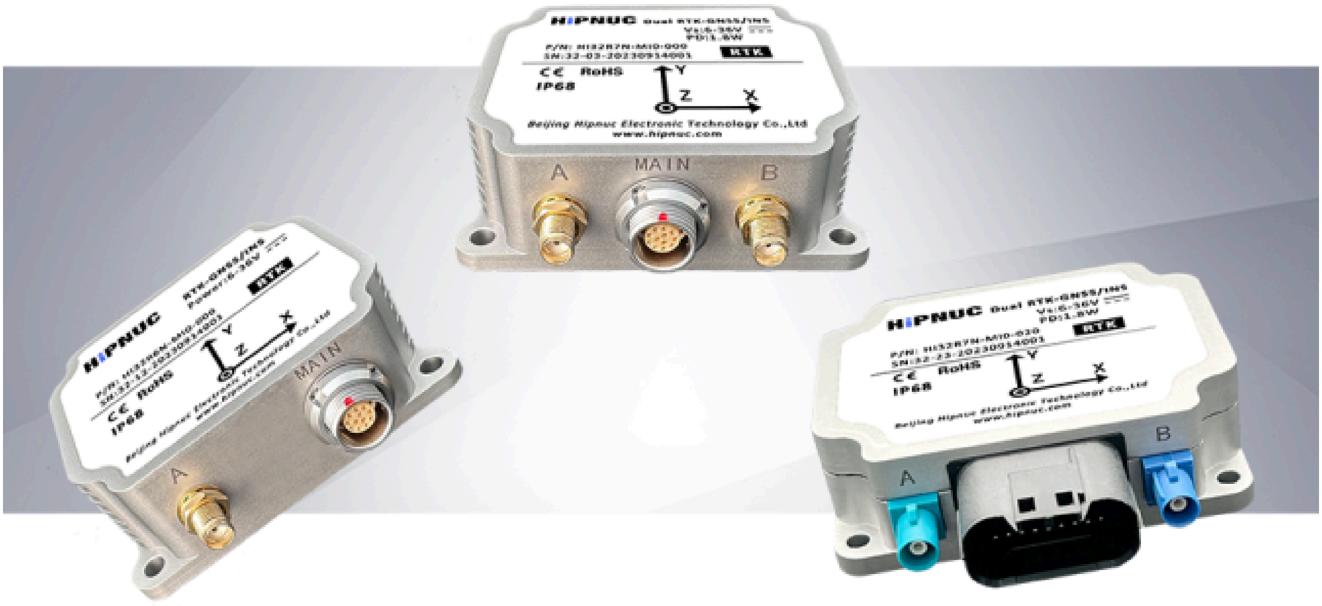
# INS Command and Programming Manual

Rev 1.0

Applicable to the CH3xx / HI30 / HI32 series




Document Revision History

| Version | Date | Author | Changes |
| --- | --- | --- | --- |
| V1.0 | Oct 1, 2023 | HiPNUC | Initial version |

# Contents

# 1. Module Configuration Commands

Module configuration uses ASCII string commands. Each command must end with a carriage return + line feed `\r\n` (similar to AT commands) before the system can recognize it.

## 1.1 Command Overview

| Command | Description |
|---|---|
| REBOOT | Reset |
| LOG | Request message output from the device |
| CONFIG | Configure the module |
| UNLOGALL | Cancel all message output |
| SAVECONFIG | Save configuration to Flash |
| SETBASELINE | Set the dual-antenna baseline length / tilt constraint, lever-arm compensation, etc.; takes effect after save + reboot. |
| SERIALCONFIG | Set the serial-port baud rate |

## 1.2 Command Reference

### 1.2.1 REBOOT

Reset and reboot, effective immediately. Equivalent to a power cycle.

### 1.2.2 LOG

1.2.2.1 ENABLE/DISABLE: turn data output on/off globally

- `LOG ENABLE` - globally enable data-frame output (default)
- `LOG DISABLE` - globally disable data-frame output

1.2.2.2 VERSION: show module version

`LOG VERSION` - print firmware version information

1.2.2.3 COMCONFIG: show serial-port configuration

`LOG COMCONFIG` - print serial port and output-protocol configuration

1.2.2.4 INSCONFIG: show integrated-navigation configuration

`LOG INSCONFIG` - show the integrated-navigation configuration, including the current kinematic model, dual-antenna parameters and the NMEA Talker ID.

```
MOTION_MODEL=CAR
ANTA=0.0,0.0,0.0
ANTB=0.0,1.0,0.0
NMEATID=GP
OK
```

#### 1.2.2.5 MSG: configure data-frame output and rate

Format: `LOG <MSG> <TYPE> <PERIOD>`

- MSG: GGA, RMC, SXT, HI81, etc.
- TYPE: ONTIME means periodic output
- PERIOD: output-frame period in seconds; allowed values: 1 (1 Hz), 0.5 (2 Hz), 0.1 (10 Hz), 0.02 (50 Hz), 0.01 (100 Hz), 0.005 (200 Hz)

Examples:

- `LOG HI81 ONTIME 0.01` - set the HI81 packet output period on the current serial port to 0.01 s (100 Hz)
- `LOG SXT ONTIME 0.05` - set the SXT packet output period on the current serial port to 0.05 s (20 Hz)
- `LOG SXT ONTIME 0` - turn off SXT packet output on the current serial port

### 1.2.3 CONFIG

Configures the module's working parameters. Most commands take effect immediately, and `SAVECONFIG` is required to persist them across power cycles.

