



K8/K9 1.2

OEM BOARD REFERENCE MANUAL

Abstract

This document describes the Commands and Logs of K8/K9 OEM Board.



REVISION HISTORY

REVISION	MODIFICATION	RELEASE DATE
1.0	-	2024/11/18
1.1	Modify the support board part of HEADING2 in Section 3.2.3.2 .	2024/12/27
1.2	<p>Add the usage conditions for the SET command to disable the CWI Mitigation module in Section 2.2.24;</p> <p>Modify the channel tracking status part of note a of RANGECMP in Section 3.2.6.2;</p> <p>Modify the range and units part of the puncture point longitude and puncture point latitude fields of TECINFO in Section 3.2.10.2;</p> <p>Modify the recommended input part of B2BRAWNAVSUBFRAME in Section 3.2.1.14;</p> <p>Modify the recommended input part of HASMESS in Section 3.2.1.15.</p> <p>Modify the description of Field ID31 in SYSRTS real-time status information in Section 3.4.5.</p>	2025/03/11

OEM BOARD REFERENCE MANUAL

Catalogue

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1.Preface

Welcome to the OEM Board Reference Manual. This manual is designed to provide comprehensive technical support for developers, helping them to efficiently utilize and configure OEM boards. We detail the supported commands, message structures, and relevant usage constraints to ensure that you can fully leverage the capabilities of the boards.

1.1.How to Use this Manual

The main content of this manual is divided into the following three parts:

- **Commands and Logs**

This section introduces the commands and Logs structures supported by the OEM boards.

- **Operational Examples**

This section provides practical operation examples to help users understand how to apply these commands and messages.

- **Board Product Specifications:**

This section includes the technical specifications of the boards and details on firmware updates.



1.2.Conventions

For the convenience of users, this manual follows the conventions outlined below for formatting and icons:

Formatting Conventions

Data starting with '0x' denotes hexadecimal data;
Angle brackets '< >' in instructions indicate mandatory parameters;
Square brackets '[]' in the instruction indicate optional parameters;
Default parts in tables indicate reserved sections for future use.

Icon Conventions

	Important information that should be noted.
	Additional information or examples.

1.3.Disclaimer

Warranty Statement:

- Products and software must be installed, configured, connected, maintained, stored, and operated strictly according to the relevant operation manuals and specifications.
- Products and software must not be modified or misused.

Disclaimer:

- ✧ The product or software is not guaranteed to work with hardware, software products, information, data, systems, interfaces, or devices not manufactured, provided, or specified by us.
- ✧ The product or software is not operated according to us product standards and specifications.
- ✧ Unauthorized modification or use of the us products or software.
- ✧ Damages caused by accidents, lightning, abnormal voltage, or immersion in water.
- ✧ Normal wear and tear of consumable parts (such as batteries).
- ✧ We does not guarantee the results obtained from using this product.

1.4.Contact Us

The configuration of terminal equipment and related functionalities should be revised according to the development of the Beidou system construction and service capabilities. The latest version of the reference manual will be timely published on the official website. If you have any technical issues, please contact us, and we will respond promptly. Errors may exist in manuals and related products. If these errors cause inconvenience or loss to you, we will not be liable.

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2.Command Reference

Our boards not only support our own commands but are also compatible with commands from other manufacturers' boards. The syntax of our board commands is similar to that of NovAtel OEM boards, but with some subtle differences.

2.1.Command List

In order to facilitate user access, the following table lists the commonly used commands and their corresponding chapters .

Table 2-1 Command List

ID	Commands	Descriptions	Refer To
1	BD2ECUTOFF	Sets elevation cut-off angle for BeiDou satellites	2.2.5
2	CLOCKOFFSET	Adjusts for delay in PPS output	2.2.2
3	COM	COM port configuration control	2.2.1
4	DGPSTXID	Set Base Station ID	2.2.3
5	ECUTOFF	Sets elevation cut-off angle for satellites	2.2.4
6	FIX	Constrains to fixed height or position	2.2.6
7	FLYCONTROL	Set Dual-Antenna Outlier Detection Threshold	2.2.8
8	FRESET	Clears selected data and reset	2.2.7
9	HEADINGOFFSET	Set Heading and Pitch Offset Values	2.2.9
10	INCONTROL	INS Control	2.2.23
11	INTERFACEMODE	Sets receive or transmit modes for ports	2.2.10
12	LOCKOUT	Prevents the receiver from using a satellite	2.2.12
13	LOCKOUTSYSTEM	Prevents the receiver from using a system	2.2.13
14	LOG	Prevents the receiver from using a system	2.2.14
15	MAGVAR	Sets a magnetic variation correction	2.2.11
16	MARKCONTROL	Controls processing of mark inputs	2.2.16
17	POSAVE	Implements base station position averaging	2.2.33
18	PPSCONTROL	Controls the PPS output	2.2.15
19	RESET	Performs a hardware reset	2.2.17
20	RTKCOMMAND	Reset the RTK engine	2.2.18
21	RTKFIXHOLDTIME	Sets maximum age of RTK Fixed data	2.2.19
22	RTKSOURCE	Sets the RTK correction source	2.2.20
23	RTKTIMEOUT	Sets maximum delay of RTK data	2.2.21
24	SAVECONFIG	Save current configuration	2.2.22
25	SBASSYS	Choose the SBAS the receiver will use	2.2.32
26	SCANSPECTRUM	Set the spectrum scanning parameters	2.2.26
27	SET	SET Command	2.2.24

28	UNDULATION	Chooses undulation	2.2.25
29	UNLOCKOUT	Reinstates a satellite in the solution	2.2.27
30	UNLOCKOUTALL	Reinstates all previously locked out satellites	2.2.28
31	UNLOCKOUTSYSTEM	Reinstates previously locked out system	2.2.29
32	UNLOG	Removes a log from logging control	2.2.30
33	UNLOGALL	Removes all logs from logging control	2.2.31

2.2.Commands

2.2.1.COM

Use this command to set the baud rate for the serial port.

Command	COM			
Description	COM port configuration control			
Format	COM <port> <baudrate>			
Comment	-			
Parameter introduction				
Parameter introduction				
Parameter	Description	Value	Default	Unit
port	Serial Port ID	COM1~COM4	-	-
baudrate	baud rate	1200,4800,9600,19200,38400,57600,115200,230400,460800,921600.	115200	-
Example	COM COM1 115200 //Set the serial port 1 baud rate to 115200			

2.2.2.CLOCKOFFSET

This command is used to remove a delay in the PPS output, with the delay specified in nanoseconds.

Command	CLOCKOFFSET
Description	Adjusts for delay in PPS output
Format	CLOCKOFFSET <delay>
Comment	<p>The PPS signal is delayed from the actual measurement time due to two major factors:</p> <ul style="list-style-type: none"> • A delay in the signal path from the antenna to the receiver. For example, Using a cable with a 10ns delay will introduce a 10ns delay in the PPS output. • An intrinsic delay through the RF and digital sections of the receiver

	The second delay is automatically accounted for by the receiver using a nominal value determined for each receiver type. However, since the delay from the antenna to the receiver cannot be determined by the receiver, an adjustment cannot automatically be made. The CLOCKOFFSET command can be used to adjust for this delay.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
delay	Specifies the offset in nanoseconds, Positive values indicate delayed output, and negative values indicate advanced output.	-	-	ns
Example	CLOCKOFFSET -200 //Advance the PPS output by 200 nanoseconds			

2.2.3.DGPSTXID

This command is used to set the station ID value for the receiver when it is transmitting corrections. This allows for the easy identification of which base station was the source of the data.

Command	TDGPSTXID			
Description	Set Base Station ID			
Format	DGPSTXID <type> <ID>			
Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
type	RTK Source Type	For example: RTCMV3 (See RTKSOURCE)	-	-
ID	Base station ID	-	-	-
Example	DGPSTXID RTCMV3 10 //Using an RTCMV3 type and ID			

2.2.4.ECUTOFF

This command is used to set the elevation cut-off angle for tracked satellites.

Command	ECUTOFF			
Description	Sets elevation cut-off angle for satellites			
Format	ECUTOFF <cutoff-angle>			
Comment	The receiver does not start automatically searching for a GPS satellite until it rises above the cut-off angle (when satellite position is known). Tracked satellites that fall below the cut-off angle are no longer tracked unless they are manually assigned.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
cutoff-angle	Elevation cut-off angle relative to horizon	0 to 90	-	deg

Example	<code>ECUTOFF 10 //Set satellite elevation cut-off to 10 degree</code>
---------	--

2.2.5. BD2ECUTOFF

This command is used to set the elevation cut-off angle for tracked BD2 satellites.

Command	BD2ECUTOFF			
Description	Sets elevation cut-off angle for BD2 satellites			
Format	<code>BD2ECUTOFF <cut-off-angle></code>			
Comment	The receiver does not start automatically searching for a GPS satellite until it rises above the cut-off angle (when satellite position is known). Tracked satellites that fall below the cut-off angle are no longer tracked unless they are manually assigned.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
cut-off-angle	Elevation cut-off angle relative to horizon	0 to 90	-	deg
Example	<code>BD2ECUTOFF 10</code>			

2.2.6. FIX

This command is used to fix height or position to the input values.

Command	FIX			
Description	Constrains to fixed height or position			
Format	<code>FIX position <lat> <lon> <hgt></code>			
Comment	The height entered here is the ellipsoidal height minus the local geoid height anomaly (which can be obtained from GPGGA).			
Parameter introduction				
Parameter	Description	Value	Default	Unit
lat	Latitude	-90 to 90	-	deg
lon	Longitude	-360 to 360	-	deg
hgt	Height	-1,000 to 20,000,000	-	m
Example	<code>FIX position 30.0 150.0 50</code>			

2.2.7. FRESET

This command is used to clear data. Such data includes the almanac, ephemeris, and any user specific configurations.

Command	FRESET			
Description	Clears selected data and reset			
Format	<code>FRESET</code>			

Comment	-
Example	FRESET

2.2.8. FLYCONTROL

This command is used to set the outlier detection thresholds for the results of RTK positioning when using the master and rover.

Command	FLYCONTROL			
Description	Set Dual-Antenna Outlier Detection Threshold			
Format	FLYCONTROL <parameter1> <parameter2>			
Comment	The system will detect outliers when the horizontal or vertical errors exceed the thresholds and persist for more than 2 seconds. When this occurs, RTK will automatically reinitialize to suppress persistent outliers.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
parameter1	Horizontal detection threshold	-	18	cm
parameter2	Vertical detection threshold	-	30	cm
Example	FLYCONTROL 18 30			

2.2.9. HEADINGOFFSET

This command sets the offset values for the heading and pitch angles.

Command	HEADINGOFFSET			
Description	Set Heading and Pitch Offset Values			
Format	HEADINGOFFSET <headingoffsetindeg> <pitchoffsetindeg>			
Comment	The offset values offsets will be used to correct the heading and pitch angles in the receiver's output for HEADING, GPHDT, GPNAV, GPTRA, GPYBM, PTNL, and AVR information.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
headingoffsetindeg	the offset values for the heading angles	-180 to 180	0	deg
pitchoffsetindeg	the offset values for the pitch angles	-90 to 90	0	deg
Example	HEADINGOFFSET 10 10			

2.2.10. INTERFACEMODE

This command is used to specify what type of data a particular port on the receiver can transmit and receive.

Command	INTERFACEMODE				
Description	Sets receive or transmit modes for ports				
Format	INTERFACEMODE <port> <input-mode> <output-mode> <switch>				
Comment	The current output mode is not affected by this command and remains in universal mode.				
Parameter introduction					
Parameter	Description	Value		Default	Unit
port	Serial port identifier	COM1~COM4		-	-
input-mode	Input mode	NONE	The port is disabled.	-	-
		RTCMV3	The port accepts RTCMV3 corrections.		
		AUTO	The port accepts RTCM/RTCMV3 corrections.		
		COMPASS	The port only accepts Qtalis commands and logs.		
output-mode	Output mode	Remains in universal mode		-	-
switch	switch	on/off		-	-
Example	INTERFACEMODE COM1 RTCMV3 RTCMV3 on				

2.2.11.MAGVAR

The receiver computes directions referenced to True North (also known as geodetic north). The Magnetic Variation Correction command (MAGVAR) is used to navigate in agreement with magnetic compass bearings.

Command	MAGVAR				
Description	Sets a magnetic variation correction				
Format	MAGVAR <type> [correction [std dev]]				
Comment	The receiver calculates values of magnetic variation for given values of latitude, longitude and time using the International Geomagnetic Reference Field (IGRF) 2020 spherical harmonic coefficients and IGRF time corrections to the harmonic coefficients.				
Parameter introduction					
Parameter	Description	Value		Default	Unit
type	-	AUTO	Use IGRF corrections	-	deg
		CORRECTION	Use the correction supplied, (range: -180~180 deg)		

std dev	Standard deviation of correction	-180~180	0	deg
Example	MAGVAR AUTO MAGVAR CORRECTION 10 0			

2.2.12.LOCKOUT

This command is used to prevent the receiver from using a satellite in the solution computations.

Command	LOCKOUT			
Description	Prevents the receiver from using a satellite			
Format	LOCKOUT <prn>			
Comment	The command does not prevent the receiver from tracking an undesirable satellite, and it must be repeated for each satellite to be locked out.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
prn	Unique identifier for the satellite being locked out	Refer to PRN Numbers on Table 2-2	-	-
Example	LOCKOUT 10			

Table 2-2: PRN Numbers

GNSS	PRN
GPS	1~32
GLONASS	38~61
IRNSS	62~70
GALILEO	71~106
QZSS	131~140
BDS	BD2: 141~158 BD3: 159~203
SBAS	220~238

2.2.13.LOCKOUTSYSTEM

This command is used to prevent the receiver from using all satellites in a system in the solution computations.

Command	LOCKOUTSYSTEM			
Description	Prevents the receiver from using a system			
Format	LOCKOUTSYSTEM <system>			

Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
system	A single satellite system to be locked out	Refer to Table 2-2 .	-	-
Example	LOCKOUTSYSTEM BD2			

2.2.14.LOG

Many different types of data can be logged using different methods of triggering the log events. Every log element can be directed to any combination of the receiver's ports. The ontime trigger option requires the addition of the period parameter.

Command	LOG				
Description	Prevents the receiver from using a system				
Format	LOG <message-type> [type-trigger] [period] [offset]				
Comment	-				
Parameter introduction					
Parameter	Description	Value	Default	Unit	
message-type	Message type of log	Refer to Chapter 3	-	-	
type-trigger	Trigger type of log	ONTIME	Output on a time interval	ONCE	-
		ONCHANGED	Outputs the current message and then continues to output when the message is changed		
		ONCE	Output only the current message		
period	Log period (for ONTIME trigger) in seconds	Valid values for the high rate logging are 0.01, 0.02, 0.05, 0.1, 0.2, 0.25 and 0.5. For logging slower than 1 Hz any integer value is accepted	1	s	
offset	A valid value is any integer (whole number) smaller than the period.	Offset for period (ONTIME trigger) in seconds.	0	s	
Example	log rangea ontime 1				

2.2.15.PPSCONTROL

This command provides a method for controlling the polarity, period and pulse width of the PPS output. The PPS output can also be disabled using this command.

Command	PPSCONTROL				
Description	Controls the PPS output				
Format	PPSCONTROL <switch> <polarity> <period> <pulse-width> [model]				
Comment	Forces PPS output after satellite signal interruption; PPS is always available, but accuracy decreases over time. Accuracy is restored once the satellite signal is recovered.				
Parameter introduction					
Parameter	Description	Value		Default	Unit
switch	switch	DISABLE	Disable the PPS	-	-
		ENABLE	Enable the PPS		
polarity	The polarity of the pulse to be generated on the PPS output.	NEGATIVE	Triggered on the rising edge of a pulse (low to high)	-	-
		POSITIVE	Triggered on the falling edge of a pulse (high to low)		
period	The period of the pulse	0.05, 0.1, 0.2, 0.25, 0.5, 1.0, 2.0, 3.0,...20.0		-	s
pulse-width	The pulse width of the PPS signal	Any positive value less than or equal to half the period		-	ms
model	PPS Output Mode	0	outputs PPS for positioning (no PPS output after satellite signal interruption).	0	-
		1	Forces PPS output after satellite signal interruption.		
		-1	Always does not output PPS.		
Example	//Force PPS output after satellite signal interruption PPSCONTROL ENABLE POSITIVE 1 1000 1				

2.2.16.MARKCONTROL

This command is used to control the processing of the mark inputs.

Command	MARKCONTROL				
Description	Controls processing of mark inputs				
Format	MARKCONTROL <signal> <switch> [polarity] [timebias [timeguard]]				
Comment					
Parameter introduction					
Parameter	Description	Value		Default	Unit
signal	Specifies which mark input the command should be applied to.	MARK1		MARK1	-
switch	Disables or enables processing of the mark input signal for the input specified.	DISABLE	Disable the mark inputs	ENABLE	-
		ENABLE	Enable the mark inputs		
polarity	The polarity of the pulse to be generated on the PPS output.	NEGATIVE	Triggered on the rising edge of a pulse (low to high)	NEGATIVE	-
		POSITIVE	Triggered on the falling edge of a pulse (high to low)		
timebias	-	Not supported		0	
timeguard	-	Not supported		0	
Example	MARKCONTROL mark1 enable negative 0 0				

2.2.17.RESET

This command performs a hardware reset. The receiver configuration reverts either to the factory default, if no user configuration was saved or the last SAVECONFIG settings.

Command	RESET
Description	Performs a hardware reset
Format	RESET
Comment	-
Example	RESET

2.2.18.RTKCOMMAND

This command resets the RTK engine and clear RTK parameters, forcing the system to restart the ambiguity resolution calculations.

Command	RTKCOMMAND
---------	-------------------

Description	Reset the RTK engine			
Format	RTKCOMMAND <action>			
Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
action	-	RESET	-	-
Example	RTKCOMMAND RESET			

2.2.19.RTKFIXHOLDTIME

This command is used to set the maximum age of RTK Fixed data to use when operating as a rover station.

Command	RTKFIXHOLDTIME			
Description	Sets maximum age of RTK Fixed data			
Format	RTKFIXHOLDTIME <time-delay>			
Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
time-delay	Maximum RTK Fixed data age	5~1200	60	s
Example	RTKFIXHOLDTIME 15			

2.2.20.RTKSOURCE

This command is used to specify and receive data only from the designated RTK differential correction source and RTK base station ID. When the receiver may receive correction data from multiple base stations, this command filters out differential data from base stations not specified by the station ID.

Command	RTKSOURCE				
Description	Sets the RTK correction source				
Format	RTKSOURCE <type> [station ID]				
Comment	-				
Parameter introduction					
Parameter	Description	Value	Default	Unit	
type	Correction type	AUTO	Use any correction type received. If multiple types are received, the first one received is used.	AUTO	-
		RTCM	Use only RTCM version 2		

			corrections from the given ID. ID: $0 \leq \text{RTCM ID} \leq 1023$ or ANY to accept all IDs		
		RTCMV3	Use only RTCM version 3 corrections from the given ID. ID: $0 \leq \text{RTCMV3 ID} \leq 4095$ or ANY to accept all IDs.		
station ID	Base station ID	-	-	-	-
Example	RTKSOURCE RTCMV3 ANY RTKSOURCE RTCMV3 5				

2.2.21.RTKTIMEOUT

This command is used to set the maximum delay of RTK data.

Command	RTKTIMEOUT			
Description	Sets maximum delay of RTK data			
Format	RTKTIMEOUT <time-delay>			
Comment	If the RTK data delay exceeds this set value, the RTK engine will stop the calculation and exit.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
time-delay		0~1200	1200	s
Example	RTKTIMEOUT 30			

2.2.22.SAVECONFIG

This command is used to save configuration, please refer to [Table 2-4](#).

Command	SAVECONFIG			
Description	Save current configuration			
Format	SAVECONFIG			
Comment	To clear the commands saved by SAVECONFIG and reset the receiver to the factory-set configuration, the FRESET command can be used.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
-	-	-	-	-
Example	SAVECONFIG			

Table 2-4 Common Configuration

Command	Description
---------	-------------

LOG	Save all serial logs
FIX	Save only the fixed position
COM	Save the baud rate of all serial ports
ECUTOFF	Save the cut-off elevation angle of the satellite
PJKPARA	Saves 6 parameters of PJK
PPSOFFSET	Save the output delay of PPS
INTERFACEMODE	Save the mode state of the port
Other configuration related to working mode	-

2.2.23. INSCONTROL

This command is used to to enable or disable INS.

Command	INSCONTROL				
Description	INS Control				
Format	INSCONTROL <switch>				
Comment	-				
Parameter introduction					
Parameter	Description	Value		Default	Unit
switch	switch	ENABLE	Disables INS navigation	DISABLE	-
		DISABLE	Enables INS navigation		
Example	INSCONTROL enable				

2.2.24. SET

This command is used to configure some parameters or positioning modes, such as PJK parameters, positioning solution frequency and positioning solution mode. The commonly used setting instructions and related descriptions are shown in Table 2-5.

Command	SET				
Description	SET Command				
Format	SET <type> <param1> <param2> ...				
Comment	-				
Parameter introduction					
Parameter	Description	Value		Default	Unit
type	Set the parameter type	Refer to Table2-5		-	-
param1	Parameter	-		-	-
...	-	-		-	-
Example	SET PJKPARA 6378137.0 298.257223563 0 120 0 500000 SET BD2PVT OBS B2I SET PVTFREQ 5 SET RTKFREQ 5				

	<pre>SET STATIONMODE mode portA portB interval SET CP SMOOTHER aa bb SET SIGNAL GPS OFF SET SIGNAL L1CA/L2C/L2P/L5C/L1C ON/OFF SET SIGNAL L2P OFF SET SIGNAL B1C/B2a OFF SET PVTOSMODE SINGLE/DUAL/SBAS</pre>
--	---

Table 2-5 Common SET command

Format	Description	Parameter
SET APPSCENE <i>Param1</i>	Set the application scenario mode to meet the requirements of high-precision modules under different scene.	<i>Param1</i> : Survey Robot Car Uav Air Space
SET PPP <i>Param1</i>	Set whether to enable PPP mode.	<i>Param1</i> : ON (Enable PPP) OFF (Disable PPP)
SET PPPSOURCE <i>Param1</i>	Set the PPP correction source.	<i>Param1</i> : B2B (Select B2B as PPP correction source) HAS (Select HAS as PPP correction source) BHS (Fusion of B2B and HAS) RTCM (External RTCM correction source)
SET ATOM <i>Param1</i>	Set the atomic clock working mode.	<i>Param1</i> : ON (Enable atomic clock) OFF (Disable atomic clock)
SET PJKPARA <i>Param1 ... Param6</i>	Set the PJK parameters of coordinate transformation.	<i>Param1 ... Param6</i> : A (Earth's semi-major axis, default value is 6378137.0) 1/F (Flattening factor of the Earth, default value is 298.257) L₀ (Reference longitude, default value is 120/180*PI) N₀ (Reference North coordinate, default value is 0) E₀ (Reference East coordinate, default value is

		500000)
SET PVTFREQ <i>Param1</i>	Set the PVT (Position, Velocity, and Time) calculation frequency.	<i>Param1</i> : 1Hz 2Hz 5Hz (Default) 10Hz 20Hz Note: Default is 5Hz. Maximum PVT update rate is 20Hz. RTK can operate at 5Hz. To operate both at 10Hz, a CPU with at least 624MHz frequency is required.
SET RTKFREQ <i>Param1</i>	Set the RTK (Real-Time Kinematic) calculation frequency.	<i>Param1</i> : 1Hz 2Hz 5Hz (Default) 10Hz Note: RTK frequency should be less than or equal to PVT frequency.
SET PPPFREQ <i>Param1</i>	Set the PPP (Precise Point Positioning) frequency.	<i>Param1</i> : 1Hz 2Hz 5Hz (Default) 10Hz
SET MODIFYCPTOPR <i>Param1</i>	Set whether to modulate the carrier phase to bring it closer to the pseudorange.	<i>Param1</i> : ON (Enable modulation) OFF (Disable modulation, default)
SET CPSMOOTHPR <i>Param1</i> [<i>Param2</i>] [<i>Param3</i>]	Set the carrier phase smoothing pseudorange mode.	<i>Param1</i> :Smoothing Enable Switch ON (Enable carrier phase smoothing pseudorange, default)

		<p>OFF (Disable carrier phase smoothing) <i>Param2</i> :Smoothing Time Constant Valid range: 10 to 200 seconds, default value is 50 seconds. <i>Param3</i> :Tracking Time Threshold Valid range: 0 to 60 seconds, default value is 15 seconds. Example: After a satellite has been tracked for the time specified by <i>Param3</i>, the receiver starts using the carrier phase to smooth the satellite's pseudorange.</p>
SET PROJECTIONTYPE <i>Param1</i>	Set the projection type.	<p><i>Param1</i> :</p> <p>Gauss (Gauss-Boaga projection) UTM (Universal Transverse Mercator, UTM projection)</p>
SET RELAYRTCMV3 <i>Param1</i> port	Set whether to forward RTCM V3 differential data.	<p><i>Param1</i> :</p> <p>ON (Forward RTCM V3) OFF (Do not forward RTCM V3) <i>Port</i>: Serial port number</p>
SET DRTIMEOUT <i>Param1</i>	Set the duration for the integrated navigation calculation. Exiting after a signal loss exceeding the threshold.	<p><i>Param1</i> :</p> <p>Duration (in seconds) for the integrated navigation calculation before exiting if the signal is lost.</p>
SET IMUAXESTYPE 1/2/3/4/5/6/7/8	Set the IMU (Inertial Measurement Unit) axis type for integrated navigation initialization and calculation.	<p>Axis type number, with the following options:</p> <p>1 (Front up, Y-axis points to the vehicle front) 2 (Rotated 90° counterclockwise) 3 (Rotated 180° counterclockwise) 4 (Rotated 270° counterclockwise) 5 (Front down, Y-axis points to the vehicle front) 6 (Rotated 90° counterclockwise) 7 (Rotated 180° counterclockwise)</p>

		8 (Rotated 270° counterclockwise)																								
SET CWI AUTO <i>Param1</i>	Set the CWI(Carrier Wave Interference) Mitigation module to automatic mode (Enable/Disable).	<i>Param1</i> : 0 (Disable all CWI Mitigation, default) 1 (Enable the 1st CWI Mitigation channel) 2 (Enable the 2nd CWI Mitigation channel) 3 (Enable both the 1st and 2nd CWI Mitigation channels)																								
SET CWI MANUAL <i>Param1 Param2 Param3</i>	Set the CWI Mitigation module to manual mode to enable or disable specific channels. Note: After disabling the CWI Mitigation module in manual mode, the CWI Mitigation in automatic mode must also be turned off(SET CWI AUTO 0).	<i>Param1</i> Channel numbers corresponding to different frequency points: <table border="1" data-bbox="1444 571 1848 1056"> <thead> <tr> <th>Channel numbers</th> <th>Frequency points</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>L5/E5a/B2a</td> </tr> <tr> <td>1</td> <td>B2/E5b/B2b</td> </tr> <tr> <td>2</td> <td>B1</td> </tr> <tr> <td>3</td> <td>L1CA/E1C/B1C</td> </tr> <tr> <td>4</td> <td>G1</td> </tr> <tr> <td>5</td> <td>L2</td> </tr> <tr> <td>6</td> <td>G2</td> </tr> <tr> <td>7</td> <td>B3</td> </tr> <tr> <td>8</td> <td>L-Band</td> </tr> <tr> <td>9</td> <td>E6C</td> </tr> <tr> <td>10</td> <td>G3C</td> </tr> </tbody> </table> <i>Param2</i> CWI Mitigation channel number: 0(First CWI Mitigation channel, default value) 1(Second CWI Mitigation channel) <i>Param3</i> Switch: 0(Off, default value) 1(On)	Channel numbers	Frequency points	0	L5/E5a/B2a	1	B2/E5b/B2b	2	B1	3	L1CA/E1C/B1C	4	G1	5	L2	6	G2	7	B3	8	L-Band	9	E6C	10	G3C
Channel numbers	Frequency points																									
0	L5/E5a/B2a																									
1	B2/E5b/B2b																									
2	B1																									
3	L1CA/E1C/B1C																									
4	G1																									
5	L2																									
6	G2																									
7	B3																									
8	L-Band																									
9	E6C																									
10	G3C																									
SET AE <i>Param1</i>	Set the working status of AE (Antenna Electronics) at power-on.	<i>Param1</i> AE working status: OFF (Turn off AE)																								

		25M (25M clock AE) 100M (100M clock AE, default value)
SET SIGNAL <i>Param1</i> OFF	Set to turn off a specific satellite navigation system.	<i>Param1</i> : GPS/GLO/GAL/BD2/BD3/SBAS
SET SIGNAL <i>Param1</i> ON/OFF	Set to turn on/off a specific satellite navigation system signal.	<i>Param1</i> : L1CA/L2C/L2P/L5C/L1C; B1I/B2I/B3I; B1C/B2b/B2a/B2; E1C/E5b/E5a/E5/E6C; S1C/S5C; G1C/G2C/G3C;
SET PVTOBSMODE <i>Param1</i>	Set the PVT engine positioning mode.	<i>Param1</i> Positioning mode: SINGLE(Default) DUAL SBAS
SET GLONASSCODETYPE <i>Param1</i>	Set GLONASS C-code and P-code signal capture options. Example: set glonasscodetype ccode	<i>Param1</i> Code type: Pcode(Default) Ccode
SET SINOVAPOS LAT LON HGT	Set the coordinates for the seismic monitoring device site. If the difference between the set coordinates and the PVT coordinates is greater than 30m, the configuration will be invalid. When no command is configured, the PVT average coordinates will be used. (The input altitude is the ellipsoid height minus the local geoid anomaly value, which can be obtained from GPGGA)	LAT:Latitude(-90°~ 90°) LON:Longitude (-180°~ 180°) HGT:Height (-1000 ~ 2000000m)
SET PVTFREQ <i>Param</i> SET PDPFREQ <i>Param</i>	Set PVT and SINOVA calculation frequency.	<i>Param</i> Valid calculation frequency: 1Hz 5Hz(PDP Default)

		10Hz 20Hz(PVT Default)
SET SINOVATHRESH E N U	Set the minimum speed threshold to determine when an earthquake occurs, in meters per second (m/s). Default values: E:0.012 N:0.018 U:0.036; Note: The command is invalid if E < 0.001 m/s, N < 0.001 m/s, U < 0.001 m/s.	E: Eastward speed threshold (m/s) N:Northward speed threshold (m/s) U:Upward (Zenith) speed threshold (m/s)
SET SINOVARESET	Clear the accumulated displacement.	-
SET NMEA ON/OFF	V4.11 version switching of NMEA0183	-
SET IONOSCINB ON/OFF	Turn on / turn off the ionospheric scintillation monitoring function.	-

2.2.25.UNDULATION

This command permits you to enter a specific geoidal undulation value.

Command	UNDULATION				
Description	Chooses undulation				
Format	UNDULATION <opt> [sep]				
Comment	-				
Parameter introduction					
Parameter	Description	Value		Default	Unit
opt	The ellipsoid of the chosen datum	TABLE	Use the built-in grid table, the same as EGM96.	EGM96	-
		USER	Use the user specified undulation value		
		OSU89B	Use the OSU89B undulation table		
		EGM96	Use global geoidal height model EGM96 table		
sep	The undulation value (required for the USER option)	-		0.000	-
Example	UNDULATION EGM96 UNDULATION OSU89B UNDULATION USER 10.000000000				

2.2.26.SCANSPECTRUM

This command is used to set the spectrum scanning parameters.

Command	SCANSPECTRUM				
Description	Set the spectrum scanning parameters				
Format	SCANSPECTRUM <center-freq> <scan-range> <scan-times>				
	SCANSPECTRUM <mode>				
Comment	-				
Parameter introduction					
Parameter	Description	Value	Default	Unit	
center-freq	The center frequency of spectrum scanning	1165000~1613000	-	kHz	
scan-range	Range of spectrum scanning	0~11500	-	kHz	
scan-times	Number of points of spectrum scanning	3~200	-	-	

mode	The center frequency of the spectrum scanning is the frequency of the L1, L2, L5 frequency points, the scanning range is 8000 kHz, and the number of scanning points is 200.	L1, L2, L5	-	-
Example	SCANSPECTRUM 1575420 8000 200 SCANSPECTRUM L1			

2.2.27.UNLOCKOUT

This command allows a satellite which has been previously locked out ([LOCKOUT](#) command) to be reinstated in the solution computation.

