Chengdu Ebyte Electronic Technology Co.,Ltd

Wireless Modem

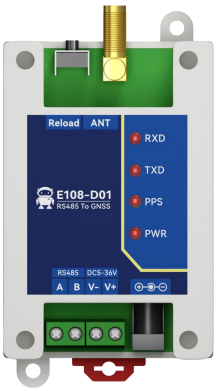
User Manual

E108-D01

Positioning Module User Manual

Contents

1. Overview



1.1 Introduction

E108-D01 is a positioning terminal that supports multiple positioning systems (GPS, BDS, GLONASS, Galileo, etc.), with fast response and accurate positioning.

It outputs positioning information through the Modbus RTU protocol, supporting the output of RMC-ASCII strings conforming to the NMEA0183 protocol. It aslo supports separate registers to store (longitude, longitude direction, latitude, latitude direction, etc.), The baud rate of the serial port can reach up to 115200bps, which can be easily modified through the Modbus RTU protocol, convenient and fast.

1.2 Features

- Support single-system positioning of BDS/GPS/GLONASS/GALILEO/QZSS/SBAS satellite navigation system, and multi-system joint positioning in any combination;
- Multiple serial port baud rates (1200-115200bps) can be configured;
- Support standard Modbus RTU protocol to read positioning information;
- Multiple output formats for positioning information;
- The antenna positioning status is output through registers and indicator lights;
- The serial port supports TVS and overcurrent protection;
- Industrial grade design, support operating temperature up to -40 ~ 85 ℃;
- Support wide voltage input DC 5-36V;
- The positioning accuracy can reach 2.5 meters (CEP50);
- Supports installation of guide and positioning hole.

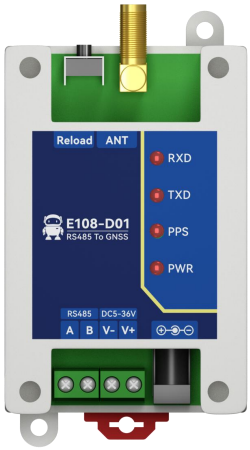
2. Quick Start

2.1 Preparation

Take obtaining the REC positioning information output by the device as an example:

Hard wares preparation:

- A computer;
- E108-D1 positioning module;
- Active GPS antenna (SMA, inner thread, inner needle);
- One USB to RS-485 serial cable;

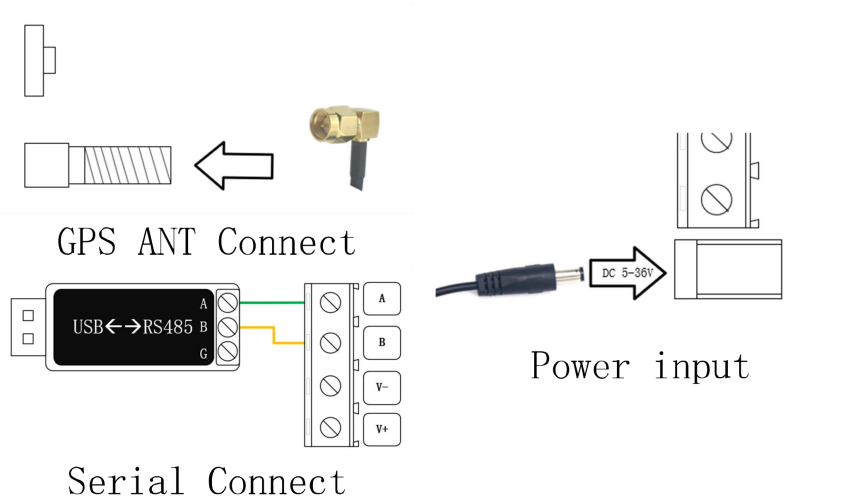
		
PC	E108-D1	DC 12V power supply
		
GPS active antenna	USB to 485 converter	cables

Software preparation:

