5100

GNSS Time & Frequency Generator

Operation Instructions

Document Version: 2025-10-14

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Safety Requirements

Thank you for choosing our product. Please read this manual carefully before using the instrument for the first time. It will help you operate the instrument proficiently.

We continuously improve our products; therefore, the instrument you are using may differ slightly from this manual. If any changes are made, we will inform you by providing supplementary documentation. Should you have any questions, please contact our after-sales service department.

> **WARNING:** Input and output terminals may carry voltage. Electrical sparks may be generated when connecting or disconnecting test leads and power cords. Exercise caution to avoid electric shock. Always prioritize personal safety.

Prevent Fire or Personal Injury

- Use appropriate power cords. Only use power cords that are specific to this product and meet its specifications.
- Product grounding. This product must be grounded through the grounding wire of the power cord, and the grounding post on the product chassis must also be grounded. To prevent electric shock, the grounding conductor must be connected to earth ground. Before connecting to the input or output terminals of this product, ensure that the product is properly grounded.
- Observe all terminal ratings. To prevent fire or electric shock hazards, please pay attention to all ratings and markings of this product. Before connecting this product, please read this user manual for further information on the rated values.
- Do not operate when a malfunction is suspected. If you suspect that this product is damaged, please contact our maintenance personnel and do not continue to operate it.
- Do not operate in humid environments.
- Do not operate in explosive environments.
- Keep the product surface clean and dry.

Safety Precautions

The product manufacturer has ensured complete safety under correct usage conditions when designing this product.

- Please carefully follow the safety guidelines in this manual to avoid personal injury or damage to the instrument.
- Be sure to operate and use the instrument according to the instructions in this manual.
- This instrument does not contain hazardous substances.
- Instrument maintenance must be performed by qualified technicians only.

A. Panel Instructions

1. Front Panel

The front panel features four LED indicators:

- State: Single green indicator. The light is on when the device is functioning normally, and off when abnormal.
- Lock: Single green indicator. When the device enters the locked state, the lock indicator remains on; otherwise, it stays off.
- Time: Single green indicator. After the device synchronizes with the external reference time, the time indicator flashes green; otherwise, it remains off.
- Power: Single green indicator. The green light remains on when the device is powered on; otherwise, it stays off.

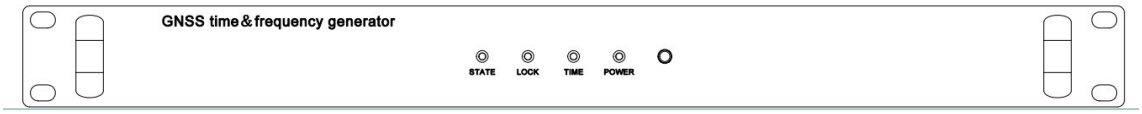


Figure 1: Front Panel Diagram

2. Rear Panel

The rear panel of the 5100 GNSS time frequency generator host includes the following connectors: Grounding Post, Power Switch, AC Power Input, GNSS Antenna Input Interface (x1), 1PPS Input Interface (x1), 1PPS Output Interface (x2), 10 MHz Output Interface (x2), IRIG-B Code Output Interface (x1), TOD Interface (x1), NTP Network Timing Output Interface (x1), and Monitoring Network Interface (x1).

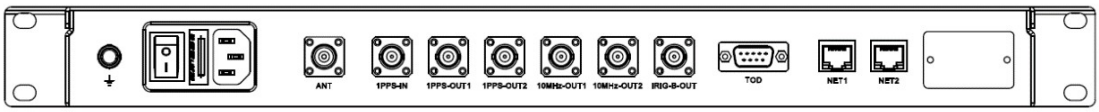


Figure 2: Rear Panel Diagram

Rear panel connector definitions are listed in the following table:

No.	Connector	Signal	Type	Pin	Signal	Direction	Note
1	Antenna	RF signal	TNC	Core	RF_SIG	Input	
1				Shell	GND		
2	1PPS-IN	TTL	BNC	Core	1PPS-IN	Input	
2				Shell	GND		
3	1PPS-OUT1/2	TTL	BNC	Core	1PPS-OUT	Output	x2
3				Shell	GND		
4	10MHz-OUT1/2	Sine	BNC	Core	10MHz	Output	x2
4				Shell	GND		
5	IRIG-B	Sine	BNC	Core	IRIG-B	Output	
5				Shell	GND		
6	TOD	RS232	DB9	Pin 2	RX	In/Out	
6				Pin 3	TX		
6				Pin 5	GND		
6				Shell	GND		
7	NTP	Gigabit	RJ45	-	-	Bidirectional	
8	Monitor	Gigabit	RJ45	-	-	Bidirectional	

B. Use and Operation

1. Device Overview

The 5100 GNSS time frequency generator features a built-in oven-controlled crystal oscillator (OCXO) and a GNSS receiver module. It receives GNSS satellite data signals through an antenna to perform frequency disciplining and local time calibration. Frequency calibration of the OCXO can also be achieved through an external 1PPS+TOD reference.

The device outputs 2 channels of 1PPS signal, 1 channel of TOD signal, 2 channels of 10 MHz frequency standard signal, 1 channel of IRIG-B time code signal, and 1 channel of network timing signal. It also provides a network management interface.

2. Startup Preheating

The 5100 contains a built-in oven-controlled crystal oscillator. After the device is powered on, the system allocates a 10-minute preheating period to ensure that the physical components of the OCXO have reached stable operating conditions before frequency disciplining can begin.

3. Working Status

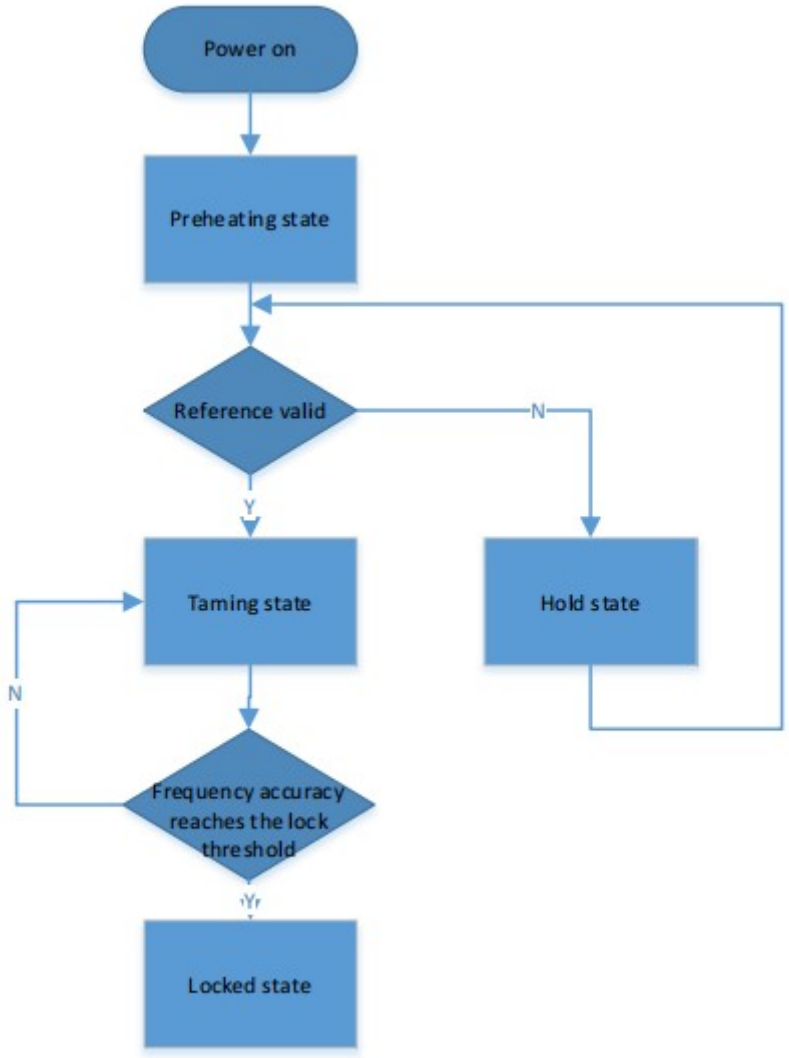
As shown in the workflow below, the device enters a preheating state by default after being powered on. During this period, the device performs only time calibration with an external reference and does not adjust the internal frequency source.