Command	UNLOCKOUT			
Description	Reinstates a satellite in the solution			
Format	UNLOCKOUT <prn>			
Comment	If more than one satellite is to be reinstated, this command must be reissued for each satellite reinstatement.			
Parameter introduction				
Parameter	Description	Value	Default	Unit
prn	Unique identifier for the satellite being locked out	Refer to PRN Numbers on Table 2-2	-	-
Example	UNLOCKOUT 10			

2.2.28.UNLOCKOUTALL

This command allows all satellites or systems which have been previously locked out ([LOCKOUT](#) command or [LOCKOUTSYSTEM](#) command) to be reinstated in the solution computation.

Command	UNLOCKOUTALL			
Description	Reinstates all previously locked out satellites			
Format	UNLOCKOUTALL			
Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
-	-	-	-	-
Example	UNLOCKOUTALL			

2.2.29.UNLOCKOUTSYSTEM

This command allows a system which has been previously locked out (refer to the

[UNLOCKOUTSYSTEM](#) command) to be reinstated in the solution computation.

Command	UNLOCKOUTSYSTEM			
Description	Reinstates previously locked out system			
Format	UNLOCKOUTSYSTEM <system>			
Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
system	Satellite system	Refer to Table 2-2	-	-
Example	UNLOCKOUTSYSTEM BD2			

2.2.30.UNLOG

This command is used to remove a specific log request from the system.

Command	UNLOG			
Description	Removes a log from logging control			
Format	UNLOG <message-type>			
Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
message-type	Message type of log	Refer to Chapter 3	-	-
Example	UNLOG VERSION			

2.2.31.UNLOGALL

The command is used to cancel the output of a specific serial port message. If the serial port is not specified, the message output of all serial ports will be stopped.

Command	UNLOGALL			
Description	Removes all logs from logging control			
Format	UNLOGALL <port>			
Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
port	Serial Port ID	COM1~COM4	-	-
Example	UNLOGALL COM1 //Stop COM1 port message output UNLOGALL //Stop all message output			

2.2.32.SBASSYS

This command is used to select the SBAS.

Command	SBASSYS					
Description	Choose the SBAS the receiver will use					
Format	SET PVTOBSMODE SBAS					
	SET SBASSYS <SBASTYPE>					
Comment	When using SET PVTOBSMODE SBAS to set the SBAS positioning mode, the receiver will use the SBAS correction according to the default SBAS constellation priority. When using the SET SBASSYS instruction to receive the specified correction type, the receiver only uses the SBAS correction provided by the specified SBAS constellation. The ASSIGN command can be used to specify the channel for the satellite.					
Parameter introduction						
Parameter	Description	Value			Default	Unit
SBASTYPE	Constellation type of SBAS	Constellation type	ID	Description	-	-
		ALL	0	The SBAS satellites are used according to the default priority, and the order of priority from high to low is : WAAS > EGNOS > MSAS > BDSBAS > SDCM > GAGAN > SouthPAN		
		WAAS	1	Uses only WAAS satellites		
		EGNOS	2	Uses only EGNOS satellites		
		MSAS	3	Uses only MSAS satellites		
		GAGAN	4	Uses only GAGAN satellites		
		SDCM	5	Uses only SDCM satellites		
		BDS	6	Uses only BDS satellites		
SPAN	7	Uses only SouthPAN satellites				
Example	SET PVTOBSMODE SBAS SET SBASSYS MSAS					

2.2.33.POSAVE

The command is used to set the smooth base station coordinate related parameters. As specified smoothing duration (until the estimated smoothing position error is within the specified accuracy range). Smoothing stops when the time limit or horizontal standard deviation limit or vertical standard deviation limit is reached. After the smoothing is completed, the FIX command is automatically called.

Command	POSAVE			
Description	Implements base station position averaging			
Format	POSAVE <switch> [maxtime] [maxhstd] [maxvstd] [threshold]			
Comment	-			
Parameter introduction				
Parameter	Description	Value	Default	Unit
switch	switch	ON/OFF	-	-
maxtime	Maximum amount of time that positions are to be averaged	0.01~100	0.01	hours
maxhstd	Desired horizontal standard deviation	0~100	0.0	m
maxvstd	Desired vertical standard deviation	0~100	0.0	m
threshold	The threshold indicates that if the difference between the smooth completion result and the saved result of the next boot is within this threshold range, the saved result is started as the base station coordinate, otherwise the new smoothing result is used.	0~50	0	m
Example	<pre>//No positioning smoothing (default setting) POSAVE off //Start smoothing after positioning for 0.01 hours POSAVE on 0.01 //After positioning, smoothing starts once the horizontal //standard deviation is less than 1.5m and the vertical //standard deviation is less than 3m. The current PVT //standard deviations can be referenced from the GPGST //message. POSAVE on 0.01 1.5 3.0 //After positioning, smoothing starts once the horizontal //standard deviation is less than 1.5m and the vertical //standard deviation is less than 3m. Once the first //smoothing is completed, the coordinates are saved. On the //next boot, if the difference between the saved smoothing //result and the new result is within the set threshold //(30m), the saved coordinates will be used as the base //station coordinates; otherwise, the new smoothing result //will be used. POSAVE on 0.01 1.5 3.0 30</pre>			

3.Logs

Qtalis OEM board can request a variety of logs through LOG command. This chapter introduces a variety of logs supported by K8 and K9 series OEM board and its structure.

3.1.Conventions

Before beginning to introduce the specific log, you first need to understand some basic conventions, including the command format of the request log and the log output format.

3.1.1.Command Format

In order to correctly parse the log, it is necessary to follow a specific command sending format :

```
LOG <message-type> [trigger] [period] [offset]
```

Please refer to Section [2.2.14](#) for more information about this command.

3.1.2.Log Format

3.1.2.1.Basic Format

The basic format of a log is shown in the following table, which is mainly divided into three parts : log header, data field and CRC check bit.

Field	Description
Header	Contains basic information such as log type and log length.
Data field	Contains information such as specific data parameters.
CRC	It is used to verify the integrity of the data and ensure that the message is not tampered with or damaged during transmission.

3.1.2.2.ASCII Log

3.1.2.2.1.Format

Conventions

- (1)The lead code identifier for each record is '#'.
- (2)Each log or command is of variable length depending on amount of data and formats.
- (3)All data fields are delimited by a comma ',' except for the last header field, which is followed by a ';' to denote the start of the data message, and the last data field, which is followed by a '*' to indicate the end of message data.

(4) Each log ends with a hexadecimal number preceded by an asterisk and followed by a line termination using the carriage return and line feed characters. For example: *1234ABCD[CR][LF], where the data following the '*' is the checksum. The data between '#' and '*' is included in the checksum calculation, excluding '#' and '*'.

Example

```
#TIMEA,COM1,0,60.0,FINESTEERING,2289,440824.150,00000000,0000,1114;VALID,7.2
55332311e-09,0.000000000e+00,-
18.00000000238,2023,11,24,2,26,46150,VALID*502dc24a
```

The ASCII log header structure is shown in [Table 3-1](#):

Table 3-1 ASCII log header structure

Field	Field Name	Description	Field Type	Example
1	Sync	Sync character	Char	#
2	Message	The ASCII name of the log	Char	TIMEA
3	Port	The name of the port from which the log was generated.	Char	COM1
4	Sequence #	Used for multiple related logs. It is a number that counts down from N-1 to 0, where 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0	Long	0
5	%Idle Time	The minimum percentage of time the processor is idle, calculated once per second	Float	60.0
6	Time Status	The value indicates the quality of the GPS reference time (see Table 3-2)	Enum	FINESTEERING
7	Week	GPS reference week number	Ulong	2289
8	Seconds	Seconds from the beginning of the GPS reference week	GPSec	440824.150
9	Receiver Status	An eight digit hexadecimal number representing the status of various hardware and software components of the receiver. The current version is fixed as: 00000000	Ulong	00000000
10	Reserved	Reserved for internal use	Ulong	0000
11	Receiver S/W Version	A value (0 - 65535) representing the receiver software build number	Ulong	1114
12	;	The character indicates the end of the header N	Char	;

Table 3-2 GPS Reference Time Status

GPS Reference Time Status	Description
---------------------------	-------------

UNKNOWN	Time validity is unknown
APPROXIMATE	Time is set approximately
COARSEADJUSTING	Time is approaching coarse precision
COARSE	This time is valid to coarse precision
COARSESTEERING	Time is coarse set and is being steered
FREEWHEELING	Position is lost and the range bias cannot be calculated
FINEADJUSTING	Time is adjusting to fine precision
FINE	Time has fine precision
FINEBACKUPSTEERING	Time is fine set and is being steered by the backup system
FINESTEERING	Time is fine set and is being steered
SATTIME	Time from satellite. Only used in logs containing satellite data such as ephemeris and almanac

3.1.2.2.2. Abbreviated ASCII

The Abbreviated ASCII format is designed to simplify the user's view of the logs. The data uses basic ASCII characters, with fields separated by spaces or commas, and does not include a checksum.

Example

```
log version
```

Abbreviated ASCII Response

```
<VERSION COM1 0 60.0 FINESTEERING 2289 214710.550 00000000 0000 1114
< 1
< GPSCARD "S32352K803" "0909737900000000" "CRDK-803AA-TTT-0"
"610U8-22A02-1" "7.3.8" "2023/Jun/29" "09:37:50"
```

3.1.2.3. Binary Log

Conventions

(1) 3 Sync bytes plus 25-bytes of header information. The header length is variable as fields may be appended in the future. Always check the header length.

(2)The length of the data field is variable depending on the amount and format of the data.

(3)The CRC is a 32-bit CRC performed on all data including the header.

The Binary log header structure is shown in [Table 3-3](#):

Table 3-3 Binary log header structure

Field	Field Name	Field Type	Description	Binary Bytes	Binary Offset
1	Sync	char	Hexadecimal 0xAA	1	0
2	Sync	char	Hexadecimal 0x44	1	1
3	Sync	char	Hexadecimal 0x12	1	2
4	Header Length	uchar	Length of the header	1	3
5	Message ID	ushort	Message ID number of the log	2	4
6	Reserved	-	Reserved for internal use	1	6
7	Reserved	-	Reserved for internal use	1	7
8	Message length	ushort	The length in bytes of the body of the message, not including the header nor the CRC	2	8
9	Reserved	-	Reserved for internal use	2	10
10	Reserved	-	Reserved for internal use	1	12
11	Reserved	-	Reserved for internal use	1	13
12	Week	ushort	GPS reference week number	2	14
13	ms	uint	Milliseconds from the beginning of the GPS reference week	4	16
14	Reserved	-	Reserved for internal use	4	20
15	Reserved	ushort	Reserved for internal use	2	24
16	Receiver S/W Version	ushort	A value (0 - 65535) representing the receiver software build number	2	26



NOTE:

In the current version, the header length is generally 28 bytes (as mentioned later when introducing the binary structure of the log, bytes: H = 28).

3.2.Self-defined Logs

This section mainly introduces Qtalis self-defined log and its format. The currently supported self-defined logs are arranged alphabetically as shown in [Table 3-4](#).

Table 3-4 Self-defined log list

No	ID	Type	Format	Description	Refer to
1	49	BASEPOS	A,B	Base position	3.2.8.2
2	71	BD2EPHEM	B	Decoded BD2 ephemeris	3.2.1.1

3	72	BD3EPHEM	B	Decoded BD3 ephemeris	3.2.1.2
4	741	BD2RAWALM	B	Decoded BD2 Almanac	3.2.1.3
5	412	BD2RAWEPHEM	B	Raw BD2 Ephemeris data	3.2.1.4
6	42	BESTPOS	A,B	Best position	3.2.5.1
7	99	BESTVEL	A,B	Best velocity	3.2.5.2
8	241	BESTXYZ	A,B	Best position and velocity	3.2.5.3
9	1697	B2BRAUNAVSUBFRAME	B	Framed BDS B2b raw navigation message	3.2.1.14
10	317	COMCONFIG	A,B	Configures serial port settings	3.2.2.1
11	1503	DCBINFO	B	Differential code bias information	3.2.10.3
12	723	GLOEPHEMERIS	B	Decoded GLONASS ephemeris	3.2.1.5
13	792	GLORAWEPHEM	B	Raw GLONASS Ephemeris data	3.2.1.6
14	71	GPSEPHEM	B	Decoded GPS ephemeris	3.2.1.7
15	1122	GALEPHEMERIS	B	Decoded Galileo ephemeris	3.2.1.8
16	71	GALEPHEM	B	Decoded Galileo ephemeris(Simplified)	3.2.1.9
17	1797	HASMESS	B	Raw HAS page	3.2.1.15
18	971	HEADING	A,B	Heading information for dual antenna product	3.2.3.1
19	1335	HEADING2	A,B	Heading information with multiple rovers	3.2.3.2
20	8	IONUTC	A,B,Abb	Ionospheric and UTC data	3.2.7.1
21	961	IONOSCIN	B	Ionospheric scintillation monitoring information	3.2.10.1
22	71	IRNEPHEM	B	Decoded IRNSS ephemeris	3.2.1.12
23	5	LOGLIST	A	List of system logs	3.2.2.2
24	925	M925	B	Extended satellite observation message	3.2.7.2
25	181	MARKPOS	A,B	Position at time of mark input event	3.2.4.1
26	231	MARKTIME	A,B	Time of mark input event	3.2.4.2
27	1504	METEMESS	B	Meteorograph information	3.2.10.4
28	174	PSRDOP	B	DOP values for the satellites used in the PSR solution	3.2.5.4
29	47	PSRPOS	A,B,Abb	Pseudorange position	3.2.5.5
30	100	PSRVEL	A,B	Pseudorange velocity	3.2.5.6
31	43	RANGE	A,B,Abb	Satellite range information	3.2.6.1
32	140	RANGECMP	A,B,Abb	Compressed version of the RANGE log	3.2.6.2
33	74	RAWALW	B	Decoded GPS ephemeris	3.2.1.10

34	41	RAWEPHEM	B	Raw GPS ephemeris	3.2.1.11
35	175	REFSTATION	A,B	Base station position and health	3.2.8.1
36	911	SATMSG	B	Satellite message	3.2.7.3
37	48	SATVIS	B	Satellite visibility	3.2.7.4
38	270	SATXYZ	A,B	Satellite positions in ECEF Cartesian coordinates	3.2.7.5
39	2222	SBASRAWFRAME	B	Raw SBAS frame data	3.2.1.13
40	1502	TECINFO	B	Ionospheric total electron content information	3.2.10.2
41	101	TIME	B	Time-related information	3.2.9.1
42	37	VERSION	A,B,Abb	Version information	3.2.2.4

3.2.1. Almanac and Ephemeris

This section introduces the raw or decoded almanac and ephemeris log structure of GNSS satellites.

3.2.1.1. BD2EPHEM

This log contains BD2 ephemeris parameters with appropriate scaling applied.

Log		BD2EPHEM			
Description		Decoded BD2 ephemeris			
Log ID		71			
Recommended Input		<i>log bd2ephemb onchanged</i>			
Supported Format		Binary			
Supported Board		K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BD2EPHEMEM Header	Log header(Refer to Table 3-3)	-	H	0
2	wSize	Log structure size	ushort	2	H
3	bIFlag	Available identifiers for ephemeris	byte	1	H+2
4	bHealth	Satellite health flag	byte	1	H+3
5	ID	Satellite PRN Number	byte	1	H+4
6	bReserved	Reserved for internal use	byte	1	H+5
7	uMsgID	Ignore bit	ushort	2	H+6
8	m_wldle time	Ignore bit	short	2	H+8
9	iodc	Issue of data clock	short	2	H+10
10	accuracy	User range accuracy, m	short	2	H+12

11	week	GPS Week number	ushort	2	H+14
12	iode	Issue of ephemeris data	int	4	H+16
13	tow	Time of week	int	4	H+20
14	toe	Reference time for ephemeris	double	8	H+24
15	toc	SV clock correction term (s)	double	8	H+32
16	af2	Clock aging parameter (s/s/s)	double	8	H+40
17	af1	Clock aging parameter (s/s)	double	8	H+48
18	af0	Clock aging parameter (s)	double	8	H+56
19	Ms0	Mean anomaly of reference time (radians)	double	8	H+64
20	deltan	Mean motion difference (radians/s)	double	8	H+72
21	es	Eccentricity, dimensionless	double	8	H+80
22	roota	Square root of Semi-major axis	double	8	H+88
23	omega0	Longitude of ascending node of orbital of plane at weekly epoch (radians)	double	8	H+96
24	i0	Inclination angle at reference time (radians)	double	8	H+104
25	ws	Argument of perigee (radians)	double	8	H+112
26	omegaot	Rate of right ascension (radians/s)	double	8	H+120
27	itoet	Rate of inclination angle (radians/s)	double	8	H+128
28	cuc	Amplitude of cosine harmonic correction term to the argument of latitude (radians)	double	8	H+136
29	cus	Amplitude of sine harmonic correction term to the argument of latitude (radians)	double	8	H+144
30	crc	Amplitude of cosine harmonic correction term to the orbit radius (m)	double	8	H+152
31	crs	Amplitude of sine harmonic correction term to the orbit radius (m)	double	8	H+160
32	cic	Amplitude of cosine harmonic correction term to the angle of inclination (radians)	double	8	H+168
33	cis	Amplitude of sine harmonic correction term to the angle of inclination (radians)	double	8	H+176
34	tgd	Estimated group delay difference (B1I)	double	8	H+184
35	tgd2	Estimated group delay difference(B2I)	double	8	H+192

36	tgd3	Estimated group delay difference(B1C)	double	8	H+200
37	tgd4	Estimated group delay difference(B2a)	double	8	H+208
38	tgd5	Estimated group delay difference(B2b)	double	8	H+216
39	CRC	32-bit CRC	hex	4	H+224

3.2.1.2.BD3EPHEM

This log contains BD3 ephemeris parameters with appropriate scaling applied.

Log		BD3EPHEM			
Description		Decoded BD3 ephemeris			
Log ID		72			
Recommended Input		<i>log bd3ephemb unchanged</i>			
Supported Format		Binary			
Supported Board		K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BD3EPHEMEM Header	Log header(Refer to Table 3-3)		H	0
2	Prn	Satellite PRN Number (1-63)	uchar	1	H
3	Valid	Available identifiers for ephemeris	uchar	1	H+1
4	sattype	Satellite orbit type: 01: GEO; 10: IGSO; 11: MEO	uchar	1	H+2
5	health	Satellite health flag	uchar	1	H+3
6	URAI	User range accuracy index	uchar	1	H+4
7	IODE	Issue of data, ephemeris	uchar	1	H+5
8	IODC	Issue of data, clock	uchar	1	H+6
9	DIF	Data Integrity Flag	uchar	1	H+7
10	SIF	Data Integrity Flag	uchar	1	H+8
11	AIF	Accuracy Integrity Flag	uchar	1	H+9
12	bEphSource	BD3 ephemeris data source: 1: B1C; 2: B2A	uchar	1	H+10
13	BRsv1	Reserved	uchar	1	H+11
14	Week	BDS week	ushort	2	H+12
15	BRsv2	Reserved	uchar	1	H+14
16	BRsv3	Reserved	uchar	1	H+15
17	toe	Reference time for ephemeris	uint	4	H+16
18	toc	SV clock correction term (s)	uint	4	H+20
19	Delt_A	Semi-major axis difference at reference time (m)	double	8	H+24
20	Dot_A	Change rate in Semi-major axis (m/s)	double	8	H+32

21	Delt_n0	Mean motion difference from computed value (radians/s)	double	8	H+40
22	Dot_n0	Rate of Mean motion difference from computed value (radians/s ²)	double	8	H+48
23	M0	Mean anomaly at reference time (radians)	double	8	H+56
24	e	Eccentricity (unitless)	double	8	H+64
25	w	Argument of perigee (radians)	double	8	H+72
26	Omega0	Longitude of ascending node of orbital of plane at weekly epoch (radians)	double	8	H+80
27	i0	Inclination angle at reference time (radians)	double	8	H+88
28	Omega_dot	Rate of right ascension (radians/s)	double	8	H+96
29	i_dot	Rate of inclination angle (radians/s)	double	8	H+104
30	Cuc	Amplitude of cosine harmonic correction term to the argument of latitude (radians)	double	8	H+112
31	Cus	Amplitude of sine harmonic correction term to the argument of latitude (radians)	double	8	H+120
32	Crc	Amplitude of cosine harmonic correction term to the orbit radius (m)	double	8	H+128
33	Crs	Amplitude of sine harmonic correction term to the orbit radius (m)	double	8	H+136
34	Cic	Amplitude of cosine harmonic correction term to the angle of inclination (radians)	double	8	H+144
35	Cis	Amplitude of sine harmonic correction term to the angle of inclination (radians)	double	8	H+152
36	a0	Constant term of clock correction polynomial (s)	double	8	H+160
37	a1	Linear term of clock correction polynomial (s/s)	double	8	H+168
38	a2	Quadratic term of clock correction polynomial (s/s ²)	double	8	H+176
39	tgdB1Cp	B1C pilot signal component delay difference (s)	double	8	H+184
40	tgdB2ap	B2a pilot signal component delay difference (s)	double	8	H+192
41	tgdB1Cd	B1C data component delay correction	double	8	H+200

		relative to B1C pilot signal component			
42	tgdB2bl	B2b signal I branch delay difference (s)	double	8	H+208
43	CRC	32-bit CRC	hex	4	H+216

3.2.1.3.BD2RAWALM

This log contains the decoded BD2 almanac parameters, with the parity information removed and appropriate scaling applied.

Log	BD2RAWALM				
Description	Decoded BD2 Almanac				
Log ID	741				
Recommended Input	<i>log bd2rawalmb ontime 1</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BD2RAWALM Header	Log header(Refer to Table 3-3)		H	0
2	Ref week	Almanac reference week number	ulong	4	H
3	Ref secs	Almanac reference time (s)	ulong	4	H+4
4	Subframes	number of subframe	ulong	4	H+8
5	svid	Satellite ID	ushort	2	H+12
6	data	Raw message data of subframe	hex	40	H+14
7	Next record offset = H+12+ (Subframes*42)				
	xxxx	32-bit CRC	hex	4	H+12+(42*Subframes)



NOTE:

The length of each subframe in the ephemeris is 10 words (each word is 30 bits, in big-endian format). Subframe 4 pages 1 to 24 and subframe 5 pages 1 to 6 contain the ephemeris data of 30 BDS satellites (refer to Table 5-11-1 and Table 5-11-2 in Beidou ICD 1.0). A word is divided into 4 bytes of data, with the high two bits of the first byte being unused. Therefore, the data of an ephemeris subframe can be represented in 40 bytes, as shown in [Figure 3-1](#).

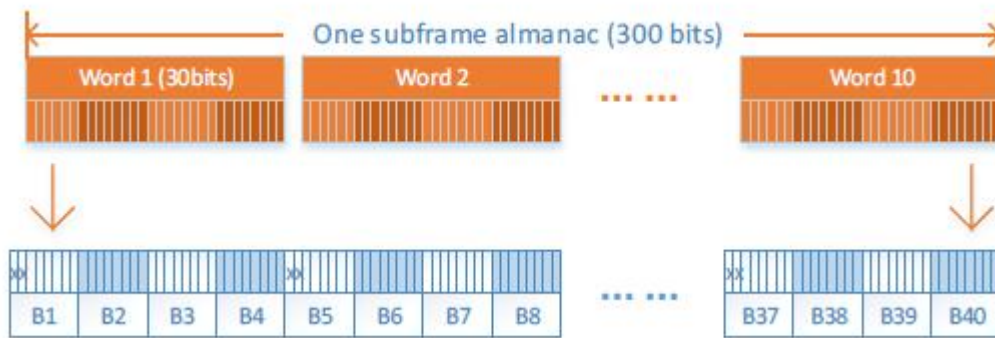


Fig 3-1 Raw Almanac and Subframe Structure for BD2

3.2.1.4.BD2RAWEPHEM

This log contains the raw ephemeris for BD2, with each raw ephemeris information being 400 bytes. Each ephemeris page is 300 bits long. For GEO satellites, subframe 1 broadcasts basic navigation information, transmitted in 10 pages, with each page consisting of 10 words, each word being 30 bits. Note that only the high 150 bits are valid. For IGSO and MEO satellites, subframes 1-3 broadcast basic navigation information, with each subframe consisting of 10 words, totaling 300 bits. Other subframes in the message are invalid. The structure of the page or subframe is shown in [Figure 3-2](#). For more detailed information, please refer to the BD2 ICD.

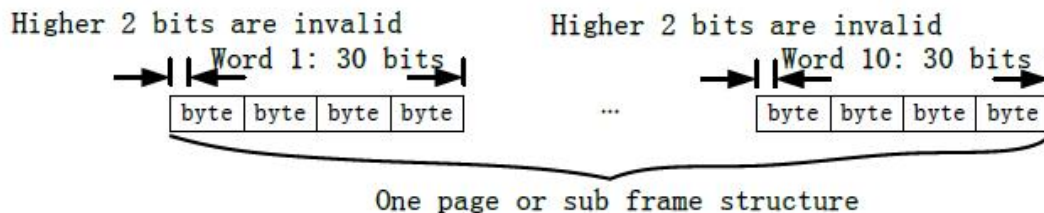


Fig 3-2 Raw Ephemeris and Subframe Structure for BD2

Log	BD2RAWEPHEM				
Description	Raw BD2 Ephemeris data				
Log ID	412				
Recommended Input	<i>log bd2rawephemb onchanged</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	BD2RAWEPHEM header	Log header(Refer to Table 3-3)		H	0
2	prn	PRN identification	ulong	4	H

3	Ref week	BDS reference week, in weeks	ulong	4	H+4
4	Ref secs	GPS reference time, in seconds	ulong	4	H+8
5	Subframe1 or page1	Subframe1 or page1 data	hex	40	H+12
6	Subframe2 or page2	Subframe2 or page2 data	hex	40	H+52
...			
7	Subframe10 or page10	Subframe10 or page10 data	hex	40	H+372
8	xxxx	32-bit CRC	hex	4	H+412

3.2.1.5.GLOEPHEMERIS

This log contains GLONASS ephemeris information. GLONASS ephemerides are referenced to the PZ90.02 geodetic datum. No adjustment between the GPS and GLONASS reference frames are made for positioning. Multiple messages are transmitted, one for each SVID with data.

Log	GLOEPHEMERIS				
Description	Decoded GLONASS ephemeris				
Log ID	723				
Recommended Input	<i>log gloephemerisb unchanged</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GLOEPHEMERIS Header	Log header(Refer to Table 3-3)		H	0
2	Sloto	Slot information offset - PRN identification (Slot + 37).	ushort	2	H
3	freqo	Frequency channel offset in the range 0 to 20	ushort	2	H+2
4	Sat type	Satellite type : 0 = GLO_SAT 1 = GLO_SAT_M 2 = GLO_SAT_K	uchar	1	H+4
5	reserved	Reserved	-	1	H+5
6	e week	GPS reference week, in weeks	ushort	2	H+6
7	e time	GPS reference time, in ms	ulong	4	H+8
8	t offset	Integer seconds between GPS and GLONASS time. A positive value implies GLONASS is ahead of GPS reference	ulong	4	H+12

		time.			
9	Nt	Calendar number of day within 4 year interval starting at Jan 1 of a leap year	ushort	2	H+16
10	reserved	Reserved	-	1	H+18
11	reserved	Reserved	-	1	H+19
12	issue	15 minute interval number corresponding to ephemeris reference time	ulong	4	H+20
13	health	Ephemeris health 0-3=GOOD 4-15=BAD	ulong	4	H+24
14	Pos x	X coordinate for satellite at reference time (PZ-90.02) (m)	double	8	H+28
15	Pos y	Y coordinate for satellite at reference time (PZ-90.02) (m)	double	8	H+36
16	Pos z	Z coordinate for satellite at reference time (PZ-90.02) (m)	double	8	H+44
17	Vel x	X coordinate for satellite velocity at reference time (PZ-90.02) (m/s)	double	8	H+52
18	Vel y	Y coordinate for satellite velocity at reference time (PZ-90.02) (m/s)	double	8	H+60
19	Vel z	Z coordinate for satellite velocity at reference time (PZ-90.02), (m/s)	double	8	H+68
20	LS acc x	X coordinate for lunisolar acceleration at reference time (PZ-90.02), (m/s/s)	double	8	H+76
21	LS acc y	Y coordinate for lunisolar acceleration at reference time (PZ-90.02) (m/s/s)	double	8	H+84
22	LS acc z	Z coordinate for lunisolar acceleration at reference time (PZ-90.02) (m/s/s)	double	8	H+92
23	Tau_n	Correction to the nth satellite time t_n relative to GLONASS time t_c (s)	double	8	H+100
24	Delta_tau_n	Time difference between navigation RF signal transmitted in L2 sub-band and navigation RF signal transmitted in L1 sub-band by nth satellite (s)	double	8	H+108
25	Gamma	Frequency correction (s/s)	double	8	H+116
26	Tk	Time of frame start (since start of GLONASS day) (s)	ulong	4	H+124
27	P	Technological parameter	ulong	4	H+128
28	Ft	User range	ulong	4	H+132
29	age	Age of data (days)	ulong	4	H+136

30	Flag	Information flags, see Table 3-5	ulong	4	H+140
31	xxxxx	32-bit CRC	hex	4	H+144

Table 3-5 GLONASS Ephemeris Flags Coding

Nibble Number	BIT	MASK	Description	Range Values
N0	0	0x00000001	P1 Flag - Time interval between adjacent values of (tb) parameter in minutes	00: 0 minutes
	1	0x00000002		01: 30 minutes
	2	0x00000004		10: 45 minutes
	3	0x00000008		11: 60 minutes
N1-N7	4-31	...	Reserved	

3.2.1.6. GLORAWEPHEM

This log contains the raw ephemeris frame data as received from the GLONASS satellite.

Log	GLORAWEPHEM				
Description	Raw GLONASS Ephemeris data				
Log ID	792				
Recommended Input	<i>log glorawephem b onchanged</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GLORAWEPHEM header	Log header(Refer to Table 3-3)		H	0
2	Sloto	PRN identification (Slot + 37)	ushort	2	H
3	freqo	Frequency channel offset in the range 0 to 20	ushort	2	H+2
4	Sigchan	Signal channel number	ulong	4	H+4
5	Week	GPS reference week, in weeks	ulong	4	H+8
6	Time	GPS reference time, in milliseconds (binary data) or seconds (ASCII data)	ulong	4	H+12
7	#recs	Number of records to follow	ulong	4	H+16
8	String	GLONASS data string	string	11	H+20
9	Reserved	Reserved	uchar	1	H+31
10	Next record offset = H+20+(#recs*12)				

	xxxx	32-bit CRC	hex	4	H+20+(#recs* 12)
--	------	------------	-----	---	------------------



NOTE:

- ❖ The navigation messages in the GLORAWEPH are broadcast in four streams.
- ❖ Each of the first four streams contains a total of 84 bits, arranged from bit 84 to bit 4 in a high-to-low order.
- ❖ According to the GLORAWEPHEM, the GLONASS data stream consists of 88 bits (11 bytes), with the first 4 bits set to 0000, and the remaining 84 bits used to store the GLONASS navigation message from bit 84 to bit 1. An additional byte is reserved after these 11 bytes, as shown in [Figure 3-3](#):

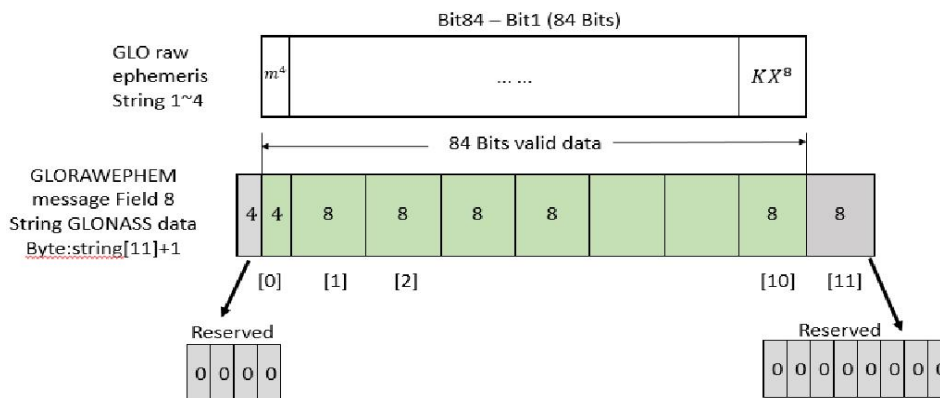


Fig 3-3 Structure of the GLONASS Raw Ephemeris Stream

3.2.1.7.GPSEPHEM

This log contains a single set of GPS(QZSS) ephemeris parameters.

