transmit data in master mode.
10	SPIM_CLK*	—	Clock signal of SPI master
11	SPIM_MISO*	I	Master In / Slave Out. This pin is used to receive data in master mode.
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	RSV	—	Reserved; leave floating
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
27	TXD2*	O	UART2 output
28	RSV	—	Reserved; leave floating
29	RSV	—	Reserved; leave floating
30	RSV	—	Reserved; leave floating
31	RSV	—	Reserved; leave floating
32	GND	—	Ground

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

No.	Pin	I/O	Description
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. Supply voltage: 2.0 V to 3.6 V, and the working current is less than 10 μA at 25 °C. 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
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^2C data (D_SEL=VCC or floating); SPI slave chip select (D_SEL=GND)
45	SCL/SPIS_CLK	—	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 an 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

No.	Pin	I/O	Description
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
Y1~Y48	GND	—	Ground

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	The main supply of the module
Backup Battery	V_BCKP	-0.2	3.6	V	The backup battery to keep RTC working
Digital Pin Voltage		-0.2	3.6	V	
Antenna RF Input Power	RF_IN	—	-3	dBm	The allowed maximum input power
Storage Temperature	T_{STG}	-40	+105	°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	VCC	2.7	3.3	3.6	V	
VCC Ripple	Vp-p			50	mV	
Peak Working Current	Iccp			200	mA	VCC = 3.0 V
Average Tracking Current[3]	I_{ACQ}		46	50	mA	VCC = 3.2 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	

[3] 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 can 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

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

Bottom Surface Flatness ≤ 0.1mm.