#### 1.2.3.6 Configure the integrated-navigation kinematic model

- `CONFIG MODEL CAR` (factory default) - set the model constraint to vehicle mode. In this mode the solver applies NHC (non-holonomic constraints), which significantly reduces accumulated error in GNSS-outage scenarios such as tunnels and underground garages.
- `CONFIG MODEL SHIP` - set the model constraint to marine/ship mode, reducing accumulated error during outages on ships.
- `CONFIG MODEL PLANE` - set the model constraint to aircraft mode. This mode applies no kinematic constraint and suits airborne use.
- `CONFIG MODEL BASE` - set the module to base-station mode. After this, the module locks its own position within 60 s (position no longer changes); commonly used to build a self-hosted RTK base station. The antenna must be in a good observation environment when configuring base mode.

Use `LOG INSCONFIG` to view the current user configuration.

#### 1.2.3.7 Configure NTRIP differential account

This device can drive certain vendors' 4G DTU terminals or an Ethernet interface to provide network RTK: it automatically configures the DTU/Ethernet interface and feeds in RTK differential data. Steps:

1. Connect COM2 to the DTU. COM2 is dedicated to the DTU and uses the 4G DTU for NTRIP RTK differential.

2. The currently supported DTU model is TAS-LTE-364 (Tas 4G transparent DTU). Make sure the model is correct and that a working 4G SIM card is inserted.
3. Configure the differential account: `CONFIG NTRIP <SERVER_IP> <PORT> <MNT_POINT> <USER_NAME> <PASSWD>`, where:

- `SERVER_IP`: CORS server address, a domain name or IP.
- `PORT`: CORS server port
- `MNT_POINT`: mount point, e.g. `AUTO` for Qianxun, or `RTCM33_GRCE` for China Mobile.
- `USER_NAME`: CORS account username
- `PASSWD`: CORS account password

Example - configure a Qianxun CORS account (sample username `qxxrli003`, password `123456`):

Example: `CONFIG NTRIP rtk.ntrip.qxwz.com 8002 AUTO qxxrli003 123456`. This is saved across power cycles; configure it once.

4. Restart the module.
5. Use `LOG NTRIPCONFIG` to view the current configuration. If `DTU NAME` shows `TAS-LTExxx`, the module has established a link with the DTU (the module auto-negotiates the baud rate; an empty NAME means the DTU link failed). Note that a non-empty NAME only confirms the module-to-DTU link, not whether the DTU-to-network link is healthy.

```
DTU     NAME:  Revision: TAS-LTE-C_C4002L242_
NTRIP SERVER:  xxxxxxx.com:xxxx
NTRIP  MOUNT:  AUTO
NTRIP  UNAME:  xxxxxxx
NTRIP PASSWD:  xxxxxxx
```

6. If the RTK IP/account details are correct, RTK is typically reached within ~30 s.

Save the configuration and reboot for it to take effect.

#### 1.2.3.8 Enable the built-in SD-card data logging

Some products have an internal SD card for data logging. On each power-up a `.jog` file named after the power-up UTC time is created automatically. You can use an FTP tool (e.g. FileZilla) to view all files on the internal card.

- `CONFIG FLOG COM1 1` - enable COM1 logging; all data output on the main serial port COM1 is also copied to a log file on the SD card.
- `CONFIG FLOG COM1 0` - disable COM1 logging.

### 1.2.4 UNLOGALL

Set the output rate of all periodic messages to 0 (no output).

### 1.2.5 SAVECONFIG

Save all configuration to Flash. Usually used together with `REBOOT`, i.e. save everything then reboot to apply.

### 1.2.6 SETBASELINE

Sets antenna A's position relative to the IMU (lever-arm compensation) and the angle of the secondary (B / heading) antenna relative to antenna A, for dual-antenna installation.

**Set antenna A's position relative to the IMU (lever-arm compensation):** X, Y, Z are antenna A's position relative to the IMU in the IMU body frame, in meters.

`SETBASELINE ANTA <X,Y,Z>`

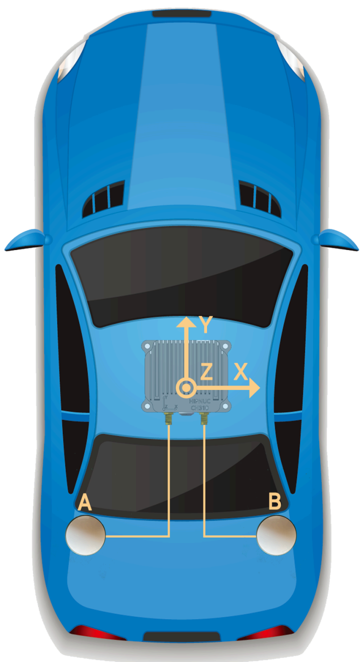
**Set the B (heading) antenna position:** like antenna A, X, Y, Z are the antenna's position relative to the IMU in the IMU body frame, in meters.

`SETBASELINE ANTB <X,Y,Z>`

Example: to set the angle between the A→B vector and the vehicle forward direction (IMU +Y axis) to 90° (clockwise positive, as shown below), where antenna A relative to the IMU is `X=-1.5,Y=-1.2,Z=-0.3` and antenna B relative to the IMU is `X=1.5,Y=-1.2,Z=-0.3`:

```
SETBASELINE ANTA -1.5,-1.2,-0.3
SETBASELINE ANTB  1.5,-1.2,-0.3
```

After installing/setting the antenna positions, power-cycle or reboot the module.