Log	GPSEPHEM				
Description	Decoded GPS ephemeris				
Log ID	71				
Recommended Input	<i>log gpsephem onchanged</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GPSEPHEM Header	Log header(Refer to Table 3-3)		H	0
2	wSize	Log structure size	ushort	2	H
3	blFlag	Available identifiers for ephemeris	byte	1	H+2

4	bHealth	Satellite health flag	byte	1	H+3
5	ID	Satellite PRN Number (1-203) GPS: 1-32, BDS: 141-203 Galileo: 71-106, QZSS: 131-140	byte	1	H+4
6	bReserved	Reserved for internal use	byte	1	H+5
7	uMsgID	Ignore bit	ushort	2	H+6
8	m_wldle time	Ignore bit	short	2	H+8
9	iodc	Issue of data clock	short	2	H+10
10	accuracy	User range accuracy (m). Refer to GPS ICD IS-GPS-200-VD.	short	2	H+12
11	week	GPS Week number	ushort	2	H+14
12	iode	Issue of ephemeris data	int	4	H+16
13	tow	Time of week	int	4	H+20
14	toe	Reference time for ephemeris	double	8	H+24
15	toc	SV clock correction term (s)	double	8	H+32
16	af2	Clock aging parameter (s/s/s)	double	8	H+40
17	af1	Clock aging parameter (s/s)	double	8	H+48
18	af0	Clock aging parameter (s)	double	8	H+56
19	Ms0	Mean anomaly of reference time (radians)	double	8	H+64
20	deltan	Mean motion difference (radians/s)	double	8	H+72
21	es	Eccentricity, dimensionless	double	8	H+80
22	rootA	Square root of Semi-major axis	double	8	H+88
23	omega0	Right ascension (radians)	double	8	H+96
24	i0	Inclination angle at reference time (radians)	double	8	H+104
25	ws	Argument of perigee (radians)	double	8	H+112
26	omegaot	Rate of right ascension (radians/s)	double	8	H+120
27	itoet	Rate of inclination angle (radians/s)	double	8	H+128
28	cuc	Amplitude of cosine harmonic correction term to the argument of latitude (radians)	double	8	H+136
29	cus	Amplitude of sine harmonic correction term to the argument of latitude (radians)	double	8	H+144
30	crc	Amplitude of cosine harmonic correction term to the orbit radius (m)	double	8	H+152
31	crs	Amplitude of sine harmonic correction term to the orbit radius (m)	double	8	H+160

32	cic	Amplitude of cosine harmonic correction term to the angle of inclination (radians)	double	8	H+168
33	cis	Amplitude of sine harmonic correction term to the angle of inclination (radians)	double	8	H+176
34	tgd	Estimated group delay difference	double	8	H+184
35	Reserved	Reserved	double	8	H+192
36	Reserved	Reserved	double	8	H+200
37	Reserved	Reserved	double	8	H+208
38	Reserved	Reserved	double	8	H+216
39	CRC	32-bit CRC	hex	4	H+224

3.2.1.8.GALEPHEMERIS

This log contains the Galileo F/NAV and I/NAV ephemeris information.

Log	GALEPHEMERIS				
Description	Decoded Galileo ephemeris				
Log ID	1122				
Recommended Input	<i>log galephemerisb onchanged</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GALEPHEMERIS Header	Log header(Refer to Table 3-3)		H	0
2	SatId	Satellite identifier (1-36)	ulong	4	H
3	FNAVReceived	0: Indicates that no F/NAV ephemeris data has been received 1: Indicates receipt of F/ NAV ephemeris data	bool	4	H+4
4	INAVReceived	0: Indicates that no I/NAV ephemeris data has been received 1: Indicates receipt of I/ NAV ephemeris data	bool	4	H+8
5	E1BHealth	E1B health status bits(only valid when the I/NAV data is received)	uchar	1	H+12
6	E5aHealth	E5a health status bits (only valid when the F/NAV data is received)	uchar	1	H+13

7	E5bHealth	E5b health status bits (only valid when the I/NAV data is received)	uchar	1	H+14
8	E1BDVS	E1B data validity status (only valid when the I/NAV data is received)	uchar	1	H+15
9	E5aDVS	E5a data validity status (only valid when the F/NAV data is received)	uchar	1	H+16
10	E5bDVS	E5b data validity status (only valid when the I/NAV data is received)	uchar	1	H+17
11	SISA	Signal in space accuracy (unitless)	uchar	1	H+18
12	Reserved	Reserved	uchar	1	H+19
13	IODNav	Issue of data ephemeris	ulong	4	H+20
14	Toe	Ephemeris reference time (s)	ulong	4	H+24
15	RootA	Square root of semi-major axis	double	8	H+28
16	DeltaN	Mean motion difference (radians/s)	double	8	H+36
17	M0	Mean anomaly at ref time (radians)	double	8	H+44
18	Ecc	Eccentricity (unitless)	double	8	H+52
19	Omega	Argument of perigee (radians)	double	8	H+60
20	Cuc	Amplitude of the cosine harmonic correction term to the argument of latitude (radians)	double	8	H+68
21	Cus	Amplitude of the sine harmonic correction term to the argument of latitude (radians)	double	8	H+76
22	Crc	Amplitude of the cosine harmonic correction term to the orbit radius (m)	double	8	H+84
23	Crs	Amplitude of the sine harmonic correction term to the orbit radius (m)	double	8	H+92
24	Cic	Amplitude of the cosine harmonic correction term to the angle of inclination (radians)	double	8	H+100
25	Cis	Amplitude of the sine harmonic correction term to the angle of inclination (radians)	double	8	H+108
26	I0	Inclination angle at ref time (radians)	double	8	H+116
27	IDot	Rate of inclination angle (radians/s)	double	8	H+124
28	Omega0	Longitude of ascending node of orbital plane at weekly epoch (radians)	double	8	H+132
29	OmegaDot	Rate of right ascension (radians/s)	double	8	H+140
30	FNAVToC	Clock correction data reference time of week from the F/NAV message (s)	ulong	4	H+148
31	FNAVAf0	SV clock bias correction coefficient from	double	8	H+152

		the F/NAV message (s) (FNAVReceived = 1 only)			
32	FNAVAf1	SV clock drift correction coefficient from the F/NAV message (s/s) (FNAVReceived = 1 only)	double	8	H+160
33	FNAVAf2	SV clock drift rate correction coefficient from the F/NAV message (s/s ²) (FNAVReceived = 1 only)	double	8	H+168
34	INAVToc	Clock correction data reference time of week from the I/NAV message (s) (INAVReceived = 1 only)	ulong	4	H+176
35	INAVAf0	SV clock bias correction coefficient from the I/NAV message (s) (INAVReceived = 1 only)	double	8	H+180
36	INAVAf1	SV clock drift correction coefficient from the I/NAV message (s/s) (INAVReceived = 1 only)	double	8	H+188
37	INAVAf2	SV clock drift rate correction coefficient from the I/NAV message (s/s ²) (INAVReceived = 1 only)	double	8	H+196
38	E1E5aBGD	E1, E5a broadcast group delay	double	8	H+204
39	E1E5bBGD	E1, E5B broadcast group delay (INAVReceived = 1 only)	double	8	H+212
40	xxxx	32-bit CRC	hex	4	H+220

3.2.1.9.GALEPHEM

This log contains a single set of Galileo ephemeris parameters.

Log	GALEPHEM				
Description	Decoded Galileo ephemeris				
Log ID	71				
Recommended Input	<i>log galephem b unchanged</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	GALEPHEM Header	Log header(Refer to Table 3-3)		H	0
2	wSize	Log structure size	ushort	2	H
3	bFlag	Available identifiers for ephemeris	byte	1	H+2
4	bHealth	Satellite health flag	byte	1	H+3

5	ID	Satellite PRN Number (1-203) GPS: 1-32, BDS: 141-203 Galileo: 71-106, QZSS: 131-140	byte	1	H+4
6	bReserved	Reserved for internal use	byte	1	H+5
7	uMsgID	Ignore bit	ushort	2	H+6
8	m_wldle time	Ignore bit	short	2	H+8
9	iodc	Issue of data clock	short	2	H+10
10	accuracy	User range accuracy (m). Refer to GPS ICD IS-GPS-200-VD.	short	2	H+12
11	week	GPS Week Number	ushort	2	H+14
12	iode	Issue of ephemeris data	int	4	H+16
13	tow	Time of week	int	4	H+20
14	toe	Reference time for ephemeris	double	8	H+24
15	toc	SV clock correction term (s)	double	8	H+32
16	af2	Clock aging parameter (s/s/s)	double	8	H+40
17	af1	Clock aging parameter (s/s)	double	8	H+48
18	af0	Clock aging parameter (s)	double	8	H+56
19	Ms0	Mean anomaly of reference time (radians)	double	8	H+64
20	deltan	Mean motion difference (radians/s)	double	8	H+72
21	es	Eccentricity, dimensionless	double	8	H+80
22	rootA	Square root of Semi-major axis	double	8	H+88
23	omega0	Right ascension (radians)	double	8	H+96
24	i0	Inclination angle at reference time (radians)	double	8	H+104
25	ws	Argument of perigee (radians)	double	8	H+112
26	omegaot	Rate of right ascension (radians/s)	double	8	H+120
27	itoet	Rate of inclination angle (radians/s)	double	8	H+128
28	cuc	Amplitude of cosine harmonic correction term to the argument of latitude (radians)	double	8	H+136
29	cus	Amplitude of sine harmonic correction term to the argument of latitude (radians)	double	8	H+144
30	crc	Amplitude of cosine harmonic correction term to the orbit radius (m)	double	8	H+152
31	crs	Amplitude of sine harmonic correction term to the orbit radius (m)	double	8	H+160
32	cic	Amplitude of cosine harmonic	double	8	H+168

		correction term to the angle of inclination (radians)			
33	cis	Amplitude of sine harmonic correction term to the angle of inclination (radians)	double	8	H+176
34	tgd	Estimated group delay difference (E1, E5A)	double	8	H+184
35	tgd2	Estimated group delay difference (E1, E5B)	double	8	H+192
36	Reserved	Reserved	double	8	H+200
37	Reserved	Reserved	double	8	H+208
38	Reserved	Reserved	double	8	H+216
39	CRC	32-bit CRC	hex	4	H+224

3.2.1.10.RAWALM

This log contains the undecoded GPS almanac subframes as received from the satellite.

Log	RAWALM				
Description	Decoded GPS ephemeris				
Log ID	74				
Recommended Input	<i>log rawalmb</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	RAWALM header	Log header(Refer to Table 3-3)		H	0
2	Ref week	Almanac reference week number	ulong	4	H
3	Ref secs	Almanac reference time (s)	ulong	4	H+4
4	Subframes	Number of subframes to follow	ulong	4	H+8
5	Svid	Satellite ID	ushort	2	H+12
6	Data	Subframe page data	hex	30	H+14
7	Next subframe offset=H+12+ (subframes*32)				
8	xxxx	32-bit CRC	hex	4	H+12+(32*subframes)

3.2.1.11.RAWEPHEM

This log contains the raw binary information for subframes one, two and three from the GPS satellite signal with the parity information removed.

Log	RAWEPHEM				
Description	Raw GPS ephemeris				
Log ID	41				
Recommended Input	<i>log rawephemb onchanged</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	RAWEPHEM header	Log header(Refer to Table 3-3)		H	0
2	Prn	Satellite PRN number	ulong	4	H
3	Ref week	Ephemeris reference week number	ulong	4	H+4
4	Ref secs	Ephemeris reference time (s)	ulong	4	H+8
5	Subframe1	Subframe 1 data	hex	30	H+12
6	Subframe2	Subframe 2 data	hex	30	H+42
7	Subframe3	Subframe 3 data	hex	30	H+72
8	xxxx	32-bit CRC	hex	4	H+102


NOTE:

- ❖ Subframe1: Word1-Word10
- ❖ Subframe2: Word11-Word20
- ❖ Subframe3: Word21-Word30
- ❖ Each Word has 24 bits, occupying 3 bytes in the subframe.

3.2.1.12.IRNEPHEM

This log contains IRNSS ephemeris parameters.

Log	IRNEPHEM				
Description	Decoded IRNSS ephemeris				
Log ID	71				
Recommended Input	<i>log IRNEPHEMB onchanged</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	IRNEPHEM Header	Log header(Refer to Table 3-3)		H	0
2	wSize	Log structure size	ushort	2	H
3	blFlag	Available identifiers for ephemeris	byte	1	H+2

4	bHealth	Satellite health flag	byte	1	H+3
5	ID	Satellite PRN Number (1-203) GPS: 1-32, BDS: 141-203 Galileo: 71-106, QZSS: 131-140	byte	1	H+4
6	bReserved	Reserved for internal use	byte	1	H+5
7	uMsgID	Ignore bit	ushort	2	H+6
8	m_wldle time	Ignore bit	short	2	H+8
9	iodc	Issue of data clock	short	2	H+10
10	accuracy	User range accuracy (m). Refer to GPS ICD IS-GPS-200-VD.	short	2	H+12
11	week	GPS Week Number	ushort	2	H+14
12	iode	Issue of ephemeris data	int	4	H+16
13	tow	Time of week	int	4	H+20
14	toe	Reference time for ephemeris	double	8	H+24
15	toc	SV clock correction term (s)	double	8	H+32
16	af2	Clock aging parameter (s/s/s)	double	8	H+40
17	af1	Clock aging parameter (s/s)	double	8	H+48
18	af0	Clock aging parameter (s)	double	8	H+56
19	Ms0	Mean anomaly of reference time (radians)	double	8	H+64
20	deltan	Mean motion difference (radians/s)	double	8	H+72
21	es	Eccentricity, dimensionless	double	8	H+80
22	rootA	Square root of Semi-major axis	double	8	H+88
23	omega0	Right ascension (radians)	double	8	H+96
24	i0	Inclination angle at reference time (radians)	double	8	H+104
25	ws	Argument of perigee (radians)	double	8	H+112
26	omegaot	Rate of right ascension (radians/s)	double	8	H+120
27	itoet	Rate of inclination angle (radians/s)	double	8	H+128
28	cuc	Amplitude of cosine harmonic correction term to the argument of latitude (radians)	double	8	H+136
29	cus	Amplitude of sine harmonic correction term to the argument of latitude (radians)	double	8	H+144
30	crc	Amplitude of cosine harmonic correction term to the orbit radius (m)	double	8	H+152
31	crs	Amplitude of sine harmonic correction term to the orbit radius (m)	double	8	H+160

32	cic	Amplitude of cosine harmonic correction term to the angle of inclination (radians)	double	8	H+168
33	cis	Amplitude of sine harmonic correction term to the angle of inclination (radians)	double	8	H+176
34	tgd	Estimated group delay difference	double	8	H+184
35	Reserved	Reserved	double	8	H+192
36	Reserved	Reserved	double	8	H+200
37	Reserved	Reserved	double	8	H+208
38	Reserved	Reserved	double	8	H+216
39	CRC	32-bit CRC	hex	4	H+224

3.2.1.13.SBASRAWFRAME

This log contains Raw SBAS frame data.

Log		SBASRAWFRAME				
Description		Raw SBAS frame data				
Log ID		2222				
Recommended Input		<i>log SBASRAWFRAME onchanged</i>				
Supported Format		Binary				
Supported Board		K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	
1	SBASRAWFRAME Header	Log header(Refer to Table 3-3)		H	0	
2	Week	GPS Week number	INT	4	H	
3	Tow	Number of seconds into GPS week	INT	4	H+4	
4	Prn	SBAS satellite PRN number		UINT	1	H+8
		Type	PRN			
		WAAS	133-135,138			
		EGNOS	123-124, 126, 136			
		MSAS	129, 137			
		GAGAN	127-128, 132			
		SDCM	125, 139-141			
BDS	130, 143-144					
SPAN	122					
5	SbasRawFrame (L1CA)	RAW SBAS L1C / A subframe, a total of 264 bits, of which the first 6 bits and the last 8 bits are invalid, the effective	HEX	33	H+9	

		number of bits is 250 bits.			
	Crc	32-bit CRC	HEX	4	H+42



NOTE:

The specific content can refer to the corresponding ICD files of each SBAS system (the structure of Qtalisis header is different from the ICD files of each SBAS system, see [Table 3-3](#)). Some SBAS satellites, such as satellite 129, are currently unavailable. For more information, please refer to the official website of each SBAS system.

3.2.1.14.B2BRAWNAVSUBFRAME

This log provides the framed BeiDou navigation message for the BeiDou B2b signals in raw bit format.

Log		B2BRAWNAVSUBFRAME		
Description		Framed BDS B2b raw navigation message		
Log ID		1697		
Recommended Input		<i>log B2BRAWNAVSUBFRAMEb ontime 1</i>		
Supported Format		Binary		
Supported Board		K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922		
Log structure				
ID	Field	Description	Format	Binary Bit
1	B2BRAWNAVSUBFRAME Header	Log header(Refer to Table 3-3)		H
2	PRN	Satellite ID / PRN	unit	32
3	PRN	The two PRN numbers in the log should be the same		6
4	Reserved	Reserved identifier bits (When the highest bit is 1, it indicates that the PPP service for this satellite is unavailable; when the highest bit is 0, it indicates the PPP service is available for this satellite. Other symbol bits are reserved.)		6
5	B2BRAWNAVSUBFRAME	Framed raw navigation data, with a total of 972 bits (for valid bits, please refer to the PPP B2b ICD file; the remaining bits are reserved by Qtalisis).		972
6	CRC	32-bit CRC	hex	32

3.2.1.15.HASMESS

This log provides Galileo raw navigation page data from Galileo E6-B signals.

Log	HASMESS
-----	----------------

Description		Raw HAS page															
Log ID		1797															
Recommended Input		<i>log HASMESS ontime 1</i>															
Supported Format		Binary															
Supported Board		K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922															
Log structure																	
ID	Field	Description	Format	Binary Bit													
1	HASMESS Header	Log header(Refer to Table 3-3)		H													
2	Flag	Availability of satellite flags	ushort	2													
3	HASMESS	Raw navigation page data :	Hex	512													
		<table border="1"> <thead> <tr> <th>Field</th> <th>Binary Bit</th> </tr> </thead> <tbody> <tr> <td>Reserved</td> <td>14</td> </tr> <tr> <td>HAS page</td> <td>448</td> </tr> <tr> <td>CRC</td> <td>24</td> </tr> <tr> <td>Tail</td> <td>6</td> </tr> <tr> <td>Invalid</td> <td>20</td> </tr> </tbody> </table>				Field	Binary Bit	Reserved	14	HAS page	448	CRC	24	Tail	6	Invalid	20
		Field				Binary Bit											
		Reserved				14											
		HAS page				448											
		CRC				24											
Tail	6																
Invalid	20																
Please refer to the Galileo HAS ICD file for details.																	
	CRC	32-bit CRC	Hex	32													

3.2.2. Configuration and State Query

3.2.2.1. COMCONFIG

This log provides the configuration of the serial port, such as baud rate, COM ID and so on.

Log	COMCONFIG					
Description	Configures serial port settings					
Log ID	317					
Recommended Input	<i>log comconfiga</i>					
Supported Format	ASCII,Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#COMCONFIGA, COM1, 0, 60.0, FINESTEERING, 2222, 199836.650, 00000000, 0000, 1114; COM1, 115200, 0, 8, 1, 0, 0, 1, 1, 1, COM2, 115200, 0, 8, 1, 0, 0, 1, 1, 1, COM3, 115200, 0, 8, 1, 0, 0, 1, 1, 1, COM4, 921600, 0, 8, 1, 0, 0, 1, 27, 27, COM5, 115200, 0, 8, 1, 0, 0, 1, 1, 1*9df517d9					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example

1	COMCONFIG Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#COMCONFIG,COM1,0,60.0,FINESTEE RING,2222,19983 6.650,00000000,00 00,1114
2	#port	-	long	4	H	
3	Port	Port identifier	enum	4	H+4	COM1
4	baud	Communication baud rate	ulong	4	H+8	115200
5	parity	Parity	enum	4	H+12	0
6	databits	Number of data bits	ulong	4	H+16	8
7	stopbits	Number of stop bits	ulong	4	H+20	1
8	handshake	Handshaking	enum	4	H+24	0
9	echo	0=OFF, Sets port echo to off 1=ON, Sets port echo to on	enum	4	H+28	0
10	breaks	0=OFF, Disable break detection 1=ON, Enable break detection	enum	4	H+32	1
11	rx type	Receive mode state	enum	4	H+36	1
12	tx type	Transmit mode state	enum	4	H+40	1
13	Next port offset = H+4+(port*44)					
14	xxxx	32-bit CRC	hex	4	H+4+(#port*44)	*9df517d9
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	

3.2.2.2. LOGLIST

This log lists which messages are currently being logged to each port and when.

Log	LOGLIST
Description	List of system logs
Log ID	5
Recommended Input	<i>log loglista once</i>
Supported Format	ASCII
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	#LOGLISTA,COM3,0,60.0,FINESTEE RING,2330,368591.450,00 000000,0000,1114;COM3,PSRPOS,ASCII,ONTIME,1.000,0.000 ,COM3,PSRDOP,ASCII,ONTIME,1.000,0.000,COM3,GPGGA,ABBA

SCII, ONTIME, 1.000, 0.000, *d8a50251				
Log structure				
ID	Field	Description	Format	ASCII Example
1	LOGLIST (ASCII) Header	Log header(Refer to Table 3-3)		#LOGLISTA,COM3,0,60.0,FINESTEERING,2330,368591.450,00000000,0000,1114;
2	#log	Number of messages to follow, maximum = 64	long	
3	Port	Output port	enum	COM3
4	Message	The ASCII name of the log	char	PSRPOS
5	Message format	Message format: ASCII, Abbreviated ASCII, Binary	char	ASCII
6	Trigger	Trigger: ONCHANGED, ONTIME, ONTRACKED	enum	ONTIME
7	Period	Log period for ONTIME	double	1.000
8	offset	Offset for period (ONTIME trigger)		0.000
...	Next log...		enum	...
	CRC	32-bit CRC	hex	*d8a50251
	[CR][LF]	Sentence terminator (ASCII only)	-	

3.2.2.3.VERSION

This log contains the version information for all components of a system.

Log	VERSION
Description	Version information
Log ID	37
Recommended Input	<i>log version</i> <i>log versiona</i> <i>log versionb</i>
Supported Format	ASCII, Abbreviated ASCII, Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
Abbreviated ASCII Example	<pre><VERSION COM1 0 60.0 FINESTEERING 2289 214710.550 00000000 0000 1114 < 1 < GPSCARD "S32352K803" "0909737900000000" "CRDK- 803AA-TTT-0" "610U8-22A02-1" "7.3.8" "2023/Jun/29" "09:37:50"</pre>

Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	Abbreviated ASCII Example
1	VERSION Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	<VERSION COM1 0 60.0 FINESTEERING 2289 214710.550 00000000 0000 1114
2	#comp	Number of components, value=1	long	4	H	1
3	Type	Component type, value=0	enum	4	H+4	GPSCARD
4	Model	Firmware model number (Refer to Figure 3-4)	char	16	H+8	S32352K803
5	PSN	Product serial number (Refer to Figure 3-5)	char	16	H+24	0909737900000000
6	Hw version	Hardware version (Refer to Figure 3-6)	char	16	H+40	CRDK-803AA-TTT-0
7	Sw version	Firmware version (Refer to Figure 3-7)	char	16	H+56	610U8-22AO2-1
8	Boot version	Boot code version	char	16	H+72	7.3.8
9	Comp date	Firmware compile date in the format	char	12	H+88	2023/Jun/29
10	Comp time	Firmware compile time in the format	char	12	H+100	09:37:50
11	CRC	32-bit CRC	hex	4	H+112	-
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]



Fig 3-4 Model

NOTE:

The numbers in [Figure 3-4](#) represent the frequency numbers of the corresponding GNSS system, which are expressed as GPS, GLONASS, Galileo and BDS in turn.

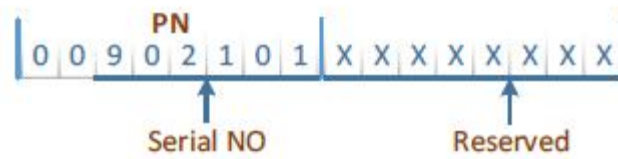


Fig 3-5 Product serial number

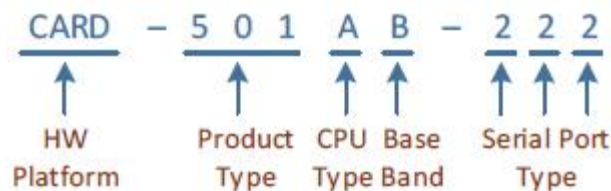


Fig 3-6 Hardware version

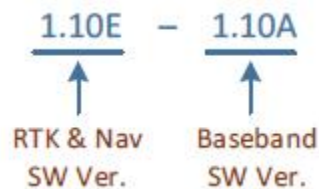


Fig 3-7 Firmware version

3.2.3.Heading, Pitch or Roll

3.2.3.1.HEADING

The heading is the angle from True North of the primary antenna to secondary antenna vector in a clockwise direction.

Log	HEADING
Description	Heading information for dual antenna product
Log ID	971
Recommended Input	<i>log headinga ontime 1</i> <i>log headingb ontime 1</i>
Supported Format	ASCII, Binary
Supported Board	K823/K825/K827/K922
ASCII Example	#HEADINGA, COM1, 0, 60.0, FINESTEERING, 2221, 209051.000, 0000000, 0000, 1114; SOL_COMPUTED, NARROW_INT, 4.069750309, 242.861648560, -0.034470331, 0.000000000, 0.383065701, 0.681626320, "0004", 48, 40, 48, 48, 0, 0, 4, 75*39d47654

Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	HEADING Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#HEADINGA,COM1,0,60.0,FINESTEERING,2221,209051.000,00000000,0000,1114;
2	Sol stat	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	Pos type	Position type, see Table 3-7	enum	4	H+4	NARROW_INT
4	Length	Baseline length in metres (0-3000 m)	float	4	H+8	4.069750309
5	Heading	Heading in degrees (0-360.0°)	float	4	H+12	242.861648560
6	Pitch	Pitch (±90 degrees)	float	4	H+16	-0.034470331
7	Reserved	float	4	H+20	0	
8	Hdg std dev	Heading standard deviation in degrees	float	4	H+24	0.383065701
9	Pitch std	Pitch standard deviation in degrees	float	4	H+28	0.681626320
10	Stn ID	Station ID string	char[4]	4	H+32	0004
11	#SVs	Number of satellites tracked	uchar	1	H+36	48
12	#solnSVs	Number of satellites used in solution	uchar	1	H+37	40
13	#obs	Number of satellites above the elevation mask angle	uchar	1	H+38	48
14	#multi	Number of satellites above the elevation mask angle with L2 frequency signals	uchar	1	H+39	48
15	reserved	Reserved	uchar	1	H+40	0
16	Ext sol stat	Extended solution status (default value = 0)	uchar	1	0	0
17	Reserved	Reserved	uchar	1	H+42	4
18	Sig mask	Signals used mask, if it is 0, indicates that the signal does not participate in the solution, (refer to Table 3-9).	uchar	1	H+43	75
19	xxxx	32-bit CRC	hex	4	H+44	*39d47654
20	[CR][LF]	Sentence terminator (ASCII	-	-	-	

		only)				
--	--	-------	--	--	--	--

3.2.3.2. HEADING2

The heading is the angle from True North of the base to rover vector in a clockwise direction. This log structure is similar to the HEADING log, but there is an additional flow rover station ID field.

Log	HEADING2					
Description	Heading information with multiple rovers					
Log ID	1335					
Recommended Input	<i>log heading2a ontime 1</i> <i>log heading2b ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#HEADING2A,COM1,0,60.0,FINESTEERING,2222,369175.000,0000000,0000,1114;SOL_COMPUTED,NARROW_INT,8037.669433594,209.430999756,51.060379028,0.000000000,0.200168282,0.400303006,"0008","",45,40,45,45,0,0,4,203*1308409f					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	HEADING2 Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#HEADING2A,COM1,0,60.0,FINESTEERING,2222,369175.000,00000000,0000,1114;
2	Sol stat	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	Pos type	Position type, see Table 3-7	enum	4	H+4	NARROW_INT
4	Length	Baseline length in metres (0-3000 m)	float	4	H+8	8037.669433594
5	Heading	Heading in degrees (0-360.0°)	float	4	H+12	209.430999756
6	Pitch	Pitch (±90 degrees)	float	4	H+16	51.060379028
7	Reserved	float	float	4	H+20	0
8	Hdg std dev	Heading standard deviation in degrees	float	4	H+24	0.200168282
9	Pitch std	Pitch standard deviation in degrees	float	4	H+28	0.400303006
10	Rover stn ID	Rover Receiver ID	char[4]	4	H+32	0008

11	Masterstn ID	Base Receiver ID	char[4]	4	H+36	
12	#SVs	Number of satellites tracked	uchar	1	H+40	45
13	#solnSVs	Number of satellites used in solution	uchar	1	H+41	40
14	#obs	Number of satellites above the elevation mask angle	uchar	1	H+42	45
15	#multi	Number of satellites above the elevation mask angle with L2 frequency signals	uchar	1	H+43	45
16	reserved	Reserved	uchar	1	H+44	0
17	Ext sol stat	Extended solution status (Default value = 0)	uchar	1	H+45	0
18	Reserved	Reserved	uchar	1	H+46	4
19	Sig mask	Signals used mask, if it is 0, indicates that the signal does not participate in the solution, (refer to Table 3-9).	uchar	1	H+47	203
20	xxxx	32-bit CRC	hex	4	H+48	*1308409F
21	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	

3.2.4.Mark Input

3.2.4.1.MARKPOS

This log contains the estimated position of the antenna when a pulse is detected at a mark input.

Log	MARKPOS
Description	Position at time of mark input event
Log ID	181
Recommended Input	<i>log markposa onnew</i> <i>log markposb onnew</i>
Supported Format	ASCII, Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	#MARKPOSA, COM1, 0, 60.0, FINESTEERING, 2217, 386379.001, 0000 0000, 0000, 1114; SOL_COMPUTED, NARROW_INT, 31.34998702572, 1 21.29245975444, 26.3427, 10.3048, WGS84, 0.0125, 0.0125, 0.01 90, "0008", 0.000, 1268.000, 47, 40, 47, 47, 198, 0, 4, 25*053c862

		b				
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	MARKPOS Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#MARKPOSA,COM1,0,60.0,FINESTEERING,2217,386379.001,00000000,0000,1114
2	Sol stat	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	Pos type	Position type, see Table 3-7	enum	4	H+4	NARROW_INT
4	Lat	Latitude (degrees)	double	8	H+8	31.34998702572
5	Lon	Longitude (degrees)	double	8	H+16	121.29245975444
6	Hgt	Height above mean sea level (m)	double	8	H+24	26.3427
7	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid (m)	float	4	H+32	10.3048
8	Datum id#	Datum ID number	enum	4	H+36	WGS84
9	lat σ	Latitude standard deviation (m)	float	4	H+40	0.0125
10	lon σ	Longitude standard deviation (m)	float	4	H+44	0.0125
11	hgt σ	Height standard deviation (m)	float	4	H+48	0.0190
12	Stn id	Base station ID	char[4]	4	H+52	0008
13	Diff_age	Differential age in seconds	float	4	H+56	0.000
14	Sol_age	Solution age in seconds	float	4	H+60	1268.000
15	#SVs	Number of satellites tracked	uchar	1	H+64	47
16	#solnSVs	Number of satellites used in solution	uchar	1	H+65	40
17	reserved	Reserved	uchar	1	H+66	47
18	reserved	Reserved	uchar	1	H+67	47
19	reserved	Reserved	uchar	1	H+68	198
20	Ext sol stat	Extended solution status (Default value = 0)	hex	1	H+69	0
21	reserved	Reserved	hex	1	H+70	4
22	Sig mask	Signals used mask, if it is 0, indicates that the signal does not participate in the solution, (refer to Table 3-9).	hex	1	H+71	25
23	xxxx	32-bit CRC	hex	4	H+72	*053C862b

24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	
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3.2.4.2.MARKTIME

This log contains the time of the leading edge of the detected mark input pulse.