- Serial port debugging tool (User can download the "XCOM" serial port debugging tool from Ebyte's official website www.cdebyte.com);

2.2 Operation demonstration

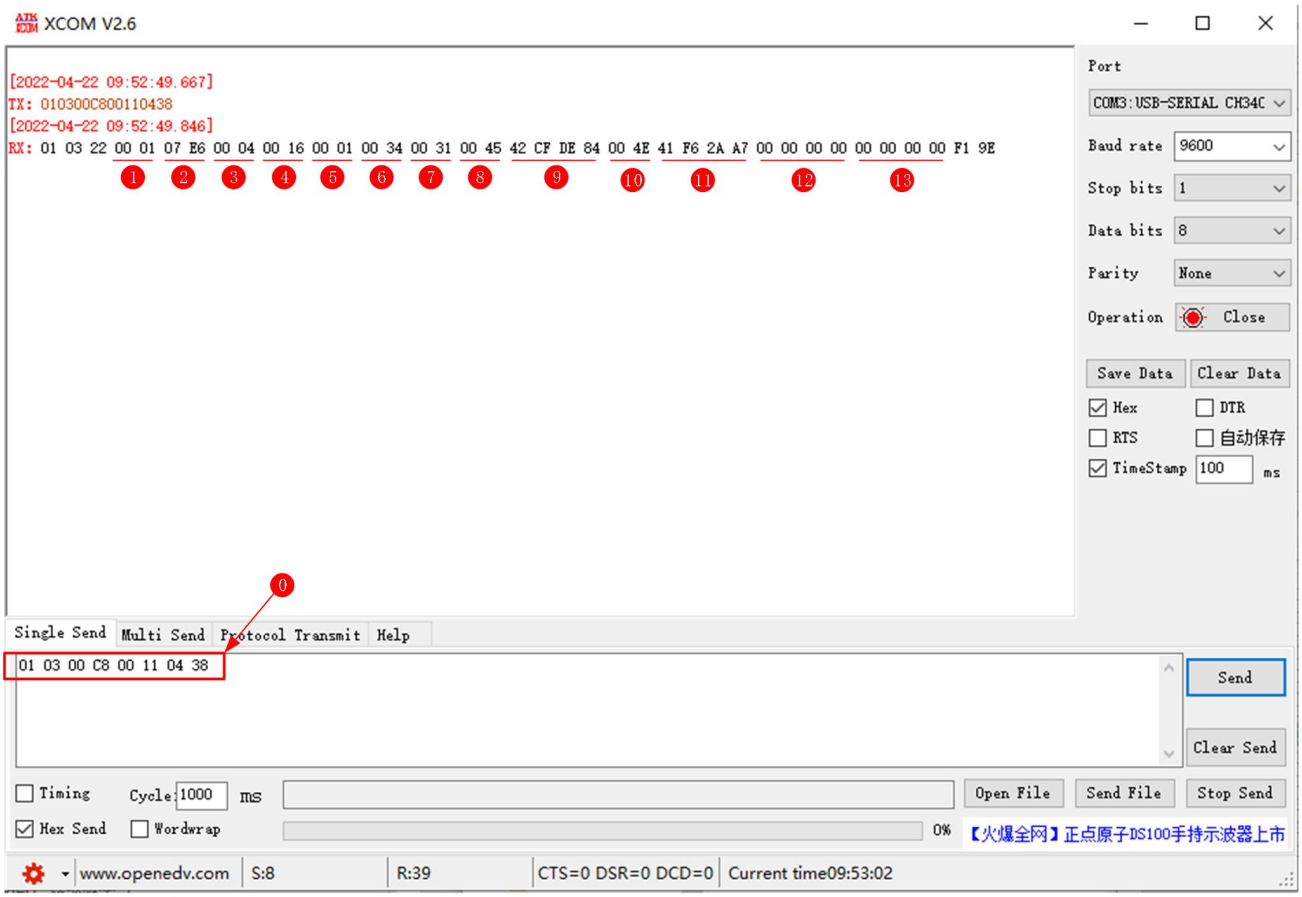
After preparing the above software and hardware, user can query the device positioning information and UTC time through the Modbus RTU command, correctly connect the device power supply and serial port, connect the antenna and move the antenna to an open space, as shown in the following figure:



Select the correct serial port number, adjust the baud rate parameter to 9600-8N1, and send the hexadecimal data "0x010300C800110438" to receive the device response data, as shown in the figure below.