After the preheating period, if a valid reference is available, the device enters the frequency disciplining state. When the accuracy of the internal frequency source reaches the lock threshold, it transitions to the locked state.

After preheating, if all references are invalid, the device enters the holdover state.

Condition	State	Description
Power On	Preheating	Time calibration only; frequency disciplining not active
Preheating + Valid ref	Disciplining	Internal frequency source being adjusted to reference
Preheating + Invalid ref	Holdover	Using stored calibration parameters
Freq accuracy in threshold	Locked	OCXO locked to external reference

Table 1: Working Status Flowchart



Work status flowchart

4. Reference Source Selection

The device can receive two types of references for time and frequency calibration: GNSS satellite signal and network interface second-difference information. The satellite signal can be configured to use GPS, GLONASS, Galileo, or BDS independently, or in any combination of two, three, or all four.

The device supports two reference source selection modes: automatic and manual. In automatic mode, the default priority order for reference source selection is: satellite signal > 1PPS+TOD signal. In manual mode, users can select the desired reference source. When selecting manually, ensure that the reference signal is properly connected before the operation.

5. Operation Instructions

5.1 SNMP Operation

5.1.1 Opening the Software

Open the SNMP test software MibBrowser by double-clicking browser.bat in the software directory.

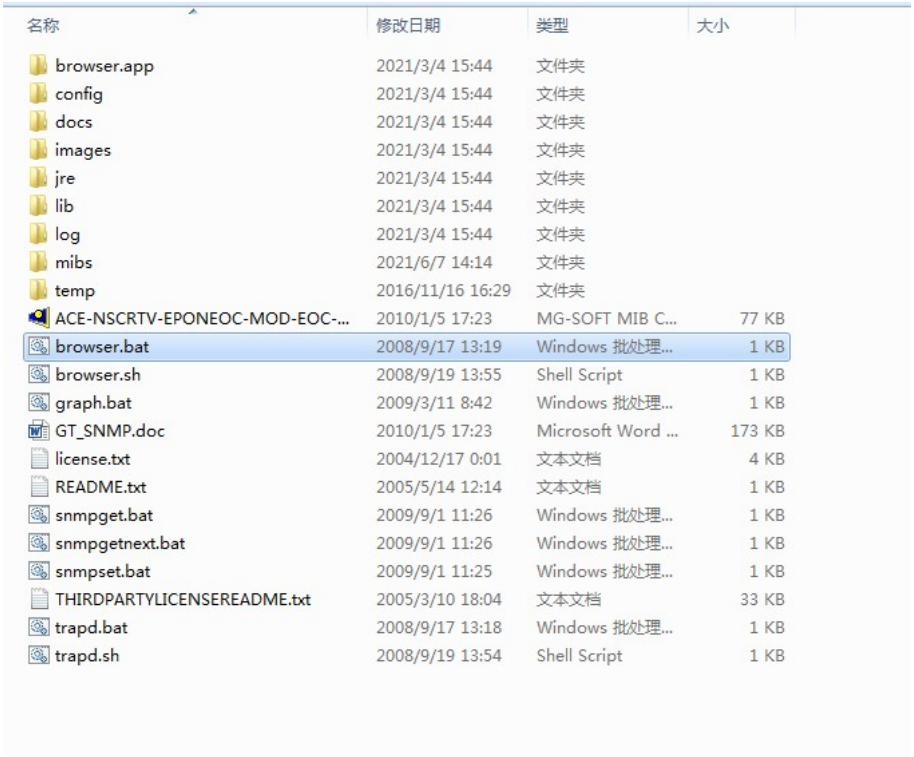


Figure 3: SNMP Software Directory

5.1.2 Loading MIB Files

Click File -> Load MIBs. In the dialog box that appears, select the 5100.my file and click Open to load the MIB file.