> 1. After setting antenna parameters, use `LOG INSCONFIG` to verify.
> 2. Integrated navigation also works without lever-arm compensation, but correct, valid compensation greatly improves position accuracy when turning after a GNSS outage.

### 1.2.7 SERIALCONFIG

Set the serial-port baud rate; 115200 / 460800 / 921600 are supported.

```
SERIALCONFIG <BAUD>
```

Example - set the current port to 115200: `SERIALCONFIG 115200`.

## 2. Output Data Protocol (RS232/422, Ethernet)

### 2.3 Overview

This product supports two output protocol families: ASCII and binary. ASCII messages use the NMEA format; binary messages use HiPNUC's custom binary format. The NMEA format follows NMEA 0183.

> - Output latitude/longitude is referenced to antenna A.
> - Antenna B is used only for dual-antenna heading and is unrelated to positioning.

### 2.4 Hardware Interfaces

- RS232 / RS422 / RS485: essentially all serial ports; both ends must use the same baud rate. Factory default is 115200.
- Ethernet: some products have Ethernet with an internal TCP/IP stack and DHCP client enabled by default. Connect the Ethernet port to a router LAN port on the same subnet as the PC; it obtains an IP automatically after connecting. Connect as a TCP client on default port 5944. Once connected, all commands and behavior are identical to the serial port.

### 2.5 Factory Default Output

By default this product outputs the binary HI81 protocol at 100 Hz.

### 2.6 NMEA Messages (ASCII)

The NMEA protocol starts with `$`, followed by the descriptor, ID and data fields. The data section ends with `*`, followed by a two-digit checksum and finally a carriage return + line feed (`0x0D, 0x0A`).

```
NMEA message format (ASCII structure):
$--<message-id>,<field>,<field>,...,<field>*<checksum><CR><LF>
```

| Field | Description |
| --- | --- |
| $ | Start delimiter (ASCII 0x24). Marks the beginning of a message. |
| --- | Satellite-system class, used to distinguish BeiDou / GPS / combined output.<br>BD - BeiDou<br>GP - GPS<br>GN - combined |
| message-id | Identifies the message type and function. Fixed 3-character ASCII; uppercase letters recommended. |
| , | Field delimiter (ASCII 0x2C). Separates multiple fields in a message. |
| data field | Each message can contain multiple fields separated by `,`. Unless noted otherwise, only printable ASCII is allowed in fields. Field position within a message is determined by counting the `,` delimiters. |
| * | Checksum delimiter, between the data content and the checksum field. |
| checksum | The checksum is the byte-wise XOR of all characters between `$` and `*` (exclusive). The high and low nibbles are each expressed as a hex ASCII character (0-9, A-F), high nibble first. |
| `<CR>` `<LF>` | Terminator (ASCII 0x0D, 0x0A). Marks the end of a message. |

### 2.6.8 NMEA Message List

| NMEA | Description | Source |
| --- | --- | --- |
| GGA | Fix data, RTC time, fix quality, satellites in view | GNSS only |
| RMC | Recommended minimum positioning information | GNSS only |
| VTG | Current ground speed | GNSS only |
| SXT | Integrated-navigation information | Integrated nav |

### 2.6.9 GGA

Receiver time, position and fix-related data. Note: this sentence outputs the GNSS-only fix, not the integrated-navigation result.

```
$GPGGA,062134.00,2813.9908005,N,11252.6285300,E,1,28,0.5,83.684,M,-17.038,M,0.000,0000*60
```

| ID | Example | Format | Description |
|---|---|---|---|
| 1 | $GPGGA | header | |
| 2 | 062134.00 | hhmmss.ss | UTC time |
| 3 | 2813.9908005 | ddmm.mmmm | Latitude, 28°13.9908005', range 0°-90°. First two digits are degrees, the rest minutes. |
| 4 | N | - | Latitude direction N/S (N = north, S = south) |
| 5 | 11252.6285300 | ddmm.mmmm | Longitude, 112°52.6285300', range 0°-180°. First three digits are degrees, the rest minutes. |
| 6 | E | - | Longitude direction E/W (E = east, W = west) |
| 7 | 1 | x | 0: invalid; 1: single-point; 2: pseudorange differential; 4: fixed; 5: float or PPP. |
| 8 | 28 | xx | Number of satellites used in the fix |
| 9 | 0.5 | x.x | HDOP: horizontal dilution of precision |
| 10 | 83.684 | x.xxx | Altitude |
| 11 | M | U | Altitude unit: m |
| 12 | -17.038 | x.x | Geoid undulation: difference between the WGS84 ellipsoidal height and altitude; "-" means the geoid is below the WGS84 ellipsoid. |
| 13 | M | U | Undulation unit: m |
| 14 | 0.000 | xxxx | Differential age, in s |
| 15 | 0000 | x.x | Differential station ID |
| 16 | 60 | hh | Checksum |

> About the lat/long format in GGA:
>
> **Latitude**: expressed as degrees and minutes (no seconds), as `ddmm.mmmm`, where `dd` is degrees (two digits) and `mm.mmmm` is minutes (two integer digits and up to four decimals), followed by N (north) or S (south). **Longitude**: similar to latitude, but degrees are three digits, as `dddmm.mmmm`, followed by E (east) or W (west).
>
> Converting to decimal degrees: although GGA natively uses degrees and minutes, you sometimes need decimal degrees. The formula:
>
> - decimal degrees = degrees + (minutes / 60)
>
>   For example, converting 4807.038 to decimal degrees: 48 + (07.038 / 60) = 48.1173°