If the response data cannot be received, please check whether the serial port is connected correctly, whether the parameter configuration is correct, whether to send hexadecimal data.

If all the configurations are correct, but no response received yet, pls press the button to restore the factory parameters and test again.



Data analysis table

No.	Original Value (HEX)	Description	Conversion Rules	After Conversion

1	0x00 00	Positioning Effectiveness	0x00：invalid 0x01：valid	valid
2	0x07 e6	year	HEX→DEC	2022
3	0x00 04	month	HEX→DEC	4
4	0x00 16	day	HEX→DEC	22
5	0x00 01	hour	HEX→DEC	1
6	0x00 34	minute	HEX→DEC	34
7	0x00 31	second	HEX→DEC	31
8	0x00 45	Longitude direction	Low level is valid, HEX→ASCII	E
9	0x42 cf de 84	longitude	32-bit floating point numbers, big endian-big endian	103.93460083007812
10	0x00 4e	Latitude direction	Low level is valid, HEX→ASCII	N
11	0x4e f6 2a a7	latitude	32-bit floating point numbers, big endian-big endian	30.77082633972168
12	0x00 00 00 00	speed over ground	32-bit floating point numbers, big endian-big endian	0
13	0x00 00 00 00	course over ground	32-bit floating point numbers, big endian-big endian	0

【Notes】： The time is UTC time.

3. Technical indicators

3.1 General Specifications

No.	Item	Specifications
1	voltage	5V~36V DC
2	Serial port spec.	Standard RS-485 interface
3	Baud rate	1200-115200bps
4	Communication protocol	Modbus RTU
5	Position system supported	BDS/GPS/GLONASS/GALILEO/QZSS/SBAS
6	User configuration	Modify the register through Modbus RTU, restart to take effect
7	Antenna interface	SMA（External thread, inner hole）
8	Size	96.5mm*50mm*31.4mm
9	Weight	63± 5g
10	Working temperature	-40 ~ +85℃, industrial grade
11	Working humidity	10% ~ 90%, Relative humidity, non-condensing

3.2 GPS performance

Category	Indicator item	Typical value	Unit
	Cold start	27.5	S

positioning time （Test Condition 1）	Hot start	＜1	S
	Recapture	＜1	S
	A-GNSS	＜10	S
Sensitivity （Test Condition 2）	Cold start	-148	dBm
	Hot start	-162	dBm
	Recapture	-164	dBm
	Track	-166	dBm
precision （Test Condition 3）	Horizontal positioning accuracy	2.5	m
	High positioning accuracy	3.5	m
	Speed positioning accuracy	0.1	m/s
	Timing accuracy	30	ns
Power consumption （Test Condition 4）	Capture current	30	mA
	Tracking current	20	mA
Working temperature	--	-35℃--85℃	--
Storage temperature	--	-55℃--100℃	--
Humidity	--	5%--95%RH （non-condensing）	--