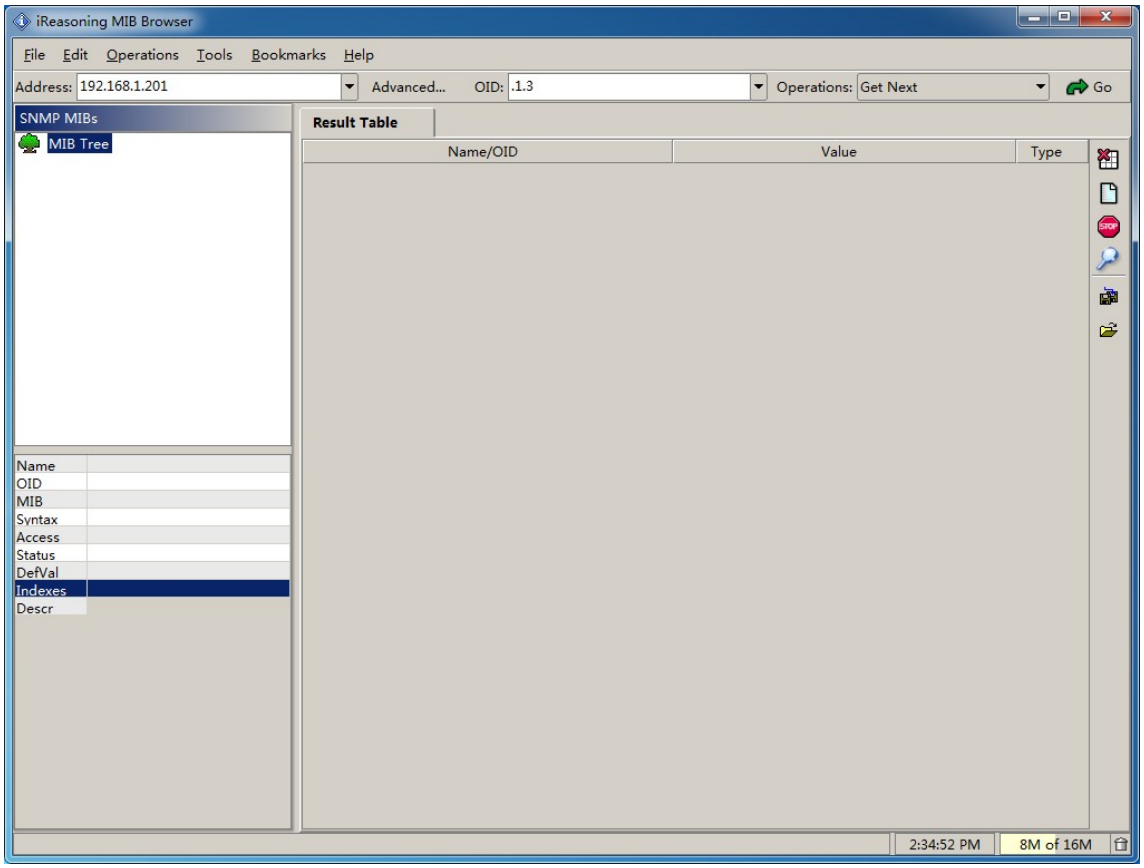


Figure 4: MIB Browser Main Interface

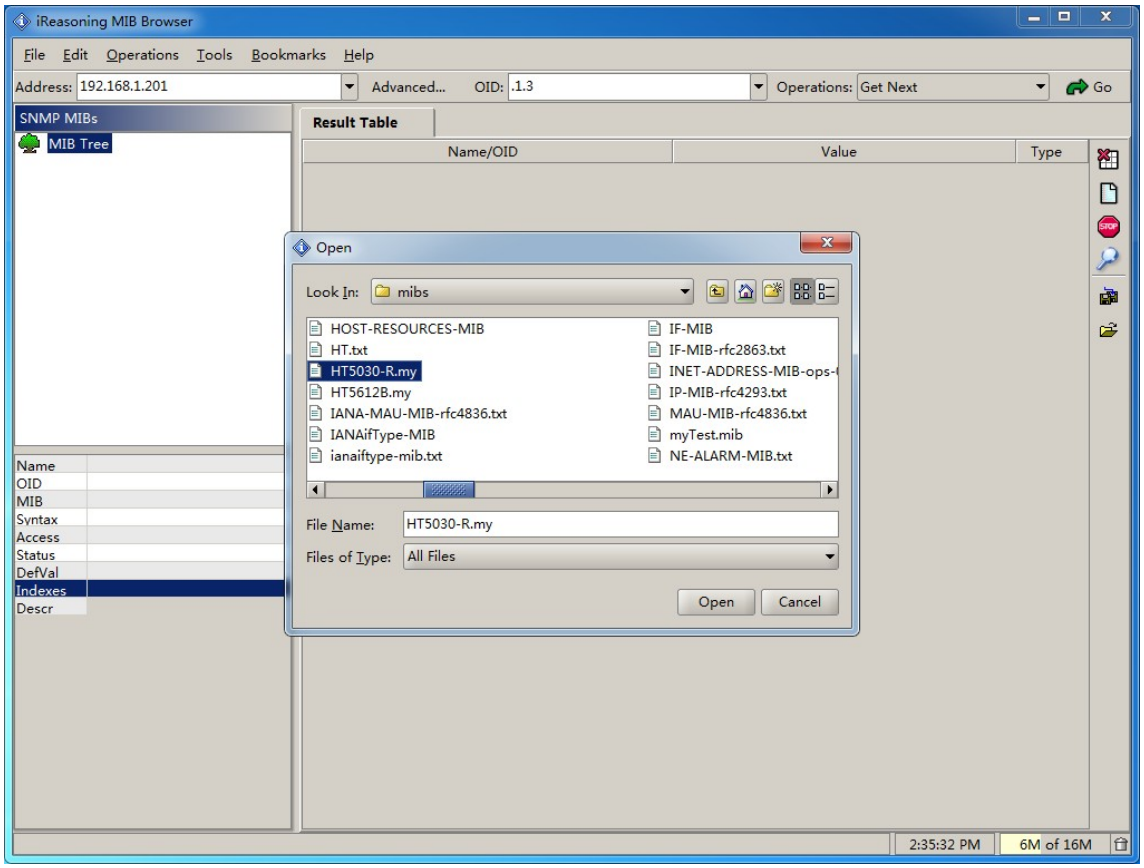
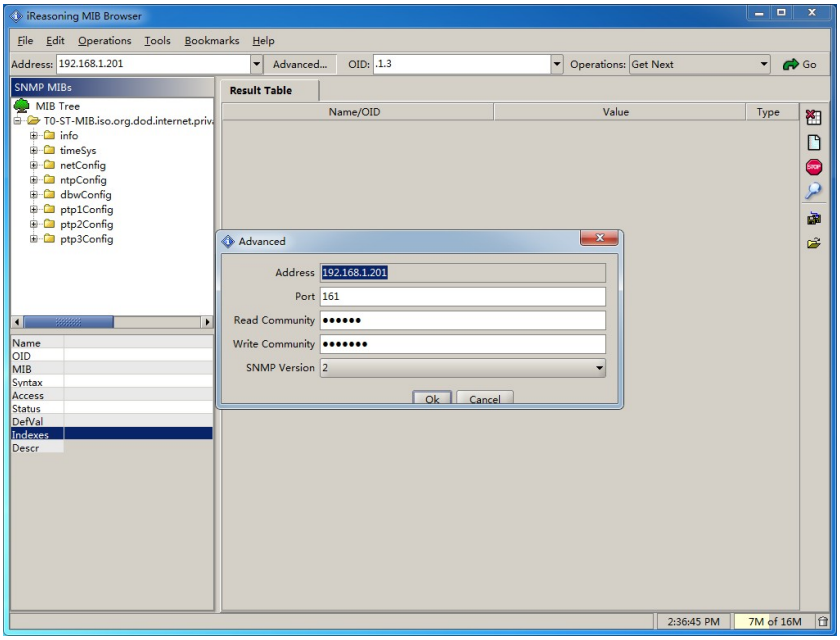


Figure 5: Loading the MIB File

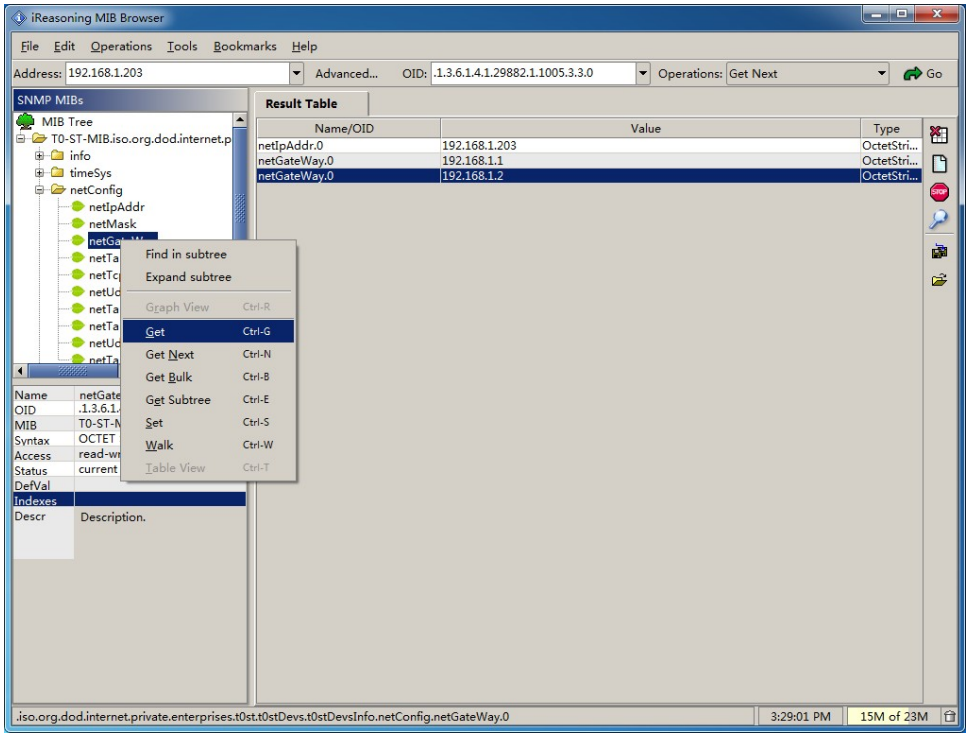
5.1.3 Software Configuration

Enter the device's SNMP network port IP address in the Address field. Click Advanced, set Read Community and Write Community to "public" and "private" respectively, select SNMP Version 2, and click OK to complete the configuration.

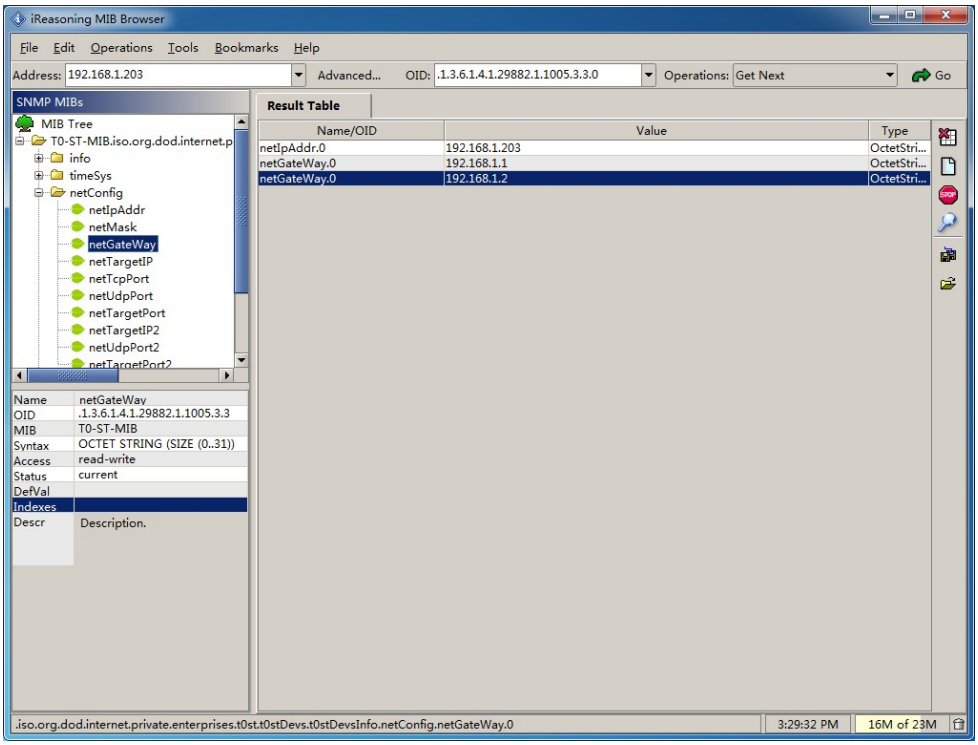


5.1.4 Obtaining Status and Settings

To check the read and write functions of SNMP on the device, click on netConfig, right-click on the netGateWay node, and select Get in the pop-up dialog to obtain the node value.