Log	MARKTIME					
Description	Time of mark input event					
Log ID	231					
Recommended Input	<i>log marktimea onnew</i> <i>log marktimeb onnew</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#MARKTIME,COM1,0,60.0,FINESTEERING,2217,386379.001,0000000,0000,1114;2217,386379.000970600,-2.426844596e-09,2.250981603e-09,-18.000000000,VALID*1a759a8f					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	MARKTIME Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#MARKTIME,COM1,0,60.0,FINESTEERING,2217,386379.001,00000000,0000,1114
2	Week	GPS reference week number	long	4	H	2217
3	Seconds	Seconds into the week as measured from the receiver clock, coincident with the time of electrical closure on the Mark Input port	double	8	H+4	386379.000970600
4	Offset	Receiver clock offset, in seconds. A positive offset implies that the receiver clock is ahead of GPS system time. To derive GPS system time, use the following formula: GPS system time = GPS reference time - (offset) Where GPS reference time can be obtained from the log header	double	8	H+12	-2.426844596e-09
5	Offset std	Standard deviation of	double	8	H+20	2.250981603e-09

		receiver clock offset (s)				
6	Utc offset	This field represents the offset of GPS system time from UTC time (s), computed using almanac parameters. UTC time is GPS reference time plus the current UTC offset minus the receiver clock offset. UTC time = GPS reference time - offset + UTC offset	double	8	H+28	-18.000000000
7	status	Clock model status (Refer to Table 3-22)	enum	4	H+36	VALID
8	xxxx	32-bit CRC	hex	4	H+40	*1a759a8f
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]

3.2.5.Position or Velocity

The logs defined in this section are mainly related to position and Velocity information.

3.2.5.1.BESTPOS

This log contains the best position computed by the receiver. In addition, it reports several status indicators, including differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections. A differential age of 0 indicates that no differential correction was used.

Log	BESTPOS					
Description	Best position					
Log ID	42					
Recommended Input	<i>log bestposa ontime 1</i> <i>log bestposb ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#BESTPOSA, COM3, 0, 60.0, FINESTEERING, 2329, 443319.000, 0000000, 0000, 1114; SOL_COMPUTED, PPP_CONVERGING, 31.35087016848, 121.29169259959, 31.9559, 10.3015, WGS84, 0.0295, 0.0295, 0.1212, "0000", 22.000, 127.000, 48, 19, 47, 47, 207, 0, 16, 0*4a980949					
Log structure						
ID	Field	Description	Format	Binary	Binary	ASCII

				Bytes	Offset	Example
1	Bestpos Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#BESTPOSA,COM3,0,6 0.0,FINESTEERING,23 29,443319.000,00000 000,0000,1114;
2	Sol stat	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	Pos type	Position type, see Table 3-7	enum	4	H+4	PPP_CONVERGING
4	Lat	Latitude (degrees)	double	8	H+8	31.35087016848
5	Lon	Longitude (degrees)	double	8	H+16	121.29169259959
6	Hgt	Height above mean sea level (metres)	double	8	H+24	31.9559
7	Undulation	Undulation - the relationship between the geoid and the ellipsoid (m) of the chosen datum	float	4	H+32	10.3015
8	Datum id#	Datum ID number	enum	4	H+36	WGS84
9	Lat σ	Latitude standard deviation (m)	float	4	H+40	0.0295
10	Lon σ	Longitude standard deviation (m)	float	4	H+44	0.0295
11	Hgt σ	Height standard deviation (m)	float	4	H+48	0.1212
12	Stn id	Base station ID	char[4]	4	H+52	"0000"
13	Diff_age	Differential age in seconds	float	4	H+56	22.000
14	Sol_age	Solution age in seconds	float	4	H+60	127.000
15	#SVs	Number of satellites tracked	uchar	1	H+64	48
16	#solnSVs	Number of satellites used in solution	uchar	1	H+65	19
17	#ggL1	Number of satellites with single-frequency signals used in solution	uchar	1	H+66	47
18	#ggL1L2	Number of satellites with multi-frequency signals used in solution	uchar	1	H+67	47
19	reserved	Reserved	uchar	1	H+68	207
20	ext sol stat	Extended solution status	uchar	1	H+69	0
21	reserved	Reserved solution status, (see Table 3-8)	uchar	1	H+70	16
22	sig mask	Signals used mask, if it is 0, indicates that the signal does not participate in the solution, (Refer to Table 3-9)	uchar	1	H+71	0

23	CRC	32-bit CRC	hex	4	H+72	*4a980949
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]

Table 3-6 Solution Status

Solution status		Description
Binary	ASCII	
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
6	COLD_START	Not yet converged from cold start
19	INVALID_FIX	The fixed position, entered using the FIX position command, is not valid

Table 3-7 Position or Velocity Type

ID	Type	Description
0	NONE	No solution
1	FIXEDPOS	Position has been fixed by the FIX position command or by position averaging.
8	DOPPLER_VELOCITY	Velocity computed using instantaneous Doppler
9	SINGLE_SMOOTH	Smoothed Single Point Positioning
16	SINGLE	Single Point Positioning
17	PSRDIFF	Solution calculated using pseudorange differential (DGPS, DGNSS) corrections
18	SBAS	Solution calculated using corrections from an SBAS satellite
34	NARROW_FLOAT	Multi-frequency RTK solution with unresolved, float carrier phase ambiguities
35	FIX_DERIVATION	Derivation from fixed solution
49	WIDE_INT	Multi-frequency RTK solution with carrier phase ambiguities resolved to wide-lane integers
50	NARROW_INT	Multi-frequency RTK solution with carrier phase ambiguities resolved to narrow lane integers
51	SUPER WIDE_LANE	Multi-frequency RTK solution with carrier phase ambiguities resolved to extra-wide-lane integers
68	PPP_CONVERGING	Converging PPP solution
69	PPP	Converged PPP solution

Table 3-8 Reserved Solution Status

ID	Type	Description
1	SINGLE	Single Point Positioning
4	NARROW_INT	Multi-frequency RTK solution with carrier phase ambiguities resolved to narrowlane integers
5	NARROW_FLOAT	Multi-frequency RTK solution with unresolved, float carrier phase ambiguities
12	PSRDIFF	Solution calculated using pseudorange differential (DGPS, DGNSS) corrections
13	SINGLE_SMOOTH	Smoothed Single Point Positioning

15	PPP	Converged PPP
16	PPP_CONVERGING	Converging PPP

Table 3-9 Signal-Used Mask

Bit	Mask	Description
0	0x01	GPS L1 used in Solution
1	0x02	GPS L2 used in Solution
2	0x04	GPS L5 used in Solution
3	0x08	BeiDou B1 used in Solution
4	0x10	GLONASS L1 used in Solution
5	0x20	GLONASS L2 used in Solution
6	0x40	BeiDou B2 used in Solution
7	0x80	BeiDou B3 used in Solution

3.2.5.2.BESTVEL

This log contains the best available velocity information computed by the receiver. In addition, it reports a velocity status indicator, which is needed to determine whether or not the corresponding data is valid. The velocities calculated by the receiver can have a latency associated with them. When present, the velocity time of validity is the time tag in the log minus the latency value.

Log	BESTVEL					
Description	Best velocity					
Log ID	99					
Recommended Input	<i>log bestvela ontime 1</i> <i>log bestvelb ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#BESTVELA,COM1,0,60.0,FINESTEERING,2222,378338.000,0000000,0000,1114;SOL_COMPUTED,DOPPLER_VELOCITY,0.000,1.000,0.0020,193.563897,0.0003,4.0*af2f3c2e					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	BESTVEL Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#BESTVELA,COM1,0,60.0,FINESTEERING,2222,378338.000,0000000,0000,1114;
2	Sol stat	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	vel type	Velocity type, see Table 3-7	enum	4	H+4	DOPPLER_VELOCITY

4	latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results (s)	float	4	H+8	0.000
5	Age	Differential age in seconds	float	4	H+12	1.000
6	Hor spd	Horizontal speed over ground, in metres per second	double	8	H+16	0.0020
7	Trk gnd	Actual direction of motion over ground (track over ground ¹) with respect to True North, in degrees	double	8	H+24	193.563897
8	Vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	double	8	H+32	0.0003
9	Reserved	Reserved	float	4	H+40	4.0
10	CRC	32-bit CRC	hex	4	H+44	*af2f3c2e
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

Annotation

Track over ground can be decomposed into north motion and east motion. Therefore, the direction error is related to the motion state. The higher the speed, the smaller the direction error ; the lower the speed, the greater the direction error. For example, in the Doppler frequency velocity model, assuming that the velocity error is 0.2 m/s and the velocity of the carrier is 70 km/h (19.4 m/s), the maximum direction error is :

$$\text{Dir_error} = \arctan (0.2/19.4) = 0.59 \text{ degree.}$$

3.2.5.3.BESTXYZ

This log contains the receiver' s best available position and velocity in ECEF coordinates.

Log	BESTXYZ
Description	Best position and velocity
Log ID	241
Recommended Input	<i>log bestxyza ontime 1</i> <i>log bestxyzb ontime 1</i>
Supported Format	ASCII, Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII	#BESTXYZA,COM1,0,60.0,FINESTEERING,2222,378599.000,00

Example	000000,0000,1114;SOL_COMPUTED,NARROW_INT,-2831765.8413,4658833.3032,3299109.2852,0.0079,0.0094,0.0078,SOL_COMPUTED,DOPPLER_VELOCITY,0.0014,0.0001,-0.0018,0.0033,0.0041,0.0034,"0008",0.000,1.000,10.000,46,40,46,46,0,0,0,203*f94f1bd1					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	Bestpos Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#BESTPOSA,COM3,0,6 0.0,FINESTEERING,23 29,443319.000,00000 000,0000,1114;
2	Sol stat	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	Pos type	Position type, see Table 3-7	enum	4	H+4	PPP_CONVERGING
4	P-X	Position X-coordinate (m)	double	8	H+8	-2831765.8413
5	p-y	Position Y-coordinate (m)	double	8	H+16	4658833.3032
6	p-z	Position Z-coordinate (m)	double	8	H+24	3299109.2852
7	P-X σ	Standard deviation of P-X (m)	float	4	H+32	0.0079
8	P-Y σ	Standard deviation of P-Y (m)	float	4	H+36	0.0094
9	P-Z σ	Standard deviation of P-Z (m)	float	4	H+40	0.0078
10	V-sol status	Solution status, see Table 3-6	enum	4	H+44	SOL_COMPUTED
11	Vel type	Velocity type, see Table 3-7	enum	4	H+48	DOPPLER_VELOCITY
12	V-X	Velocity vector along X-axis (m/s)	double	8	H+52	0.0014
13	V-Y	Velocity vector along Y-axis (m/s)	double	8	H+60	0.0001
14	V-z	Velocity vector along Z-axis (m/s)	double	8	H+68	-0.0018
15	V-X σ	Standard deviation of V-X (m/s)	float	4	H+76	0.0033
16	V-Y σ	Standard deviation of V-Y (m/s)	float	4	H+80	0.0041
17	V-Z σ	Standard deviation of V-Z (m/s)	float	4	H+84	0.0034
18	Stn ID	Base station identification	char[4]	4	H+88	0008
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results	float	4	H+92	0.000
20	Diff_age	Differential age in seconds	float	4	H+96	1.000

21	Sol_age	Solution age in seconds	float	4	H+100	10.000
22	#SVs	Differential age in seconds	uchar	1	H+104	46
23	#solnSVs	Solution age in seconds	uchar	1	H+105	40
24	#ggL1	Number of satellites tracked	uchar	1	H+106	46
25	#ggL1L2	Number of satellites used in solution	uchar	1	H+107	46
26	reserved	Reserved	char	1	H+108	0
27	Ext sol stat	Extended solution status	hex	1	H+109	0
28	reserved	Reserved	hex	1	H+110	0
29	Sig mask	Signals used mask, if it is 0, indicates that the signal does not participate in the solution, (Refer to Table 3-9)	hex	1	H+111	203
30	xxxx	32-bit CRC	hex	4	H+112	*f94f1bd1
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.2.5.4.PSRDOP

The PSRDOP log contains the Dilution Of Precision (DOP) values for the satellites being used in the PSR solution. The PSR DOPs are updated every 60 seconds or whenever the satellites used in the PSR solution changes. Therefore, the total data field length of the log output depends on the number of satellites tracked.

Log	PSRDOP					
Description	DOP values for the satellites used in the PSR solution					
Log ID	174					
Recommended Input	<i>log psrdopa ontime 1</i> <i>log psrdopb ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#PSRDOPA,COM3,0,60.0,FINESTEERING,2328,093674.000,0000000,0000,1114;0.8519,0.7380,0.4106,0.5913,0.4255,10.0,48,20,19,5,6,30,29,11,12,13,15,141,142,143,144,145,147,148,150,153,154,181,178,199,180,183,200,168,167,179,172,173,39,38,61,60,45,0,0,0,0,0,0,0,0,0,0,0*07c10d13					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example

1	PSRDOP Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#PSRDOPA,COM3,0,6 0.0,FINESTEERING,23 28,093674.000,00000 000,0000,1114;
2	gdop	Geometric dilution of precision-assumes 3D position and receiver clock offset (all 4 parameters) are unknown	float	4	H	0.8519
3	Pdop	Position dilution of precision	float	4	H+4	0.7380
4	Hdop	Horizontal dilution of precision.	float	4	H+8	0.4106
5	Htdop	Horizontal position and time dilution of precision.	float	4	H+12	0.5913
6	Tdop	GPS time dilution of precision	float	4	H+16	0.4255
7	Cutoff	GPS elevation cut-off angle	float	4	H+20	10.0
8	#prn	Number of satellites PRNs to follow	long	4	H+24	48
9	PRN	PRN of SV PRN tracking, null field until position solution available	ulong	4	H+28	20
10	Next PRN offset =H+28+(#prn*4)					
11	CRC	32-bit CRC	hex	4	H+28+(#prn*4)	*07c10d13
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.2.5.5.PSRPOS

This log contains the position computed by the receiver, along with three status flags. In addition, it reports other status indicators, including differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections.

Log	PSRPOS
Description	Pseudorange position
Log ID	47
Recommended Input	<i>log psrposa ontime 1</i> <i>log psrposb ontime 1</i>
Supported Format	ASCII, Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922

ASCII Example	#PSRPOSA,COM3,0,60.0,FINESTEERING,2328,094324.000,00000000,0000,1114;SOL_COMPUTED,SINGLE,31.35088123094,121.29169081884,27.7641,10.3014,WGS84,0.1950,0.1775,0.5573,"",0.000,0.000,49,49,49,49,0,0,0,25*55503607					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	PSRPOS Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#PSRPOSA,COM3,0,60.0,FINESTEERING,2328,094324.000,00000000,0000,1114;
2	Sol status	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	Pos type	Position type, see Table 3-7	enum	4	H+4	SINGLE
4	Lat	Latitude (degrees)	double	8	H+8	31.35088123094
5	Lon	Longitude (degrees)	double	8	H+16	121.29169081884
6	Hgt	Height above mean sea level (metres)	double	8	H+24	27.7641
7	Undulation	Undulation - the relationship between the geoid and the ellipsoid (m) of the chosen datum	float	4	H+32	10.3014
8	Datum id#	Datum ID number	enum	4	H+36	WGS84
9	lat σ	Latitude standard deviation (m)	float	4	H+40	0.1950
10	lon σ	Longitude standard deviation (m)	float	4	H+44	0.1775
11	hgt σ	Height standard deviation (m)	float	4	H+48	0.5573
12	Stn id	Base station ID	char[4]	4	H+52	" "
13	Diff_age	Differential age in seconds	float	4	H+56	0.000
14	Sol_age	Solution age in seconds	float	4	H+60	0.000
15	#SVs	Number of satellites tracked	uchar	1	H+64	49
16	#solnSVs	Number of satellites used in solution	uchar	1	H+65	49
17	#ggL1	Number of satellites with single-frequency signals used in solution	uchar	1	H+66	49
18	#ggL1L2	Number of satellites with multi-frequency signals used in solution	uchar	1	H+67	49
19	reserved	Reserved	uchar	1	H+68	0
20	Ext sol stat	Extended solution status	hex	1	H+69	0

21	reserved	Reserved solution status, (see Table 3-8)	hex	1	H+70	0
22	Sig mask	Signals used mask, if it is 0, indicates that the signal does not participate in the solution, (Refer to Table 3-9)	hex	1	H+71	25
23	xxxx	32-bit CRC	hex	4	H+72	*55503607
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	

3.2.5.6.PSRVEL

In the PSRVEL log, the actual speed and direction of the receiver antenna over ground is provided. The velocity measurements sometimes have a latency associated with them. The time of validity is the time tag in the log minus the latency value.

Log	PSRVEL					
Description	Pseudorange velocity					
Log ID	100					
Recommended Input	<i>log psrvela ontime 1</i> <i>log psrvelb ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#PSRVELA,COM1,0,60.0,FINESTEERING,222,378887.000,0000000,0000,1114;SOL_COMPUTED,DOPPLER_VELOCITY,0.000,0.000,0.0407,222.315848,-0.0300,4.0*3b030b53					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	PSRVEL Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#PSRVELA,COM1,0,60.0,FINESTEERING,222,378887.000,0000000,0000,1114
2	Sol stat	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	vel type	Velocity type, see Table 3-7	enum	4	H+4	DOPPLER_VELOCITY
4	latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results (s)	float	4	H+8	0.000

5	Age	Differential age in seconds	float	4	H+12	0.000
6	Hor spd	Horizontal speed over ground, in metres per second	double	8	H+16	0.0407
7	Trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	double	8	H+24	222.315848
8	Vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	double	8	H+32	-0.0300
9	Reserved	Reserved	float	4	H+40	4.0
10	CRC	32-bit CRC	hex	4	H+44	*b030b53
11	[CR][LF]	Sentence terminator (ASCII only)	-			

3.2.6.Original Observations and Correction Values

3.2.6.1.RANGE

The RANGE log contains the channel measurements for the currently tracked satellites such as pseudorange, carrier phase, Doppler, signal-to-noise ratio, etc.

Log	RANGE
Description	Satellite range information
Log ID	43
Recommended Input	<i>log rangea ontime 1</i> <i>log rangeb ontime 1</i>
Supported Format	ASCII, Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	#RANGEA, COM3, 0, 60.0, FINESTEERING, 2328, 094965.000, 0000 0000, 0000, 1114; 162, 20, 0, 20832603.218, 0.075, - 109476062.353789, 0.004, - 519.855, 45.9, 3954.350, 08009c24, 20, 0, 20832611.616, 0.05 0, -85306055.163052, 0.002, - 405.079, 40.1, 3948.130, 09209c24, 133, 0, 37821799.349, 0.0 75, - 198754885.540760, 0.004, 857.511, 45.0, 3954.310, 08059c44 ,

	.... 173,0,23748693.242,0.075,-124800198.569834,0.004,- 2408.824,46.3,3946.800,09049f64,173,0,23748742.098,0. 075,-93195130.099752,0.004,- 1798.788,45.9,3954.740,09849f64,173,0,23748734.830,0. 075,-95626167.541293,0.004,- 1845.721,45.3,3954.200,0a649f84,63,0,39719596.131,0.0 50,-155868157.355560,0.006,- 586.021,43.5,3952.520,08069c44*bcf080a8					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	RANGE Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#RANGEA,COM3,0,60.0,FINESTEERING,2328,094965.000,00000000,0000,1114;
2	# obs	Number of observations with information to follow	long	4	H	162
3	PRN/slot	Satellite PRN number of range measurement	ushort	2	H+4	20
4	glofreq	GLONASS Frequency + 7	ushort	2	H+6	0
5	psr	Pseudorange measurement (m)	double	8	H+8	20832603.218
6	psrstd	Pseudorange measurement standard deviation (m)	float	4	H+16	0.075
7	adr	Carrier phase, in cycles (accumulated Doppler range)	double	8	H+20	-109476062.35
8	adrstd	Estimated carrier phase standard deviation (cycles)	float	4	H+28	0.004
9	dopp	Instantaneous carrier Doppler frequency (Hz)	float	4	H+32	-519.855
10	C/No	Carrier to noise density ratio C/No=10[log10(S/N0)] dB-Hz	float	4	H+36	45.9
11	locktime	Number of seconds of continuous tracking	float	4	H+40	3954.350
12	ch-tr-status	Tracking status (see Table 3-11 and Table 3-13)	ulong	4	H+44	08009c24
13	Next PRN offset = H+4+(#obs*44)					
	CRC	32-bit CRC	hex	4	H+4+(#obs*44)	*bcf080a8

)	
	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]

3.2.6.2.RANGECMP

This log contains the RANGE data in a compressed format.

Log	RANGECMP					
Description	Compressed version of the RANGE log					
Log ID	140					
Recommended Input	<i>log rangecmpa ontime 1</i> <i>log rangecmpb ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	<pre>#RANGECMPA,COM3,0,60.0,FINESTEERING,2328,096205.000,0 0000000,0000,1114;170,249c0008a437fd1fd8d6000ab66bd66 d11144b8962030000,249c2009e9d4fd6f21d7000a513e39e1101 4848882020000,449c0508044903502e68f011f0b1573711854a8 922030000,449cc509077402609368f0119cfb4c331085d087c20 30000,449c250a568f02108a68f011627a5bd10085af88e203000 0,449c050a014903502468f0112fb557371185d28882030000,64 9c050896acfd2f3a0c51121875dcf71186498922030000,649cc5 095f43fecf8f0c51125052e5031086a488c2030000,649c250a06 30feff830c5112c528e49f0086ac88e2030000, ... 249f0409ef9e0b307d53240c0747340624aa594481020000,249f 840991ad08907d54240caedd470b22aa604481020000,449f640a 9ae708703a54240c4a7881e322aa8813c1020000,449f0409e5e3 07004c3a7c0b80909f7422ac5a8802030000,449f84096ce40500 3e3b7c0bbb47bc5d11ac588942030000,649f640ac60b0690f93a 7c0b81061d3811ac478942030000,649f0409b820f61f9b519a0b 37f8db6012ad5a8842030000,649f8409c3a0f85f2b539a0bfa06 fa4e11ad588922030000,849f640a7d6ff8afee529a0ba730f828 12ad468922030000,449c06088694fddf0adc0713d63439aa023f 1189c2020000*e4aacd18</pre>					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	RANGECMP	Log header(For ASCII format,		H	0	#RANGECMPA,COM3,

	Header	see Table 3-1 ; for binary format, see Table 3-3)				0,60.0,FINESTEERING,2328,096205.000,0000000,0000,1114;
2	# obs	Number of satellite observations with information to follow	ulong	4	H	170
3	1st range record	Compressed range log in format (Refer to Note a)	hex	24	H+4	-
4	Next rangecmp offset = H+4+(#obs*24)					
	CRC	32-bit CRC	ulong	4	H+4+(#obs*24)	*e4aacd18
	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]

 **NOTE**

a.Range Record Format

Data	Bits first to last	Length (bits)	Scale Factor	Units
Channel Tracking Status	0-31	32	See Table 3-13	-
Doppler Frequency	32-59	28	1/256	Hz
Pseudorange (PSR)	60-95	36	1/128	m
Accumulated Doppler Range (ADR) ^b	96-127	32	1/256	cycle
StdDev-PSR ^c	128-131	4	(Refer to Note c)	m
StdDev-ADR	132-135	4	(n+1) /512	cycle
PRN/Slot	136-143	8	1(See Table 3-10)	-
Lock Time ^d	144-164	21	1/32	s
C/NO ^e	165-169	5	(20+n)	dB-Hz
Reserved	170-191	22		

b.ADR is calculated as follows:

$$ADR_ROLLS = (RANGECMP_PSR / WAVELENGTH + RANGECMP_ADR) / MAX_VALUE$$

IF (ADR_ROLLS <= 0)

$$ADR_ROLLS = ADR_ROLLS - 0.5$$

ELSE

$$ADR_ROLLS = ADR_ROLLS + 0.5$$

At this point integerise ADR_ROLLS

$$CORRECTED_ADR = ADR - (MAX_VALUE*ADR_ROLLS)$$

where

ADR has units of cycles

MAX_VALUE=8388608

GPS L1: WAVELENGTH = 0.1902936727984

GPS L2: WAVELENGTH = 0.2442102134246

c.StdDev-PSR Values

Code	StdDev-PSR (m)
0	0.050
1	0.075
2	0.113
3	0.169
4	0.253
5	0.380
6	0.570
7	0.854
8	1.281
9	2.375
10	4.750
11	9.500
12	19.000
13	38.000
14	76.000
15	152.000

d.Lock Time

Number of seconds of continuous tracking (no cycle slipping) .This field is constrained to a maximum value of 2,097,151 which represents a lock time of 65535.96875 s (2097151/32).

e.Carrier to noise density ratio

The C/No is constrained to a value between 20- 51 dB-Hz. Thus, if it is reported that C/No = 20 dB-Hz, the actual value could be less. Likewise, if it is reported that C/No = 51, the true value could be greater.

Table 3-10 PRN Numbers for Logs

GNSS	PRN	Offset
GPS	1-32	0
GLONASS	38-61	37
SBAS	120-144	0
BDS	141-203	140

Galileo	1-36	0
QZSS	131-140	-62
IRNSS	62-70	61

Table 3-11 Tracking Status

State	Description	State	Description
0	Idle	7	Frequency lock loop
2	Wide frequency band pull-in	9	Channel alignment
3	Narrow frequency band pull-in	10	Code search
4	Phase lock loop	11	Aided phase lock loop

Table 3-12 Correlator Type

State	Description
0	Not Available
1	Not Available/ Not applicable
2	Narrow correlator: spacing < 1 chip
3	Reserved
4	Pulse Aperture Correlator (PAC)
5-6	Reserved

Table 3-13 Channel Tracking Status

Nibble	Bit	Mask	Description	Range value
N0	0	0x00000001	Tracking state	0-11 (Refer to Table 3-11)
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010	SV channel number	(n-1) (0 = first, n = last) n depends on the receiver
	5	0x00000020		
	6	0x00000040		
	7	0x00000080		
N2	8	0x00000100	Phase lock flag	0 = Not locked, 1 = Locked
	9	0x00000200		
	10	0x00000400		
N3	11	0x00000800	Parity known flag	0 = Not known, 1 = Known
	12	0x00001000	Code locked flag	0 = Not locked, 1 = Locked
	13	0x00002000	Correlator type	0-7 (Refer to Table 3-12)
	14	0x00004000		
N4	15	0x00008000	Satellite system	0 = GPS 1 = GLONASS
	16	0x00010000		
	17	0x00020000		

	18	0x00040000		2 = SBAS 3 = Galileo 4 = BDS 5 = QZSS 6 = IRNSS 7 = Other
	19	0x00080000	Reserved	-
	20	0x00100000	Grouping	0 = Not grouped, 1 = Grouped
N5	21	0x00200000	Signal type	Dependent on satellite system above <u>GPS:</u> 0 = L1 C/A 2 = L5C 5 = L2 P 9 = L2 P codeless 14 = L5 Q 17 = L2 C <u>GLONASS:</u> 0 = L1 C/A 1 = L2 C/A 5 = L2 P 6 = L3 Q <u>Galileo:</u> 1 = E1B 2 = E1C 7 = E6C 12 = E5a Q 17 = E5b Q 20 = AltBOC Q <u>BDS:</u> 0 = B1 C/A 17 = B2 C/A 2 = B3 C/A 8 = B1C 12 = B2a 19 = B2b <u>QZSS:</u> 0 = L1 C/A 14 = L5Q 17 = L2C <u>SBAS:</u> 0 = L1 C/A
	22	0x00400000		

				6 = L5I <u>IRNSS:</u> 0 = L5A
	23	0x00800000		
N6	24	0x01000000		
	25	0x02000000		
	26	0x04000000	Forward error correction	0 = Non-forward error correction 1 = Forward error correction
	27	0x08000000	Primary L1 channel	0 = Not primary, 1 = Primary
N7	28	0x10000000	Carrier phase measurement^b	0 = Half Cycle Not Added 1 = Half Cycle Added
	29	Reserved		
	30	0x40000000	PRN lock flag 2	0 = PRN Not Locked Out 1 = PRN Locked Out
	31	0x80000000	Channel assignment	0 = Auto, 1 = Forced

3.2.7.SATELLITE OBSERVATION

3.2.7.1.IONUTC

This log contains the Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC).

Log	IONUTC
Description	Ionospheric and UTC data
Log ID	8
Recommended Input	<i>log ionutc onchanged</i> <i>log ionutca onchanged</i> <i>log ionutcb onchanged</i>
Supported Format	Abbreviated ASCII, ASCII, Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	#IONUTCA,COM1,0,60.0,FINESTEERING,2222,380256.650,0000000,0000,1114;8.381903171539307e-09,2.235174179077148e-08,-5.960464477539063e-08,-1.192092895507813e-07,9.216000000000000e+04,1.146880000000000e+05,-6.553600000000000e+04,-5.898240000000000e+05,174,589824,-9.3132257461547852e-10,-9.313225746e-10,137,7,18,18,0*045bd1bc
Log structure	

ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	IONUTC Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#IONUTCA,COM1,0,60.0,FINESTEERING,2222,380256.650,00000000,0000,1114
2	a0	Alpha parameter constant term	double	8	H	8.381903171539307e-09
3	a1	Alpha parameter 1st order term	double	8	H+8	2.235174179077148e-08
4	a2	Alpha parameter 2st order term	double	8	H+16	-5.960464477539063e-08
5	a3	Alpha parameter 3st order term	double	8	H+24	-1.192092895507813e-07
6	b0	Beta parameter constant term	double	8	H+32	9.216000000000000e+04
7	b1	Beta parameter 1st order term	double	8	H+40	1.146880000000000e+05
8	b2	Beta parameter 2st order term	double	8	H+48	-6.553600000000000e+04
9	b3	Beta parameter 3st order term	double	8	H+56	-5.898240000000000e+05
10	Utc wn	UTC reference week number	ulong	4	H+64	174
11	tot	Reference time of UTC parameters	ulong	4	H+68	589824
12	A0	UTC constant term of polynomial (s)	double	8	H+72	-9.3132257461547852e-10
13	A1	UTC 1st order term of polynomial (s)	double	8	H+80	-9.313225746e-10
14	Wn Isf	Future week number	ulong	4	H+88	137
15	dn	Day number (the range is 1 to 7 where Sunday = 1 and Saturday = 7)	ulong	4	H+92	7
16	Deltat Is	Delta time due to leap seconds	long	4	H+96	18
17	Deltat Isf	Future delta time due to leap seconds	long	4	H+100	18
18	Reserved	Reserved	ulong	4	H+104	0
19	xxxx	32-bit CRC	hex	4	H+4+(#prn*44)	*045bd1bc
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	

3.2.7.2.M925

This log provides extended information of the satellite, such as PRN, elevation angle, azimuth and

some receiver message including signal strength, battery status, default to empty. This log is an updated version of **SATMSG**.