### 2.6.10 RMC

Recommended minimum navigation data. Note: this sentence outputs the GNSS-only fix, not the integrated-navigation result.

```
$GPRMC,020550.00,A,2813.9891299,N,11252.6278784,E,0.033,315.7,161117,0.0,E,A,V*4A
```

| ID | Example | Format | Description |
|---|---|---|---|
| 1 | $GPRMC | header | Start delimiter + message ID |
| 2 | 020250.00 | hhmmss.ss | UTC time |
| 3 | A | x.x | Fix status: A = valid, V = invalid |
| 4 | 2813.9891299 | ddff.ff | Latitude, same format as GGA |
| 5 | N | - | Latitude direction, same as GGA |
| 6 | 11252.6278784 | dddff.ff | Longitude, same format as GGA |
| 7 | E | - | Longitude direction, same as GGA |
| 8 | 0.033 | x.x | Ground speed, in knots |
| 9 | 315.7 | x.x | Ground course, referenced to true north, clockwise (0°-360°) |
| 10 | 161117 | ddmmyy | Date (day, month, year) |
| 11 | 0.0 | x.x | Magnetic declination, in degrees |
| 12 | E | - | Declination direction |
| 13 | A | - | Mode indicator: N = invalid; A = autonomous; E = estimated; D = differential; M = manual input |
| 14 | V | - | S = Safe, C = Caution, U = Unsafe, V = Not valid |
| 15 | 4A | hh | Checksum |

### 2.6.11 VTG

Outputs ground-speed information.

```
$GPVTG,134.395,T,134.395,M,0.019,N,0.035,K,A*33
```

| ID | Example | Format | Description |
|---|---|---|---|
| 1 | $GPVTG | header | |
| 2 | 134.395 | xxx.xxx | Ground course referenced to true north, 000-359.999° |
| 3 | T | U | True-north indicator |
| 4 | 134.395 | xxx.xxx | Ground course referenced to magnetic north, 000-359.999° |
| 5 | M | U | Magnetic-north indicator |
| 6 | 0.019 | xxx.xxx | Horizontal speed 000-999, in knots |
| 7 | N | U | Unit: N = knots |
| 8 | 0.035 | xxx.xxx | Horizontal speed 000-999, in km/h |
| 9 | K | U | Unit: K = km/h |
| 10 | A | U | A = autonomous; D = differential; E = estimated; M = manual input; N = invalid. |
| 11 | 33 | hh | Checksum |

### 2.6.12 SXT

Outputs integrated-navigation information.

```
$GPSXT,20230310090529.59,116.45784882,39.90572287,158.2289,359.87,-4.99,359.87,0.001,171.25,1,0,15,15,0
.056,-0.040,0.017,-0.001,-0.000,0.002,8,0*43
```

| ID | Example | Format | Description |
| --- | --- | --- | --- |
| 1 | $GPSXT | header | |
| 2 | 20230310090529.59 | yyyy/mm/dd/hh/mm/ss.ss | UTC time |
| 3 | 116.45784882 | ddd.dddddddd | Fused longitude (deg) |
| 4 | 39.90572287 | ddd.dddddddd | Fused latitude (deg) |
| 5 | 158.2289 | ddd.dddd | Fused altitude (m) |
| 6 | 359.87 | ddd.dd | Yaw (deg), 0-360° |
| 7 | -4.99 | ddd.dd | Pitch (deg), -90:90° |
| 8 | 359.87 | ddd.dd | Velocity course (deg) |
| 9 | 0.001 | ddd.ddd | Horizontal speed (m/s) |
| 10 | 171.25 | ddd.dd | Roll (deg), -180:180° |
| 11 | 1 | | GNSS-only fix flag: 0 invalid; 1 single-point; 2 pseudorange differential; 4 fixed; 5 float/PPP.<br>Relates to antenna A only, not B. |
| 12 | 0 | | GNSS-only heading flag: 4 fixed (heading valid); other values: heading not locked, invalid.<br>Relates to antennas A and B; heading is meaningful only with a fixed solution (4). |
| 13 | 15 | | Satellites used by antenna A (positioning) |
| 14 | 15 | | Satellites used by antenna B (heading) |
| 15 | 0.056 | | X-axis angular rate (deg/s) |
| 16 | -0.040 | | Y-axis angular rate (deg/s) |
| 17 | 0.017 | | Z-axis angular rate (deg/s) |
| 18 | -0.001 | ddd.ddd | East velocity (m/s) |
| 19 | -0.000 | ddd.ddd | North velocity (m/s) |
| 20 | 0.002 | ddd.ddd | Up velocity (m/s) |
| 21 | 8 | | Integrated-navigation status:<br>0: invalid - no GNSS, cannot initialize position<br>1: aligning - position initialized, but some motion is needed to finish filter initialization and enter integrated navigation<br>3: navigating - integrated navigation engaged<br>6: inertial dead-reckoning - integrated navigation engaged but GNSS lost, in pure-inertial mode (tunnel, garage, etc.) |

| ID | Example | Format | Description |
|---|---|---|---|
| 22 | antenna status | | 0: A normal, B normal<br>1: A abnormal (not inserted, feeder open/short), B normal<br>2: A normal, B abnormal<br>3: A abnormal, B abnormal<br>Valid only with our dedicated measurement antenna. |
| 23 | 08 | hh | Checksum |

## 2.7 Binary Messages (HiPNUC)

This is HiPNUC's custom binary protocol. It can output all sensor information and is supported by products with UART (RS-232/TTL), USB and RS-485 interfaces. Default serial format is N-8-N-1 (8 data bits, 1 stop bit, no parity).

