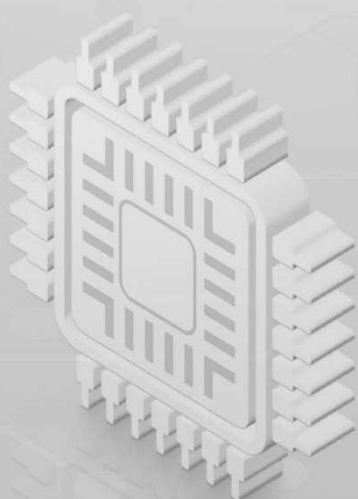


# CM121 User Manual

---



## Revision History

Revision	Revision Record	Date
R1.0.0	Initial Version	2025-06

## DISCLAIMER

This manual provides information about the products of ICOE (Shanghai) Technology Co., Ltd. This document does not transfer any patent, trademark, copyright or ownership rights or licenses of the company or any third party by implication, estoppel or other forms.

Except for the responsibilities stated in the sales terms and conditions of the products, our company does not assume any other responsibilities. Moreover, ICOE make no express or implied warranties regarding the sale or use of their products, including the suitability for specific purposes, marketability, or liability for infringement of any patent, copyright, or other intellectual property rights. If the connection or operation does not comply with the manual requirements, our company is exempt from liability. The product specifications and product descriptions may be modified at any time without prior notice.

For our company's products that may contain certain design defects or errors, once discovered, they will be included in the error table, which may result in differences between the product and the published specifications. If requested by the customer, the latest errata can be provided.

Before ordering products, please contact our company or local distributor to obtain the latest specifications.

ICOE and its logo have been applied for trademark registration by ICOE (Shanghai) Technology Co., Ltd.

Other names and brands are the property of their respective owners.

Copyright © From 2025 to 2026, ICOE (Shanghai) Technology Co., Ltd. All rights reserved.

## **Preface**

This manual provides users with information about the hardware features, performance specifications, and usage guidelines of CM121 single-frequency multi-system positioning module.

## **Target Readers**

This manual is intended for use by technical personnel. It is not aimed at the general readers.

# Contents

1. Product Overview .....	1
1.1. Key Features .....	2
1.2. Technical Specifications .....	2
2. Module Overview .....	4
2.1. System Block Diagram .....	4
2.1.1. Communication interfaces .....	4
2.1.2. 1PPS .....	4
2.1.3. Reset (nRESET) .....	5
2.2. Package and Pin Definition .....	5
2.3. Mechanical Dimensions .....	7
3. Electrical Characteristics .....	8
3.1. Absolute Maximum Ratings .....	8
3.2. Operating conditions .....	8
3.3. IO Threshold Characteristics .....	9
3.4. Antenna Characteristics .....	9
3.5. External Antenna Feed Design .....	10
4. Production requirements .....	11
5. Packaging .....	13
5.1. Labeling .....	13
5.2. Packaging .....	13
6. Ordering Information .....	14

# 1. Product Overview

CM121 is a new-generation single-frequency, multi-constellation meter-level positioning module independently developed by ICOE. It simultaneously supports GPS L1, BDS B1I/B1C\*, GLONASS L1, Galileo E1, and QZSS L1 systems.

The module incorporates the latest generation low-power RF baseband integrated GNSS SoC design, delivering meter-level positioning accuracy while maintaining optimal power efficiency. This module is applicable to various scenarios requiring high positioning accuracy coupled with low power consumption.

CM121 module features a compact 10.1x9.7x2.5mm SMT-compatible package with standard pads layout, supporting pick-and-place assembly and reflow soldering processes.

The module is commonly used in navigation and positioning applications including trackers, two-way radios, portable devices, two-wheeled vehicles and so on.