【Notes】：The above results are GPS/BDS dual-mode working mode

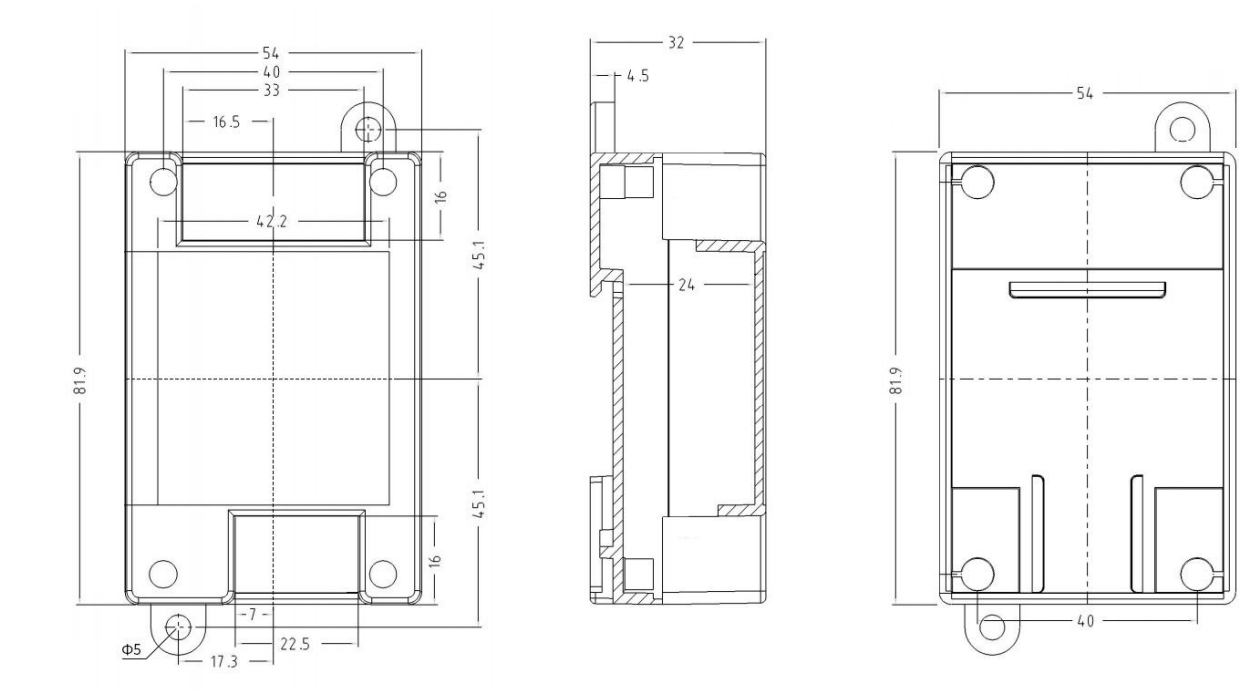
[Test Condition 1]: More than 6 of receiving satellites, the signal strength of all satellites is -130dBm, the average value is obtained after 10 tests, and the positioning error is less than 10 meters.

[Test Condition 2]：The noise figure of the external LNA is 0.8, the number of receiving satellites is greater than 6, and the received signal strength value under the condition of locking within five minutes or not losing the lock.

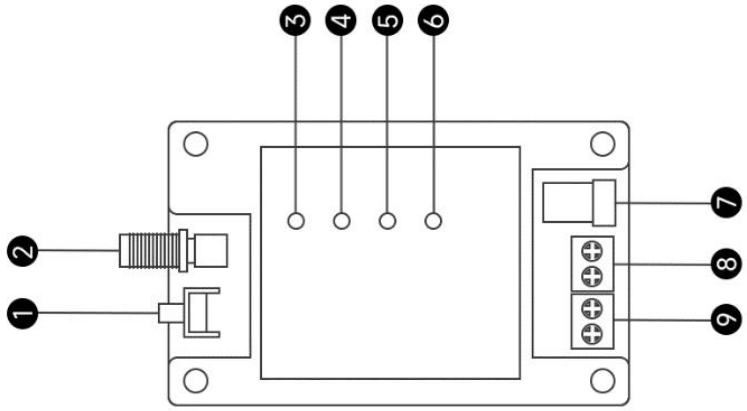
[Test Condition 3]：Open and unobstructed environment, 24 hours of continuous power-on test, 50% CEP.