### 2.7.13 Frame Format

After power-up, the module outputs frame data at the default rate (100 Hz). The frame format:

| Field | Value | Length (bytes) | Description |
|---|---|---|---|
| Frame header | 0x5A | 1 | 0x5A |
| Frame type | 0xA5 | 1 | 0xA5 |
| Payload len | 1-512 | 2 | Length of the payload, LSB first.<br>Counts the payload only (excludes header, type, length, CRC). |
| CRC | - | 2 | 16-bit CRC over all fields except CRC itself (header, type, length, payload).<br>LSB first. |
| Payload | - | 1-512 | Data carried in one frame, made of several sub-packets. Each packet has a tag and data; the tag determines the data type and length. |

### 2.7.14 Payload Content

#### 2.7.14.9 Integrated Navigation Data (HI81)

The payload is 104 bytes and contains all navigation information.

| Offset | Name | Type | Size (Byte) | Unit | Scale | Description |
|---|---|---|---|---|---|---|
| 0 | tag | uint8_t | 1 | - | - | Packet tag: 0x81 |
| 1 | status | uint16_t | 2 | - | - | Status word, reserved |
| 3 | ins_status | uint8_t | 1 | - | - | Integrated-navigation status:<br>0: invalid - no GNSS, cannot initialize position<br>1: aligning<br>3: navigating<br>6: inertial dead-reckoning (GNSS lost) |
| 4 | gpst_wn | uint16_t | 2 | week | 1 | GPS time, week |
| 6 | gpst_tow | uint32_t | 4 | s | 0.001 | GPS time, time of week |
| 10 | reserved | uint16_t | 2 | - | - | Reserved |
| 12 | gyr_b | int16_t *3 | 6 | rad/s | 0.001 | Body-frame angular rate: X, Y, Z (factory calibrated) |
| 18 | acc_b | int16_t *3 | 6 | m/s^(2) | 0.0048828 | Body-frame acceleration: X, Y, Z (factory calibrated) |
| 24 | mag_b | int16_t *3 | 6 | uT | 0.030517 | Body-frame magnetic field: X, Y, Z (factory calibrated) |
| 30 | air_pressure | int16_t | 2 | Pa | 1 | Air pressure + 100000 Pa: e.g. 2000 means 102000 Pa |
| 32 | od_speed | int16_t | 2 | m/s | 0.01 | Odometer speed (vehicle OBD-II speed) |
| 34 | temperature | int8_t | 1 | °C | 1 | System average temperature |
| 35 | utc_year | uint8_t | 1 | year | 1 | UTC year, e.g. 24 = 2024 |
| 36 | utc_mouth | uint8_t | 1 | month | 1 | UTC month |
| 37 | utc_day | uint8_t | 1 | day | 1 | UTC day |
| 38 | utc_hour | uint8_t | 1 | hour | 1 | UTC hour |
| 39 | utc_min | uint8_t | 1 | min | 1 | UTC minute |
| 40 | utc_sec | uint16_t | 2 | s | 0.001 | UTC second |
| 42 | roll | int16_t | 2 | deg | 0.01 | Integrated-nav roll, range -180:180 |
| 44 | pitch | int16_t | 2 | deg | 0.01 | Integrated-nav pitch, range -90:90 |
| 46 | yaw | uint16_t | 2 | deg | 0.01 | Integrated-nav yaw, range 0-360, north-to-east positive |
| 48 | quat | int16_t *4 | 8 | - | 0.0001 | Quaternion: W, X, Y, Z |
| 56 | ins_lon | int32_t | 4 | deg | 1e-7 | Fused longitude |
| 60 | ins_lat | int32_t | 4 | deg | 1e-7 | Fused latitude |

| Offset | Name | Type | Size (Byte) | Unit | Scale | Description |
|---|---|---|---|---|---|---|
| 64 | ins_msl | int32_t | 4 | m | 0.001 | Fused altitude |
| 68 | pdop | uint8_t | 1 | - | 0.1 | GNSS position dilution of precision |
| 69 | hdop | uint8_t | 1 | - | 0.1 | GNSS horizontal dilution of precision |
| 70 | solq_pos | uint8_t | 1 | - | - | GNSS-only fix flag: 0 invalid; 1 single-point; 2 pseudorange differential; 4 fixed; 5 float/PPP.<br>Antenna A only. |
| 71 | nv_pos | uint8_t | 1 | - | - | Satellites used for GNSS positioning |
| 72 | solq_heading | uint8_t | 1 | - | - | GNSS-only heading flag: 4 fixed (heading valid); other values: not locked.<br>Relates to A and B; only fixed makes heading meaningful. |
| 73 | nv_heading | uint8_t | 1 | - | - | Satellites used for GNSS heading |
| 74 | diff_age | uint8_t | 1 | s | 1 | RTK differential age |
| 75 | undulation | int16_t | 2 | m | 0.01 | Geoid undulation |
| 77 | ant_status | uint8_t | 1 | - | - | Antenna status flag<br>0: A normal, B normal<br>1: A abnormal (not inserted, feeder open/short), B normal<br>2: A normal, B abnormal<br>3: A abnormal, B abnormal<br>Valid only with our dedicated measurement antenna. |
| 78 | vel_enu | int16_t *3 | 6 | m/s | 0.01 | ENU velocity in the navigation frame (integrated-nav output) |
| 84 | acc_enu | int16_t *3 | 6 | m/s^(2) | 0.0048828 | ENU acceleration in the navigation frame (integrated-nav output) |
| 90 | reserved | int16_t | 2 | | | Reserved |
| 92 | reserved | int16_t | 2 | | | Reserved |
| 94 | reserved | int16_t | 2 | | | Reserved |
| 96 | reserved | int16_t | 2 | | | Reserved |
| 98 | reserved | - | 6 | - | - | Reserved |