Log	M925					
Description	Extended satellite observation message					
Log ID	925					
Recommended Input	<i>log m925a</i> <i>log m925b</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	<pre>#M925A,COM3,0,60.0,FINESTEERING,2330,089624.450,0000 0000,0000,1114;58,0,0,0,0,31,0,0,0,3,68,7,0.8,0.0,,3 1.3508694,121.2916882,38.3690,0.0000,0.02,0.02,0.03, 16,0,24,58,0,,,;5,283,50,1,47,0,0,1,48,0,0,0,0,0,0 ,0,0,0,0,0,0,6,93,37,1,44,0,0,1,45,0,0,1,45,0,0,0, 0,0,0,0,0,0,9,40,13,1,38,0,0,1,35,0,0,1,40,0,0,0,0 ,0,0,0,0,0,0,11,29,65,1,46,0,0,1,52,0,0,1,53,0,0,0,0 ,0,0,0,0,0,0,12,242,14,1,41,0,0,1,40,0,0,0,0,0,0,0,0 ,0,0,0,0,0,0,13,182,34,1,43,0,0,1,33,0,0,0,0,0,0,0,0 ,0,0,0,0,0,0, ,94,277,14,1,39,0,0,1,43,0,0,1,42,0,0,0,0,0,0,0,0,0,0, 0,96,101,19,1,43,0,0,1,43,0,0,1,42,0,0,0,0,0,0,0,0,0,0, ,0,101,227,13,1,40,0,0,1,43,0,0,1,39,0,0,0,0,0,0,0,0,0,0, ,0,0,103,59,58,1,47,0,0,1,50,0,0,1,49,0,0,0,0,0,0,0,0, 0,0,0,237,169,53,1,43,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0, 0,0,0,230,146,49,1,46,0,0,0,0,0,0,1,48,0,0,0,0,0,0,0,0, ,0,0,0,243,201,52,1,48,0,0,0,0,0,0,1,49,0,0,0,0,0,0,0,0, 0,0,0,0,244,241,34,1,43,0,0,0,0,0,0,1,46,0,0,0,0,0,0,0,0, ,0,0,0,0,63,265,19,0,0,0,0,0,0,0,0,0,1,44,0,0,0,0,0,0,0, 0,0,0,0*089bcc6f</pre>					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	M925 Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#M925A,COM3,0,60.0,FINESTEERING,2330,089624.450,0000000,0000,1114;

2	M925 Header2 length	Length of the header = 88 byte	byte	1	H	-
3	Sat Number	Number of satellites	byte	1	H+1	58
4	GPRS str	GPRS signal strength	byte	1	H+2	0
5	Bluetooth str	Bluetooth signal strength	byte	1	H+3	0
6	Battery Status	Battery Status	byte	1	H+4	0
7	Rcvr Temp	Receiver temperature	byte	1	H+5	0
8	Fre Flag	Frequency Flag (See Table 3-14)	byte	1	H+6	31
9	Fre Flag2	Frequency Flag2 (See Table 3-15)	byte	1	H+7	0
10	Data-link status	Data-link	byte	1	H+8	0
11	Diff Data Type	Differential data type	byte	1	H+9	0
12	Work mode	Work mode	byte	1	H+10	3
13	Fix status	Fix type, see Table 3-7	byte	1	H+11	68
14	Diff age	Differential age in seconds.	byte	1	H+12	7
15	PDOP	Position DOP , Scale Factor = 0.1	byte	1	H+13	0.8
16	RMS	RMS value of the standard deviation of the range inputs to the navigation process, Scale Factor = 0.1	byte	1	H+14	0.0
17	Reserved	Reserved	byte	1	H+15	
18	Latitude	Latitude (degrees)	double	8	H+16	31.3508694
19	longitude	Longitude (degrees)	double	8	H+24	121.2916882
20	Height	Ellipsoidal height (metres)	double	8	H+32	38.3690
21	Undulation	the relationship between the geoid and the ellipsoid (m) of the chosen datum	float	4	H+40	0.0000
22	variance E	Positioning error variance in east	float	4	H+44	0.02
23	variance N	Positioning error variance in north	float	4	H+48	0.02
24	variance U	Positioning error variance in up	float	4	H+52	0.03
25	FreqHealth1	Frequency health Flag1 (See Table 3-15)	byte	1	H+56	16
26	FreqHealth2	Frequency health Flag2 (See Table 3-16)	byte	1	H+57	0
27	Use Sats	Number of satellites in the solution	byte	1	H+58	24
28	Tracking Sats	Number of satellites tracked	byte	1	H+59	58
29	GPRS status	GPRS status, see Table 3-17	byte	1	H+60	0

30	Reserved	Reserved	byte	1	H+61	-
31	Reserved	Reserved	byte	1	H+62	-
32	Reserved	Reserved	byte	1	H+63	-
33	Reserved	Reserved	byte	24	H+64	-
34	PRN	PRN number	byte	1	H1(=H+88)	5
35	Azimuth	Azimuth, degrees	short	2	H1+2	283
36	Elevation	Elevation, degrees	byte	1	H1+3	50
37	L1 status	Frequency status of L1 (See Table 3-19)	byte	1	H1+4	1
38	L1 SNR	SNR (C/No) of L1	byte	1	H1+5	47
39	L1 RMS	RMS of L1	byte	1	H1+6	0
40	L1 Lost counter	Lost counter of L1	byte	1	H1+7	0
41	L2 status	Frequency status of L2 (See Table 3-19)	byte	1	H1+11	1
42	L2 SNR	SNR (C/No) of L2	byte	1	H1+15	48
43	L2 RMS	RMS of L2	byte	1	H1+16	0
44	L2 Lost counter	Lost counter of L2	byte	1	H1+17	0
45	L3 status	Frequency status of L3 (See Table 3-19)	byte	1	H1+18	0
46	L3 SNR	SNR (C/No) of L3	byte	1	H1+19	0
47	L3 RMS	RMS of L3	byte	1	H1+20	0
48	L3 Lost counter	Lost counter of L3	byte	1	H1+21	0
49	L4 status	Frequency status of L4 (See Table 3-19)	byte	1	H1+22	0
50	L4 SNR	SNR (C/No) of L4	byte	1	H1+23	0
51	L4 RMS	RMS of L4	byte	1	H1+24	0
52	L4 Lost counter	Lost counter of L4	byte	1	H1+25	0
53	L5 status	Frequency status of L5 (See Table 3-19)	byte	1	H1+26	0
54	L5 SNR	SNR (C/No) of L5	byte	1	H1+27	0
55	L5 RMS	RMS of L5	byte	1	H1+28	0
56	L5 Lost counter	Lost counter of L5	byte	1	H1+29	0
57	Next Sat offset = H1+Sat Number*(4+freNO*4), H1=H+88(ver:0x03)					
58	CRC	32-bit CRC	hex	4	H1+Sat Number	*089bcc6f

					*(4+freN O*4)	
59	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]

Table 3-14 Frequency Flag (version 4)

BIT	Description
BIT7	Reserved
BIT6	Reserved
BIT5	B2B
BIT4	B2A/E6
BIT3	B1C/E5ab
BIT2	L5/B3I/G3/E5a
BIT1	L2/B2I/G2/E5b
BIT0	L1/B1I/G1/E1

Table 3-15 Frequency health Flag1

BIT	Description	Value
BIT7	GLONASS G2	0: Good Health 1: Bad Health
BIT6	GLONASS G1	
BIT5	BD2 B3	
BIT4	BD2 B2	
BIT3	BD2 B1	
BIT2	GPS L5	
BIT1	GPS L2	
BIT0	GPS L1	

Table 3-16 Frequency health Flag2

BIT	Description	Value
BIT7	BD3 B2B	0: Good Health 1: Bad Health
BIT6	BD3 B2A	
BIT5	BD3 B1C	
BIT4	Galileo E5AB	
BIT3	Galileo E6	
BIT2	Galileo E5A	
BIT1	Galileo E5B	
BIT0	Galileo E1	

Table 3-17 GPRS connection status

BIT	Description	Value
BIT7	Reserved	-

BIT6	Reserved	-
BIT5	Reserved	-
BIT4	Reserved	-
BIT3	CORS status	0 : Not connected, 1 : Connected
BIT2	Network registration status	0 : Not registered, 1 : Registered
BIT1	SIM card status	0 : Not Ready, 1 : Ready
BIT0	Module status	0 : Not Ready, 1 : Ready

3.2.7.3.SATMSG

This log provides satellite-related information such as PRN, elevation angle, azimuth angle, and some related information of the board such as signal strength, battery status, etc.

Log	SATMSG				
Description	Satelite message				
Log ID	911				
Recommended Input	<i>log satmsgb</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bit	Binary Offset
1	SATMSG Header	Log header(Refer to Table 3-3)		H	0
2	Sat number	Number of satellites	byte	1	H
3	Version number	Version number: 8	byte	1	H+1
4	GPRS Str	GPRS signal strength	byte	1	H+2
5	Bluetooth Str	Bluetooth signal strength	byte	1	H+3
6	Battery status	Battery Status	byte	1	H+4
7	Fre flag	Frequency Flag , see Table 3-14 Default value = 0x1F (freNum = 5)	byte	1	H+5
8	PRN	Satelite number, see Table 2-2	byte	1	H+6
9	Azimuth	Azimuth, degrees	short	2	H+7
10	Elevation	Elevation, degrees	byte	1	H+9
11	L1 status	Frequency status of L1 (See Table 3-19)	byte	1	H+10
12	L1 SNR	SNR (C/No) of L1	byte	1	H+11
13	L1 RMS	RMS of L1	byte	1	H+12
14	L1 Lost counter	Lost counter of L1	byte	1	H+13
15	Next Fre infor	According to the frequency flag(see Table 3-18), may be the information of L2	4bytes	4	H+14
16	Next Fre infor	According to the frequency flag(see Table 3-	4bytes	4	H+18

		18), may be the information of L5			
17	Next Sat offset = $H+6+satNum(4+freNum*4)$				
18	CRC	32-bit CRC	hex	4	$H+6+satNum*(4+freNum*4)$

Table 3-18 Frequency Flag (version 2)

BIT	Description
BIT7	Reserved
BIT6	Reserved
BIT5	Reserved
BIT4	BDS: B2a, GAL: E5AB
BIT3	BDS: B1c, GAL: E6
BIT2	GPS: L5, BDS: B3, GLO: G3, GAL: E5A
BIT1	GPS: L2, BDS: B2, GLO: G2, GAL: E5B
BIT0	GPS: L1, BDS: B1, GLO: G1, GAL: E1

Table 3-19 Frequency Status

BIT	Description	Value
BIT7	Participate in RTK solution	1: Yes 0: No
BIT6	Reserved	-
BIT5	Non-differential observations (no differential data, but involved in solution)	1: Yes 0: No
BIT4	Use combined ambiguity resolution in RTK solution	1: Use 0: Don't use
BIT3	Need for fixed ambiguity in RTK solution	1: Need 0: Don't need
BIT2	Use carrier phase observations in RTK solution	1: Use 0: Don't use
BIT1	Use pseudorange observations in RTK solution	1: Use 0: Don't use
BIT0	Is this frequency information available	1: Available 0: Not available

3.2.7.4.SATVIS

This log contains satellite visibility data for all available systems with additional satellite and satellite system information.

Log	SATVIS
Description	Satellite visibility
Log ID	48
Recommended Input	<i>log satvisb ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K92
Log structure	2

ID	Field	Description	Format	Binary Bit	Binary Offset
1	SATVIS Header	Log header(Refer to Table 3-3)		H	0
2	Sat vis	Satellite visibility 0 : invisible, 1 : visible	enum	4	H
3	Comp alm	Was complete almanac used? 0 : FALSE, 1 : TRUE	enum	4	H+4
4	#sat	Number of satellites with data to follow	ulong	4	H+8
5	PRN/slot	Satellite number, see Table 2-2	short	2	H+12
6	Glofreq	Not used	short	2	H+14
7	Health	Satellite health	ulong	4	H+16
8	Elev	Elevation (degrees)	double	8	H+20
9	Az	Azimuth (degrees)	double	8	H+28
10	True dop	Theoretical Doppler of satellite - the expected Doppler frequency based on a satellite's motion relative to the receiver.	double	8	H+36
11	App dop	Apparent Doppler for this receiver - the same as Theoretical Doppler above but with clock drift correction added (Hz).	double	8	H+44
12	Next satellite offset =H+12+(#sat*40)				
	CRC	32-bit CRC	hex	4	H+12+ (#sat*4 0)

3.2.7.5.SATXYZ

This log set contains the decoded satellite information necessary to compute the solution: satellite coordinates (ECEF), satellite clock correction, ionospheric corrections and tropospheric corrections.

Log	SATXYZ
Description	Satellite positions in ECEF Cartesian coordinates
Log ID	270
Recommended Input	<i>log satxyza ontime 5</i> <i>log satxyzb ontime 5</i>
Supported Format	ASCII, Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	#SATXYZA, COM1, 0, 60.0, FINESTEERING, 2222, 444885.000, 00 000000, 0000, 1114; 0.0, 49, 133, - 29643782.2631, 27316826.3205, 17291284.0721, -

```

122.125,4.870000000,2.570000000,0.000000000,0.000000
000,20,-
2933895.8887,20527128.4171,16728546.5814,148558.872,
5.060000000,2.710000000,0.000000000,0.000000000,11,-
6694479.7788,13819108.0464,21664551.7528,-
3303.539,5.280000000,2.820000000,0.000000000,0.00000
000,6,-
18704290.1892,7737558.4284,17297786.3120,126445.020,
5.880000000,3.120000000,0.000000000,0.000000000,
... ..
72,4259794.7685,41930879.3312,382912.8601,-
90760.175,11.880000000,12.800000000,0.000000000,0.00
000000,81,-
4177032.3444,17142395.5141,21670056.8974,-
142283.970,5.190000000,2.760000000,0.000000000,0.000
00000,95,11906141.8047,27100142.8019,-192284.8955,-
175153.563,10.220000000,7.970000000,0.000000000,0.00
000000,106,12388915.8870,15440767.1829,22000842.003
1,-
124562.152,9.080000000,5.810000000,0.000000000,0.000
00000*5d808334
    
```

Log structure

ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	SATXYZ Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)	-	H	0	#SATXYZA,CO M1,0,60.0,FIN ESTEERING,22 22,443635.00 0,00000000,0 000,1114
2	Reserved	Reserved	double	8	H	0.0
3	#sat	Number of satellites to follow	ulong	4	H+8	49
4	PRN/slot	Satellite system (See Table 2-2)	ulong	4	H+12	133
5	X	Satellite X co-ordinates (ECEF,m)	double	8	H+16	- 29643782.263 1
6	Y	Satellite Y co-ordinates (ECEF,m)	double	8	H+24	27316826.320 5
7	Z	Satellite Z co-ordinates (ECEF,m)	double	8	H+32	17291284.072 1

8	Clc corr	Satellite clock correction (m)	double	8	H+40	122.125
9	Iono delay	Ionosphere delay (m)	double	8	H+48	4.870000000
10	Tropo delay	Troposphere delay (m)	double	8	H+56	2.570000000
11	Reserved1	Reserved	double	8	H+64	0.000000000
12	Reserved2	Reserved	double	8	H+72	0.000000000
13	Next satellite offset = H+12+(#sat*68)					
14	CRC	32-bit CRC	hex	4	H+12+ (#sat*6 8)	*5d808334
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]

3.2.8.BASE STATION

3.2.8.1.REFSTATION

This log contains the ECEF Cartesian position of the base station as received through the RTCMV3 message. It also features a time tag, the health status of the base station and the station ID.

Log	REFSTATION					
Description	Base station position and health					
Log ID	175					
Recommended Input	<i>log refstationa ontime 1</i> <i>log refstationb ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#REFSTATIONA,COM1,0,60.0,FINESTEERING,2222,445216.000,00000000,0000,1114;00000000,-2831364.360,4654319.237,3305747.461,0,4,"0008"*bfc732dd					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	REFSTATION Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#REFSTATIONA,COM1,0,60.0,FINESTEERING,2222,445216.000,000000,0000,1114
2	status	Status of the base station information, see Table 3-20	ulong	4	H	00000000
3	X	ECEF X value (m)	double	8	H+4	-2831364.360
4	Y	ECEF Y value (m)	double	8	H+12	4654319.237

5	Z	ECEF Z value (m)	double	8	H+20	3305747.461
6	health	Base station health Flag 0: (Health OK)	ulong	4	H+28	0
7	stn type	Station type, see Table 3-21	enum	4	H+32	4
8	stn ID	Base station ID	char[5]	8 ^a	H+36	0008
9	xxxx	32-bit CRC	hex	4	H+44	*bfc732dd
10	[CR][LF]	Sentence terminator (ASCII only)	-		-	[CR][LF]

 ANNOTATION

a. In the binary case, each string field needs to be NULL terminated and additional bytes of padding added to maintain 8-byte alignment.

Table 3-20 Base Station Status

BIT	Mask	Description	Bit=0	Bit=1
0	0x00000001	Validity of the base station	Valid	Invalid
1	0x00000002	Station type	Real, Physical Base Station	Non-Physical, Computed Base Station

Table 3-21 Base Station Type

Type		Description
Binary	ASCII	
0	NONE	Base station is not used
1	RTCMV2	Base station is RTCMV2
3	RSV	Reserved
4	RTCMV3	Base station is RTCMV3

3.2.8.2.BASEPOS

This log provides the real-time position information of the fixed base at the fixed base station mode, which plays a role in real-time dynamic monitoring of the base station position.

Log	BASEPOS
Description	Fixed base station position
Log ID	49
Recommended Input	<i>log baseposa ontime 1</i> <i>log baseposb ontime 1</i>
Supported Format	ASCII, Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII	#BASEPOSA, COM1, 0, 60.0, FINESTEERING, 2331, 357930.000, 00

Example	000000,0000,1114;SOL_COMPUTED,NARROW_INT,31.35087560294,121.29167783299,28.0606,10.3014,WGS84,0.0039,0.0039,0.0065,"0004",1.000,212.000,54,40,52,52,191,0,4,207*4895dcb9					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	BASEPOS Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#BASEPOSA,COM1,0,60.0,FINESTEERING,2331,357930.000,00000000,0000,1114;
2	Sol stat	Solution status, see Table 3-6	enum	4	H	SOL_COMPUTED
3	Pos type	Position type, see Table 3-7	enum	4	H+4	PPP_CONVERGING
4	Lat	Latitude (degrees)	double	8	H+8	31.35087016848
5	Lon	Longitude (degrees)	double	8	H+16	121.29169259959
6	Hgt	Height above mean sea level (metres)	double	8	H+24	31.9559
7	Undulation	Undulation - the relationship between the geoid and the ellipsoid (m) of the chosen datum	float	4	H+32	10.3015
8	Datum id#	Datum ID number	enum	4	H+36	WGS84
9	Lat σ	Latitude standard deviation (m)	float	4	H+40	0.0295
10	Lon σ	Longitude standard deviation (m)	float	4	H+44	0.0295
11	Hgt σ	Height standard deviation (m)	float	4	H+48	0.1212
12	Stn id	Base station ID	char[4]	4	H+52	"0000"
13	Diff_age	Differential age in seconds	float	4	H+56	22.000
14	Sol_age	Solution age in seconds	float	4	H+60	127.000
15	#SVs	Number of satellites tracked	uchar	1	H+64	48
16	#solnSVs	Number of satellites used in solution	uchar	1	H+65	19
17	#ggL1	Number of satellites with single-frequency signals used in solution	uchar	1	H+66	47
18	#ggL1L2	Number of satellites with multi-frequency signals used in solution	uchar	1	H+67	47
19	reserved	Reserved	uchar	1	H+68	207
20	ext sol stat	Extended solution status	uchar	1	H+69	0

21	reserved	Reserved solution status, see Table 3-8	uchar	1	H+70	16
22	sig mask	Signals used mask, if it is 0, indicates that the signal does not participate in the solution, (Refer to Table 3-9)	uchar	1	H+71	0
23	CRC	32-bit CRC	hex	4	H+72	*4a980949
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]



NOTE:

This log does not take effect at the moving station mode.

3.2.9.TIME

3.2.9.1.TIME

The log provides some time-related information, including board clock offset, UTC time and offset. It can also be used to determine any offset of the PPS signal relative to GPS time.

Log	TIME					
Description	Time-related information					
Log ID	101					
Recommended Input	<i>log timea ontime 1</i> <i>log timeb ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922					
ASCII Example	#TIMEA, COM3, 0, 60.0, FINESTEERING, 2328, 098718.000, 0000000, 0000, 1114; VALID, -2.607973012e-07, 0.000000000e+00, -17.99999999902, 2024, 8, 19, 3, 25, 0, VALID*f50b93c5					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	TIME Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#TIMEA,COM3,0,60.0, FINESTEERING,2328,098718.000,00000000, 0000,1114;
2	Clock status	Clock model status, see Table 3-22	enum	4	H	VALID

3	Offset	Receiver clock offset	double	8	H+4	-2.607973012e-07
4	Offset std	The standard deviation of clock bias	double	8	H+12	0.000000000e+00
5	Utc offset	The deviation between GPS time and UTC time and	double	8	H+20	-17.99999999902
6	Utc year	Years in UTC time	ulong	4	H+28	2024
7	Utc month	Months in UTC time (0-12)	uchar	1	H+32	8
8	Utc day	Days in UTC time (0-31)	uchar	1	H+33	19
9	Utc hour	Hours in UTC time (0-23)	uchar	1	H+34	3
10	Utc min	Minutes in UTC time (0-59)	uchar	1	H+35	25
11	Utcms	Milliseconds in UTC time (0-60999)	ulong	4	H+36	0
12	Utc status	UTC status 0 = Invalid 1 = Valid 2 = Warning	enum	4	H+40	VALID
13	CRC	32-bit CRC	hex	4	H+44	*f50b93c5
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]

Table 3-22 Clock Model Status

Value	Clock Model Status	Description
0	VALID	The clock model is valid
1	CONVERGING	The clock model is near validity
2	ITERATING	The clock model is iterating towards validity
3	INVALID	The clock model is not valid
4	ERROR	The clock model is wrong

3.2.10.CUSTOMIZED LOGS

3.2.10.1.IONOSCIN

This log provides the ionospheric scintillation monitoring information, including satellite elevation angle, azimuth angle, ionospheric scintillation beacon, beacon amplitude scintillation index, beacon phase scintillation index and other parameters.

Log	IONOSCIN
Description	Ionospheric scintillation monitoring information
Log ID	1501
Recommended Input	<i>log ionoscinb ontime 30</i>
Supported Format	Binary
Supported Board	K807
Log structure	

ID	Field	Description	Format	Binary Bit	Scale Factor	Range	Unit
1	IONOSCIN Header	Log header(Refer to Table 3-3)	-	-	-	-	-
2	NSAT	Number of satellites	Ulong	4	1	0~255	-
3	sat1 ID	Satellite ID	Ushort	2	1	0~255	-
4	sat1 Elevation	Elevation, degree	Float	4	1	-90~90	degree
5	Sat1 Azimuth	Azimuth, degree	Float	4	1	0~360	degree
6	sat1 Nfre	Represents the total number of frequency points of the satellite participating in ionospheric scintillation.	Uchar	1	1	0-27	-
7	sat1 Beacon1	Ionospheric scintillation beacon source: 0: Invalid 1: L1C/A 2: L1P 3: L2C 4: L2P 5: L5C 6: B1I 7: B2I 8: B3I 9: G1C 10: G2C 11: G2P 12: S1C 13: E1C 14: E5A 16: / 17: E6C 18: / 19: / 20: / 21: / 22: / 23: / 24: B1C 25: B2A 26: B2B 27: L1C	Ushort	2	1	-	-
8	Sat1 beacon1 amplitude scintillation index	Satellite 1 beacon 1 amplitude scintillation index	Float	4	1	-	-
9	Sat1 beacon1 phase scintillation index	Satellite 1 beacon 1 phase scintillation index	Float	4	1	-	rad
10	Sat1 beacon1 correction amplitude scintillation index	Satellite 1 beacon 1 correction amplitude scintillation index	Float	4	1	-	-
11	Sat1 beacon1 S/N	Satellite 1 beacon 1 signal-to-noise ratio	Float	4	1	-	dB
12	...						
13	sat1 Beacon x	See ID 7	Ushort	2	1	-	-
14	Sat1 beacon x amplitude scintillation index	Satellite 1 beacon x amplitude scintillation index	Float	4	1	-	-
15	Sat1 beacon x phase scintillation index	Satellite 1 beacon x phase scintillation index	Float	4	1	-	rad
16	Sat1 beacon x correction amplitude scintillation index	Satellite 1 beacon x correction amplitude scintillation index	Float	4	1	-	-
17	Sat1 beacon x	Satellite 1 beacon x signal-to-	Float	4	1	-	dB

	S/N	noise ratio					
18	...	...	...	...	...	...	...
19	satn ID	Satellite ID	Ushort	2	1	0~255	-
20	satn Elevation	Elevation, degree	Float	4	1	-90~90	degree
21	satn Azimuth	Azimuth, degree	Float	4	1	0~360	degree
22	satn Nfre	Represents the total number of frequency points of the satellite participating in ionospheric scintillation.	Uchar	1	1	0-27	-
23	satn Beacon 1	See ID 7	Ushort	2	1	-	-
24	Satn beacon1 amplitude scintillation index	Satellite n beacon 1 amplitude scintillation index	Float	4	1	-	-
25	Satn beacon1 phase scintillation index	Satellite n beacon 1 phase scintillation index	Float	4	1	-	rad
26	Satn beacon1 correction amplitude scintillation index	Satellite n beacon 1 correction amplitude scintillation index	Float	4	1	-	-
27	Satn beacon1 S/N	Satellite n beacon 1 signal-to-noise ratio	Float	4	1	-	dB
28	...						
29	satn Beacon x	See ID 7	Ushort	2	1	-	-
30	Satn beaconx amplitude scintillation index	Satellite n beacon x amplitude scintillation index	Float	4	1	-	-
31	Satn beaconx phase scintillation index	Satellite n beacon x phase scintillation index	Float	4	1	-	rad
32	Satn beaconx correction amplitude scintillation index	Satellite n beacon x correction amplitude scintillation index	Float	4	1	-	-
33	Satn beaconx S/N	Satellite n beacon x signal-to-noise ratio	Float	4	1	-	dB
34	xxxx	32-bit CRC	Hex	4	-	-	-

3.2.10.2.TECINFO

This log provides Ionospheric total electron content message, including satellite **STEC _ RAW**, **STEC _ CORR**, **VTEC _ CORR** and other parameters.

Log	TECINFO
Description	Ionospheric total electron content information
Log ID	1502
Recommended Input	<i>log tecinfob ontime 5</i>

Supported Format	Binary						
Supported Board	K807						
Log structure							
ID	Field	Description	Format	Binary Bit	Scale Factor	Range	Unit
1	TECINFO Header	Log header(Refer to Table 3-3)	-	H	-	-	-
2	GPS sec	Seconds from the beginning of the GPS reference week	UINT	20	1	0~604799s	s
3	Sat sys	1: GPS 2: BDS 3: GLO 4: GAL (Others are invalid values)	Uint	3	1	0~7	-
4	NSAT	Number of satellites	Uint	6	1	0~63	-
5	Sat 1	Satellite ID	Uint	6	1	1~63	-
6	DCB cor	0: Ionospheric detection is not corrected by DCB. 1: Ionospheric detection is corrected by DCB.	Bit	1	1	0~1	-
7	Azimuth	Azimuth	Uint	16	0.01	0~360	degree
8	Elevation	Elevation	Int	15	0.01	-90~90	degree
9	puncture point longitude	Longitude of the puncture point	Int	36	0.00000001	$-\pi \sim \pi$	rad
10	puncture point latitude	Latitude of puncture point	Int	35	0.00000001	$-\pi/2 \sim \pi/2$	rad
11	STEC_RAW	Slant Total Electron Content (Without DCB correctio), 1TECu=1E16 Electron /m ²	Int	21	0.001	-1048.575 ~1048.575	TECu
12	STEC_CORR	Slant Total Electron Content (DCB correctio)	Int	21	0.001	-1048.575 ~1048.575	TECu
13	VTEC_CORR	Vertical Total Electron Content (DCB correctio)	Int	21	0.001	-1048.575 ~1048.575	TECu
14	ROT	Rate of TEC	Int	21	0.0001	-104.8575 ~104.8575	TECu /min
15	ROTI	Standard deviation of ROT	Int	21	0.000001	-1.048575 ~1.048575	TECu /min
16	...		...	...
17	Sat n	Satellite ID	Uint	6	1	1~63	-
18	DCB cor	0: Ionospheric detection is not corrected by DCB. 1: Ionospheric detection is	Bit	1	1	0~1	-

		corrected by DCB.					
19	Azimuth	Azimuth	Uint	16	0.01	0~360	degree
20	Elevation	Elevation	Int	15	0.01	-90~90	degree
21	puncture point longitude	Longitude of the puncture point	Int	36	0.00000001	$-\pi \sim \pi$	rad
22	puncture point latitude	Latitude of puncture point	Int	35	0.00000001	$-\pi/2 \sim \pi/2$	rad
23	STEC_RAW	Slant Total Electron Content (Without DCB correctio), 1TECu=1E16 Electron /m ²	Int	21	0.001	-1048.575 ~1048.575	TECu
24	STEC_CORR	Slant Total Electron Content (DCB correctio)	Int	21	0.001	-1048.575 ~1048.575	TECu
25	VTEC_CORR	Vertical Total Electron Content (DCB correctio)	Int	21	0.001	-1048.575 ~1048.575	TECu
26	ROT	Rate of TEC	Int	21	0.0001	-104.8575 ~104.8575	TECu /min
27	ROTI	Standard deviation of ROT	Int	21	0.000001	-1.048575 ~1.048575	TECu /min
28	xxxx	32-bit CRC	Hex	4	-	-	-

3.2.10.3.DCBINFO

This log contains parameter information such as receiver differential code bias and satellite differential code bias.

Log	DCBINFO						
Description	Differential code bias information						
Log ID	1503						
Recommended Input	<i>log dcbinfo ontime 5</i>						
Supported Format	Binary						
Supported Board	K807						
Log structure							
ID	Field	Description	Format	Binary Bit	Scale Factor	Range	Unit
1	DCBINFO Header	Log header(Refer to Table 3-3)	-	H	-	-	-
2	Sat sys	1: GPS 2: BDS 3: GLO 4: GAL (Others are invalid values)	Uint	3	1	0~7	-
3	Rec DCB	Differential code bias of	Int	17	0.001	-65.535	ns

		receiver			ns	~65.535	
4	NSAT	Number of satellites	UInt	6	1	0~63	-
5	Sat 1	Satellite ID	UInt	6	1	1~63	-
6	GPS day	Days from the beginning of the GPS reference week	UInt	3	1	0~6	day
7	GPS Week	GPS reference week number	UInt	12	1	0~4095	week
8	Sat DCB	Differential code bias of satellite	Int	17	0.001 ns	-65.535 ~65.535	ns
9	...		...	...
10	Sat n	Satellite ID	UInt	6	1	1~63	-
11	GPS day	Days from the beginning of the GPS reference week	UInt	3	1	0~6	day
12	GPS Week	GPS reference week number	UInt	12	1	0~4095	week
13	Sat DCB	Differential code bias of satellite	Int	17	0.001 ns	-65.535 ~65.535	ns
14	xxxx	32-bit CRC	Hex	4	-	-	-

3.2.10.4.METEMESS

This log contains Meteorograph information.

Log	METEMESS					
Description	Meteorograph information					
Log ID	1504					
Recommended Input	<i>log metemessb ontime 5</i>					
Supported Format	Binary					
Supported Board	K807					
Log structure						
ID	Field	Description	format	Binary Bit	Scale Factor	Unit
1	METEMESS Header	Log header(Refer to Table 3-3)		H	-	-
2	Sig0	Horizontal solution accuracy	float	4	-	
3	esig	Vertical solution accuracy	float	4	-	
4	Lat	latitude	float	4	-	degree
5	Lon	longitude	float	4	-	degree
6	Altitude	Altitude	float	4	-	degree
7	ZHD PV	Prior value of ZHD	float	4	-	m
8	ZWD PV	Prior value of ZWD	float	4	-	m
9	ZWD correction	The correction value of ZWD	float	4	-	m
10	ZTD sigma	Standard deviation of zenith	float	4	-	m

	(ZWD standard deviation)	tropospheric delay (Standard deviation of tropospheric zenith wet delay)				
11	ZTD	Zenith tropospheric delay	float	4	-	m
12	ZHD	Tropospheric zenith dry delay	float	4	-	m
13	ZWD	Tropospheric zenith wet delay	float	4	-	m
14	PWV	Precipitable water vapor	float	4	-	mm
15	PWV sigma	Standard deviation of precipitable water vapor	float	4	-	m
16	Temperature	Atmospheric weighted mean temperature	float	4	-	Tm
17	Grad NS	Meridional moisture gradient (Gradient North-South)	float	4	-	m
18	Grad EW	Zonal moisture gradient (Gradient East-West)	float	4	-	m
19	NS sig	Standard deviation of Meridional moisture gradient	float	4	-	m
20	EW sig	Standard deviation of Zonal moisture gradient	float	4	-	m
21	ZTD QC Code	Quality control code of ZTD	char	1	-	-
22	PWV QC Code	Quality control code of PWV	char	1	-	-
23	Grad NS QC Code	Quality control code of Gradient North-South	char	1	-	-
24	Grad EW QC Code	Quality control code of Gradient East-West	char	1	-	-
25	Met device ID	Device identification symbol of meteorology	Hex (ASCII)	4	-	-
26	Met ID	Device ID of meteorograph	short	2	-	-
27	Met time	Meteorology time	double	8	-	
28	Temp	Meteorology display temperature	short	2	0.01	°C
29	Press	Air pressure	int	4	0.01	hPa
30	RH	Relative humidity	short	2	0.1	
31	Temp QC Code	Quality control code of temperature	char	1	-	-
32	Press QC Code	Quality control code of air pressure	char	1	-	-
33	RH QC Code	Quality control code of air pressure relative humidity	char	1	-	-
34	Equipment status	Equipment status	char	1	-	-
35	Supply voltage value	Supply voltage value	short	2	0.1	V
36	Motherboard temp	Motherboard temperature	short	2	0.1	°C
37	xxxx	32-bit CRC	Hex	4	-	-

3.3.NMEA Logs and RTCM standard Logs

3.3.1.NMEA LOGS

The NMEA format is a data structure based on the NMEA communication protocol, which is used for the standardized exchange of data between various electronic devices, particularly in the fields of navigation and marine electronics. This format facilitates the interoperability of different equipment by providing a standardized way to encode and transmit information such as position, time, speed, and other sensor data.