Fig. 1-1 CM121 Module Physical Diagram

Industrial Grade	System						Interfaces				Data Update Rate
	GPS	BDS	GLONASS	Galileo	QZSS	SBAS	UART0	UART1	I2C	SPI	
●	●	●	●	●	●		●		*		1Hz~5Hz

Table 1-1 Key Features

## 1.1. Key Features

- Supports simultaneous multi-constellation positioning with BDS, GPS, GLONASS, Galileo, QZSS.
- High sensitivity with acquisition sensitivity  $\leq -149\text{dBm}$  and tracking sensitivity  $\leq -165\text{dBm}$ .
- Integrated anti-jamming technology features real-time interference detection and suppression. Total anti-jamming capability is not less than  $-75\text{dBm}$ .
- Low power consumption: the power consumption is  $13.5\text{mA}@3.3\text{V}$  in continuous tracking mode.
- Data update frequency up to  $5\text{Hz}$
- $10.1 \times 9.7 \times 2.5\text{mm}$ , 18-pin LCC package

## 1.2. Technical Specifications

Performance		
Operating Frequency	GPS: L1C/A	
	BDS: B1I, B1C	
	Galileo: E1B/C	
	GLONASS: G1	
	QZSS: L1C/A	
Sensitivity*	Cold Start	-149dBm
	Warm Start	-155dBm
	Re-acquisition	-159dBm
	Tracking	-165dBm
Horizontal Positioning Accuracy		2.0m (CEP50, Open Sky)
Rate Accuracy*		0.1m/s
TTFF*(CEP50)	Cold start: 26s	
	Hot start: 1s	
	Recapture: 2s	
Power Supply		
Input Voltage		2V~3.6V
Power Consumption*	Tracking	13.5mA@3.3V

Acquisition	16.2mA@3.3V
RF Input	
Input Gain	5dB~35dB
Input Impedance	50Ω
Input Power (Max)	10 dBm
Physical Characteristics	
Dimension	10.1mm×9.7mm×2.5mm
Environment	
Working Temperature	-40°C~+85°C
Storage Temperature	-40°C~+85°C
Humidity	35%~75%
Vibration	GB/T2423.10
Shock	GB/T2423.5
Communication Interface	
UART	1
I2C <sup>1</sup>	1

Table 1-2 CM121 Module Specifications

<sup>1</sup>The function will be available in customized versions.