### 2.7.15 CRC

16-bit CRC reference implementation:

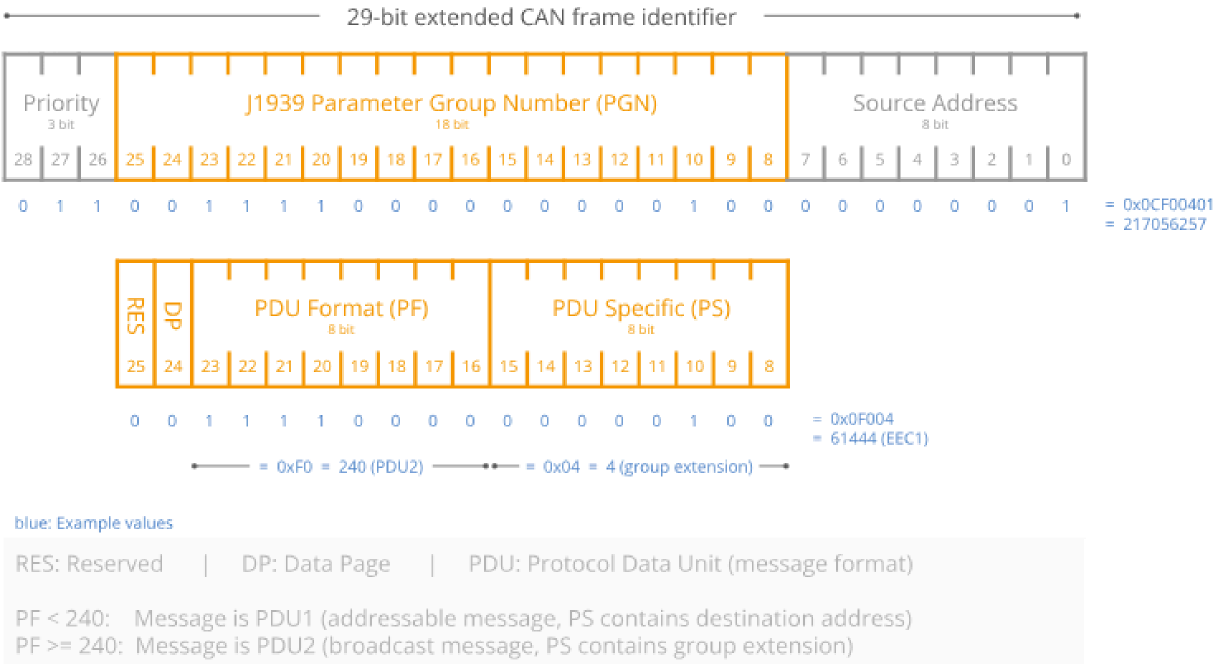
```
/*
        currectCrc: previous crc value, set 0 if it's first section
        src: source stream data
        lengthInBytes: length
*/
static void crc16_update(uint16_t *currectCrc, const uint8_t *src, uint32_t lengthInBytes)
{
    uint32_t crc = *currectCrc;
    uint32_t j;
    for (j=0; j < lengthInBytes; ++j)
    {
        uint32_t i;
        uint32_t byte = src[j];
        crc ^= byte << 8;
        for (i = 0; i < 8; ++i)
        {
            uint32_t temp = crc << 1;
            if (crc & 0x8000)
            {
                temp ^= 0x1021;
            }
            crc = temp;
        }
    }
    *currectCrc = crc;
}
```

# 3. Data Protocol (CAN - SAE J1939)

The CAN interface supports both CANopen and SAE J1939. The module defaults to SAE J1939; contact technical support for a CANopen version. The default CAN baud rate is 500 Kbps.

## 3.8 SAE J1939 Protocol

J1939 uses a 29-bit extended frame ID: 3 bits of priority, 1 reserved bit, an 8-bit page that defines its function via the PGN, with the first 8 of the lower 24 bits being the source address (SA), the middle 8 the specific PGN (describing the data function/content), and the last 8 the destination address (DA) or a further-refined PGN. This structure supports prioritized message transmission, a wide range of parameter-group identifiers, and source/destination addressing on the network.




| PGN | Description |
|---|---|
| Communication mode | Broadcast |
| Default interval | 100 ms |
| Data length | 8 bytes per PGN |
| PF (PDU format) | 0xFF |
| PS (PDU specific) | Extended PGN address (GE) when PF > 0xF0, otherwise the destination address (DA) |
| Priority | 3 |
| Default J1939 address | 0x08 |
| Data format | All frames use LSB (little-endian); unless noted, signed integers |

## 3.9 PGN Message List

### 3.9.16 PGN65296 (FF10) Latitude/Longitude

CANID=0x0CFF1008

| SPN name | SPN position (byte) | Description |
|---|---|---|
| Latitude | 0-3 | Unit: deg, scale: 0.0000001 |
| Longitude | 4-7 | Unit: deg, scale: 0.0000001 |

### 3.9.17 PGN65300 (FF14) Altitude and Differential Age

CANID=0x0CFF1408

| SPN name | SPN position (byte) | Description |
|---|---|---|
| Altitude | 0-3 | Unit: m, scale: 0.01 |
| UNDULATION | 4-5 | Unit: m, scale: 0.01 |
| Diff age | 6-7 | Unit: s, scale: 0.01 |