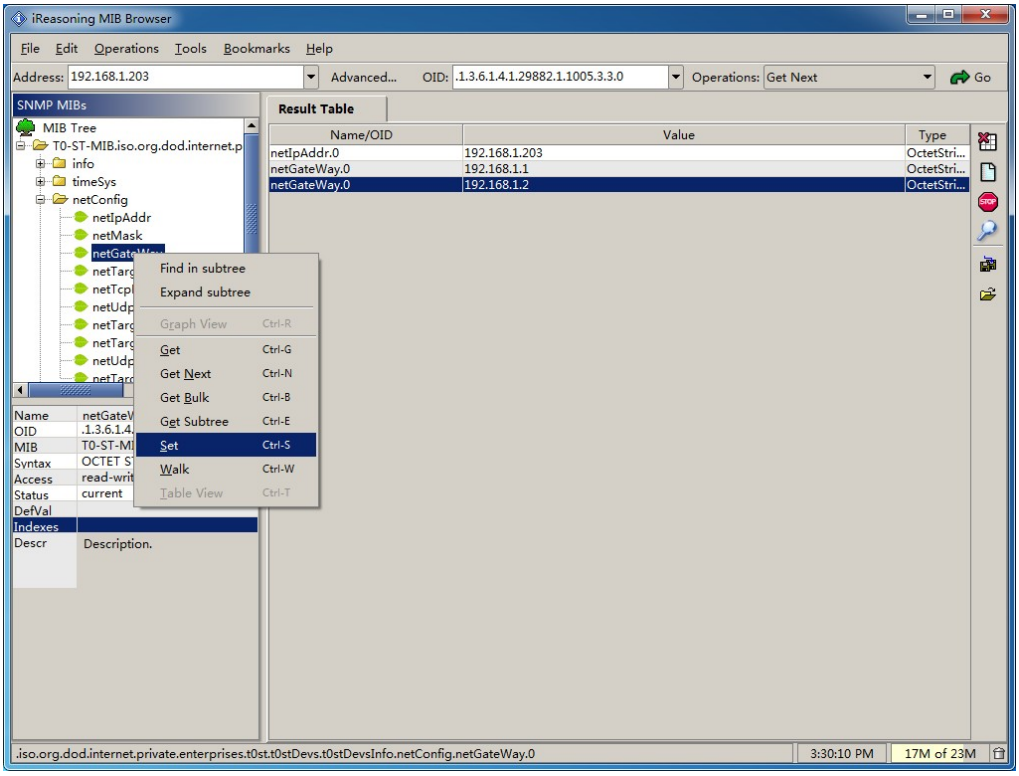


SNMP Status acquisition diagram 1

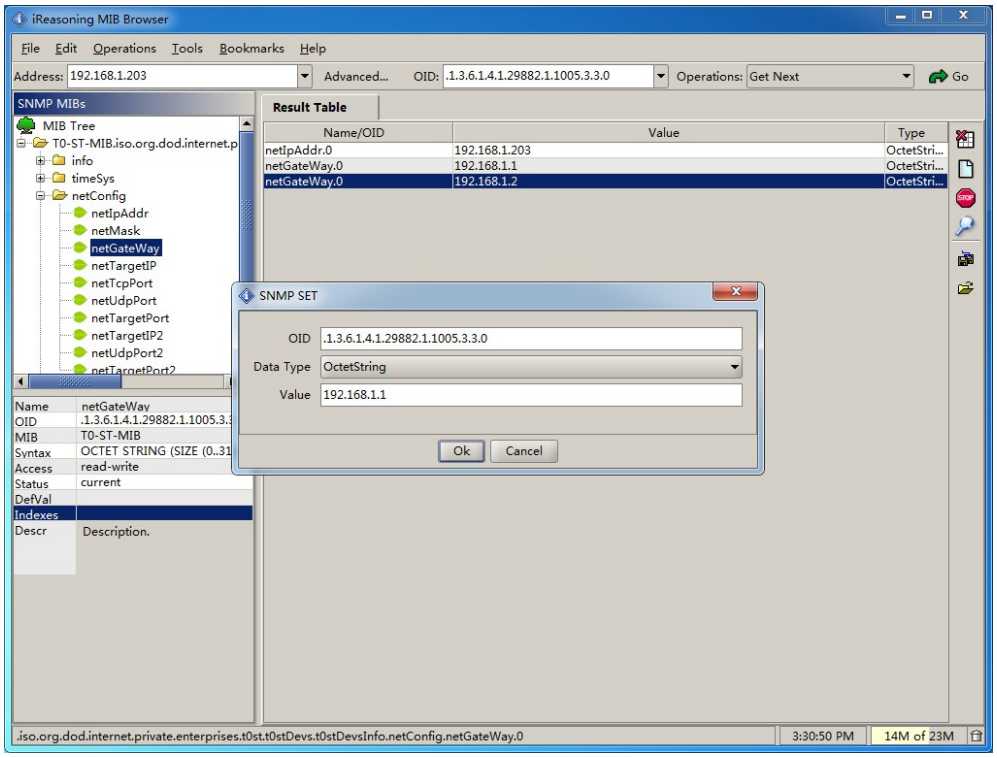


SNMP Status acquisition diagram 2

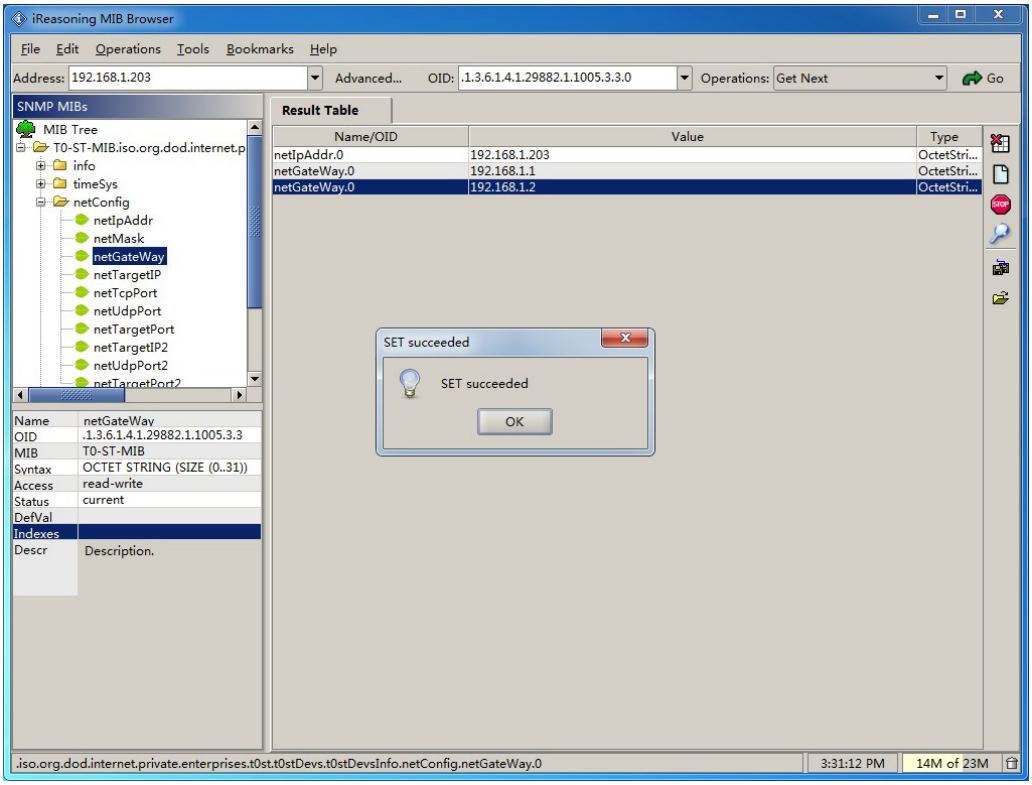
To verify the read and write functions, right-click on the netGateWay node and select Set in the pop-up dialog to set the node value.