\*Test environment: -130dBm signal under the simulator at 25°C

## 2. Module Overview

### 2.1. System Block Diagram

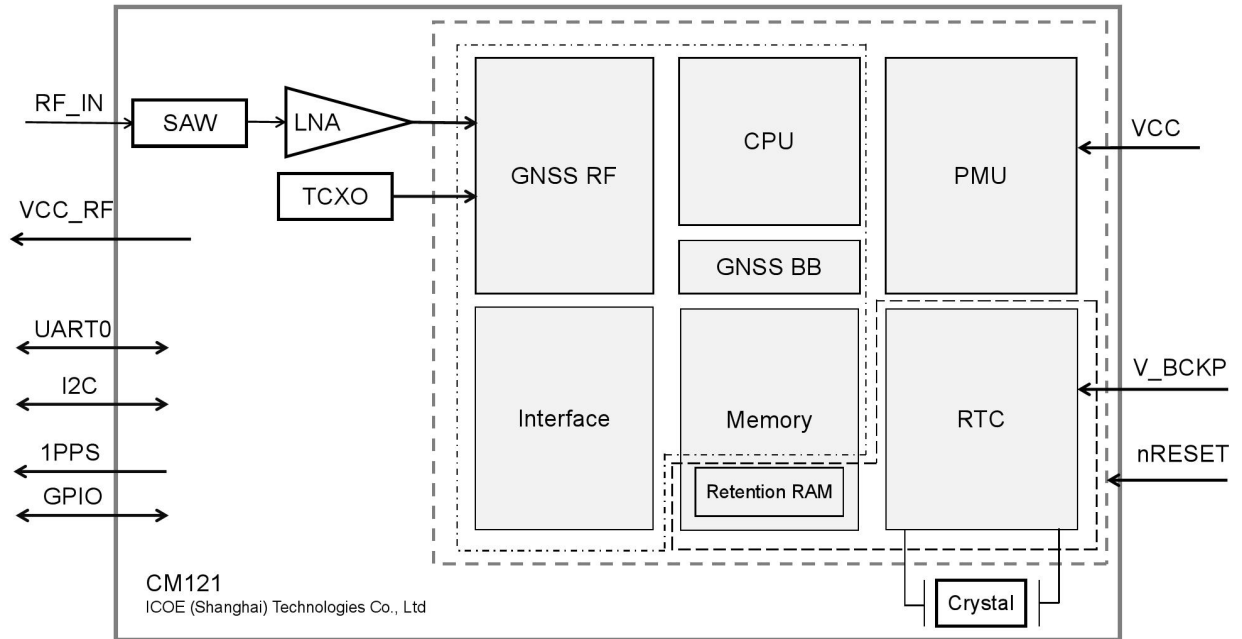


Figure 2-1 CM121 module block diagram

#### 2.1.1. Communication interfaces

The CM121 supports one UART interface (UART) and one I2C<sup>1</sup> interface.

##### ● UART

TXD and RXD pins operate at 115,200bps by default, with a maximum baud rate of 4 Mbps. Baud rate can be adaptive or manually configured.

UART interface supports data transmission and firmware upgrade function.

In order to support the firmware upgrade function, it is necessary to ensure that the UART is connected to a PC or external processor.

##### ● I2C<sup>1</sup>

The I2C interface can work in master mode to connect to the external sensor and support 100kbps, 400kbps and 1Mbps transmission rates.

#### 2.1.2. 1PPS



1PPS outputs pulse sequence synchronized with GPS or UTC time grid, and the pulse width and polarity can be configured.

All input and output signals are synchronized with the internal clock frequency of the receiver, so that the inherent maximum quantization error of the signal reaches  $\pm 20$  ns.

### 2.1.3. Reset (nRESET )

Input signal, active low;

The low level duration of the reset signal remains not less than 5ms.

## 2.2. Package and Pin Definition

10	GND	CM121 (Top View)	nRESET	9
11	RF_IN		VCC	8
12	GND		Reserved	7
13	Reserved		V_BCKP	6
14	VCC_RF		EINT	5
15	Reserved		1PPS	4
16	I2C_SDA		RXD	3
17	I2C_SCL		TXD	2
18	NC		GND	1

Figure 2-2 Pinout (Top View)

Pin No.	Pin Name	Direction <sup>2</sup>	Level Standard	Description
1	GND	-		Ground
2	TXD	O	LVTTL	Serial output
3	RXD	I	LVTTL	Serial input
4	1PPS	O	LVTTL	One pulse per second If unused, keep open
5	EINT	I	-	External Interrupt Input
6	V_BCKP			Backup power supply Connect VCC if the backup power is not used.
7	Reserved	-	-	Reserved
8	VCC	I	LVTTL	Main power supply Input voltage range: 2V~3.6V
9	nRESET	I	LVTTL	Reset the module, active low Connected to master GPIO or floating
10	GND	-		Ground
11	RF_IN	I/O		RF signal input, 50Ω impedance control
12	GND	-		Ground
13	Reserved	-	-	Reserved
14	VCC_RF	O		Power supply for external antenna, voltage same as 8-pin VCC
15	Reserved	-	-	Reserved
16	I2C_SDA	I/O	LVTTL	I2C Data Signal
17	I2C_SCL	I/O	LVTTL	I2C Clock Signal
18	NC	-	-	NC

Table 2-1 Pin Descriptions

**Notes:** IO levels are determined by VCC supply.

<sup>2</sup> Direction: I--input, input; O--output, output; I/O--bidirection;