[Test Condition 4]： The number of receiving satellites is greater than 6, and the signal strength of all satellites is -130dBm.

3.3 Mechanical dimension drawing



3.4 Pin and Indicator light Definitions

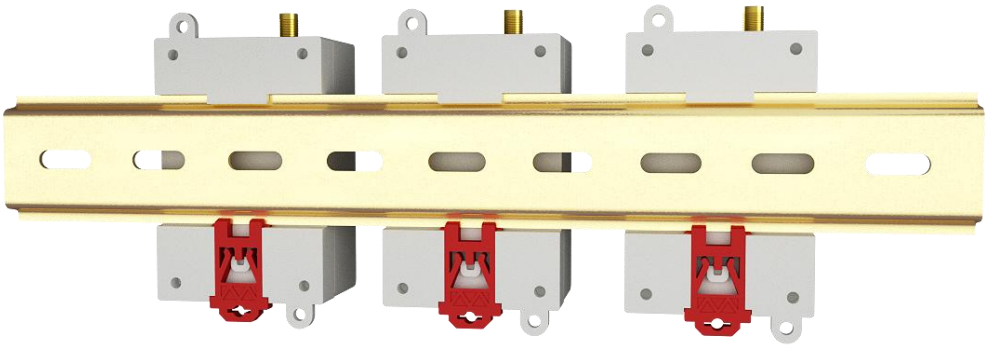


No.	Identification name	Function description
1	Factory button	Long press for 5-10s is valid, and the device address and baud rate parameters are restored to the factory parameters; Factory parameters: the device address is 1, the serial port parameter is 9600/8/no parity/1
2	ANT	SMA antenna interface, need to use GPS active antenna
3	RXD Indicator light	Receive indicator, flashes when receiving data from RS485 bus
4	TXD Indicator light	Transmitting indicator, flashes when transmitting data to RS485 bus

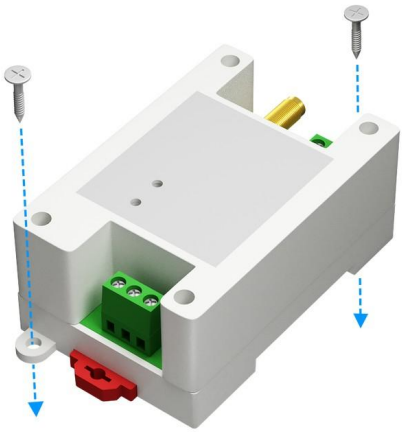
5	PPS Second pulse indicator	Steady on when the positioning is invalid; flashes once per second after the positioning is valid
6	PWR Indicator light	Power indicator, steady on when power on
7	DC_IN	Power interface, 5~36V DC female socket (inner needle diameter 2.0mm, hole diameter 6.4mm)
8	Power interface	3.81mm phoenix terminal power input positive (top), power input negative (bottom), 5~36V DC, cannot supply power with socket at the same time
9	RS-485 interface	RS485 bus B (top), RS485 bus A (bottom)

3.5 Installation

The equipment is installed with guide rail and positioning hole.



Guide rail installation



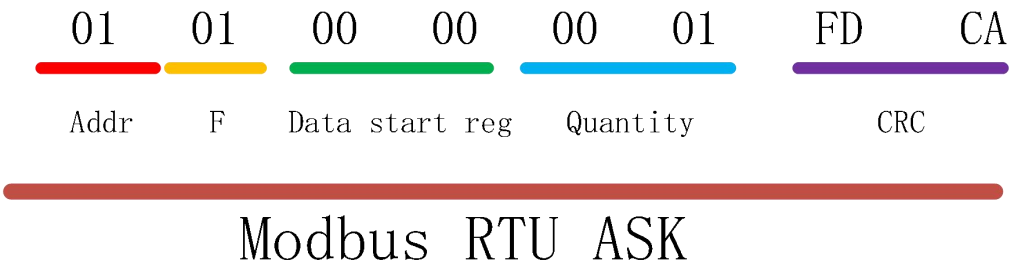
Position hole installation

4. Modbus Register

4.1 Communication Protocol

The protocol layer of the GPS/BDS positioning module is a standard Modbus communication protocol, which conforms to the national standard GBT 19582.1-2008 "Industrial Automation Network Specification Based on Modbus Protocol". It adopts the Modbus RTU communication protocol, and return data according to the parsing result by receiving and parsing the frame data on the data bus.