SNMP Status acquisition diagram 1

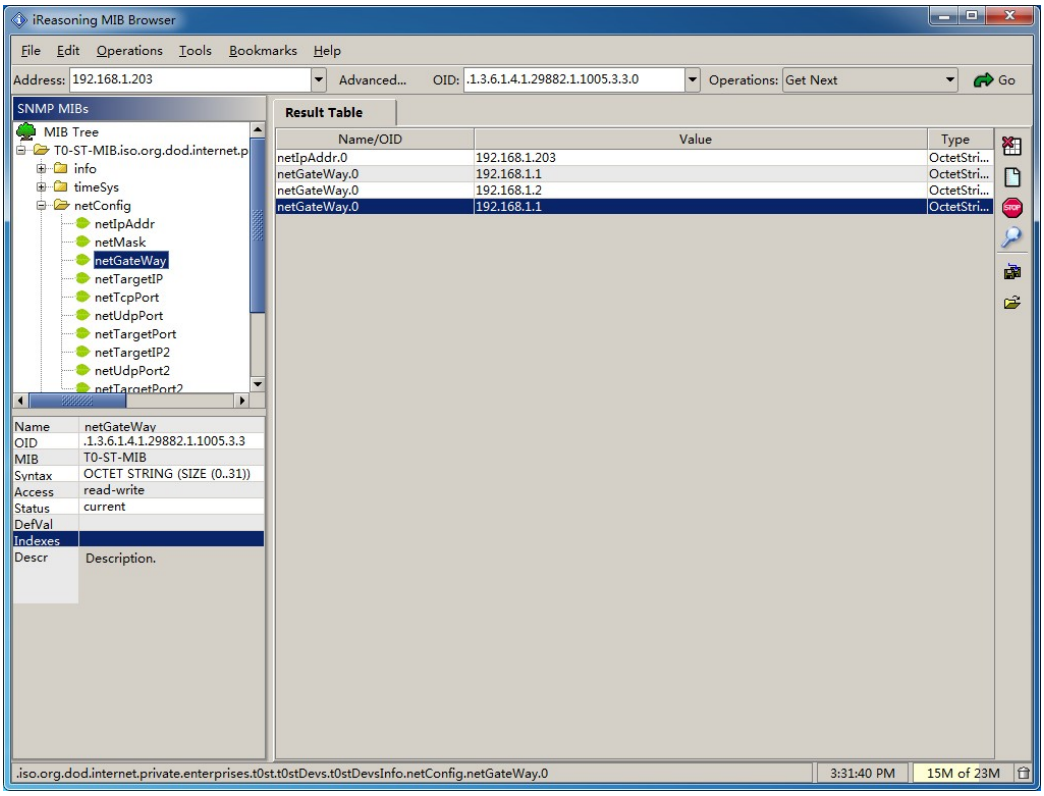


SNMP Status acquisition diagram 2



SNMP Status acquisition diagram 3

To verify if the setting was successful, right-click on the netGateWay node and select Get to retrieve the node value again.



SNMP Status acquisition diagram 4

5.1.5 Other Node Settings

Similar to Step 5.1.4 above, specific node operations can be performed according to the protocol definitions. Note that some nodes are read-only, some are write-only, and some are readable and writable.

5.2 SNMP Protocol Definition

a) BDS/Time System Information Management

Info OID: .1.3.6.1.4.1.29882.1.1005.1.x

No.	Name	Definition	Format	Length	R/W	Description
1	productDate	Factory date	OCTET STR	0-32 B	R	
2	serialNumber	Serial number	INTEGER	4 B	R/W	
3	bdState	BDS status	INTEGER	4 B	R	0: Invalid, 1: Valid

No.	Name	Definition	Format	Length	R/W	Description
4	lockSatNumber	Locked sats	INTEGER	4 B	R	Number of locked satellites
5	lon	Longitude	OCTET STR	0-32 B	R	Format: dddff.xxxxxx E
6	lat	Latitude	OCTET STR	0-32 B	R	Format: ddff.xxxxxx N
7	alt	Altitude	OCTET STR	0-32 B	R	Unit: meters
8	utcDate	UTC date	OCTET STR	0-32 B	R	Example: 2016:06:26
9	utcTime	UTC time	OCTET STR	0-32 B	R	Example: 13:12:34
10	AntSta	Antenna status	INTEGER	4 B	R	0: Invalid, 1: Valid

timeSys OID: .1.3.6.1.4.1.29882.1.1005.2.x

No.	Name	Definition	Format	Length	R/W	Description
1	zone	Time zone	INTEGER	4 B	R/W	Range: -12 to +12
2	leapFlag	Leap second	INTEGER	4 B	R/W	0: None, 1: +, 2: -
3	timing	Timing mode	INTEGER	4 B	R/W	0: Auto, 1: Manual
4	timingThreshold	Threshold	INTEGER	4 B	R/W	Range: 0-100s
5	pllMode	PLL mode	INTEGER	4 B	R/W	0: Discipline, 1: Free run
6	pllSta	PLL state	INTEGER	4 B	R	1: Disc, 2: Hold, 3: Preheat, 4: Lock
7	rubClock	Clock status	INTEGER	4 B	R	0: Unlocked, 1: Locked
8	timeValid	Time validity	INTEGER	4 B	R	0: Invalid, 1: Valid
9	refMode	Reference mode	INTEGER	4 B	R/W	0: Auto, 1: Manual
10	ref	Current ref	INTEGER	4 B	R/W	0: Inv, 1: GNSS, 2: 1PPS+TOD
11	refSta	Reference status	OCTET STR	0-32 B	R	Reserved/GNSS/1PPS+TOD
12	phaseDiff	Phase diff	INTEGER	4 B	R	Unit: ns
13	freqAccuracy	Freq accuracy	OCTET STR	0-32 B	R	Example: +1.3E-12
14	daValue	VCO value	INTEGER	4 B	R	0-65536 (0-5V)

No.	Name	Definition	Format	Length	R/W	Description
15	phaseShift	Phase shift	INTEGER	4 B	R/W	Unit: 1ns
16	pulseWidth	Pulse width	INTEGER	4 B	R/W	10000-500000000 ns
17	singleSync	Single sync	INTEGER	4 B	W	1: Valid
18	setClock	Clock setting	OCTET STR	0-32 B	W	yyyymmddhhmmss
19	temperature	Temperature	INTEGER	4 B	R	Unit: Celsius
20	b_code_delay	B-code delay	INTEGER	4 B	R/W	Unit: 1ns
21	recv_mode	Receiver mode	INTEGER	4 B	R/W	Bit 0-3: BDS/GPS/GLO/GAL; 0: enable, 1: disable
22	b_ac_ratio	B-code ratio	INTEGER	4 B	R/W	2-6: 1:2~1:6
23	b_ac_AM	B-code amplitude	INTEGER	4 B	R/W	1-20, unit: 0.5V (0.5-10V)

b) Network Management - Target IP and Port

netConfig OID: .1.3.6.1.4.1.29882.1.1005.3.x

No.	Name	Definition	Format	Length	R/W	Description
1	netTargetIP	Target IP	OCTET STR	32 B	R/W	Null-terminated string
2	netTcpPort	TCP port	INTEGER	4 B	R/W	Default: 2000
3	netUdpPort	UDP port	INTEGER	4 B	R/W	Default: 3000
4	netTargetPort	Target port	INTEGER	4 B	R/W	Default: 3001

c) Network Port 1 Management

net1Config OID: .1.3.6.1.4.1.29882.1.1005.4.x

No.	Name	Definition	Format	Length	R/W	Description
1	net1IPAddr	IP address	OCTET STR	32 B	R/W	Null-terminated string
2	net1Mask	Subnet mask	OCTET STR	32 B	R/W	Null-terminated string
3	net1GateWay	Default gateway	OCTET STR	32 B	R/W	Null-terminated string

d) Network Port 2 Management

net2Config OID: .1.3.6.1.4.1.29882.1.1005.5.x

No.	Name	Definition	Format	Length	R/W	Description
1	net2IPAddr	IP address	OCTET STR	32 B	R/W	Null-terminated string
2	net2Mask	Subnet mask	OCTET STR	32 B	R/W	Null-terminated string
3	net2GateWay	Default gateway	OCTET STR	32 B	R/W	Null-terminated string

5.3 WEB Operation

Through the device's network monitoring port, you can log in using a web browser to view and configure device status and settings.