### 2.3. Mechanical Dimensions

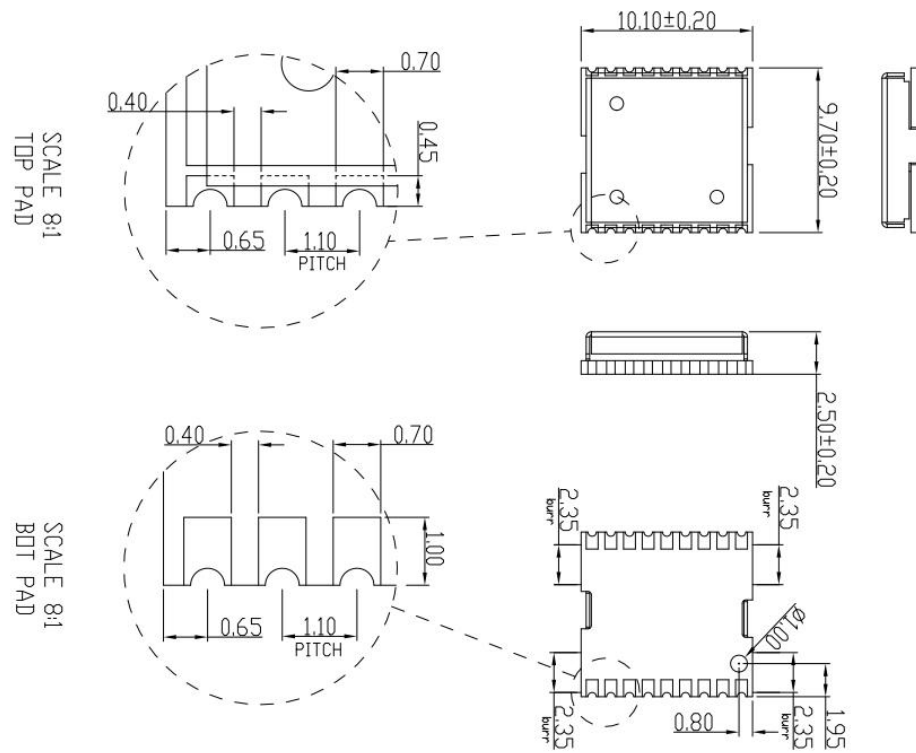


Figure 2-3 Mechanical Dimensions (Unit: mm)

## 3. Electrical Characteristics

### 3.1. Absolute Maximum Ratings

Parameter	Symbol	Minimum value	Maximum value	Unit
Power Supply Voltage	VCC	-0.3	3.6	V
Backup Voltage	V_BCKP	1.7	3.6 V	V
Input Pin Voltage	V <sub>in</sub>	-0.3	3.6 V	V
Input Power of RF_IN	P <sub>RF_IN</sub>		10	dBm
Output voltage of External LNA	VCC_RF	-0.3	3.6	V
Storage Temperature	Tstg	-40	85	°C

Table 3-1 Absolute Ratings

### 3.2. Operating conditions

Parameter	Symbol	Minimum value	Typical value	Maximum value	Unit	Condition
Supply Voltage	VCC	2		3.6	VCC	
VCC Maximum Ripple	Vrpp			50	mV	
Operating Current <sup>3</sup> (VCC=3.3 V)	Iopr		13.5	20	mA	
Operating	Topr	-40		85	°C	

<sup>3</sup>Operating current: Due to the capacitors inside the product, an inrush current will be generated during power-up.

In practical applications, it is necessary to evaluate and confirm the impact of voltage dips caused by inrush current on the system.

Parameter	Symbol	Minimum value	Typical value	Maximum value	Unit	Condition
temperature						
Tracking power consumption (VCC = 3.3 V)	P		45		mW	

Table 3-2 Recommended Operating Conditions

### 3.3. IO Threshold Characteristics

Parameter	Symbol	Minimum value	Typical Value	Maximum value	Unit	Condition
Low-Level Input	Vin_low	Vin_low		0.2*VCC	V	
High-Level Input	Vin_high	0.7*VCC		VCC+0.2	V	
Low-Level Output	Vout_low	0		0.45 V	Iout = 4 mA	Iout = 4 mA
High-level output	Vout_high	VCC-0.45		VCC	Iout = 4 mA	Iout = 4 mA

Table 3-3 IO Threshold Characteristics

### 3.4. Antenna Characteristics

Parameter	Symbol	Minimum value	Typical value	Maximum value	Unit	Condition
Input Gain	Gain	5		35 dB	dB	