The frame format is as follows:



4.2 Register description

The following table describes the specific meaning of the decimal registers and the function codes used for operation.

Register	Read function code (HEX)	Write function code （HEX）	Channel example
[Area 1] Discrete Input Register	02	——	10001, indicating the DI1 register address
[Area 0] Switch output register	01	05 0F	00001, indicating the DO1 register address
[Area 3] Input register	04	——	30001, means address 1 of zone 3
[Area 4] Holding Registers	03	06 10	40001, indicating address 1 of area 4

【Note】This device will only use the register address of zone 4 (that is, the holding register).

4.3 Register table

Register Function	Register Address		Data Format	Data Range/Remarks
	（Decimal）	（Hex）		
Version number	40001	0001	Int16	The low byte is valid, where the upper 4 bits represent the major version number, and the lower 4 bits represent the minor version number. 0x0010 represents version 1.0. The version number is read-only.
Device address	40002	0002	Int16	1-255, default 1, support to read and modify broadcast address (0x00).

Baud rate	40003	0003	Int16	Baud rate code： 0x0000：1200bps， 0x0001：2400bps， 0x0002：4800bps， 0x0003：9600bps， 0x0004：19200bps，0x0005：38400bps， 0x0006：57600bps，0x0007：115200bps，
Parity	40004	0004	Int16	0x0000：None parity， 0x0001：Odd parity， 0x0002：Even parity， Configuring other parameters does not take effect;
RMC-Location Data	40005	0005	String (70Btye)	Store 70 bytes of RMC-NMEA0183 protocol data, use ASCII encoding, and use AB in the decoding order;
…	…	…	…	Reserve;
Positioning status	40200	00C8	Int16	0：invalid positioning，1：valid positioning, read only；
Year	40201	00C9	Int16	2022 represents year 2022, read only;
Month	40202	00CA	Int16	The value range is 1 to 12, representing January to December respectively, read-only;
Day	40203	00CB	Int16	The value range is 1 to 31, representing 1st to 31st respectively, read-only;
Hour	40204	00CC	Int16	The value range is 0 to 23, representing 0 to 23 o’clock respectively, read-only;
Minute	40205	00CD	Int16	The value ranges from 0 to 59, representing 0 to 59 minutes respectively, read-only;
Second	40206	00CE	Int16	The value ranges from 0 to 59, representing 0 to 59 seconds respectively, read only;
Longitude direction	40207	00CF	Int16	0x45(ASCII：E) represents the East longitude, 0x57(ASCII：W) represents the West longitude;
Longitude	40208	00D0	Float (4Byte)	The unit is degrees, 5 decimal places after the decimal point, read only Example: 103.93416°, word order: big endian, byte order: big endian;
Latitude direction	40210	00D2	Int16	0x4E(ASCII： N) Represents North latitude, read only 0x53(ASCII：S) Represents South latitude
Latitude	40211	00D3	Float (4Byte)	The unit is degrees, 5 decimal places after the decimal point, read only Example: 30.77056°, word order: big endian, byte order: big endian;
Speed over ground	40213	00D5	Float (4Byte)	The unit is Kn, read-only, word order: big endian, byte order: big endian;
Course over ground	40215	00D7	Float (4Byte)	The unit is Kn, read-only, word order: big endian, byte order: big endian;

【Note】 Single-precision floating-point uses the standard IEEE754 format, with a total of 32 bits (4 bytes). The default single-precision floating point endian mode is ABCD (high byte first, low byte last), for example: 0x3FF1EB85 represents 1.89 (reserved 2 decimal places).