5.3.1 Login

After the device is powered on, connect the monitoring network port to your computer. Open a web browser, enter the device IP address, and input the username "admin" and password "123456".

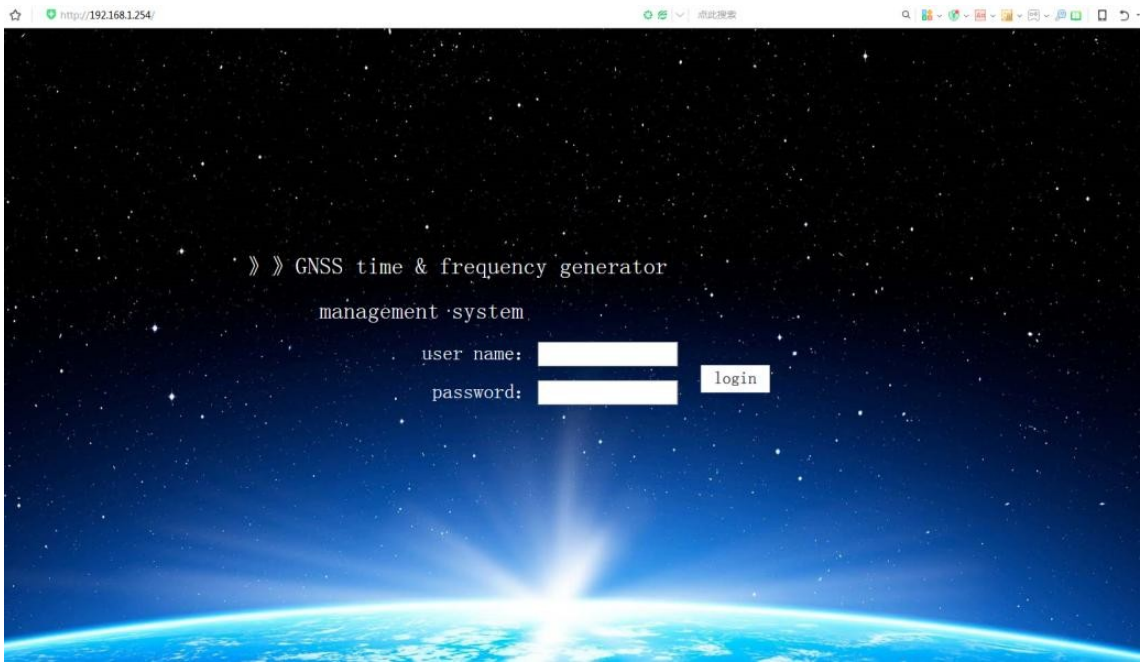


Figure 6: WEB Login Interface

5.3.2 Work Status Menu

Click the "Device Monitor" menu on the left side of the page to view and configure device operating status information.

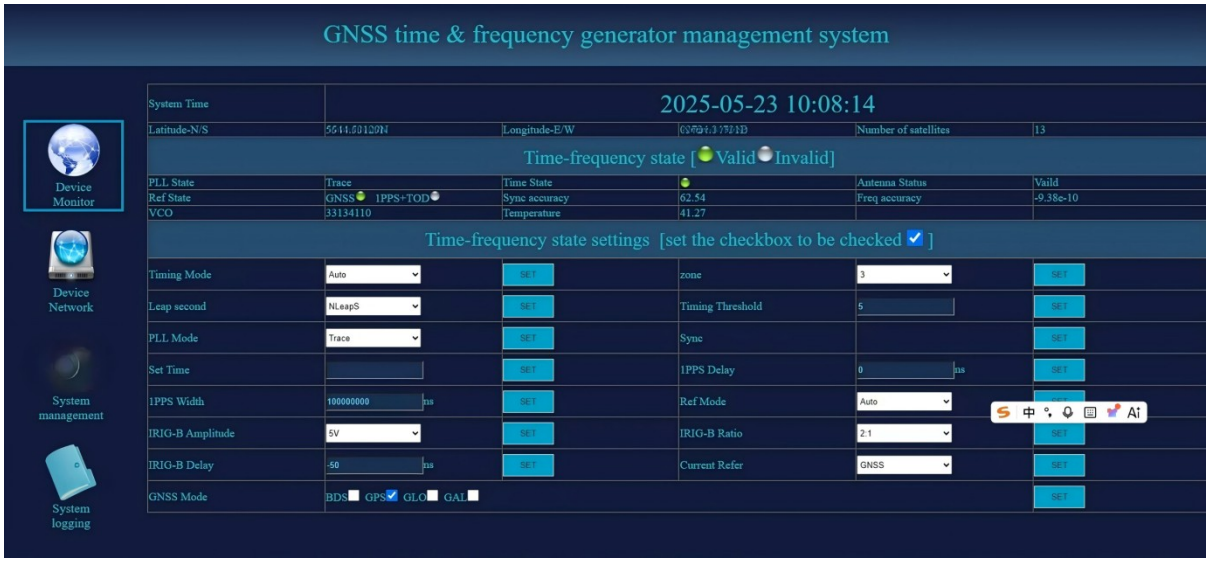


Figure 7: Work Status Menu

5.3.3 Network Settings Menu

Click the "Device Network" menu on the left side of the page to view and configure network port information.

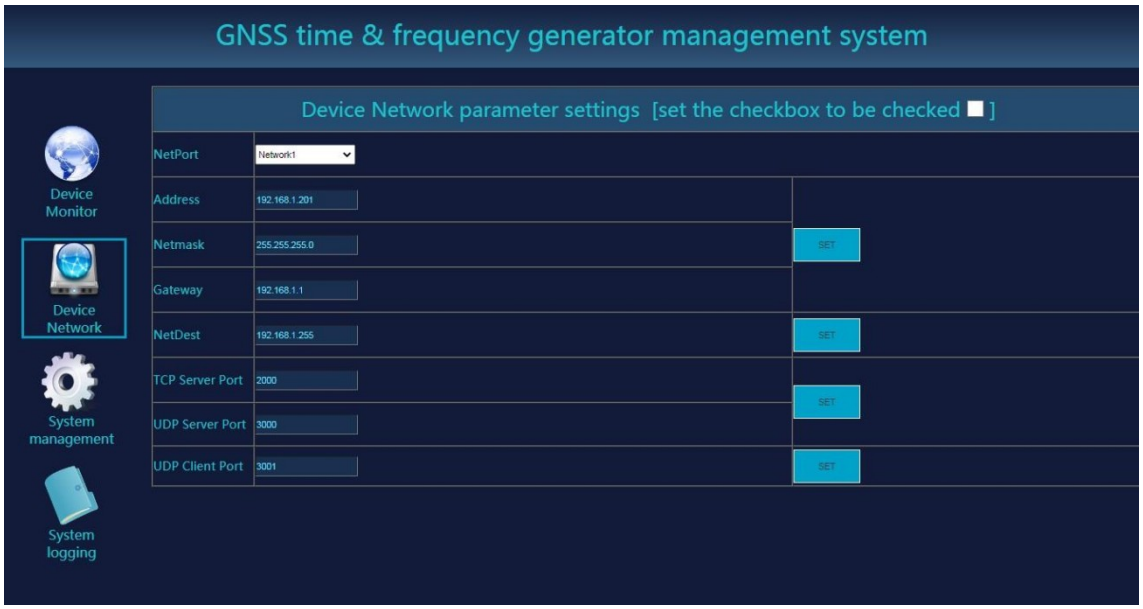


Figure 8: Network Settings Menu

5.3.4 System Management Menu

Click the "System Management" menu on the left side of the page to view device version information and perform remote firmware upgrades.