3.3.1.1.NMEA Logs Structure

NMEA (National Marine Electronics Association) defines a series of data sentences, each representing a specific type of information, such as GPS position, satellite status, or speed over ground. These sentences are transmitted in a human-readable ASCII format, making it easy for devices from different manufacturers to exchange data without the need for complex translation or interpretation. The structure of an NMEA message primarily consists of four parts:

Fields	Description
Logs Header	Each NMEA log begins with a dollar sign (\$), followed by an identifier (e.g., GGA, RMC), which indicates the type and function of the log. For example, \$GPGGA represents a GPS fix data log.
Data Fields	After the log header, there are fields separated by commas, with each field containing specific data items. These fields can include information such as time, position, speed, and direction. The number and content of these fields depend on the type of log. For example, the \$GPGGA log contains fields for time, latitude, longitude, and GPS quality.
Checksum	The log ends with an asterisk (*), followed by two hexadecimal digits representing the checksum, which is used to verify the integrity of the data. The checksum is computed by performing an XOR operation on all characters from the log header up to the asterisk. This ensures that any errors during transmission can be detected.
[CR][LF]	The log concludes with a carriage return (\r) and a newline (\n), marking the end of the log. These characters ensure the completeness of the log and allow the receiving device to correctly recognize the end of the log.

NMEA messages come in multiple versions, with NMEA 0183 being the earlier standard and NMEA 2000 being the more recent version. NMEA 2000 offers higher communication speeds and a broader range of functionalities compared to NMEA 0183. For detailed specifications and standards on NMEA messages, you can refer to the official NMEA website at <http://www.nmea.org>.

3.3.1.2.NMEA Logs List

Table 3-23 NMEA Logs List

ID	Log ID	Field	Description
Standard Logs			
1	218	GPGGA	GNSS Position Data

2	219	GPGLL	Geographic position
3	221	GPGSA	DOP and active satellites
4	222	GPGST	Estimated error in position solution
5	223	GPGSV	Satellites in view
6	213	GPHDT	NMEA heading log
7	225	GPRMC	NMEA heading log
8	226	GPVTG	NMEA heading log
9	227	GPZDA	UTC date and time
Self-defined Logs			
1	211	GPHPR	Attitude (heading, pitch, roll)
2	209	GPNTR	Distance from the rover station to the base station
3	207	GPTRA	Attitude of the baseline vector between the two antennas
4	87	GPYBM	Position, velocity, and projection information...
5	264	GPNVAV	Navigation Information (Qtalisis self-defined)
6	160	GPPWV	Precipitable water vapor monitoring message
7	0	GPLVM	Velocity message in Earthquake monitoring
8	0	GPLDM	Displacement message (Earthquake monitoring)
9	0	GPVAM	Accumulative displacement message (Earthquake monitoring)

3.3.1.3.NMEA Standard Logs

3.3.1.3.1. GPGGA

This log contains time, position and fix related data of the GNSS receiver.

Log	GPGGA			
Description	GNSS Position Data			
Recommended Input	<i>log gpgga ontime 1</i>			
Supported Format	ASCII			
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
ASCII Example	\$GPGGA,034303.00,3120.9969586,N,12117.5424216,E,4,40,0.4,26.3811,M,10.305,M,1.0,0008*43			
Log structure				
ID	Field	Description	Format	Example
1	\$GPGGA	Log header	-	\$GPGGA
2	utc	UTC time status of position	hhmmss.ss	034303.00
3	lat	Latitude	IIII.IIIIII	3120.9969586
4	latdir	Latitude direction (N = North, S = South)	a	N

5	lon	Longitude	YYYYY.YYYYYYY	12117.5424216
6	londir	Longitude direction (E = East, W = West)	a	E
7	GPS qual	Solution status: 0 = Invalid 1 = Single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution 6 = GNSS/INS integrated solution 7 = Manual input 15 = Converged PPP 16 = Converging PPP	x	4
8	#sats	Number of satellites in use	xx	40
9	Hdop	Horizontal dilution of precision	x.x	0.4
10	Alt	Antenna altitude above/below mean sea level	x.x	26.3811
11	a-units	Units of antenna altitude, m	M	M
12	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid	x.x	10.305
13	u-units	Units of undulation, m	M	M
14	age	Age of correction data, s	xx	1.0
15	Stn ID	Differential base station ID, 0000-1023	xxxx	0008
16	*xx	Check sum	*hh	*43
17	[CR][LF]	Sentence terminator	-	[CR][LF]

3.3.1.3.2. GPGLL

This log contains latitude and longitude of present vessel position, time of position fix and status.

Log	GPGLL			
Description	Geographic position			
Recommended Input	<i>log gppll ontime 1</i>			
Supported Format	ASCII			
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
ASCII Example	\$GPGLL, 3120.9969010, N, 12117.5423825, E, 061559.00, A, D*67			
Log structure				
ID	Field	Description	Format	Example
1	\$GPGLL	Log header	-	\$GPGLL

2	lat	Latitude	IIII.IIIIII	3120.9969010
3	latdir	Latitude direction (N = North, S = South)	a	N
4	lon	Longitude	YYYYY.YYYYYYY	12117.5423825
5	londir	Longitude direction (E = East, W = West)	a	E
6	utc	UTC time status of position	hhmmss.ss	061559.00
7	data status	A = Data valid V = Data invalid	A	A
8	mode ind	Positioning Mode Indicator A = Single point positioning D = Differential positioning E = Estimated Mode M = Manual input N = Data Invalid	a	D
9	*xx	Check sum	*hh	*67
10	[CR][LF]	Sentence terminator		[CR][LF]

3.3.1.3.3. GPGSA

This log contains GNSS receiver operating mode, satellites used for navigation and DOP values.

Log	GPGSA
Description	DOP and active satellites
Recommended Input	<i>log gpgsa ontime 1</i>
Supported Format	ASCII
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	<p>GPS and BDS:</p> <pre>\$GNGSA,M,3,05,13,15,18,23,24,132,133,134,137,,0.7,0.4,0.6*2A</pre> <pre>\$GNGSA,M,3,141,142,143,144,145,146,148,149,152,153,156,159,0.7,0.4,0.6*2D</pre> <p>GPS Only:</p> <pre>\$GPGSA,M,3,25,14,15,18,31,27,09,21,22,12,,1.5,0.9,1.3*30</pre> <p>BDS Only:</p> <pre>\$BDGSA,M,3,141,143,144,146,147,148,149,150,,,,,2.7,1.7,2.2*2B</pre>

Log structure				
ID	Field	Description	Format	Example
1	\$GPGSA	Log header	-	\$GPGSA
2	mode MA	A = Automatic 2D/3D M = Manual, forced to operate in 2D or 3D	M	M
3	mode 123	Mode: 1 = Fix not available 2 = 2D 3 = 3D	x	3
4-12	prn	PRN numbers of satellites used in solution (See Table 2-2)	xx,xx,....	141,142,143,144,145,146,148,149,152,153,156,159
13	pdop	Position dilution of precision	x.x	0.7
14	hdop	Horizontal dilution of precision	x.x	0.4
15	vdop	Vertical dilution of precision	x.x	0.6
16	*xx	Check sum	*hh	*2D
17	[CR][LF]	Sentence terminator		[CR][LF]

3.3.1.3.4. GPGST

This log contains pseudorange measurement noise statistics.

Log	GPGST			
Description	Estimated error in position solution			
Recommended Input	<i>log gpgst ontime 1</i>			
Supported Format	ASCII			
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
ASCII Example	\$GPGST,062920.00,0.25,0.01,0.00,88.2330,0.0238,0.0238,0.0469*57			
Log structure				
ID	Field	Description	Format	Example
1	\$GPGST	Log header	-	\$GPGST
2	utc	UTC time status of position	hhmmss.ss	062920.00
3	rms	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudoranges and DGPS corrections	x.x	0.25
4	smjstd	Standard deviation of semi-major axis of error	x.x	0.01

		ellipse, m		
5	smnrstd	Standard deviation of semi-minor axis of error ellipse, m	x.x	0.00
6	orient	Orientation of semi-major axis of error ellipse (degrees from true north)	x.x	88.2330
7	latstd	Standard deviation of latitude error, m	x.x	0.0238
8	lonstd	Standard deviation of longitude error, m	x.x	0.0238
9	alt std	Standard deviation of altitude error, m	x.x	0.0469
10	*xx	Check sum	*hh	*57
11	[CR][LF]	Sentence terminator		[CF][LF]

3.3.1.3.5. GPGSV

This log contains the number of GPS SVs in view, PRN numbers, elevation, azimuth and SNR value.

Log	GPGSV
Description	Satellites in view
Recommended Input	<i>log gpgsv ontime 1</i>
Supported Format	ASCII
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	<pre> \$GPGSV,3,1,12,133,48,170,40,20,36,076,39,11,31,134,40, 29,39,259,40*40 \$GPGSV,3,2,12,02,58,145,42,18,26,319,39,05,57,028,43,1 37,53,169,36*4C \$GPGSV,3,3,12,24,14,185,31,30,20,054,35,13,76,036,43,1 5,63,256,43*77 \$BDGSV,6,1,22,149,25,194,36,199,49,146,41,174,17,169,3 7,168,39,301,41*6B \$BDGSV,6,2,22,182,49,035,42,148,63,003,38,200,34,240,3 8,141,46,140,39*6B \$BDGSV,6,3,22,166,20,088,36,153,58,341,40,178,71,037,4 3,143,53,201,38*60 \$BDGSV,6,4,22,144,35,123,36,151,36,180,39,156,50,192,4 1,183,53,213,43*68 \$BDGSV,6,5,22,146,44,195,37,173,52,298,44,142,37,237,3 4,154,62,351,42*67 \$BDGSV,6,6,22,179,59,192,42,164,18,136,37,,,,,,,,,*6D \$GLGSV,2,1,06,42,16,042,37,57,36,169,30,58,70,288,44,4 4,32,268,42*6A \$GLGSV,2,2,06,43,55,338,34,52,11,062,36,,,,,,,,,*6D </pre>

3.3.1.3.7. GPRMC

This log contains time, date, position, track made good and speed data provided by the GNSS navigation receiver.

Log	GPRMC			
Description	NMEA heading log			
Recommended Input	<i>log gprmc ontime 1</i>			
Supported Format	ASCII			
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
ASCII Example	\$GPRMC,074539.00,A,3120.9969570,N,12117.5424237,E,000.004,133.5,120822,10.0,W,D*1C			
Log structure				
ID	Field	Description	Format	Example
1	\$GPRMC	Log header	-	\$GPRMC
2	utc	UTC of position	hhmmss.ss	074539.00
3	pos status	A = Data valid V = Data invalid	A	A
4	lat	Latitude	IIII.II	3120.9969570
5	latdir	Latitude direction (N = North, S = South)	a	N
6	lon	Longitude	YYYYY.YY	12117.5424237
7	londir	Longitude direction (E = East, W = West)	a	E
8	speed Kn	Speed over ground, knots	x.x	000.004
9	track true	Track made good, degrees True	x.x	133.5
10	date	UTC Date: dd/mm/yy	xxxxxx	120822
11	mag var	Magnetic variation, degrees, (000-180.0°)	x.x	10.0
12	vardir	Magnetic variation direction , E/W	a	W
13	mode ind	Positioning Mode Indicator A = Single point positioning D = Differential positioning E = Estimated Mode M = Manual input N = Data Invalid	a	D
14	*xx	Check sum	*hh	*1C
15	[CR][LF]	Sentence terminator	-	-

3.3.1.3.8. GPVTG

This log contains the track made good and speed relative to the ground.

Log	GPVTG			
Description	NMEA ground speed log			
Recommended Input	<i>log gpvtg ontime 1</i>			
Supported Format	ASCII			
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
ASCII Example	\$GPVTG,148.030,T,158.030,M,0.001,N,0.001,K,D*27			
Log structure				
ID	Field	Description	Format	Example
1	\$GPVTG	Log header	-	\$GPVTG
2	track true	Track made good, degrees True	x.x	148.030
3	T	True track indicator	T	T
4	track mag	Track made good, degrees Magnetic	x.x	158.030
5	M	Magnetic track indicator	M	M
6	speed Kn	Speed over ground, knots	x.x	0.001
7	N	Nautical speed indicator (N = Knots)	N	N
8	speed Km	Speed, km/hr	x.x	0.001
9	K	Speed indicator, km/hr	K	K
10	mode ind	Positioning Mode Indicator A = Single point positioning D = Differential positioning E = Estimated Mode M = Manual input N = Data Invalid	a	D
11	*xx	Check sum	*hh	*27
12	[CR][LF]	Sentence terminator		[CR][LF]

3.3.1.3.9. GPZDA

This log provides the UTC date and time.

Log	GPZDA			
Description	UTC date and time			
Recommended Input	<i>log gpzda ontime 1</i>			
Supported Format	ASCII			
Supported	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			

Board				
ASCII Example	\$GPZDA,081756.00,12,08,2022,,,*62			
Log structure				
ID	Field	Description	Format	Example
1	\$GPZDA	Log header	-	\$GPZDA
2	utc	UTC time	hhmmss.ss	081756.00
3	Day	Day, 01 to 31	xx	12
4	Month	Month, 01 to 12	xx	08
5	Year	Year	xxxx	2022
6	Null	Local zone description-not available	xx	-
7	Null	Local zone minutes description-not available	xx	-
8	*xx	Check sum	*hh	*62
9	[CR][LF]	Sentence terminator	-	-

3.3.1.4. Self-defined NMEA Logs

3.3.1.4.1. GPHPR

This log contains the heading angle, pitch angle, roll angle and other message of the dual antenna device.

Log	GPHPR			
Description	Attitude (heading, pitch, roll)			
Recommended Input	<i>log gphpr ontime 1</i>			
Supported Format	ASCII			
Supported Board	K823/K825/K827/K922			
ASCII Example	\$GPHPR,082602.00,77.94,51.30,0.00,4,40,0.00,0004*43			
Log structure				
ID	Field	Description	Format	Example
1	\$GPHPR	Log header	-	\$GPHPR
2	Utc	UTC time	hhmmss.ss	082602.00
3	heading	Heading angle, 0-360°	hhh.hh	77.94
4	pitch	Pitch angle, -90-90°	ppp.pp	51.30
5	Roll	Roll angle, -90-90°	rrr.rr	0.00
6	QF	Solution status: 0 = Invalid Solution 1 = GPS fixed Solution	q	4

		2 = Code Differential 4 = RTK Fixed Solution 5 = RTK Float Solution 6 = Estimating 7 = Manual input 8 = Ultra-Wide Lane Solution 9 = SBAS Solution		
7	solnSVs	Number of satellites used in solution	n	40
8	age	Age of correction data, s	dd.dd	0.00
9	stn ID	Differential base station ID	xxxx	0004
10	*xx	Check sum	*hh	*43
11	[CR][LF]	Sentence terminator		[CR][LF]

3.3.1.4.2. GPNTR

This log contains the distance from the rover station to the base station in the east, north, and vertical directions.

Log	GPNTR			
Description	Distance from the rover station to the base station			
Recommended Input	<i>log gpntr ontime 1</i>			
Supported Format	ASCII			
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
ASCII Example	\$GPNTR,082748.00,4,8037.620,-7784.012,-2003.105,+8.477,0008*75			
Log structure				
ID	Field	Description	Format	Example
1	\$GPNTR	Log header	-	\$GPNTR
2	Utc	UTC time	hmmss.ss	082748.00
3	Pos status	Solution status: 0: Invalid 1: Single point positioning 2: Pseudorange Differential positioning 4: RTK fixed 5: RTK floating 6: Estimating 7: Manual input	I	4
4	Distance	Distance, m	dddd.ddd	8037.620
5	Distance in north	Distance in north + : North - : South	dddd.ddd	-7784.012

6	Distance in east	Distance in east + : East - : West	dddd.ddd	-2003.105
7	Distance in Vertical direction	Distance in Vertical direction + : Up - : Down	dddd.ddd	+8.477
8	Station ID	Differential base station ID	l	0008
9	*xx	Check sum	*hh	*75
10	[CR][LF]	Sentence terminator		[CR][LF]

3.3.1.4.3. GPTRA

This log contains the heading angle, pitch angle, and roll angle of the baseline vector between the two antennas, which is used in conjunction with the dual GNSS RF receiver for attitude determination.

Log	GPTRA			
Description	Attitude of the baseline vector between the two antennas			
Recommended Input	<i>log gptra ontime 1</i>			
Supported Format	ASCII			
Supported Board	K823/K825/K827/K922			
ASCII Example	\$GPTRA,083056.00,77.92,51.34,0.00,4,40,0.00,0004*4A			
Log structure				
ID	Field	Description	Format	Example
1	\$GPTRA	Log header	-	\$GPTRA
2	utc	UTC time	hhmmss.ss	083056.00
3	heading	Heading angle, 0-360°	hhh.hh	77.92
4	pitch	Pitch angle, -90-90°	ppp.pp	51.34
5	roll	Reserved	rrr.rr	0.00
6	sol status	Solution status: 0 = Invalid 1 = Single point positioning 2 = Pseudorange differential 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution	l	4

7	# sats	Number of satellites in use	n	40
8	age	Age of correction data, s	dd.dd	0.00
9	stn ID	Differential base station ID	xxxx	0004
10	*xx	Check sum	*hh	*4A
11	[CR][LF]	Sentence terminator		[CR][LF]

3.3.1.4.4. GPYBM

This log contains position, velocity, and projection information, and also includes the heading angle and pitch angle information from a dual-antenna system.

Log	GPYBM			
Description	Position, velocity, and projection information...			
Recommended Input	<i>log gpybm ontime 1</i>			
Supported Format	ASCII			
Supported Board	K823/K825/K827/K922			
ASCII Example	\$GPYBM,SN10016910,083603.00,+31.349949341,+121.29237 3783,36.695,77.901,51.245,-0.000,0.001,- 0.001,0.001,3470495.739,622978.989,-7784.020,- 2003.102,4,4,40,1,0008,3.132,40,*5A			
Log structure				
ID	Field	Description	Format	Example
1	\$GPYBM	Log header	-	\$GPYBM
2	Serial NO.	Device serial number	SNxxxxxxxx,x=0-9	SN10016910
3	utc	UTC time	hhmmss.ss	083603.00
4	Lat	Latitude, degree + : latitude north - : latitude south	dd.dddddddd	+31.349949341
5	Lon	Longitude, degree + : east longitude - : west longitude	ddd.dddddddd	+121.292373783
6	ElpHeight	Ellipsoidal height	.xxx(m)	36.695
7	Heading	Heading angle	0-360° .xxx	77.901
8	Pitch	Pitch angle	-90~90° .xxx	51.245
9	Vel N	Velocity in North	.xxx(m/s)	-0.000
10	Vel E	Velocity in East	.xxx(m/s)	0.001
11	Vel D	Velocity in down	.xxx(m/s)	-0.001
12	Vel G	Ground speed	.xxx(m/s)	0.001

13	Coordinate Northing	Gauss projection coordinate on X-axis (Refer PTNLPJK)	.xxx(m)	3470495.739
14	Coordinate Easting	Gauss projection coordinate on Y-axis (Refer PTNLPJK)	.xxx(m)	622978.989
15	North Distance	Rover station X coordinate in the base station coordinate system (base station at origin)	+: North, -: South .xxx(m)	-7784.020
16	East Distance	Rover station Y coordinate in the base station coordinate system (base station at origin)	+: East, -: West .xxx(m)	-2003.102
17	Position status	Position solution status: 0 = Invalid 1 = Single point positioning 4 = RTK fixed 5 = RTK floating	X	4
18	Heading status	Heading solution status: 0 = Invalid 1 = Single point positioning 4 = RTK fixed 5 = RTK floating	X	4
19	SVn	Number of satellites received by master antenna		40
20	Diff Age	Age of correction data, s		1
21	Station ID	Base station ID	0000	0008
22	Baseline length	Baseline length for dual-antenna system	.xxx(m)	3.132
23	Solution sv	Number of satellites used in solution by slave antenna		40
24	rolling	Roll angle (only supported by boards or systems with inertial navigation modules)	.xxx(deg)	
25	*xx	Check sum	*hh	*5A
26	[CR][LF]	Sentence terminator		

3.3.1.4.5. GPNAV

This log contains position, speed, tracking position information, but also contains the heading angle, pitch angle, roll angle and other information of the dual antenna carrier.

Log	GPNAV
Description	Navigation Information (Qtalys self-defined)
Recommended Input	<i>log gpnave ontime 1</i>

Supported Format	ASCII			
Supported Board	K823/K825/K827/K922			
ASCII Example	\$GPRMC,20240904,084008.00,18.4,,31.35089740237,121.29167995271,24.9583,10.3014,072.427,72.427,0.000,,0.004,-0.005,-0.006,0.006,9,VN,7,0.000,11,6,21,,,11,6,21,,,,,*49			
Log structure				
ID	Field	Description	Format	Example
1	\$GPRMC	Log header	-	\$GPRMC
2	Date	UTC data	yyyymmdd	20240904
3	UTC Time	UTC time	hhmmss.ss	084008.00
4	GPS leap second	The time deviation of GPS relative to UTC, null means invalid.	x	18
5	BDS leap second	The time deviation of BDS relative to UTC, null means invalid.	x	4
6	Reserved	Reserved	x	
7	Latitude	Latitude, degree + : latitude north - : latitude south	.xxxxxxxxxxx	31.35089740237
8	longitude	Longitude, degree + : east longitude - : west longitude	.xxxxxxxxxxx	121.29167995271
9	Altitude	Altitude, m	.xxxx	24.9583
10	Separation	Undulation - the relationship between the geoid and the WGS84 ellipsoid, m	.xxxx	10.3014
11	Tracking angle	Tracking angle, 0-360°, same to GPRMC	.xxx	072.427
12	Heading	Heading angle, based on the true north direction, 0-360°	.xxx	72.427
13	Pitch	Pitch angle, the direction from the horizontal plane to the zenith is positive, and below the horizontal plane is negative, -90~90°	.xxx	0.000
14	Roll	Roll angle, -90-90°, null means invalid	.xxx	
15	Ve	Velocity in East	.xxx	0.004
16	Vn	Velocity in North	.xxx	-0.005
17	Vu	Velocity in up	.xxx	-0.006
18	Vg	Ground speed	.xxx	0.006
19	Status1	Solution status:	X	9

		0 = Invalid 1 = Single 2 = Pseudorange differential 3 = RTK floating ambiguity solution 4 = RTK fixed ambiguity solution		
20	Status2	Heading solution indication: NV, VN, NN, VV V-Valid N-Not Valid (The first letter represents the output state of the master station, and the second represents the output state of the slave station. Whether the message is output from the master station or from the slave station, these two states cannot be empty)	XX	VN
21	System Mask	The GNSS system used in solution GPS:1(0x01,00000001) GLO:2(0x02,00000010) BDS:4(0x04,00000100) GAL:8(0x08,00001000) GPS+GLO:3(0x03,00000011) GPS+BDS:5(0x05,00000101) GPS+GAL:9(0x09,00001001) GLO+BDS:6(0x06,00000110) GPS+GLO+BDS:7(0x07,00000111) GPS+GLO+BDS+GAL:15(0x08,00001111)	X	7
22	Baseline length	Baseline length, m	.xxx	0.000
23-27	#SV Used	Number of satellites used in solution	x,x,x,,	11,6,21,,
28-32	#SV Tracked	Number of satellites tracked	x,x,x,,	11,6,21,,
33	Reserved	Reserved		
34	Reserved	Reserved		
35	Reserved	Reserved		
36	Reserved	Reserved		
37	*xx	Check sum	*hh	*49
38	[CR][LF]	Sentence terminator		

3.3.1.4.6. GPPWV

This log provides message related to the monitoring of precipitable water vapor.

Log	GPPWV			
Description	Precipitable water vapor monitoring message			
Recommended Input	<i>log gppwv ontime 1</i>			
Supported Format	ASCII			
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922			
ASCII Example	\$GPPWV,20240315,235942.00,2,86397,1013.170,295.500,2548.86,2311.29,36.55*49			
Log structure				
ID	Field	Description	Format	Example
1	\$GPPWV	Log header	-	\$GPPWV
2	Date	UTC data	yyyymmdd	20240315
3	UTC	UTC time	hhmmss.ss	235942.00
4	Mode	Precipitable water vapor solution mode : 0 = Invalid 1 = Standard atmospheric model 2 = Meteorograph data	l	2
5	MeteTime	Time of meteorograph data, seconds from the beginning of the GPS day	sssss	86397
6	Pressure	Air pressure, hPa	pppp.ppp	1013.170
7	Temperature	Temperature, K	Kkk.kkk	295.500
8	ZTD	Zenith tropospheric delay, mm	zzzz.zz	2548.86
9	ZHD	Tropospheric zenith dry delay, mm	zzzz.zz	2311.29
10	PWV	Precipitable water vapor, mm	pp.pp	36.55
11	*xx	Check sum	*hh	*49
12	[CR][LF]	Sentence terminator		[CR][LF]

 **NOTE :**

If the mode (ID=4) is set to 1, the standard atmospheric model will be used for parameter calculation, and the default calculated parameter information will be output. If the mode (ID=4) is set to 2, a meteorological instrument will be used for parameter calculation, and the meteorological instrument calculated parameter information will be output. (Currently, only the K807 module supports external meteorological instrument data and only supports the DZQ301 meteorological instrument data format.)

3.3.1.4.7. GPLVM

This log provides velocity-related message in earthquake monitoring, including the velocity and velocity variance in the east, north and up directions of the receiver.

Log	GPLVM			
Description	Velocity message in Earthquake monitoring			
Recommended Input	<i>log gplvm ontime 0.2</i>			
Supported Format	ASCII			
Supported Board	K807			
ASCII Example	\$GPLVM,121634.00,030424,-0.003,-0.002,- 0.005,0.000133,0.000137,0.000148,- 0.000019,0.000031,-0.000026,0.000513,43*6B			
Log structure				
ID	Field	Description	Format	Example
1	\$GPLVM	Log header	-	\$GPLVM
2	UTC	UTC time	hhmmss.ss	121634.00
3	Date	UTC data	mmddyy	030424
4	Velocity of East	Velocity of East, m/s	e.eeee	-0.003
5	Velocity of North	Velocity of North, m/s	n.nnnn	-0.002
6	Velocity of Up	Velocity of Up, m/s	u.uuuu	-0.005
7	Variance of East	The variance of the velocity in the east direction, m2/s2	v.vvvvvv	0.000133
8	Variance of North	The variance of the velocity in the north direction, m2/s2	v.vvvvvv	0.000137
9	Variance of Up	The variance of the velocity in the up direction, m2/s2	v.vvvvvv	0.000148
10	Variance of East and North	Velocity covariance in the east and north directions, m2/s2	v.vvvvvv	-0.000019
11	Variance of East and Up	Velocity covariance in the east and up directions, m2/s2	v.vvvvvv	0.000031
12	Variance of North and Up	Velocity covariance in the north and up directions, m2/s2	v.vvvvvv	-0.000026
13	Noise of Velocity	Velocity noise affected by environment and solution frequency, m/s	n.nnnnnn	0.000513
14	Number of satellites	Number of satellites whose observations have been used to calculate the velocity values	nn	43
15	*xx	Check sum	*hh	*6B
16	[CR][LF]	Sentence terminator		[CR][LF]

3.3.1.4.8. GPLDM

This log provides displacement-related message in earthquake monitoring, including the

displacement and displacement variance in the east, north and up directions of the receiver.

Log	GPLDM			
Description	Displacement message (Earthquake monitoring)			
Recommended Input	<i>log gpldm ontime 0.2</i>			
Supported Format	ASCII			
Supported Board	K807			
ASCII Example	<pre>\$GPLDM,121634.00,030424,091118.60,030424,- 0.2170,0.5470,0.2429,0.000133,0.000137,0.000148,- 0.000019,0.000031,- 0.000026,0.000513,43,1,0.9777273,1.000000*6B</pre>			
Log structure				
ID	Field	Description	Format	Example
1	\$GPLDM	Log header	-	\$GPLDM
2	UTC	UTC time	hhmmss.ss	121634.00
3	Date	UTC data	mmddyy	030424
4	UTC	The UTC time of the beginning of the displacement calculation	hhmmss.ss	091118.60
5	Date	The UTC data of the beginning of the displacement calculation	mmddyy	030424
6	Displacement of East	Displacement of East, m	e.eeee	-0.2170
7	Displacement of North	Displacement of North, m	n.nnnn	-0.5470
8	Displacement of Up	Displacement of Up, m	u.uuuu	0.2429
9	Variance of Eastward Displacement	The variance of the displacement in the east direction, m2	v.vvvvvv	0.000133
10	Variance of Northward Displacement	The variance of the displacement in the north direction, m2	v.vvvvvv	0.000137
11	Variance of Upward Displacement	The variance of the displacement in the up direction, m2	v.vvvvvv	0.000148
12	Displacement Variance of East and North	Displacement covariance in the east and north directions, m2	v.vvvvvv	-0.000019
13	Displacement Variance of East and Up	Displacement covariance in the east and up directions, m2	v.vvvvvv	0.000031
14	Displacement Variance of	Displacement covariance in the north and up directions, m2	v.vvvvvv	-0.000026

	North and Up			
15	Noise of Velocity	Velocity noise affected by environment and solution frequency, m/s	n.nnnnnn	0.000513
16	Number of satellites	Number of satellites whose observations have been used to calculate the velocity values	nn	43
17	Displacement Coordinate	Receiver coordinates for displacement monitoring: 1 = Manual input 0 = Automatic input	d	1
18	Epoch to Epoch Data Completeness Ratio	Epoch to epoch data completeness ratio. It indicates the ratio of available observations for displacement computation divided by the number of complete observations between the last and current epoch. Range from 0 to 1: 0: No observations are available 0.x: Parts of observations are available 1: All observations are available	e.eeeee	0.9777273
19	Overall Data Completeness Ratio	Overall data completeness ratio. It indicates the ratio of available observations for displacement computation divided by the number of complete observations between the start of displacement computation and the current epoch. Range from 0 to 1: 0: No observations are available 0.x: Parts of observations are available 1: All observations are available	o.ooooo	1.000000
20	*xx	Check sum	*hh	*6B
21	[CR][LF]	Sentence terminator		[CR][LF]

3.3.1.4.9. GPVAM

This log provides accumulative displacement message during earthquake monitoring, including the accumulative displacement in the east, north and day directions under the total duration of the earthquake.

Log	GPVAM
Description	Accumulative displacement message (Earthquake monitoring)
Recommended Input	<i>log gpvam ontime 0.2</i>
Supported Format	ASCII
Supported Board	K807

ASCII Example	\$GPVAM, 121634.00, 121635.20, -0.543, 0.482, 0.185, 0.0215, 0.0224, 0.0748, 0*51			
Log structure				
ID	Field	Description	Format	Example
1	\$GPVAM	Log header	-	\$GPVAM
2	OpenTime	The start time of the earthquake	hhmmss.ss	121634.00
3	EndTime	The end time of the earthquake	hhmmss.ss	121635.20
4	Displace of East	The accumulative displacement of the earthquake in the east, m	e.eeee	-0.543
5	Displace of North	The accumulative displacement of the earthquake in the north, m	n.nnnn	0.482
6	Displace of Up	The accumulative displacement of the earthquake in the up, m	u.uuuu	0.185
7	Recommend Thresh of East	The recommended displacement threshold set in the east	e.eeee	0.0215
8	Recommend Thresh of North	The recommended displacement threshold set in the north	n.nnnn	0.0224
9	Recommend Thresh of UP	The recommended displacement threshold set in the up	u.uuuu	0.0748
10	Current State	Is there an earthquake currently 1 = Yes 0 = No	c	0
11	*xx	Check sum	*hh	*51
12	[CR][LF]	Sentence terminator		[CR][LF]

3.3.2.RTCM 3.X LOGS

The RTCM (Radio Technical Commission for Maritime Services) format is a commonly used differential signal format in Global Navigation Satellite Systems. Compared to earlier versions, RTCM 3.X provides higher accuracy and richer data content, making it widely used in high-precision positioning and navigation applications. Detailed information about the RTCM protocol can be found on the official RTCM website (<http://www.rtcn.org>).

Qtalis board supports various RTCM 3.X log formats, with different log types used to transmit different types of GNSS data. [Table 3-24](#) lists some commonly used RTCM 3.X log types, allowing users to choose the appropriate log type for differential data transmission and processing according to their specific needs.