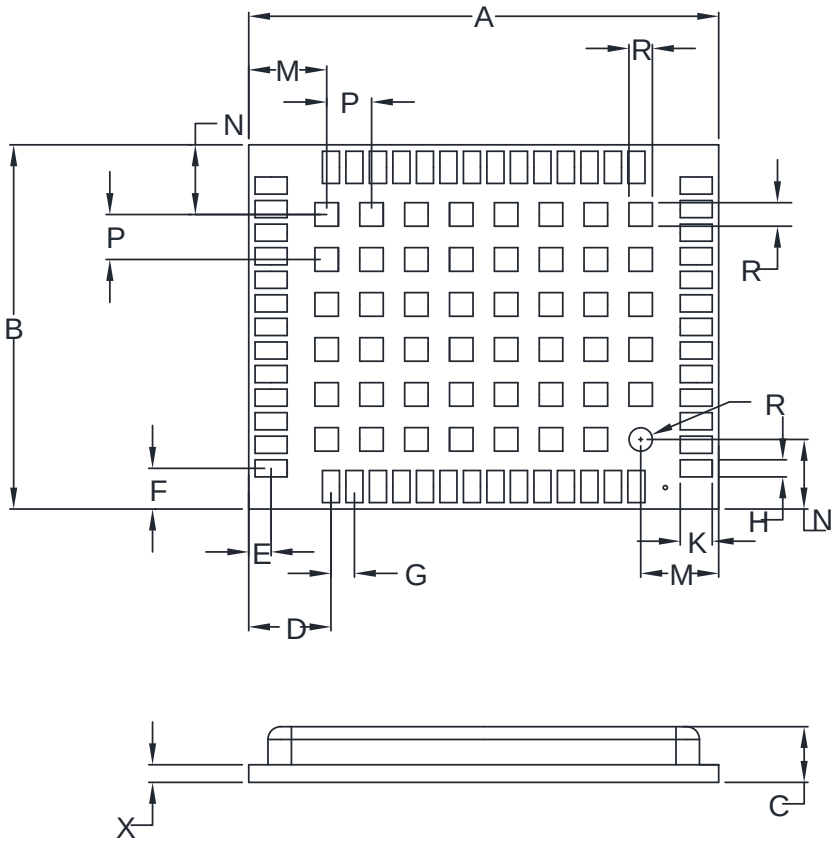


Figure 2-2 UM670A-03 Mechanical Dimensions

3 Hardware Design

3.1 Recommended Minimal Design

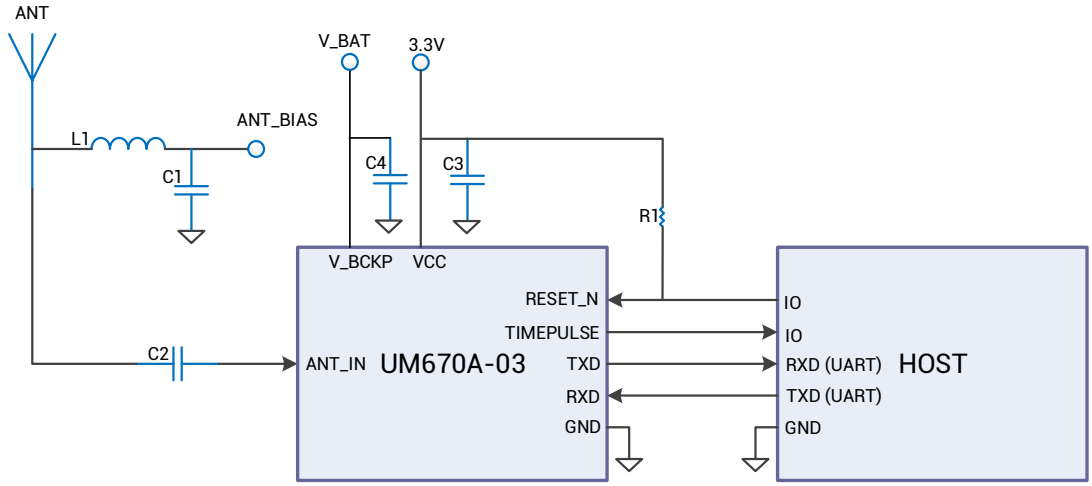


Figure 3-1 UM670A-03 Recommended Minimal Design

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

3.2 Antenna Feed Design

UM670A-03 supports feeding the antenna 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 lighting 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 generated at the antenna will be directly applied to 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.

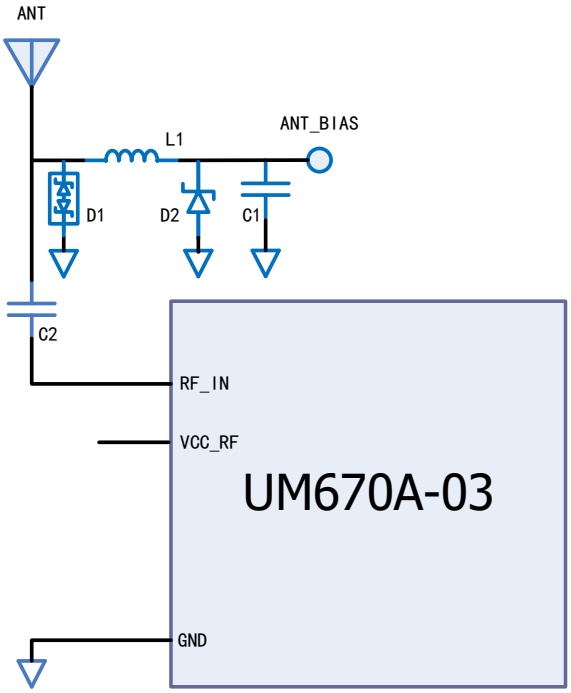


Figure 3-2 UM670A-03 External Antenna Feed Reference Circuit

Remarks:

- L1: feed inductor, 68 nH RF inductor in 0603 package is recommended.
- C1: decoupling capacitor, it is recommended to connect two capacitors of 100 nF/100 pF in parallel.
- C2: DC blocking capacitor, recommended 100 pF capacitor.
- Not recommended to use VCC_RF as ANT_BIAS to feed the antenna (VCC_RF is not 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 Antenna Detection Design[4]

UM670A 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.

☞ Refer to *UM670A_Hardware Reference Design* for the details of the antenna detection circuit.

3.4 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.

[4] Optional.

3.5 Grounding and Heat Dissipation

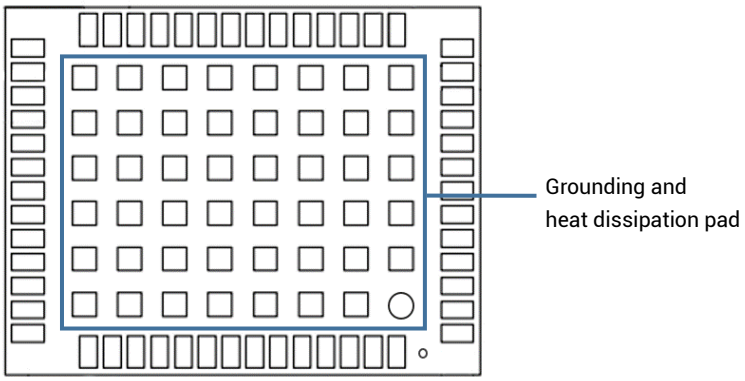


Figure 3-3 Grounding and Heat Dissipation Pad

The 48 pads in the rectangle 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 UM670A'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 **2.3 Dimensions**.