Table 3-4 External Antenna Characteristics

### 3.5. External Antenna Feed Design

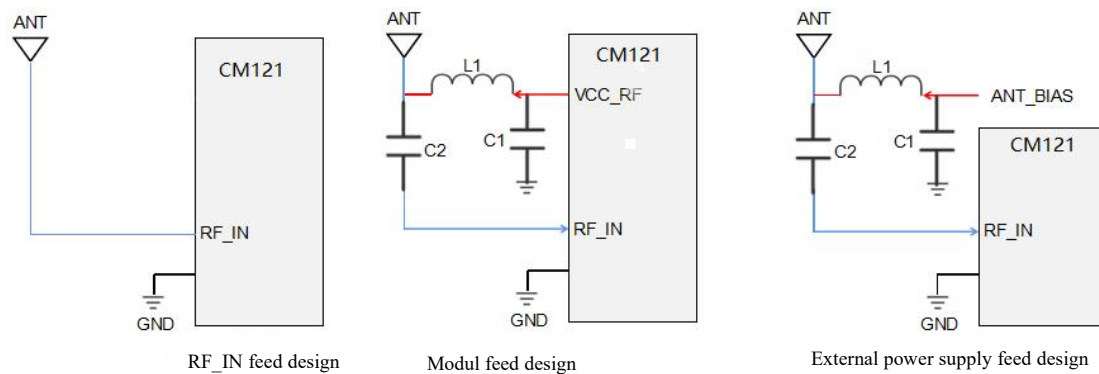


Fig. 3-5 External antenna feed reference circuit

- L1, feed inductor, 68nH RF inductor recommended
- C1, decoupling capacitor, parallel combination of 100nF and 100pF capacitors recommended
- C2, RF DC-Blocking (or DC-Isolating) Coupling Capacitor
- L1, C1, C2 and CM121 module need to be placed close to the antenna feed point;
- External antenna feed mode:

If the antenna detection function is required, it is necessary to match the peripheral matching circuit and use the output V\_ANT of the antenna detection circuit to feed the external antenna (module feed design);

If the antenna detection function is not required,, it is recommended to use external power supply to feed the external antenna directly (external power supply feed design).

- Red line: power supply line of antenna feed
- Blue line: RF trace, 50Ω impedance control is required
- RF\_IN feed design is not recommended for passive antenna configuration

## 4. Production requirements

The recommended soldering temperature profile is shown below:

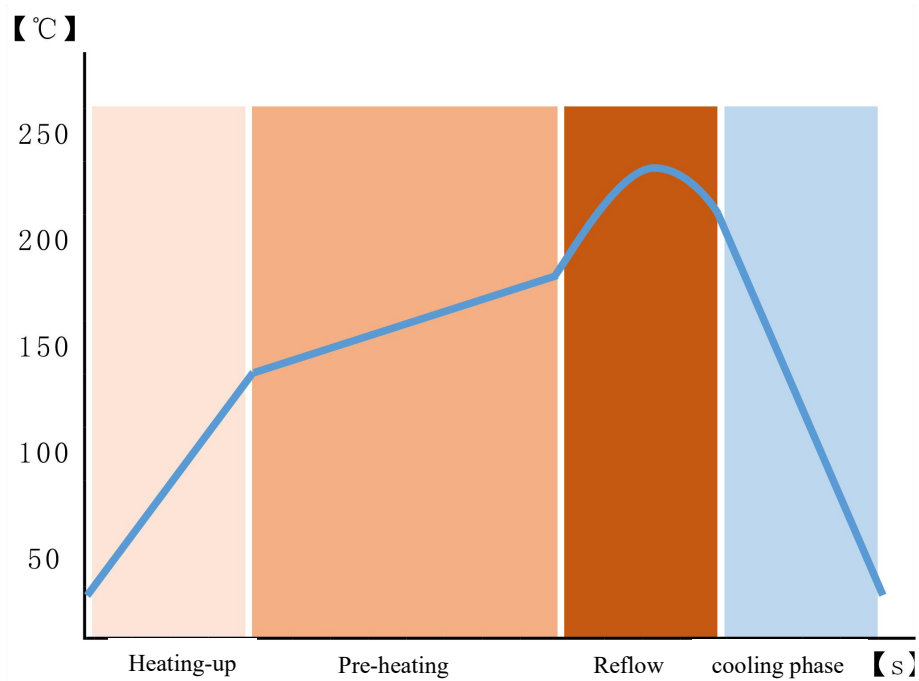


Figure 4-1 Lead-Free Reflow Solder Temperature Curve

Lead-Free Process	Ramp-up Phase	Preheat Phase	Reflow Phase	Cooling Phase
Temperature Zone (°C <sup>4</sup> )	50~150	150~180	>217(melting point) and < 245	< 217
Ramp Rate (°C/s <sup>5</sup> )	< 3			≤4
Duration (s)	~50	60~120	40~60(> 217°C)	~40
Remarks	Ramp-up Rate: <3°C/s		The peak reflow temperature shall not exceed 245°C	Ramp-down Rate: max. 4°C/s

Table 4-1 Lead Free Process Parameter Table

<sup>4</sup> °C: degrees Celsius

<sup>5</sup> °C/s: degrees Celsius per second.



1. To prevent the module from falling off during soldering, please do not design the module to be soldered on the back of the board. Dual reflow cycles are strongly discouraged.
2. The setting of soldering temperature depends on many factors in the product factory, such as PCB substrate characteristics, type of solder paste, thickness of the paste, etc. Please also refer to the relevant IPC standards as well as specifications of the solder paste.
3. Due to the relatively low temperature of Pb-containing solder, please prioritize other components on the board if using this soldering method.
4. Stencil aperture design should meet the customer-specific design requirements and inspection criteria.
5. Stencil thickness should be no less than 0.12mm, with 0.15mm recommended as standard."



## 5. Packaging

### 5.1. Labeling



Fig. 5-1 Product Label

### 5.2. Packaging

CM121 module is vacuum-sealed in an anti-static aluminum foil bag with desiccant for moisture protection and is supplied in carrier tape & reel packaging for compatibility with mainstream SMT (Surface Mount Technology) equipment.

When soldering the module using reflow processes, strictly adhere to IPC standards for humidity control. Since the carrier tape and other packaging materials can only withstand temperatures up to 55°C, the module must be removed from its packaging before baking.

Parameter	Description
Reel Quantity	1000pcs/roll
Reel Size	Reel: 13 inches Outer diameter: 330mm, Inner diameter: 100mm, Width: 24mm, Wall thickness:2mm.
Carrier Tape	Module pitch (center distance): 16mm

Table5-2 Tape & Reel Packaging Specifications

CM121 LCC package is rated at MSL level 3. Baking requirements should comply with IPC/JEDEC standards (available for download at [www.jedec.org](http://www.jedec.org)).

The shelf life of CM121 module is one year.



1. After opening the vacuum-sealed bag, SMT placement must be completed within 48 hours when ambient conditions are maintained at: Temperature: <30°C and Relative Humidity: <60% RH.
2. In original intact aluminum foil vacuum packaging (undamaged/airtight), the shelf life is 12 months when stored under: Temperature: 18°C to 28°C (controlled environment) and Relative Humidity: <60% RH.

## 6. Ordering Information

Model Number	Package Size	Operating Temperature	Grade	Function	Packaging
CM121-11	10.1x9.7x2.5mm	-40~+85°C	Industrial Grade	Single Frequency PVT DCDC Configuration	Tape and Reel Packaging. 1000 pcs/roll

Table 6-1 Ordering Information Sheet



ICOE (Shanghai) Technologies Co.,Ltd

Floor 8, Building 1, Lane 500, Shengxia Road, China (Shanghai) Pilot Free Trade Zone 200120

Web: <http://www.icoe-tech.com>

Tel: 021-58213950 Fax: 021-58213950