Table 3-24 RTCM Logs

Serial number	ID	Log type	Format	Description
RTCM3.X				
1	787	RTCM1004	B	Extended L1&L2 GPS RTK Observables
2	148	RTCM1005	B	Stationary RTK Base Station ARP

3	789	RTCM1006	B	Stationary RTK Base Station ARP with Antenna Height
4	856	RTCM1007	B	Antenna Descriptor
5	857	RTCM1008	B	Antenna Descriptor & Serial Number
6	898	RTCM1010	B	Extended L1-only GLONASS RTK Observables
7	900	RTCM1012	B	Extended L1&L2 GLONASS RTK Observables
8	893	RTCM1019	B	GPS Ephemerides
9	895	RTCM1020	B	GLONASS Ephemerides
10	150	RTCM1042	B	BDS Ephemerides
11	151	RTCM1044	B	QZSS Ephemerides
12	152	RTCM1045	B	Galileo F/NAV Ephemerides
13	154	RTCM1046	B	Galileo I/NAV Ephemerides
14	999	RTCM1033	B	Receiver and Antenna Descriptors
15	624	RTCM1074	B	GPS MSM4
16	644	RTCM1084	B	GLONASS MSM4
17	654	RTCM1094	B	GAL MSM4
18	674	RTCM1114	B	QZSS MSM4
19	684	RTCM1124	B	BDS MSM4
20	-	RTCMCOMPASS	B	-

3.3.2.1.RTCM1004

This log contains extended L1&L2 GPS RTK observations information.

Log	RTCM1004
Description	Extended L1&L2 GPS RTK Observables
Log ID	787
Recommended Input	<i>log rtcm1004b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtc.org).	

3.3.2.2.RTCM1005

This log contains Stationary RTK base station antenna reference point(ARP) information.

Log	RTCM1005
Description	Stationary RTK Base Station ARP
Log ID	148

Recommended Input	<i>log rtcm1005b ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.3.RTCM1006

This log contains Stationary RTK base station antenna reference point(ARP) and antenna Height information.

Log	RTCM1006
Description	Stationary RTK Base Station ARP with Antenna Height
Log ID	789
Recommended Input	<i>log rtcm1006b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.4.RTCM1007

This log contains extended antenna descriptor information.

Log	RTCM1007
Description	Antenna Descriptor
Log ID	856
Recommended Input	<i>log rtcm1007b ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.5.RTCM1008

This log contains antenna descriptor and serial number information.

Log	RTCM1008
Description	Antenna Descriptor & Serial Number

Log ID	857
Recommended Input	<i>log rtcm1008b ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtc.org).	

3.3.2.6.RTCM1010

This log contains extended L1-only GLONASS RTK observations information.

Log	RTCM1010
Description	Extended L1-only GLONASS RTK Observables
Log ID	898
Recommended Input	<i>log rtcm1010b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtc.org).	

3.3.2.7.RTCM1012

This log contains extended GLONASS L1&L2 observables information.

Log	RTCM1012
Description	Extended L1&L2 GLONASS RTK Observables
Log ID	900
Recommended Input	<i>log rtcm1012b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtc.org).	

3.3.2.8.RTCM1019

This log contains GPS ephemeris information.

Log	RTCM1019
Description	GPS Ephemerides
Log ID	893

Recommended Input	<i>log rtcm1019b ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtc.org).	

3.3.2.9.RTCM1020

This log contains GLONASS ephemeris information.

Log	RTCM1020
Description	GLONASS Ephemerides
Log ID	895
Recommended Input	<i>log rtcm1020b ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtc.org).	

3.3.2.10.RTCM1042

This log contains BDS ephemeris information.

Log	RTCM1042
Description	BDS Ephemerides
Log ID	150
Recommended Input	<i>log rtcm1042b ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtc.org).	

3.3.2.11.RTCM1044

This log contains QZSS ephemeris information.

Log	RTCM1042
Description	QZSS Ephemerides
Log ID	901
Recommended Input	<i>log rtcm1044b ontime 5</i>

Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.12.RTCM1045

This log contains Galileo F/NAV ephemeris information.

Log	RTCM1042
Description	Galileo F/NAV Ephemerides
Log ID	152
Recommended Input	<i>log rtcn1044b ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.13.RTCM1046

This log contains Galileo I/NAV ephemeris information.

Log	RTCM1046
Description	Galileo I/NAV Ephemerides
Log ID	154
Recommended Input	<i>log rtcn1046b ontime 5</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.14.RTCM1033

This log contains receiver and antenna descriptors information.

Log	RTCM1046
Description	Receiver and Antenna Descriptors
Log ID	999
Recommended Input	<i>log rtcn1033b ontime 5</i>
Supported Format	Binary
Supported	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922

Board	
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.15.RTCM1074

This log contains GPS pseudoranges and phaseranges plus CNR measurements.

Log	RTCM1074
Description	GPS MSM4
Log ID	624
Recommended Input	<i>log rtcm1074b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.16.RTCM1084

This log contains GLONASS pseudoranges and phaseranges plus CNR measurements.

Log	RTCM1084
Description	GLONASS MSM4
Log ID	644
Recommended Input	<i>log rtcm1084b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.17.RTCM1094

This log contains Galileo pseudoranges and phaseranges plus CNR measurements.

Log	RTCM1094
Description	Galileo MSM4
Log ID	654
Recommended Input	<i>log rtcm1094b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document	

(<http://www.rtcn.org>).

3.3.2.18.RTCM1114

This log contains QZSS pseudoranges and phaseranges plus CNR measurements.

Log	RTCM1114
Description	QZSS MSM4
Log ID	684
Recommended Input	<i>log rtcn1114b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.19.RTCM1124

This log contains BDS pseudoranges and phaseranges plus CNR measurements.

Log	RTCM1124
Description	BDS MSM4
Log ID	674
Recommended Input	<i>log rtcn1124b ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
For detailed structure about this log, please refer to the RTCM 10403.3 document (http://www.rtcn.org).	

3.3.2.20.RTCMCOMPASS

This log is a custom RTCM3.X message defined by Qtalıs. If you wish to share its sub-information, please contact Qtalıs for more details about this log.

Log	RTCMCOMPASS
Description	-
Recommended Input	<i>log rtcncompassb ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
If you wish to share its sub-information, please contact Qtalıs for more details about this log. (www.qtalısgnss.com)	

3.4. Other Logs

Table 3-25 Other Log List

ID	Log ID	Log type	Format	Description
Trimble Logs				
1	224	PTNLAVR	A	Time, yaw, tilt/roll, range for moving baseline RTK
2	76	PTNLGGK	A	Time, position, position type, DOP
3	229	PTNLPJK	A	Local coordinate position output
4	230	PTNBPO	A	Base station position and quality indicator
Parameter Check Log				
1	2013	PJKPARA	A	Check the six parameters of PTNLPJK
KSXT				
1	155	KSXT	A	Positioning and orientation information
Spectrum scanning information				
1	2260	SPECTRUM	B	Spectrum scanning information
Real-time status information				
1	1	SYSRTS	A	Real-time status information
AGRIC				
1	11276	AGRIC	A,B	Position, heading and other related information
Real-time status information of dual antenna				
1	666	DRONE	A,B	Real-time status information of dual antenna
Tilt Measurement Logs				
1	2365	GNSSRAWDATA	B	GNSSRAWDATA for tilt measurement
2	2364	IMURAWDATA	B	IMURAWDATA for tilt measurement
3	2366	INSRTKCOMPENSATE	B	Tilt measurement information
IMU Data				
1	2264	IMUDATA	B	IMU raw data

3.4.1. TRIMBLE LOGS

3.4.1.1. PTNLAVR

This log provides time, yaw, tilt/roll, range for moving baseline RTK.

Log	PTNLAVR
Description	Time, yaw, tilt/roll, range for moving baseline RTK
Log ID	224
Recommended Input	<i>log ptnlavr ontime 1</i>
Supported Format	ASCII

Supported Board	K823/K825/K827/K922
ASCII Example	\$PTNL,AVR,020926.00,+77.8990,Yaw,+51.3333,Tilt,,,3.134,3,1.0,40*37
For detailed structure about this log, please refer to the Trimble site. (https://www.trimble.com/en).	

3.4.1.2.PTNLGGK

This log provides time, position, position type and DOP message.

Log	PTNLGGK
Description	Time, position, position type, DOP
Log ID	76
Recommended Input	<i>log ptnlggk ontime 1</i>
Supported Format	ASCII
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	\$PTNL,GGK,021031.00,081522,3120.99603883,N,12117.54152528,E,1,35,1.0,EHT39.711,M*40
For detailed structure about this log, please refer to the Trimble site. (https://www.trimble.com/en).	

3.4.1.3.PTNLPJK

This log provides local coordinate position, which is convenient for users to configure PJK parameters.

Log	PTNLPJK
Description	Local coordinate position output
Log ID	229
Recommended Input	<i>log ptnlpjk ontime 1</i>
Supported Format	ASCII
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	\$PTNL,PJK,021136.00,081522,+3470494.027,N,+622977.605,E,1,35,1.0,EHT+39.699,M*7C
For detailed structure about this log, please refer to the Trimble site. (https://www.trimble.com/en).	

3.4.1.4.PTNLBPQ

This log describes the base station position and its quality. It is used when the moving base antenna position and quality are required on one serial port (along with a heading message) from a receiver in heading mode.

Log	PTNLBPQ
Description	Base station position and quality indicator
Log ID	230
Recommended Input	<i>log ptnlbpq ontime 1</i>
Supported Format	ASCII
Supported Board	K823/K825/K827/K922
ASCII Example	\$PTNL, BPQ, 075438.00, 050924, 3125.2094416, N, 12118.805 0446, E, EHT+23.125, M, 5*4D
For detailed structure about this log, please refer to the Trimble site. (https://www.trimble.com/en).	

3.4.2.PARAMETER CHECK LOG

3.4.2.1.PJKPARA

This log is used to check the six parameters used in the **PTNL**PJK log.

Log	PJKPARA
Description	Check the six parameters of PTNL PJK
Log ID	2013
Recommended Input	<i>log pjkpara</i>
Supported Format	ASCII
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922
ASCII Example	PJK Parameter: A:6378137.000, 1/F:298.257223563, B0:0.000000deg, L0:120.000000, N0:0.000, E0:500000.000.

3.4.3.KSXT

This log contains GNSS receiver positioning and heading information.

Log	KSXT
-----	-------------

Description	Positioning and heading information			
Log ID	155			
Recommended Input	<i>log ksxt ontime 1</i>			
Supported Format	ASCII			
Supported Board	K823/K825/K827/K922			
ASCII Example	\$KSXT, 20220815021257.00, 121.29235950, 31.34993419, 39.6784, 77.93, 51.29, 50.16, 0.001, 0.00, 1, 3, 40, 35, , , , 0.001, 0.001, 0.007, 71, 88, *12			
Log structure				
ID	Field	Description	Format	Example
1	\$KSXT	Log header	-	\$KSXT
2	utc	UTC time status of position	yyyy/mm/dd/hh/mm/ss.ss	20220815021257.00
3	Lon	Longitude	xxx.xxxxxxxx	121.29235950
4	Lat	Latitude	xx.xxxxxxxx	31.34993419
5	Height	Height above mean sea level, m	xx.xxxx	39.6784
6	Heading	Heading angle, 0-360°		77.93
7	Pitch	Pitch angle, -90-90°		51.29
8	Track true	Track made good, degrees True, 0-360°		50.16
9	Vel	Velocity, km/h	.xxx	0.001
10	Roll	Roll angle, -90-90°		0.00
11	Pos qual	Position status: 0 = Invalid 1 = Single 2 = RTK floating ambiguity solution 3 = RTK fixed ambiguity solution	x	1
12	Heading qual	Heading status: 0 = Invalid 1 = Single 2 = RTK floating ambiguity solution 3 = RTK fixed ambiguity solution	x	3
13	#SsolnSVs	Number of satellites used in solution for Slave antenna	x	40
14	#MsolnSVs	Number of satellites used in solution for Master antenna	x	35
15	Pos east	Eastward position in the geographic coordinate system with the base station as	xxx.xxx	

		the origin, m		
16	Pos north	Northward position in the geographic coordinate system with the base station as the origin, m	xxx.xxx	
17	Pos up	Upward position in the geographic coordinate system with the base station as the origin, m	xxx.xxx	
18	Vel east	Eastward velocity in the geographic coordinate system, km/h	xxx.xxx	0.001
19	Vel north	Northward velocity in the geographic coordinate system, km/h	xxx.xxx	0.001
20	Vel up	Upward velocity in the geographic coordinate system, km/h	xxx.xxx	0.007
21	M SNR	Signal-to-noise ratio (SNR) of the master antenna 95-100: Excellent 90-94: Good 85-89: Medium 80-84: General Less than 80: Poor	xx	71
22	S SNR	Signal-to-noise ratio (SNR) of the slave antenna: 95-100: Excellent 90-94: Good 85-89: Medium 80-84: General Less than 80: Poor	xx	88
23	*XX	Check sum	*hh	*12
24	[CR][LF]	Sentence terminator	-	[CR][LF]

3.4.4.SPECTRUM

This log contains data related to spectrum scanning.

Log	SPECTRUM
Description	Spectrum scanning information
Log ID	2260
Recommended Input	<i>log spectrumb ontime 1</i>
Supported Format	Binary
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922

Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	SPECTRUM Header	Log header(Refer to Table 3-3)		H	0
2	CentFreq	The center frequency of spectrum scanning, kHz	int	4	H
3	ScanRange	Range of spectrum scanning, KHZ	int	4	H+4
4	ScanTimes	Number of points of spectrum scanning, N	int	4	H+8
5	ScanStart	Starting frequency of spectrum scanning, kHz	int	4	H+12
6	ScanSample	Step length of spectrum scanning, kHz	int	4	H+16
7	ScanRatio	Scanning values of points of spectrum scanning	ushort	2*N	H+20
8	CRC	32-bit CRC	hex	4	H+20+2*N

3.4.5.SYSRTS

This log contains real-time status information of the board.

Log	SYSRTS				
Description	Real-time status information				
Log ID	1				
Recommended Input	<i>log sysrts ontime 1</i>				
Supported Format	ASCII				
Supported Board	K823/K825/K827/K922				
ASCII Example	<code> \$SYSRTS,354666.00,023048.00,67,17,41,AT,43,84,1,4,47,,,,,,,,44,92,44,M,SURVEY,0,,,0,9,2174,0,6,47,,,,,*7B </code>				
Log structure					
ID	Field	Description	Format	Example	
1	\$SYSRTS	Log header	-	\$SYSRTS	
2	GPS time	GPS time status of position, s	ssssss.ss	354666.00	
3	UTC time	UTC time status of position, s	hhmmss.ss	023048.00	
4	Interrupt utilization	Interrupt utilization, 0-100, %	xx	67	
5	CPU utilization	CPU utilization, 0-100, %	xx	17	
6	CPU temperature	CPU temperature, °C	xx	41	

7	AT	Prompt: AT		AT
8	ANT1 SNR	Signal-to-noise ratio of antenna1, 0-100, dB	xx	43
9	ANT1 qual	Signal quality score of antenna1, 0-100 Score ≥ 85 in an open and undisturbed environment.	xx	84
10	ANT1 status	Status of antenna1 0 = No Load 1 = Normal 2 = Short circuit 3 = Crosstalk	x	1
11	ANT1 sol status	Position solution status of antenna1: 0 =Invalid 1 = Single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution	x	4
12	ANT1 soln SVs	Number of satellites used in solution of antenna1	xx	47
13	ANT2 SNR	Signal-to-noise ratio of antenna1, 0-100, dB	xx	If there is no slave antenna, the following data is empty
14	ANT2 qual	Signal quality score of antenna1, 0-100 Score ≥ 85 in an open and undisturbed environment.	xx	
15	ANT2 status	Status of antenna1 0 = No Load 1 = Normal 2 = Short circuit 3 = Crosstalk	x	
16	ANT2 sol status	Heading solution status of antenna1: 0 =Invalid 1 = Single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution	x	
17	ANT2 soln SVs	Number of satellites used in solution of antenna2	xx	
18	Base station SNR	Signal-to-noise ratio for base station, 0-100, dB (If the base station differential data is	xx	44

		transmitted in packets, this item will display in a loop according to the packetization strategy. The 'Base station qual' and 'Base station SVs' are the same in this regard.)		
19	Base station qual	Signal quality score of base station, 0-100 Score ≥ 85 in an open and undisturbed environment.	xx	92
20	Base station SVs	Number of satellites used in solution of base station, 0-256	xx	44
21	M	Prompt: M		M
22	Application scenario mode	Survey, Robot, Car, Air, Space	X	SURVEY
23	Ionospheric activity index	Ionospheric activity index, 0-200, mm (More than 50 indicates that the current ionosphere is active)	x	0
24	Interference status	0 = no interference 1 = Interference present	x	
25	Spoofing status	0 = No spoofing 1 = Spoofing present	x	
26	IMU switch	0 = IMU Off 1 = IMU on, initialization failed 2 = IMU on, initialization successful 3 = IMU on, with combined state attitude estimation completed, entering vehicle kinematic constraint model	x	0
27	System time status	0 = System time unavailable 1-8 = System time adjusting, available but unstable 9 = System time stable and available	xx	9
28	VCXO Frequency Value	Voltage-Controlled Crystal Oscillator (VCXO) value, 0-9999 (Normally, the value ranges from 2000 to 2400 at room temperature. This value decreases as temperature increases and increases as temperature decreases.)	xxxx	2174
29	Rover station Blockage Rate	Blockage rate = 100% - (Number of tracked satellites / Number of available satellites)	x	0
30	Base station Blockage Rate	The smaller the value, the better the performance.	x	6
31	SVs	Number of common-view satellites	x	47

		between master station and base station.		
32	Reserved	Reserved	x	
33	Reserved	Reserved	x	
34	Reserved	Reserved	x	
35	Reserved	Reserved	x	
36	*XX	Check sum	*hh	*7B
37	[CR][LF]	Sentence terminator	-	[CR][LF]

3.4.6.AGRIC

This log contains the position, velocity, serial number, heading, baseline and other related information of receiver.

Log	AGRIC			
Description	Position, heading and other related information			
Log ID	11276			
Recommended Input	<i>log agrica ontime 1</i> <i>log agricb ontime 1</i>			
Supported Format	ASCII, Binary			
Supported Board	K823/K825/K827/K922			
ASCII Example	#AGRICA, 35, GPS, FINE, 2223, 283006000, 0, 1, 18, 27; GNSS, 236, 22, 8, 17, 6, 36, 28, 4, 4, 14, 21, 0, -7782.5864, -2000.3002, 8.4380, 0.0046, 0.0056, 0.0041, 243.0610, -0.2899, 0.0000, 0.013, -0.010, 0.008, -0.012, 0.013, 0.015, 0.012, 31.34996227620, 121.29240322121, 36.6529, -2831767.7449, 4658831.1477, 3299110.4542, 0.0194, 0.0194, 0.0280, 0.0043, 0.0053, 0.0039, 31.42015535053, 121.31342487993, 23.1344, 31.34994264898, 121.29236881723, 42.6828, 283006000, 1.000, 139.352203, 10.304612, 2.753604, 0.717130, 0, 0, 0, 0*acab1bc9			
Log structure(ASCII)				
ID	Field	Description	Format	ASCII Example
1	#AGRICA	Log header		#AGRICA
2	CPUIIdle	Minimum Percentage of CPU Idle Time	xx	35
3	TimeRef	Time reference system: GPST/BDST	x	GPS
4	TimeStatus	Time status UNKNOW = Receiver has failed to calculate an accurate GPS time. FINE = Receiver has successfully calculated	x	FINE

		an accurate GPS time.		
5	Wn	GPS Week number	xxxx	2223
6	Ms	Number of seconds into GPS week, ms	ssssss.ss	283006000
7	Res	Reserved		0
8	Version	Format Version Number, Current Version is 1	x	1
9	GPS leap Sec	The time deviation of GPS relative to UTC	xx	18
10	Output Delay	Data output delay, μ s (Data output and GNSS satellite signal sampling time difference)	x	27
11	GNSS	Prompt: GNSS		GNSS
12	Length	Message Length	xxx	236
13	Year	Years in UTC time	yy	22
14	Month	Months in UTC time	mm	8
15	Day	Days in UTC time	dd	17
16	Hour	Hours in UTC time	hh	6
17	Minute	Minutes in UTC time	mm	36
18	Second	Seconds in UTC time	ss	28
19	RTK Status	Position solution status of rover station: 0 = Invalid solution 1 = single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution	x	4
20	Heading Status	Heading solution status of rover station: 0 =Invalid solution 1 =single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution	x	4
21	Num GPS Sta	Number of GPS satellites used in solution	xx	14
22	Num BDS Sta	Number of BDS satellites used in solution	xx	21
23	Num GLO Sta	Number of GLONASS satellites used in solution	xx	0
24	Baseline_N	Base station to rover station baseline vector, north component	xxx	-7782.5864
25	Baseline_E	Base station to rover station baseline vector, east component	xxx	-2000.3002
26	Baseline_U	Base station to rover station baseline vector, up component	xxx	8.4380
27	Baseline_NStd	Standard deviation of north component of	xxx	0.0046

		base station to rover station baseline vector		
28	Baseline_EStd	Standard deviation of east component of base station to rover station baseline vector	xxx	0.0056
29	Baseline_UStd	Standard deviation of up component of base station to rover station baseline vector	xxx	0.0041
30	Heading	Heading angle	x	243.0610
31	Pitch	Pitch angle	x	-0.2899
32	Roll	Roll angle	x	0.0000
33	Speed	Ground speed,m/s	x	0.013
34	Velocity of North	Velocity of East, m/s	x	-0.010
35	Velocity of East	Velocity of North, m/s	x	0.008
36	Velocity of Up	Velocity of Up, m/s	x	-0.012
37	Xigma_Vx	Variance of velocity in the east direction, m ² /s ²	x	0.013
38	Xigma_Vy	Variance of velocity in the north direction, m ² /s ²	x	0.015
39	Xigma_Vz	Variance of velocity in the up direction, m ² /s ²	x	0.012
40	lat	Latitude of rover station, degrees	x	31.34996227620
41	lon	Longitude of rover station, degrees	x	121.29240322121
42	alt	Height above mean sea level of rover station, m	x	36.6529
43	ECEF_X	X coordinate in ECEF coordinate system	x	-2831767.7449
44	ECEF_Y	Y coordinate in ECEF coordinate system	x	4658831.1477
45	ECEF_Z	Z coordinate in ECEF coordinate system	x	3299110.4542
46	Xigma_lat	Variance of lat	x	0.0194
47	Xigma_lon	Variance of lon	x	0.0194
48	Xigma_alt	Variance of alt	x	0.0280
49	Xigma_ECEF_X	Variance of ECEF_X	x	0.0043
50	Xigma_ECEF_Y	Variance of ECEF_Y	x	0.0053
51	Xigma_ECEF_Z	Variance of ECEF_Z	x	0.0039
52	BASE_lat	Latitude of base station, degrees	x	31.42015535053
53	BASE_lon	Longitude of base station, degrees	x	121.31342487993
54	BASE_alt	Height above mean sea level of base station, m	x	23.1344
55	SEC_lat	Latitude of slave antenna, degrees	x	31.34994264898
56	SEC_lon	Longitude of slave antenna, degrees	x	121.29236881723

57	SEC_alt	Height above mean sea level of slave antenna, m	x	42.6828	
58	GPS_WEEK_SECONDS	Number of seconds into GPS week, ms	ssssss.ss	283006000	
59	Diffage	Age of correction data, s	x	1.000	
60	Speed_Heading	Ground speed Heading	x	139.352203	
61	Undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid	x	10.304612	
62	Res	Reserved		2.753604	
63	Res	Reserved		0.717130	
64	Res	Reserved		0	
65	Res	Reserved		0	
66	Res	Reserved		0	
67	Res	Reserved		0	
68	*XX	Check sum	*hhhh	0*acab1bc9	
69	[CR][LF]	Sentence terminator	-	[CR][LF]	
Log structure(Binary)					
ID	Field	Description	Format	Binary byte	Binary Offset
1	Sync	0xAA	uchar	1	0
2	Sync	0x44	uchar	1	1
3	Sync	0xB5	uchar	1	2
4	CPUIdle	Minimum Percentage of CPU Idle Time	uchar	1	3
5	Message ID	Message ID	ushort	2	4
6	MessageLength	Message length	ushort	2	6
7	TimeRef	Time reference system: GPST/BDST	uchar	1	8
8	TimeStatus	Time status	uchar	1	9
9	Wn	GPS Week number	ushort	2	10
10	Ms	Number of seconds into GPS week, ms	ulong	4	12
11	Res	Reserved	ulong	4	16
12	Version	Format Version Number, Current Version is 1	uchar	1	20
13	Leap sec	The time deviation of GPS relative to UTC	uchar	1	21
14	DelayMs	Data output delay, μ s (Data output and GNSS satellite signal sampling time difference)	ushort	2	22
15	GNSS	Prompt: GNSS	char	4	24
16	Length	Message Length	uchar	1	28
17	Year	Years in UTC time	uchar	1	29
18	Month	Months in UTC time	uchar	1	30
19	Day	Days in UTC time	uchar	1	31

20	Hour	Hours in UTC time	uchar	1	32
21	Minute	Minutes in UTC time	uchar	1	33
22	Second	Seconds in UTC time	uchar	1	34
23	RTK Status	Position solution status of rover station: 0 =Invalid solution 1 =single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution	uchar	1	35
24	Heading Status	Heading solution status of rover station: 0 =Invalid solution 1 =single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed ambiguity solution 5 = RTK floating ambiguity solution	uchar	1	36
25	Num GPS Sta	Number of GPS satellites used in solution	uchar	1	37
26	Num BDS Sta	Number of BDS satellites used in solution	uchar	1	38
27	Num GLO Sta	Number of GLONASS satellites used in solution	uchar	1	39
28	Baseline_N	Base station to rover station baseline vector, north component	float	4	40
29	Baseline_E	Base station to rover station baseline vector, east component	float	4	44
30	Baseline_U	Base station to rover station baseline vector, up component	float	4	48
31	Baseline_NStd	Standard deviation of north component of base station to rover station baseline vector	float	4	52
32	Baseline_EStd	Standard deviation of east component of base station to rover station baseline vector	float	4	56
33	Baseline_UStd	Standard deviation of up component of base station to rover station baseline vector	float	4	60
34	Heading	Heading angle	float	4	64
35	Pitch	Pitch angle	float	4	68
36	Roll	Roll angle	float	4	72
37	Speed	Ground speed,m/s	float	4	76
38	Velocity of North	Velocity of East, m/s	float	4	80
39	Velocity of East	Velocity of North, m/s	float	4	84

40	Velocity of Up	Velocity of Up, m/s	float	4	88
41	Xigema_Vx	Variance of velocity in the east direction, m ² /s ²	float	4	92
42	Xigema_Vy	Variance of velocity in the north direction, m ² /s ²	float	4	96
43	Xigema_Vz	Variance of velocity in the up direction, m ² /s ²	float	4	100
44	lat	Latitude of rover station, degrees	double	8	104
45	lon	Longitude of rover station, degrees	double	8	112
46	alt	Height above mean sea level of rover station, m	double	8	120
47	ECEF_X	X coordinate in ECEF coordinate system	double	8	128
48	ECEF_Y	Y coordinate in ECEF coordinate system	double	8	136
49	ECEF_Z	Z coordinate in ECEF coordinate system	double	8	144
50	Xigema_lat	Variance of lat	float	4	152
51	Xigema_lon	Variance of lon	float	4	156
52	Xigema_alt	Variance of alt	float	4	160
53	Xigema_ECEF_X	Variance of ECEF_X	float	4	164
54	Xigema_ECEF_Y	Variance of ECEF_Y	float	4	168
55	Xigema_ECEF_Z	Variance of ECEF_Z	float	4	172
56	BASE_lat	Latitude of base station, degrees	double	8	176
57	BASE_lon	Longitude of base station, degrees	double	8	184
58	BASE_alt	Height above mean sea level of base station, m	double	8	192
59	SEC_lat	Latitude of slave antenna, degrees	double	8	200
60	SEC_lon	Longitude of slave antenna, degrees	double	8	208
61	SEC_alt	Height above mean sea level of slave antenna, m	double	8	216
62	GPS_WEEK_SEC OND	Number of seconds into GPS week, ms	int	4	220
63	Diffage	Age of correction data, s	float	4	224
64	Speed_Heading	Ground speed Heading	float	4	228
65	Undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid	float	4	232
66	Res	Reserved	float	4	236
67	Res	Reserved	float	4	240
68	Res	Reserved	uchar	1	241
69	Res	Reserved	uchar	1	242
70	Res	Reserved	uchar	1	243
71	Res	Reserved	HEX	4	244
72	xxxx	32 bit CRC	-	-	-

3.4.7.DRONE

This log contains real-time status information of master antenna and slave antenna.

Log	DRONE					
Description	Real-time status information of dual antenna					
Log ID	666					
Recommended Input	<i>log dronea ontime 1</i> <i>log droneb ontime 1</i>					
Supported Format	ASCII, Binary					
Supported Board	K823/K825/K827/K922					
ASCII Example	#DRONE,COM1,0,60.0,FINESTEERING,2263,267570.000,00000000,0000,1114;23,5,24,2,19,12,1,45,45,21,12,7,5,21,12,7,5,121.29169275851,31.35089750559,27.8769,0.3036,0.3035,1.4278,0.0006,-0.0006,0.0146,0.0165,0.0024,0.0036,1,1,45,45,121.29162252337,31.35088292530,28.8125,1,4,248.7460,1.0419,0.8830,0.4550,0.5530,0.0000,10.3014,4096,*4ff8b7c6					
Log structure						
ID	Field	Description	Format	Binary Bytes	Binary Offset	ASCII Example
1	DRONE Header	Log header(For ASCII format, see Table 3-1 ; for binary format, see Table 3-3)		H	0	#DRONE,COM1,0,60.0,FINESTEERING,2263,267570.000,0000000,0000,1114;
2	Year	Years in UTC time	uchar	1	H	23
3	Month	Months in UTC time	uchar	1	H+1	5
4	Day	Days in UTC time	uchar	1	H+2	24
5	Hour	Hours in UTC time	uchar	1	H+3	2
6	Minute	Minutes in UTC time	uchar	1	H+4	19
7	Second	Seconds in UTC time	uchar	1	H+5	12
8	Master Fix Status	Position solution status of master antenna: 0 = Invalid 1 = Single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed	uchar	1	H+6	1

		5 = RTK floating				
9	master Lock Star Num	Number of locked satellites of master antenna	uchar	1	H+7	45
10	master Follow Star Num	Number of tracked satellites of master antenna	uchar	1	H+8	45
11	master BDS Lock Star Num	Number of locked BDS satellites of master antenna	uchar	1	H+9	21
12	master GPS Lock Star Num	Number of locked GPS satellites of master antenna	uchar	1	H+10	12
13	master GAL Lock Star Num	Number of locked Galileo satellites of master antenna	uchar	1	H+11	7
14	master GLO Lock Star Num	Number of locked GLONASS satellites of master antenna	uchar	1	H+12	5
15	master BDS Follow Star Num	Number of tracked BDS satellites of master antenna	uchar	1	H+13	21
16	master GPS Follow Star Num	Number of tracked GPS satellites of master antenna	uchar	1	H+14	12
17	master GAL Follow Star Num	Number of tracked Galileo satellites of master antenna	uchar	1	H+15	7
18	master GLO Follow Star Num	Number of tracked GLONASS satellites of master antenna	uchar	1	H+16	5
19	master Lon	Longitude of master antenna, degrees	double	8	H+17	121.29169275851
20	master Lat	Latitude of master antenna, degrees	double	8	H+25	31.35089750559
21	master Alt	Height above mean sea level of master antenna, m	double	8	H+33	27.8769
22	master Lon Xigma	Variance of master Lon	float	4	H+41	0.3036
23	master Lat Xigma	Variance of master Lat	float	4	H+45	0.3035
24	master Alt	Variance of master Alt	float	4	H+49	1.4278

	Xigema					
25	master North Speed	Velocity of master antenna in north, m/s	float	4	H+53	0.0006
26	master East Speed	Velocity of master antenna in east, m/s	float	4	H+57	-0.0006
27	master Up Speed	Velocity of master antenna in up, m/s	float	4	H+61	0.0146
28	master North Speed Xigema	Variance of velocity of master antenna in north, m2/s2	float	4	H+65	0.0165
29	master East Speed Xigema	Variance of velocity of master antenna in east, m2/s2	float	4	H+69	0.0024
30	master Up Speed Xigema	Variance of velocity of master antenna in up, m2/s2	float	4	H+73	0.0036
31	master Insert Status	Master antenna status 0 = Disconnected 1 = Connected 2 = Short-circuited	uchar	1	H+77	1
32	From Fix Status	Position solution status of slave antenna: 0 = Invalid 1 = Single point position 2 = Pseudorange differential (or SBAS) 4 = RTK fixed 5 = RTK floating	uchar	1	H+78	1
33	From Lock Star Num	Number of locked satellites of slave antenna	uchar	1	H+79	45
34	From Follow Star Num	Number of tracked satellites of slave antenna	uchar	1	H+80	45
35	From Lon	Longitude of slave antenna, degrees	double	8	H+81	121.29162252337
36	From Lat	Latitude of slave antenna, degrees	double	8	H+89	31.35088292530
37	From Alt	Height above mean sea level of slave antenna, m	double	8	H+97	28.8125
38	From Insert Status	Slave antenna status 0 = Disconnected	uchar	1	H+105	1

		1 = Connected 2 = Short-circuited				
39	Heading Status	Heading Status 0 = Invalid 4 = RTK fixed 5 = RTK floating	uchar	1	H+106	4
40	Heading	Heading angle, based on the true north direction, 0-360°	float	4	H+107	248.7460
41	Gdop	Geometric dilution of precision-assumes 3D position and receiver clock offset (all 4 parameters) are unknown	float	4	H+111	1.0419
42	Pdop	Position dilution of precision	float	4	H+115	0.8830
43	Hdop	Horizontal dilution of precision	float	4	H+119	0.4550
44	Tdop	Time dilution of precision.	float	4	H+123	0.5530
45	Age	Age of correction data, s	float	4	H+127	0.0000
46	Undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid, m	float	4	H+131	10.3014
47	StnID	Base station ID: 0-4096	ushort	2	H+135	4096
48	xxxx	32-bit CRC	hex	4	H+137	*4ff8b7c6
49	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	[CR][LF]

3.4.8.TILT MEASUREMENT LOGS

3.4.8.1.INSRTK GNSSRAWDATA

This log contains raw GNSS satellite navigation data for tilt measurement, including GNSS positioning status, RTK solution, number of satellites, position, velocity and other parameters information.