### 3.9.18 PGN65304 (FF18) Fix Status and Satellite Count

CANID=0x0CFF1808

| SPN name | SPN position (byte) | Description |
| --- | --- | --- |
| GNSS-only fix quality | 0 | 0 invalid; 1 single-point; 2 pseudorange differential; 4 fixed; 5 float/PPP. |
| GNSS-only heading qual | 1 | 0 invalid; 4 fixed (only a fixed solution makes heading meaningful) |
| Positioning sat count | 2 | Satellites used for positioning |
| Heading sat count | 3 | Satellites used for heading |
| Integrated-nav status | 4 | 1: aligning, 3: navigating |
| Reserved | 5-7 | - |

### 3.9.19 PGN65318 (FF26) Velocity

CANID=0x0CFF2608

| SPN name | SPN position (byte) | Description |
| --- | --- | --- |
| East velocity | 0-1 | Unit: m/s, scale: 0.01 |
| North velocity | 2-3 | Unit: m/s, scale: 0.01 |
| Up velocity | 4-5 | Unit: m/s, scale: 0.01 |
| Ground speed (E/N resultant magnitude) | 6-7 | Unit: m/s, scale: 0.01 |

### 3.9.20 PGN65327 (FF2F) Time

CANID=0x0CFF2F08

| SPN name | SPN position (byte) | Description |
| --- | --- | --- |
| UTC year | 0 | 20 = 2020, and so on |
| UTC month | 1 | |
| UTC day | 2 | |
| UTC hour | 3 | |
| UTC min | 4 | |
| UTC sec | 5 | |
| UTC ms | 6-7 | Unit: ms, scale: 1 |

### 3.9.21 PGN65332 (FF34) Acceleration

CANID=0x0CFF3408

| SPN name | SPN position (byte) | Description |
| --- | --- | --- |
| Accel X | 0-1 | Unit: G (1G = gravity), scale: 0.00048828 |
| Accel Y | 2-3 | Unit: G (1G = gravity), scale: 0.00048828 |
| Accel Z | 4-5 | Unit: G (1G = gravity), scale: 0.00048828 |
| Reserved | 6-7 | - |

### 3.9.22 PGN65335 (FF37) Angular Rate

CANID=0x0CFF3708

| SPN name | SPN position (byte) | Description |
| --- | --- | --- |
| Rate X | 0-1 | Unit: deg/s, scale: 0.061035 |
| Rate Y | 2-3 | Unit: deg/s, scale: 0.061035 |
| Rate Z | 4-5 | Unit: deg/s, scale: 0.061035 |
| Reserved | 6-7 | |

### 3.9.23 PGN65341 (FF3D) Integrated-Nav Attitude (Pitch/Roll)

CANID=0x0CFF3D08

| SPN name | SPN position (byte) | Description |
| --- | --- | --- |
| Roll | 0-3 | Unit: °, scale: 0.001 |
| Pitch | 4-7 | Unit: °, scale: 0.001 |

### 3.9.24 PGN65345 (FF41) Integrated-Nav Attitude (Heading)

CANID=0x0CFF4108

| SPN name | SPN position (byte) | Description |
| --- | --- | --- |
| Yaw | 0-3 | 0-360, unit: °, scale: 0.001 |
| Reserved | 4-7 | |

### 3.9.25 PGN65347 (FF43) Temperature and Air Pressure

CANID=0x0CFF4308

| SPN name | SPN position (byte) | Description |
| --- | --- | --- |
| Temperature | 0-1 | Unit: °C, scale: 0.01 |
| Reserved | 2-3 | |
| Air pressure | 4-7 | Unit: Pa, scale: 0.01 |

## 3.10 Module Configuration (CAN)

### 3.10.26 Configuration Format

Host sends: `ADDR + CMD + STATUS + VAL`; device replies: `ADDR + CMD + STATUS + VAL`.

| Field | Size (Byte) | Description |
| --- | --- | --- |
| ADDR | 2 | Register address |
| CMD | 1 | 0x06: write, 0x03: read |
| STATUS | 1 | Reserved |
| VAL | 4 | Value written or read |