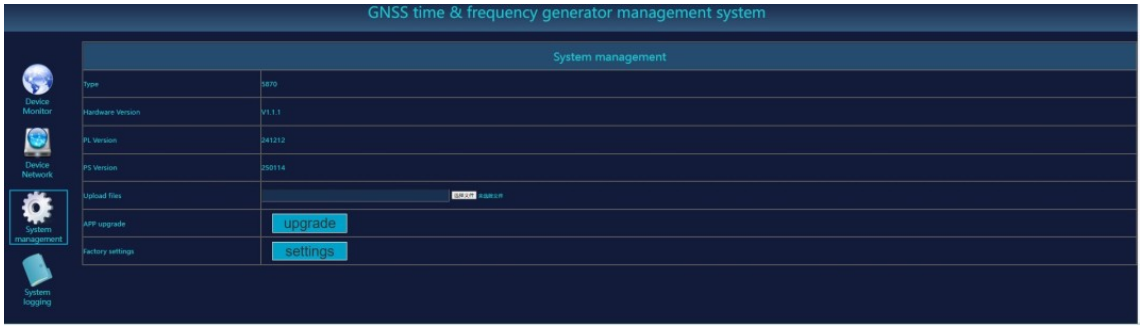


Figure 9: System Management Menu

5.3.5 Log Menu

Click the "System Logging" menu on the left side of the page to view operation log information.

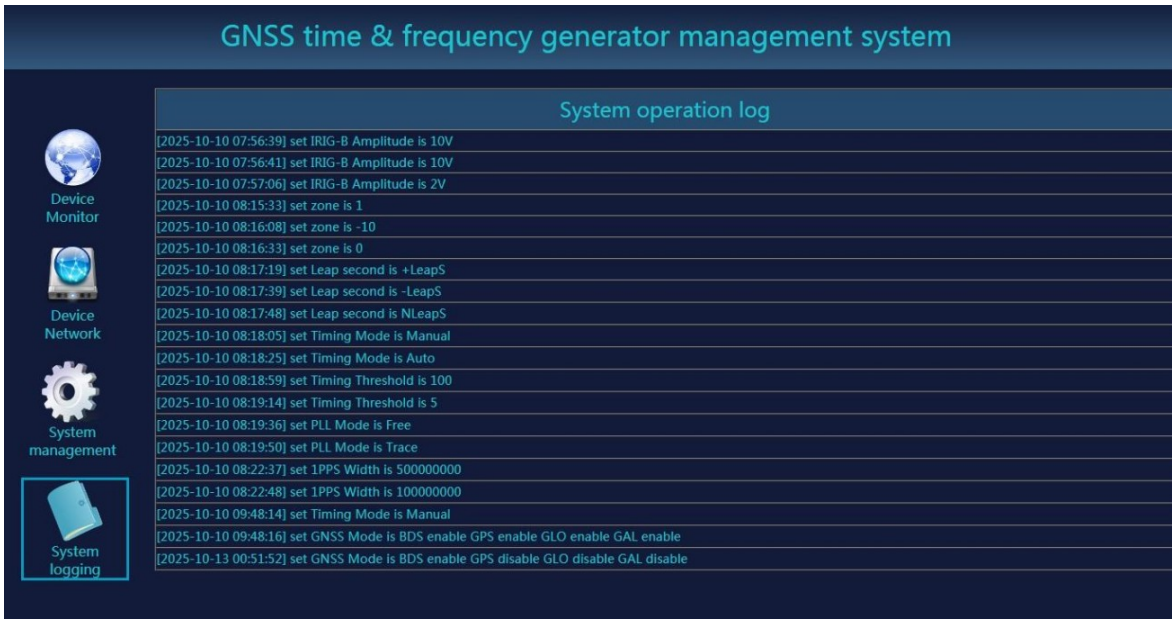


Figure 10: System Log Menu

6. Routine Operating Procedures

Preparation Before Power-On

1. Remove the instrument from the packaging box and place it on a flat operating table or rack.
2. Connect the grounding post of this unit securely to the power system ground.
3. Connect the power cord securely to the local power input interface. Turn on the power switch on the front panel and use a multimeter to measure the static resistance between the live wire and ground wire, and between the neutral wire and ground wire of the power cord plug. An open-circuit state is considered normal. Then turn off the power switch.

Power-On Procedure

1. Connect the power cord securely to the power outlet and turn on the device power switch. Observe whether the power indicator on the front panel is normal.
2. After the device completes its self-test, the "Status" indicator should be green and steadily lit.

C. Maintenance and Troubleshooting

1. Daily Maintenance

During daily use, handle the device with care to avoid vibration and impact while powered on. Ensure good grounding at all times and verify that the power supply is functioning properly. Regularly clean and maintain the exterior of the instrument.

2. General Fault Handling

- Device cannot be powered on: Check whether the power cord is properly connected. When using AC power, verify that the external power supply is functioning properly.
- Abnormal satellite acquisition: Check whether the antenna of the host device is in good contact, and ensure that the antenna installation location has a clear view of the sky.

D. Transportation and Storage

The product is packed and transported in a special packing box with anti-vibration soft foam lining. The product should not move inside the packaging box to ensure it is not damaged during transportation. The product should be placed horizontally during transportation and must not be exposed to rain.

The warehouse where products are stored should have good ventilation and maintain a dry environment. There should be no acidic or corrosive gases indoors, and no strong mechanical vibration.

E. Communication Protocol

The output protocol can be transmitted through the network and control serial port. The network communication protocol supports both TCP and UDP formats.

1. Output Protocol

1.1 Network Status Protocol

```
Format: $HTN,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>*xx\r\n
Example: $HTN,1,0,192.168.1.126,255.255.255.0,192.168.1.1,192.168.1.210,3000,2000
,2001*xx\r\n
```

Field	Definition	Description
$HTN	Frame header	Network status frame
,	Delimiter	Comma separator
<1>	Module number	1: NET1 (NTP/PTP/SNMP); 2: NET2 (NTP/PTP)
<2>	Info type	Variable length
<3>	IP address	Example: 192.168.1.126
<4>	Subnet mask	Example: 255.255.255.0 (check PTP status)
<5>	Default gateway	Example: 192.168.1.1 (check PTP status)
<6>	Target address	Example: 192.168.1.210
<7>	TCP port	Example: 3000
<8>	UDP port	Example: 2000
<9>	UDP target port	Example: 2001
*	Delimiter	Asterisk separator

Field	Definition	Description
xx	Checksum	XOR of all data between $ and *
\r\n	Frame end	CRLF terminator

1.2 Version Information

```
Format: $HTV,<1>,<2>,<3>,<4>*xx\r\n
Example: $HTV,5100,1.1.1,241129,241129*7F\r\n
```

Field	Definition	Description
$HTV	Frame header	Version information frame
<1>	Type	Model number (e.g., 5100)
<2>	Hardware version	e.g., 1.1.1
<3>	PL version	e.g., 241129
<4>	PS version	e.g., 241129
*	Delimiter	Asterisk separator
xx	Checksum	XOR of all data between $ and *

1.3 System Working Status Output

```
Format: $HTF,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>,<1
5>,<16>,<17>,<18>,<19>,<20>,<21>,<22>*xx\r\n
Example: $HTF
```

Field	Definition	Description
$HTF	Frame header	System working status
<1>	Time zone	Variable length, e.g., 8 = UTC+8
<2>	Leap second	0: None, 1: Positive, 2: Negative
<3>	Timing mode	0: Auto, 1: Manual
<4>	Time threshold	0-100 (seconds)
<5>	PLL mode	0: Discipline, 1: Free run
<6>	PLL state	1: Discipline, 2: Hold, 3: Preheat, 4: Lock
<7>	Reserved	NC
<8>	Time status	0: Invalid, 1: Valid
<9>	Reference mode	0: Auto, 1: Manual
<10>	Current reference	0: Invalid, 1: GNSS, 2: 1PPS+TOD

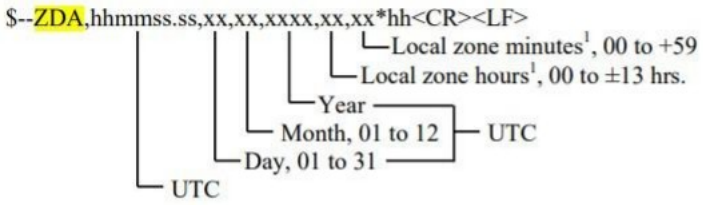
Field	Definition	Description
<11>	Reference state	6 chars: Reserved/GNSS/1PPS+TOD
<12>	Sync accuracy	Unit: ns (e.g., 100 = 100ns)
<13>	Frequency accuracy	8 chars (e.g., +/-1.0E-12)
<14>	VCO value	VCO control voltage
<15>	1PPS delay	Reserved, unit: 1ns
<16>	1PPS width	10000-500000000 ns
<17>	Temperature	Range: -25 to +100 C
<18>	IRIG-B delay	Unit: 1ns
<19>	GNSS mode	Bit 0-3: BDS, GPS, GLO, GAL
<20>	IRIG-B Ratio	2-6: 1:2~1:6
<21>	IRIG-B Amplitude	1-20, unit: 0.5V (0.5-10V)
<22>	Antenna status	0: Invalid, 1: Normal, 2: Fault

1.4 Receiver Protocol

The receiver output protocol complies with the NMEA 0183 standard. The device defaults to outputting three message types: GGA, ZDA, and RMC.