5. Use of Modbus RTU

【Note】In the following demo, the device address is 1. If using a different device address, then the address bits and checking code are different from below values.

5.1 Holding Registers

The register used by E108-D01 is holding register. The function code for writing the holding register is 0x06 (write a single holding register), and reading the holding register uses 0x03 (reading the holding register)

0x03 code read instruction format (take the read version as an example):

Device address	Function code	First address	Read quantity	Check code CRC
01	03	00 01	00 01	D5 CA

Return format (take the read version as an example):

Device address	Function code	Data length	Read quantity	Check code CRC
01	03	02	00 10	B9 88

0x06 code configuration command format (configure device address as an example):

Device address	Function code	Data length	Value	Check code CRC
01	03	00 02	00 01	25 CA

Return format (configured device address as an example): the same as the command format;

5.2 Read Holding Register Instruction

5.2.1 Read version number

Command frame: 01 03 00 01 00 01 D5 CA

Address	Function code	Register start address	Number of registers	CRC check
0x01	0x03	0x00 0x01	0x00 0x01	0xD5 0xCA

Response frame: 01 03 02 00 10 B9 88

Address	Function code	Data length	data	CRC check
0x01	0x03	0x02	0x00 0x10	0xB9 0x88

Note:

The version number in the returned data is 0x0010, indicating that the version number is V1.0.

5.2.2 Read device address (broadcast)

Command frame: 00 03 00 02 00 01 24 1B

Address	Function code	Register start address	Number of	CRC check

			registers	
0x00	0x03	0x00 0x02	0x00 0x01	0x24 0x1B

Response frame: 00 03 02 00 01 44 44

Address	Function code	Data length	data	CRC check
0x00	0x03	0x02	0x00 0x01	0x44 0x44

【Note】This command is a general read command of the address. When using the broadcast command, to avoid conflicts with other devices in the system, please ensure that only the device to be read is connected to the bus when reading.

5.2.3 Read device baud rate

Command frame: 01 03 00 03 00 01 74 0A

Address	Function code	Register start address	Number of registers	CRC check
0x01	0x03	0x00 0x03	0x00 0x01	0x74 0x0A

Response frame: 01 03 02 00 03 F8 45

Address	Function code	Data length	data	CRC check
0x01	0x03	0x02	0x00 0x03	0xF8 0x45

Note:

The returned baud rate is 0x03, which means 9600 bps. For other baud rate codes, see the description of "Modbus register table".

5.2.4 Read parity

Command frame: 01 03 00 04 00 01 C5 C8

Address	Function code	Register start address	Number of registers	CRC check
0x01	0x03	0x00 0x04	0x00 0x01	0xC5 0xC8

Response frame: 01 03 02 00 00 B8 44

Address	Function code	Data length	data	CRC check
0x01	0x03	0x02	0x00 0x00	0xB8 0x44

Note: The return check digit is 0x00, which means no parity check. See the description of "Modbus register table" for other check codes.

5.2.5 Read positioning data（RMC）

Command frame: 01 03 00 05 00 23 14 12

Address	Function code	Register start address	Number of registers	CRC check
0x01	0x03	0x00 0x05	0x00 0x23	0x14 0x12

Response frame:

Address	Function code	Data length	data	CRC check
0x01	0x03	0x46	70byte data	2byte check

Positioning data (RMC) parsing

The 70-byte data returned by reading the positioning data (RMC) conforms to the NMEA0183 protocol, and the ASCII display is as follows:

$GNRMC,083429.00,A,3046.26769,N,10356.04948,E,000.00,089.80,190422*21

Field	Symbol	Meaning	Value Range	Example	Remarks
1	$				
2	GNRMC				RMC protocol header, GNRMC means joint positioning
3	hhmmss.ss	UTC time	hhmmss.ss	072905.00	Plus 8h for Beijing East Eighth District needs
4	A	Positioning status	A/V		A-valid，V-invalid
5	ddmm.mmmmm	Latitude	ddmm.mmmmm	3640.46260	Convert to degrees when calculating: 36 degrees + 40.46260 minutes. 40.46260/60=0.67438 degree, so the value 3640.46260 should be 36.67438 degree
6	a	Latitude direction	N/S		N-North latitude，S-South latitude
7	ddmm.mmmmm	Longitude	ddmm.mmmmm	3640.46260	Convert to degrees when calculating: 36 degrees + 40.46260 minutes. 40.46260/60=0.67438 degree, so the value 3640.46260 should be 36.67438 degree
8	a	Longitude direction	E/W		E-East longitude，W-West longitude
9	xxx.xx-xxx.xx	Speed over ground	Knot	123.2	Ground speed, unit Kn, range 000.00 to 999.99 knots, zero if the leading digit is insufficient
10	xxx.xx-xxx.xx	Course over	degree	000.0～359.9	Ground heading

		ground			(000.00~359.99 degrees, with true north as the reference), zero if the leading digit is insufficient
11	xxxxxx	date	DDMMYY	190422	Apr.19, 2022
13	*	statement terminator			
14	24	checksum	XOR the data between '$' and '*' (excluding these two characters) by byte, expressed as a hexadecimal value		

5.3 Write Holding Register Instructions

5.3.1 Modify device address (broadcast)

【Note】This command is a general read command of the address. When using the broadcast command, to avoid conflicts with other devices in the system, please ensure that only the device to be read is connected to the bus when reading.

Command frame: 00 06 00 02 00 01 E8 1B

Address	Function code	Register start address	Number of registers	CRC check
0x00	0x06	0x00 0x02	0x00 0x01	0xE8 0x1B

Response frame: 00 06 00 02 00 01 E8 1B

Address	Function code	Register start address	Number of registers	CRC check
0x01	0x06	0x00 0x02	0x00 0x01	0xE8 0x1B

Note:

This command is used to set the device address, use 0x00 as the broadcast address, and modify the device address to 0x01.

5.3.2 Modify baud rate

Command frame: 01 06 00 03 00 03 39 CB

Address	Function code	Register start address	Number of registers	CRC check
0x01	0x06	0x00 0x03	0x00 0x03	0x39 0xCB

Response frame: 01 06 00 03 00 03 39 CB

Address	Function code	Register start address	Number of registers	CRC check

0x01	0x06	0x00 0x03	0x00 0x03	0x39 0xCB

Note:

This command is used to set the baud rate of the device to 9600.

The device defaults to 9600 baud rate without verification when it leaves the factory. Users can set the baud rate and verification method according to actual needs.

5.5.3 Modify the parity

Command frame: 01 06 00 06 00 04 09 CB

Address	Function code	Register start address	Number of registers	CRC check
0x01	0x06	0x00 0x06	0x00 0x04	0x09 0xCB

Response frame: 01 06 00 06 00 04 09 CB

Address	Function code	Register start address	Number of registers	CRC check
0x01	0x06	0x00 0x06	0x00 0x04	0x09 0xCB

Note:

This command is used to set the parity bit of the device to odd parity.

The final interpretation right belongs to Chengdu Ebyte Electronic Technology Co., Ltd.

Revise history

Version	Revise date	Revise instruction	Issued by
1.0	2022-05-05	Initial version	LC
1.1	2022-06-17	Content revision	LC
1.2	2023-03-13	Content revision	LT

About us

Technical support: support@cdebyte.com
Documents and RF Setting download link: https://www.cdebyte.com
Thank you for using Ebyte products! Please contact us with any questions or suggestions: info@cdebyte.com
---
Official hotline: 028-61399028
Web: https://www.cdebyte.com
Address: , Building B5, Mould Industrial Park, 199# Xiqu Ave, High-tech Zone, Chengdu, 611731, Sichuan, China