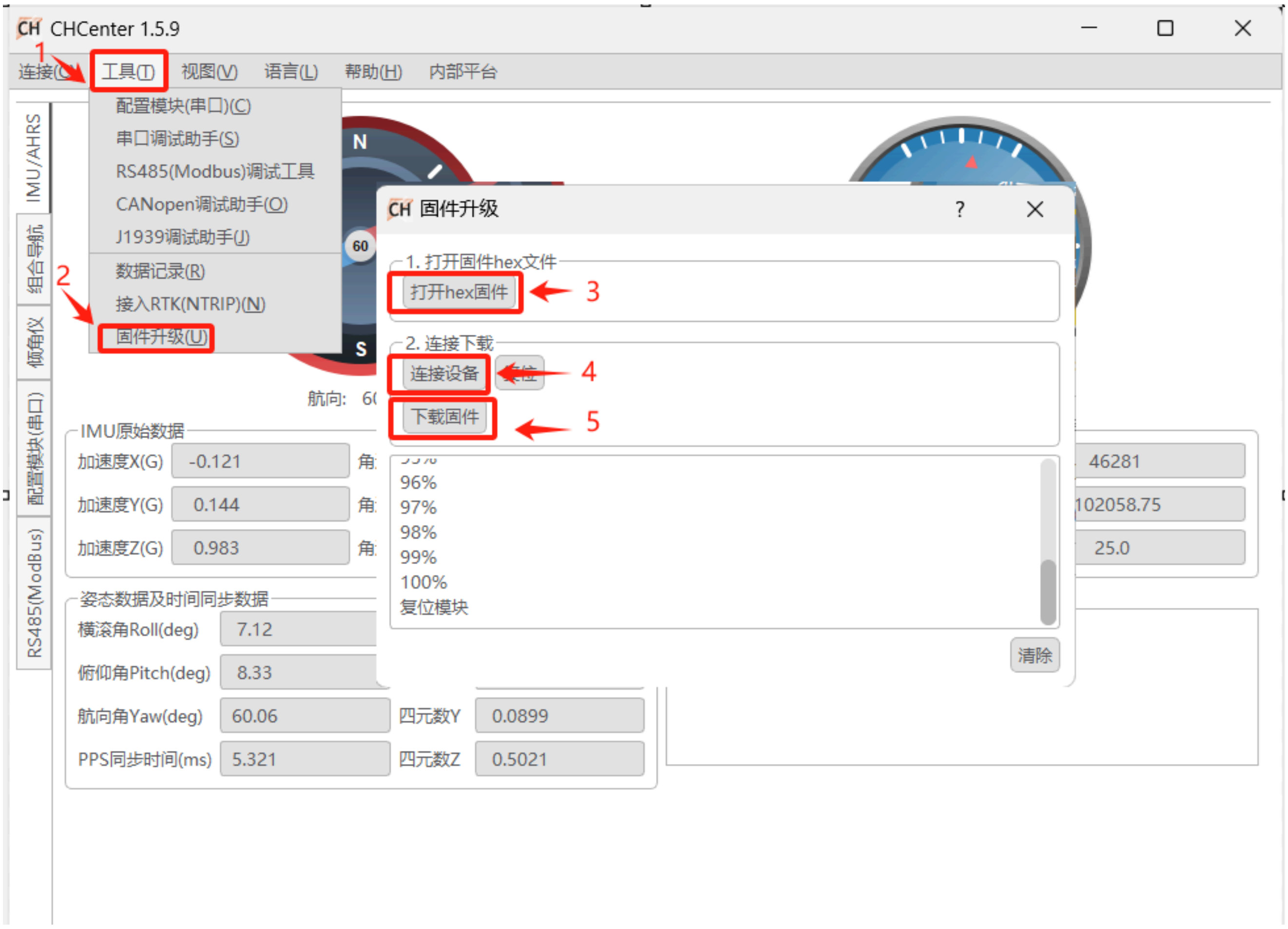
### 3.10.27 Common Command Examples

| 29-bit CAN ext. frame ID | CAN data | Description | Notes |
|---|---|---|---|
| 0x0CEF08xx | 10 01 06 00 [VAL] | VAL: 4 bytes (LE) | PGN FF10 (lat/long) interval, ms, range 10-1000 |
| 0x0CEF08xx | 14 01 06 00 [VAL] | VAL: 4 bytes | PGN FF14 (altitude & diff age) interval, ms, range 10-1000 |
| 0x0CEF08xx | 18 01 06 00 [VAL] | VAL: 4 bytes | PGN FF18 (fix status & sats) interval, ms, range 10-1000 |
| 0x0CEF08xx | 2F 01 06 00 [VAL] | VAL: 4 bytes | PGN FF2F (time) interval, ms, range 10-1000 |
| 0x0CEF08xx | 34 01 06 00 [VAL] | VAL: 4 bytes | PGN FF34 (acceleration) interval, ms, range 10-1000 |
| 0x0CEF08xx | 37 01 06 00 [VAL] | VAL: 4 bytes | PGN FF37 (angular rate) interval, ms, range 10-1000 |
| 0x0CEF08xx | 3D 01 06 00 [VAL] | VAL: 4 bytes | PGN FF3D (pitch/roll) interval, ms, range 10-1000 |
| 0x0CEF08xx | 41 01 06 00 [VAL] | VAL: 4 bytes | PGN FF41 (heading) interval, ms, range 10-1000 |
| 0x0CEF08xx | 43 01 06 00 [VAL] | VAL: 4 bytes | PGN FF43 (temp & pressure) interval, ms, range 10-1000 |
| 0x0CEF08xx | 9A 00 06 00 [VAL] | VAL: 4 bytes | Set baud rate (saved, effective on reset): 0:1000K, 1:800K, 2:500K, 3:250K, 4:125K |
| 0x0CEF08xx | 9C 00 06 00 [VAL] | VAL: 4 bytes | J1939 device ID, 1-64 (default 8). Caution: changing the ID also requires updating the destination address in all J1939 frame IDs. |
| 0x0CEF08xx | 00 00 06 00 00 00 00 00 | - | Save all configuration to Flash |
| 0x0CEF08xx | 00 00 06 00 01 00 00 00 | - | Restore factory defaults |
| 0x0CEF08xx | 00 00 06 00 FF 00 00 00 | - | Reset |

> `xx` in the ID field: the J1939 source address, any byte. `xx` in the data field: any byte.
>
> Example: ID=0x0CEF0855, DATA = 37 01 06 00 64 00 00 00 sets PGN FF37 to a 100 ms period (10 Hz).

# 4. Firmware Upgrade

This product supports firmware upgrades. Use the CHCenter host software and follow the steps below; request the firmware file (.hex) from our technical support.




## 5. Technical Support

New product and document information is available via our website and WeChat official account. WeChat:

Telegram:

HS

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