☞ 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.

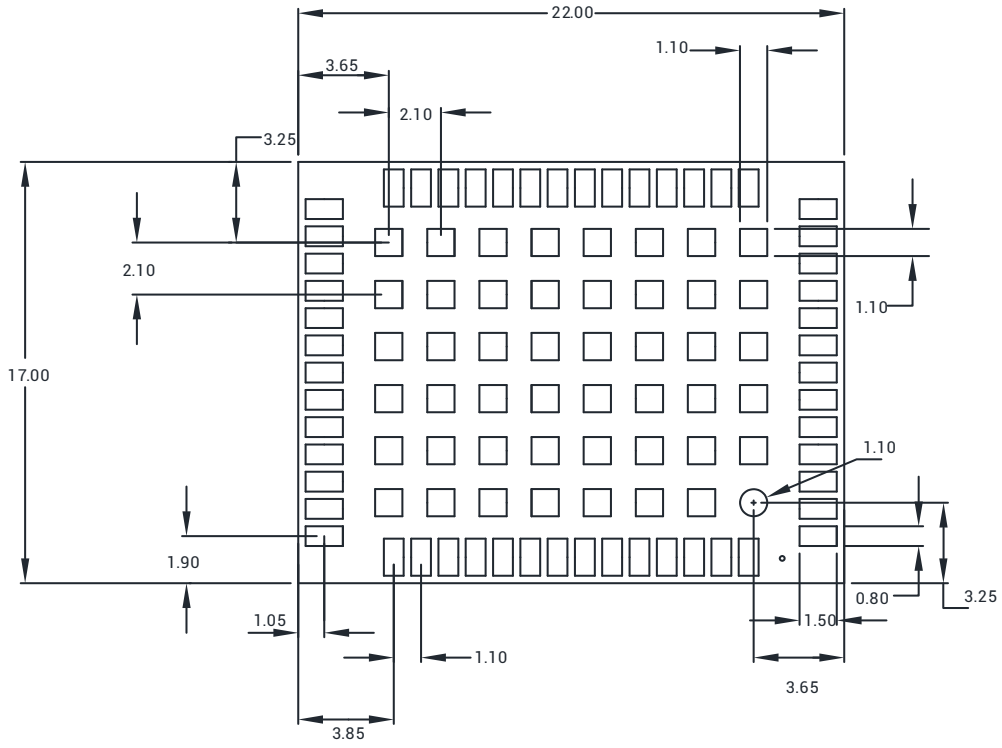


Figure 3-4 Recommended Footprint (Unit: mm)

4 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 cover, causing mildew and other problems.

4.2 Soldering

Recommended soldering temperature curve is as follows:

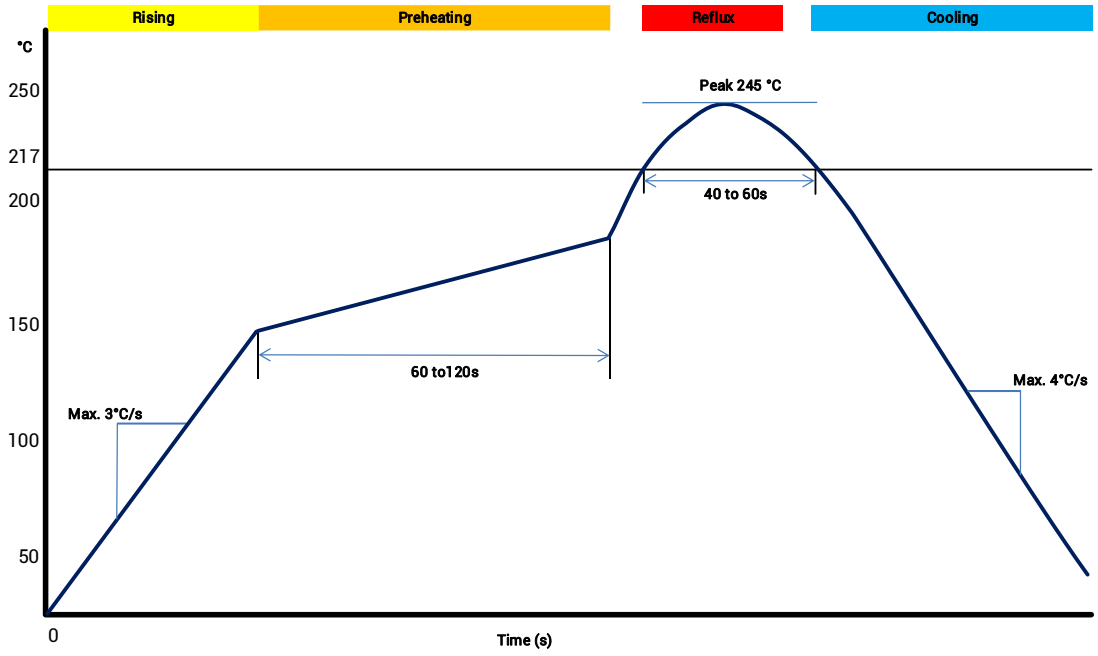


Figure 4-1 Soldering Temperature (Lead-free)

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, 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.

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).

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

5 Packaging

5.1 Label Description

Figure 5-1 Label Description

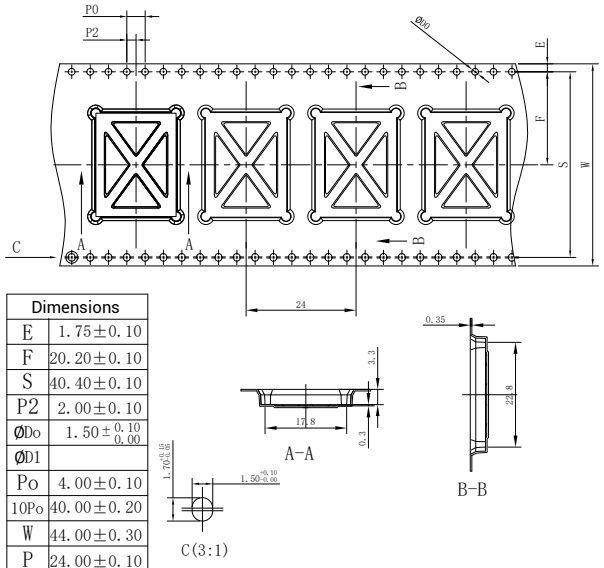
5.2 Ordering Information

Main Model	Sub-Model	Description
UM670A	03	Automotive grade; dual-frequency single point positioning module; L1+L5; operating temperature: -40 °C to +105 °C; supporting firmware upgrade; 22 mm x 17 mm; 250 pieces/reel

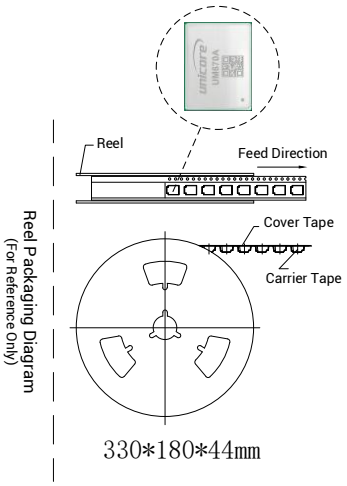
5.3 Product Packaging

The UM670A-03 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 UM670A-03 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. 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).

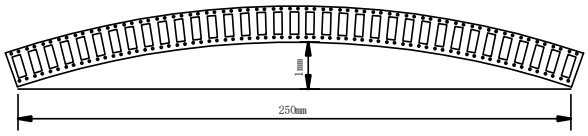


Figure 5-3 UM670A-03 Reel Package Diagram

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 UM670A-03 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.

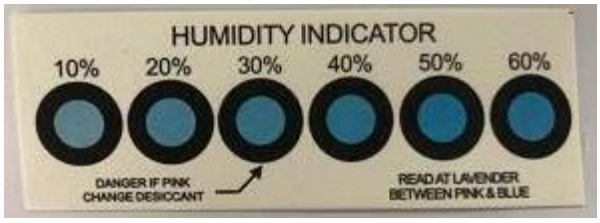


Figure 5-4 Normal Humidity Indication

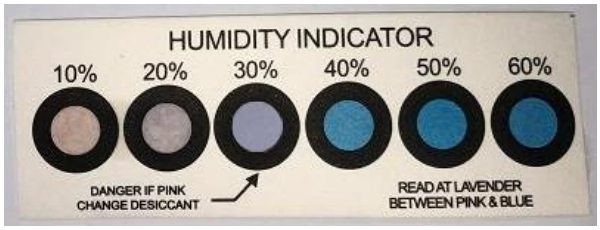


Figure 5-5 Abnormal Humidity Indication

The shelf life of the UM670A-03 module packaged in vacuum-sealed aluminum foil antistatic bags is one year.

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