ZDA – Time & Date

UTC, day, month, year and local time zone.



Notes:

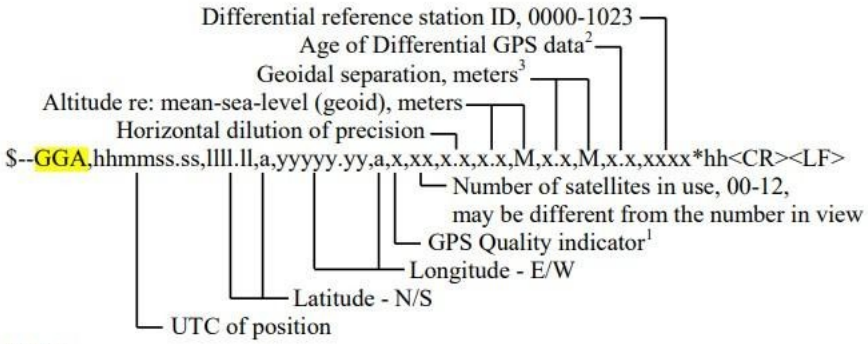
1) Local time zone is the magnitude of hours plus the magnitude of minutes added, with the sign of local zone hours, to local time to obtain UTC. Local zone is generally negative for East longitudes with local exceptions near the International Date Line.

For Example: At Chatham Is. (New Zealand) at 1230 (noon) local time on June 10, 1995 :
$GPZDA,234500,09,06,1995,-12,45*6C<CR><LF>

In the Cook Islands at 1500 local time on June 10, 1995:
$GPZDA,013000,11,06,1995,10,30*4A<CR><LF>

GGA – Global Positioning System Fix Data

Time, position and fix related data for a GPS receiver.



Notes:

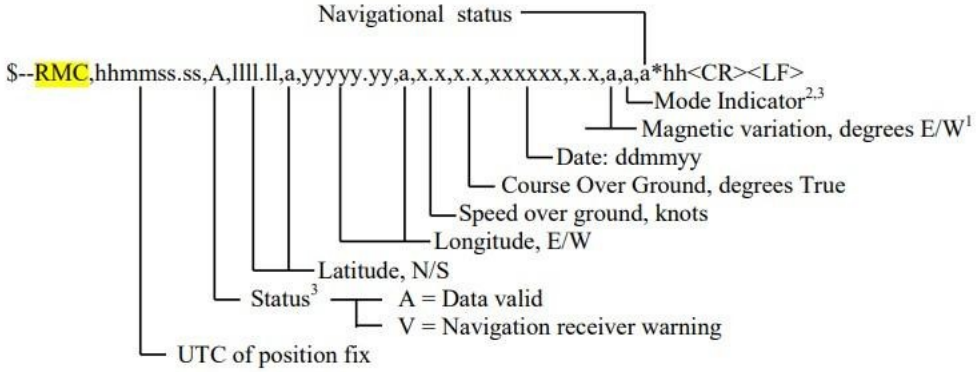
1) GPS Quality Indicator: All GPS quality indicators in heading 1-5 are considered valid. The GPS quality indicator filed shall not be a null field
   - 0 = Fix not available or invalid
   - 1 = GPS SPS Mode, fix valid
   - 2 = Differential GPS, SPS Mode, fix valid
   - 3 = GPS PPS Mode, fix valid
   - 4 = Real Time Kinematic. System used in RTK mode with fixed integers
   - 5 = Float RTK. Satellite system used in RTK mode, floating integers
   - 6 = Estimated (dead reckoning) Mode
   - 7 = Manual Input Mode
   - 8 = Simulator Mode

   The GPS Quality Indicator field shall not be a null field.

RMC – Recommended Minimum Specific GNSS Data

Time, date, position, course and speed data provided by a GNSS navigation receiver. This sentence is transmitted at intervals not exceeding 2-seconds and is always accompanied by RMB when a destination waypoint is active.

RMC and RMB are the recommended minimum data to be provided by a GNSS receiver. All data fields must be provided, null fields used only when data is temporarily unavailable.



1.5 ZDA Time Information

```
Format: $HTZDA,<1>,<2>,<3>,<4>,<5>,<6>*xx\r\n

Example: $HTZDA,073216.00,26,03,2021,00,01*xx\r\n
```

Field	Definition	Description

Field	Definition	Description
$HTZDA	Frame header	ZDA time message (UTC)
<1>	hhmmss.ss	hh: hour; mm: minute; ss: second
<2>	dd	Day
<3>	mm	Month
<4>	yyyy	Year
<5>	00	Reserved
<6>	00/01	00: Invalid, 01: Valid
*	Delimiter	Asterisk separator
xx	Checksum	XOR of all data between $ and *

2. Control Protocol

The control protocol can be sent to the module through the network and control serial port. The network communication protocol supports both TCP and UDP formats.

2.1 Network Status Settings

```
Format: $HTSETN,<1>,<2>,<3>*xx\r\n
Example: $HTSETN,1,2,192.168.1.210*xx\r\n
```

Field	Definition	Description
$HTSETN	Frame header	Network status setting
<1>	Module number	1: NET1; 2: NET2
<2>	Setup command	Variable length command code
<3>	Parameter	Target address / port number
*	Delimiter	Asterisk separator
xx	Checksum	XOR of all data between $ and *

2.2 System Parameter Settings

```
Format: $HTSETF,<1>,<2>,<3>*xx\r\n
```

Cmd	Info ID	Function	Parameter
$HTSETF	01	Timing mode	0: Auto, 1: Manual
$HTSETF	02	Time zone	+/-xx (default: 0)
$HTSETF	03	Leap second	0: None, 1: +, 2: -

Cmd	Info ID	Function	Parameter
$HTSETF	04	Threshold	0-100 (seconds)
$HTSETF	05	PLL mode	0: Discipline, 1: Free run
$HTSETF	06	Single sync	1: Valid, other: Invalid
$HTSETF	07	Clock setting	yyyymmddhhmmss
$HTSETF	08	Phase shift	Variable length, +/-500ms
$HTSETF	09	Pulse width	10000-500000000 ns
$HTSETF	10	Reference mode	0: Auto, 1: Manual
$HTSETF	12	IRIG-B Ratio	2-6: 1:2~1:6
$HTSETF	13	IRIG-B Amplitude	1-20, unit: 0.5V (0.5-10V)
$HTSETF	16	Reference source	1: GNSS, 2: 1PPS+TOD
$HTSETF	26	Reset	1: Reset to factory defaults
$HTSETF	28	B-code delay	Variable length (ns)
$HTSETF	50	Receiver mode	Bit 0-3: BDS/GPS/GLO/GAL; 0: en, 1: dis

3. Verification Calculation Method

The communication protocol uses ASCII code format. XOR checksum is used for verification. The following provides a detailed description of the checksum calculation method with examples.

The checksum consists of two bytes and is the XOR sum of all data between the '$' and '*' characters, excluding the '$' and '*' characters themselves.

Example: Sending the ASCII command '$MZMSG,1,20240819,120130,200030,52100,,,,,*4D\r\n'

Step 1. Gather all data between '$' and '*'. Convert 'MZMSG,1,20240819,120130,200030,52100,,,,,' to hexadecimal: 4D 5A 4D 53 47 2C 31 2C 32 30 34 38 31 39 2C 31 32 30 31 33 30 2C 32 30 30 30 30 33 2C 2C 2C 2C 2C

Step 2. XOR all the converted hexadecimal bytes sequentially to obtain a single byte '4D' (hexadecimal).

Step 3. Convert the hexadecimal result to two ASCII bytes, '4D' (uppercase letters required).

Step 4. The checksum xx is therefore calculated as '4D'.

Step 5. The final correct command to send is: '$MZMSG,1,20240819,120130,200030,52100,,,,,*4D\r\n'

Thank You

For Choosing Our Product

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