Log	INSRTK GNSSRAWDATA
Description	GNSSRAWDATA for tilt measurement
Log ID	2365
Recommended Input	<i>INSRTK GNSSRAWDATA COM1</i>
Supported Format	Binary
Supported Board	K803D
Log structure	

ID	Field	Description	Format	Binary Bytes	Binary Offset
1	Header	Log header(Refer to Table 3-3)		H	0
2	FiqCount	Fast Interrupt Request(FIQ) Count	uint	4	H
3	Quality	Position solution status	uint	4	H+4
4	DoPvtRtk	RTK&PVT solution flags	uchar	1	H+8
5	nSm	Number of satellites	uchar	1	H+9
6	HDOP	Horizontal dilution of precision	double	8	H+10
7	time_tag	Number of seconds into GPS week, s	double	8	H+18
8	Lat	Latitude, degree	double	8	H+26
9	Lon	Longitude, degree	double	8	H+34
10	Hgt	Ellipsoidal height, m	double	8	H+42
11	VelNorth	Velocity in north, m/s	double	8	H+50
12	VelEast	Velocity in east, m/s	double	8	H+58
13	VelDown	Velocity in down m/s	double	8	H+66
14	LatVar	Variance of Lat, m ²	double	8	H+74
15	LonVar	Variance of Lon, m ²	double	8	H+82
16	HgtVar	Variance of Hgt, m ²	double	8	H+90
17	VelNorthVar	Variance of Velocity in north, m ² /s ²	double	8	H+98
18	VelEastVar	Variance of Velocity in east, m ² /s ²	double	8	H+106
19	VelDownVar	Variance of Velocity in down, m ² /s ²	double	8	H+114
20	CRC	32-bit CRC	uint	4	H+122

3.4.8.2.INSRTK IMURAWDATA

This log contains raw data from the inertial sensors for tilt measurement, including IMU identification flag, FIQ count, raw IMU data, and other parameters information.

Log	INSRTK IMURAWDATA				
Description	IMURAWDATA for tilt measurement				
Log ID	2364				
Recommended Input	<i>INSRTK IMURAWDATA COM1</i>				
Supported Format	Binary				
Supported Board	K803D				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	Header	Log header(Refer to Table 3-3)		H	0
2	imu_id	IMU identification flag	uchar	1	H
3	FiqCount	Fast Interrupt Request(FIQ) Count	uint	4	H+1
4	dt	Sampling interval	double	8	H+5
5	time_tag	Number of seconds into GPS week, s	double	8	H+13
6	rawIMUData	raw data from the inertial sensors	uchar[1	15	H+21

			5]		
7	CRC	32-bit CRC	uint	4	H+36

3.4.8.3.Insrtkcompensate

This log contains parameters such as the positioning solution status of the board's tilt measurement, the antenna phase center's latitude, longitude, and altitude, as well as ENU position compensation data from the antenna phase center to the boresight of the centering pole. Users can utilize the antenna phase center's latitude, longitude, altitude, and ENU position compensation data to perform tilt measurement functionality.

Log		Insrtkcompensate			
Description		Tilt measurement information			
Log ID		2366			
Recommended Input		<i>log com1 insrtkcompensate ontime 1</i>			
Supported Format		Binary			
Supported Board		K803D			
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	Header	Log header(Refer to Table 3-3)		H	0
2	PosMode	Positioning solution status (Refer to Table 3-26)	uchar	1	H
3	Lat	Latitude, degree	double	8	H+1
4	Lon	Longitude, degree	double	8	H+9
5	Hgt	Ellipsoidal height, m	double	8	H+17
6	VelEast	Velocity in east, m/s	float	4	H+25
7	VelNorth	Velocity in north, m/s	float	4	H+29
8	VelUp	Velocity in up, m/s	float	4	H+33
9	Pitch	Pitch angle, degree	float	4	H+37
10	Roll	Roll angle, degree	float	4	H+41
11	Heading	Heading angle, degree	float	4	H+45
12	Tilt angle	Tilt Angle, degree	float	4	H+49
13	Compensate Valid	Position compensation data validity: 0: Invalid, 1: Valid	uchar	1	H+53
14	DeltaEast	East position compensation, m	double	8	H+54
15	DeltaNorth	North position compensation, m	double	8	H+62
16	DeltaUp	Upward position compensation, m	double	8	H+70
17	InsRtkStatus	Tilt measurement status	char	1	H+78
18	StepProcess	Initialize progress parameters (0-1000, unit: 1/1000)	ushort	4	H+79
19	DirectionStatus	Status indication of shaking and	uchar	1	H+83

		rotating switches during the corner installation calibration process, as shown in Table 3-27			
20	NeedAShock	Indication of whether the filter diverges: 0 = Filter re-converged, 1 = Filter diverged.	uchar	1	H+84
21	ErrorCode	Error code indicator, as shown in Table 3-28	uint	4	H+85
22	Reserved	Reserved		4	H+89
23	CRC	32-bit CRC	uint	4	H+93

Table 3-26 Positioning solution status

PosMode		Description
Mode	Value	
PVT	1	Single Point Positioning
RTD/SBAS	2	Pseudorange Differential or SBAS
RTK FIXED	4	RTK fixed ambiguity solution
RTK FLOAT	5	RTK floating ambiguity solution
DR	6	Integrated Navigation Solution

Table 3-27 shaking and rotating switches during the corner installation calibration process indicator

DirectionStatus		Description
Mode	Value	
SHACK	1	Front-and-back shaking of the receiver
ROT	2	Slowly rotating the receiver until it transitions to SHACK state

Table 3-28 Error code indicator

PosMode		Description
Mode	Value	
ERROR_GYRO_OUTRANGE	0x0001	Gyroscope data is out of range. A resent command must be sent to reset the tilt measurement module before sending the initialization command to reinitialize.
ERROR_ACC_OUTRANGE	0x0002	Accelerometer data is out of range.
ERROR_RTK_UNSTABLE	0x0004	A warning only, no further user action required.
ERROR_INITIALFAILED	0x0010	RTK fixed solution is unstable.
ERROR_CENTERINGROD_LENGTH	0x0100	If the module resets automatically during the MOTIONLESS phase, an initialization command must be sent. No action required in other phases.

ERROR_MISALIGNMENTANGLE	0x0200	Initialization failed, module automatically reset. An initialization command must be sent to reinitialize.
ERROR_ATTITUDE	0x1000	The centering rod length estimate deviates significantly from the input. Check the centering rod input and send a reset command to reset the tilt measurement module, then send the initialization command to reestimate.
ERROR_RTK_FIXEDERR	0x2000	The installation angle estimate of the IMU module is too large. A reset command must be sent to reset the tilt measurement module before sending the initialization command to reinitialize.
ERROR_NOTSTATIC	0x4000	The user needs to shake the receiver until it reaches the " NeedAShock " state.

3.4.9.IMUDATA

This log contains raw IMU (Inertial Measurement Unit) output data, including time information, three-axis gyroscope output, and three-axis accelerometer output.

Log	IMUDATA				
Description	IMU raw data				
Log ID	2264				
Recommended Input	<i>log imudatab ontime 0.01</i>				
Supported Format	Binary				
Supported Board	K803/K803S/K823/K825/K827/K802/K802C/K807/K901/K902/K922				
Log structure					
ID	Field	Description	Format	Binary Bytes	Binary Offset
1	Header	Log header(Refer to Table 3-3)		H	0
2	GPS Second	Number of seconds into GPS week	double	8	H
3	Gyr_0	Gyroscope x-axis output, rad/s	double	8	H+8
4	Gyr_1	Gyroscope y-axis output, rad/s	double	8	H+16
5	Gyr_2	Gyroscope z-axis output, rad/s	double	8	H+24
6	Acc_0	Accelerometer x-axis output, m/s ²	double	8	H+32
7	Acc_1	Accelerometer y-axis output, m/s ²	double	8	H+40
8	Acc_2	Accelerometer z-axis output, m/s ²	double	8	H+48
9	CRC	32 bit CRC	uint	4	H+56

4.Common Configuration Commands

4.1.COM port configuration control

Configuration Command:

COM <port> <baudrate> //Refer to section [2.2.1](#)

4.2.Removes all logs from logging control

Configuration Command:

unlogall

4.3.Request Raw Data

Configuration Command:

```
ecutoff <cutoff-angle>
log <port> rangecmpb ontime <period>
log <port> rawephemb onchanged
log <port> bd2rawephemb onchanged
log <port> glorawephemb onchanged
log <port> galephemerisb onchanged
log <port> ionutcb onchanged
```

4.4.Base Station Configuration Command Set

Configuration Command:

```
unlogall
fix auto
log com2 rtdcm1074b ontime 1
log com2 rtdcm1084b ontime 1
log com2 rtdcm1094b ontime 1
log com2 rtdcm1114b ontime 1
log com2 rtdcm1124b ontime 1
log com2 rtdcm1005b ontime 5
log com2 rtdcm1033b ontime 10
saveconfig
```

4.5.INS Usage

4.5.1.INSTALLATION

It is recommended that the Y-axis marked on the device should be aligned with the Y-axis of the vehicle coordinate system, meaning the Y-axis should point in the direction of vehicle travel. After installing the device, ensure that it is securely fixed on a flat surface and that no movement of the device occurs during operation.

Configuration Command:

```
inscontrol enable/disable
set imuaxestype 1/2/3/4/5/6/7/8
```

4.5.2.LEVER ARM MEASUREMENT

The three-dimensional distance from the GNSS antenna phase center to the navigation center of the board is referred to as the antenna lever arm. Lever arm measurement: The lever arm value is the three-axis vector from the antenna phase center to the IMU phase center in the IMU coordinate system. The measurement method is the same for both the primary and secondary antennas.

Configuration Command:

```
set drleverarm X Y Z
```



NOTE:

The XYZ coordinates here are not related to the inertial navigation axis system.

X: Positive direction points to the front of the vehicle.

Y: Positive direction points to the right of the vehicle.

Z: Positive direction points downward.

The lever arm range is between -20 meters and +20 meters. Once the configuration is complete, remember to save the settings using saveconfig.

4.5.3.INITIALIZATION

Inertial Navigation Systems (INS) calculate navigation results by integrating measurements from inertial sensors (e.g., accelerometers and gyroscopes). In each iteration of the navigation equation, previous navigation parameters such as position, velocity, and attitude are used as the initial values. Therefore, INS must be initialized before it can provide valid navigation results.

Initialization Method

- Enable INS:** After activating the INS, use differential data to enter RTK fixed solution mode.
- Environment Setup:** Drive the vehicle into an open environment, ensuring the vehicle reaches the threshold speed required for initialization.
- Initialization Distance:** Drive for approximately 10 meters to complete the initialization process.

Purpose

The goal is to determine the position and attitude of the IMU in the satellite navigation coordinate system.

4.5.4.COMMAND

Configuration Command:

```
inscontrol enable/disable
inscontrol enable 0/1/2/3
set smoothedrr on/off
set imuaxestype 1/2/3/4/5/6/7/8
```

```
set drleverarm x y z
set drconfig 1.0
inscontrol clear
set drtimeout 0-3600
tst dr raw on
```

4.6. Tilt Measurement Usage

4.6.1. CONFIGURATION COMMAND

Command	Description
<code>insrtk reset</code>	Reset the tilt measurement module
<code>insrtk saveconfig</code>	Save configuration parameters
<code>insrtk showconfig</code>	Retrieve the configuration information of the tilt measurement module
<code>insrtk freset</code>	Clear user configuration parameters
<code>tst ins debug [param]</code>	Configure Debug output: 0 = no output (Default) 2 = enable output
<code>insrtk rodlength [param]</code>	Configure centering rod length, 0-20,000mm
<code>insrtk leverarmgnss [param1] [param2] [param3]</code>	Configure GNSS antenna phase center lever arm vector, -500-500mm
<code>insrtk leverarmarp [param1] [param2] [param3]</code>	Configure receiver ARP lever arm vector, unit: millimeters, -500-500mm
<code>insrtk installangle [param1] [param2] [param3]</code>	Configure IMU module installation angle, unit: degrees (range: -180 to 180)
<code>insrtk fastinit [on/off]</code>	Configure fast initialization (FAST_INIT) mode. Default is off , which is the installation angle error calibration mode.
<code>insrtk spattitudeth [param1] [param2]</code>	Configure threshold values for heading and attitude angle convergence in fast initialization mode, 0-5 deg Default is 1.5,1.5
<code>insrtk polexy on [param1] [param2]</code>	Manually configure the lever arm vector's planar coordinates after installation angle error correction during fast initialization mode, -0.1-0.1m
<code>insrtk shakeparam [param1] [param2] [param3]</code>	Configure the calibration parameters in the installation angle error calibration mode: shake group count (param1), rotation direction count (param2), shakes per group (param3). Default is 2, 2, 5
<code>insrtk init 1</code>	Start the tilt measurement module initialization

4.6.2. CONFIGURATION COMMAND DESCRIPTIONS

4.6.2.1. insrtk showconfig

This command retrieves the configuration information of the tilt measurement module.

No.	Field	Description												
1	INSRTK Version	Version information, containing 18 uchar bytes, formatted as: M. S. sss, ee, yymmdd												
		<table border="1"> <thead> <tr> <th>Field</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>M</td> <td>Main Revision [0 ~ 9]</td> </tr> <tr> <td>S</td> <td>Stage Infor 0: Development Stage 1: Alpha Release Stage 2: Beta Release Stage 3: Production Release Stage 4: QFE Version</td> </tr> <tr> <td>sss</td> <td>Sub Revision [000 ~ 999]</td> </tr> <tr> <td>ee</td> <td>Engineer Revision</td> </tr> <tr> <td>yymmdd</td> <td>year, month, day</td> </tr> </tbody> </table>	Field	Description	M	Main Revision [0 ~ 9]	S	Stage Infor 0: Development Stage 1: Alpha Release Stage 2: Beta Release Stage 3: Production Release Stage 4: QFE Version	sss	Sub Revision [000 ~ 999]	ee	Engineer Revision	yymmdd	year, month, day
		Field	Description											
		M	Main Revision [0 ~ 9]											
		S	Stage Infor 0: Development Stage 1: Alpha Release Stage 2: Beta Release Stage 3: Production Release Stage 4: QFE Version											
		sss	Sub Revision [000 ~ 999]											
ee	Engineer Revision													
yymmdd	year, month, day													
2	Install Angle	IMU module installation angle												
3	GNSS Lever Arm	GNSS antenna phase center lever arm vector												
4	ARP Lever Arm	ARP (Antenna Reference Point) lever arm vector												
5	Centering Rod	Centring rod length												
6	InitFast	Fast initialization switch												
7	SPAttTH	In fast initialization mode, filter convergence thresholds for heading and attitude angles												
8	Pole XY	In fast initialization mode, the planar coordinates of the lever arm vector after installation angle error correction												
9	ShakeRotation	In installation angle calibration mode, the number of shake groups, number of rotation directions, and the number of shakes per group												

4.6.2.2. insrtk leverarmgnss

This command is used to configure the GNSS antenna phase center lever arm vector, with units in millimeters. The acceptable range for the vector components is (-500, 500).

Example:

```
insrtk leverarmgnss -10 10 50
```

This configuration sets the GNSS antenna phase center lever arm vector to coordinates (-10, 10, 50) millimeters.

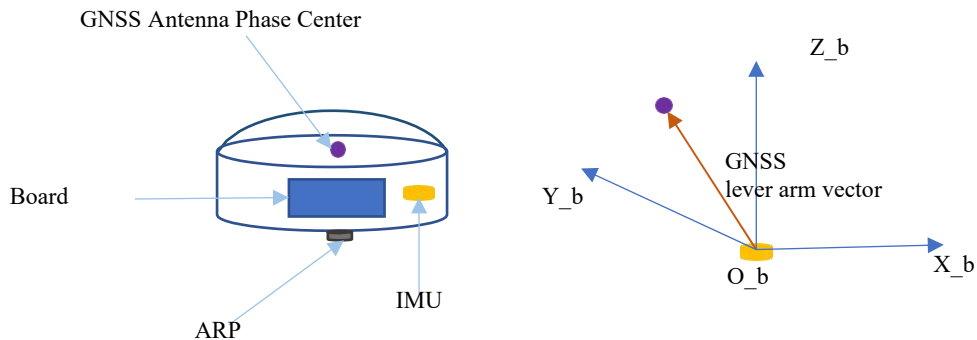


Fig 4-1 GNSS antenna phase center lever arm vector

Details:

- Before using the tilt measurement module, the user must define the body coordinate system (denoted as the b-frame) based on the actual receiver design. The origin of the b-frame is at the IMU center (the corner of the shielding cover on the K803D module with a perforated corner). It follows a right-handed coordinate system (O-XYZ).
- Coordinate System Definitions (Refer to [Figure 4-1](#)):
 - Y-axis: Perpendicular to the board, pointing outward as positive.
 - Z-axis: Perpendicular to the board, pointing upward as positive.
 - X-axis: Perpendicular to the O-YZ board, completing the right-handed coordinate system.
- Lever Arm Effect:
 - The actual tilt measurement data is obtained by fusing GNSS and IMU sensor data. Typically, the GNSS antenna phase center and the IMU center do not coincide. When the receiver rotates, the position and velocity measured by the GNSS differ from those perceived by the IMU. This phenomenon is known as the lever arm effect.
 - To eliminate the effect of the lever arm, the GNSS antenna phase center lever arm vector must be configured. The lever arm vector is defined as the projection of the vector from the IMU center to the GNSS antenna phase center in the body coordinate system.

4.6.2.3.insrtk leverarmarp

This command is used to configure the ARP lever arm vector, with units in millimeters. The acceptable range for the vector components is (-500, 500).

Example:

```
insrtk leverarmarp -10 10 -30
```

This configuration sets the ARP lever arm vector to coordinates (-10, 10, -30) millimeters.

Details:

The ARP lever arm vector is defined as the projection of the vector from the IMU center (the perforated corner of the K803D module shielding) to the Receiver ARP (Antenna Reference Point) in the body coordinate system. Properly configuring this vector is essential for accurate tilt measurements.(Refer to [Figure 4-2](#))

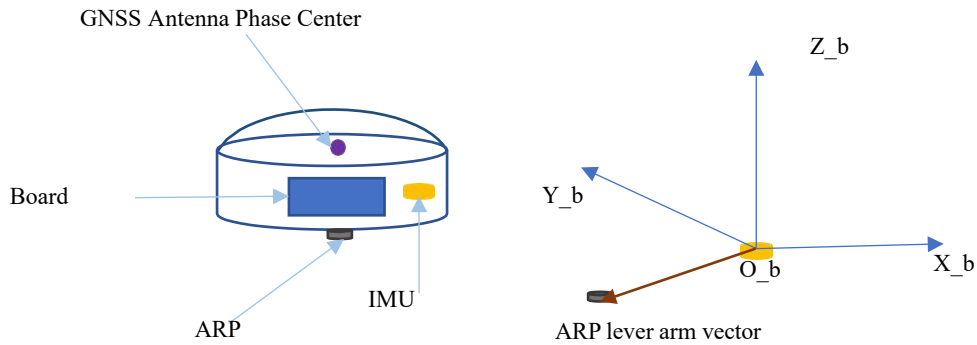


Fig 4-2 GNSS Antenna Reference Point lever arm vector

4.6.2.4.insrtk installangle

This command configures the IMU module installation angle, with units in degrees, and an acceptable range of [-180, 180] degrees.

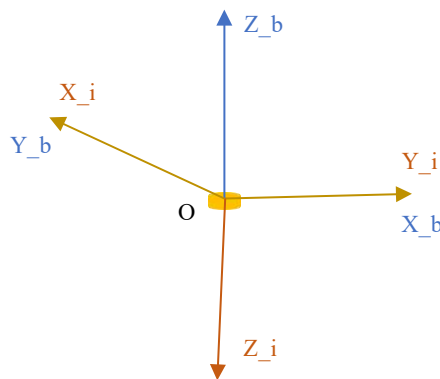


Fig 4-3 IMU module installation angle

Example:

For the following installation relationship:

- Installation Angle 1 = 180°
- Installation Angle 2 = 0°
- Installation Angle 3 = +90°

You would send the following command to configure the installation angles (Refer to [Figure 4-3](#)) :

```
insrtk installangle 180 0 90
```

This will configure the tilt measurement system to correctly align the IMU module with the body coordinate system based on the specified angles.

Details:

Before using the tilt measurement module, the user needs to configure the installation angle based on the relative positioning between the IMU module and the receiver motherboard. The installation angle defines the rotation relationship between the body coordinate system (b-frame) and the IMU coordinate system (i-frame). The IMU coordinate system (i-frame) is defined as:

- The origin is at the IMU center (the perforated corner of the K803D module shielding).
- The axes align with the IMU's sensitive directions, as indicated by the module's shielding.
- It forms a right-handed coordinate system.

The body coordinate system (b-frame) is rotated around the Z-axis, then the X-axis, and finally the Y-axis, to align with the IMU coordinate system. The rotation angles corresponding to installation angle 1, installation angle 2, and installation angle 3 are as follows:

- Installation angle 1: Rotation around the X-axis.
- Installation angle 2: Rotation around the Y-axis.
- Installation angle 3: Rotation around the Z-axis.
- All rotations are considered counter-clockwise as positive.

4.6.2.5.insrtn fastinit

This command is used to configure the initialization mode of the tilt measurement system. There are two modes available:

- **OFF** - IMU installation angle error calibration mode (default setting).
- **ON** - Fast initialization mode.

Example:

```
insrtn fastinit on
```

This sets the system to fast initialization mode.

Details:

- Fast Initialization Mode

When this mode is enabled, the initialization process is simplified. The user only needs to shake the receiver to complete initialization.

- Installation Angle Error Calibration Mode

When fast initialization mode is disabled (set to off), the system enters the installation angle error calibration mode. This mode is used to calibrate the IMU module's installation angle error. Once calibration is successful, the system will automatically store the compensated lever arm vector (PoleXY) in FLASH memory. Upon rebooting, the system will automatically retrieve and use the compensated values for fast initialization. Although the system typically auto-compensates for installation angle errors, users can manually configure the PoleXY compensation values by using

the `insrtk polaxy` on command, but it is generally not recommended to manually configure these values.

- Calibration Recommendation

If this is the first time using the receiver, or if there is a significant discrepancy between the actual measurement accuracy and nominal accuracy, it is highly recommended to perform the installation angle error calibration before use.

4.6.3.CONFIGURATION PROCESS

No.	Command	Description
1	<code>insrtk installangle [param1] [param2] [param3]</code>	Configure the IMU module installation angle
2	<code>insrtk leveramgnss [param1] [param2] [param3]</code>	Configure the GNSS antenna phase center lever arm
3	<code>insrtk leveramarp [param1] [param2] [param3]</code>	Configure the ARP lever arm vector These configuration parameters are the basic hardware settings. After configuring them, send <code>insrtk saveconfig</code> to save and restart the receiver. If the receiver's hardware parameters haven't changed, you do not need to reconfigure them each time.
Note	After steps 1, 2, and 3 have been saved and the receiver has been restarted	
4	<code>insrtk fastinit [on/off]</code>	Configure the initialization mode
5	<code>insrtk spattitudeth [param1] [param2]</code>	Only applies to fast initialization mode. Set the thresholds for heading (param1) and attitude (param2) angles before initialization. The setting takes effect immediately and can be saved.
6	<code>insrtk shakeparam [param1] [param2] [param3]</code>	Only applies to IMU installation angle calibration mode. Set the number of shakes (param1), the number of rotation directions (param2), and the number of shakes per group (param3) before initialization. The setting takes effect immediately and can be saved.
7	<code>insrtk init 1</code>	Start the initialization process. Once completed, the system will enter the compensating state.



NOTE:

The configuration in steps 1, 2, and 3 represents the basic hardware setup. After completing these steps, use the command `insrtk saveconfig` to save the settings, and then restart the receiver. If the receiver's hardware has not changed, you do not need to repeat these configurations every time. After saving and restarting the receiver for steps 1, 2, and 3, proceed with configuring steps 4 to 7 to finalize the initialization process.

4.6.4.USAGE PROCESS

4.6.4.1.Tilt Measurement Status Indicator

InsRtkStatus indicates the current working phase of the tilt measurement, including waiting for initialization, dynamic convergence, and entering the working mode after convergence is completed.

Name	Value	Description
WAIT_INIT	-1	Waiting to receive initialization command.
SHACK	2	Initialization command received, entering dynamic convergence phase; the receiver shakes back and forth.
COLIBRATE	3	If in installation angle error calibration mode, follow the DirectionStatus to shake or rotate the receiver. If in FAST_INIT mode, DirectionStatus will always indicate shaking the receiver, and no rotation indication will appear.
INITOK	4	Entering compensating state.

4.6.4.2.Installation Angle Error Calibration Process

DirectionStatus is valid only when **InsRtkStatus** is in the **COLIBRATE** phase.

Name	Value	Description
SHACK	1	Shake the receiver back and forth.
ROT	2	Slowly rotate the receiver until it switches to SHACK state.

4.6.4.3.Tilt Measurement Positioning Solution Status

Name	Value	Description
PVT	1	Single Point Positioning
RTD/SBAS	2	Pseudorange Differential or SBAS Positioning
RTK FIXED	4	RTK Fixed
RTK FLOAT	5	RTK Float
DR	6	GNSS/INS Integrated Navigation Solution (Dead Reckoning)

4.6.4.4.Error Code

Name	Value	Description
ERROR_GYRO_OUTRANGE	0x0001	The gyroscope data exceeds the range. A reset command is required to reset the inclination measurement module, followed by sending an initialization command to re-initialize.
ERROR_ACC_OUTRANGE	0x0002	Accelerometer Data Out of Range. Just a warning, no further action is required from the user
ERROR_RTK_UNSTABLE	0x0004	RTK Fixed State Unstable. If the module automatically resets during the MOTIONLESS phase, an initialization command is needed. If in any other phase, it is just a warning and no user action is needed.
ERROR_INITIALFAILED	0x0010	Initialization Failed. The module automatically resets. An initialization command is required to reinitialize.
ERROR_CENTERINGROD_LENGTH	0x0100	Centering Rod Length Estimation Deviation Too Large. Check

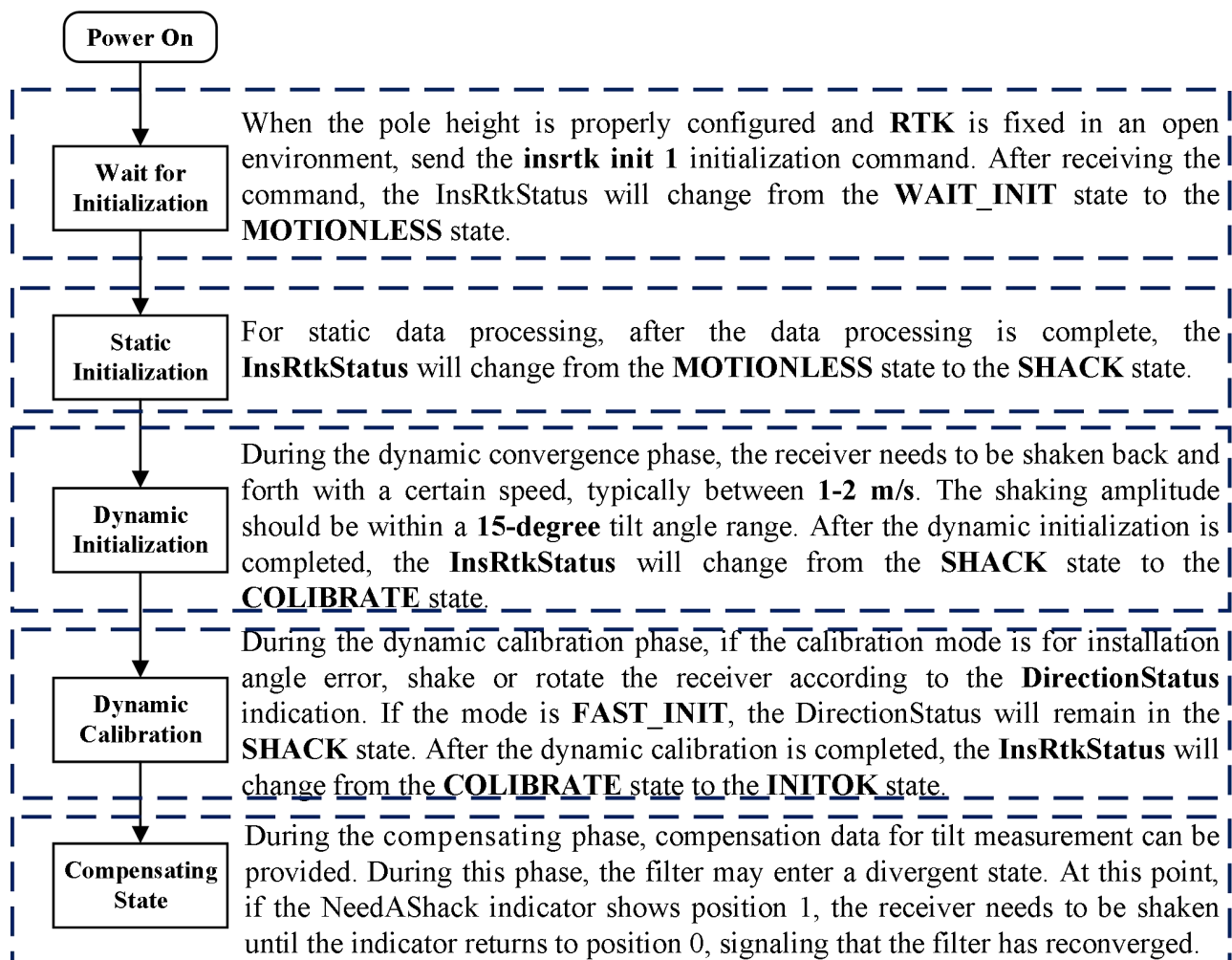
		the centering rod input, and send a reset command to reset the inclination measurement module, then send an initialization command to re-estimate.
ERROR_MISALIGNMENTANGLE	0x0200	IMU Installation Angle Estimation Error Too Large. Send a reset command to reset the inclination measurement module, then send an initialization command to reinitialize.
ERROR_ATTITUDE	0x1000	Filter Divergence. The user needs to shake the receiver until the NeedAShock status appears, indicating that the filter has re-converged.
ERROR_RTK_FIXEDERR	0x2000	RTK Fixed Solution Error. No specific action required from the user.
ERROR_NOTSTATIC	0x4000	Receiver Not Static. Applies only during the MOTIONLESS phase. It is just a prompt to ask the user to keep the receiver still, no further action needed.



NOTE:

The error codes listed in the table above may appear simultaneously in the **ErrorCode**.

4.6.4.5. Usage flow chart




NOTE:

During each stage of the tilt measurement process, **ErrorCode** need to be monitored and processed in real time. The system may encounter errors at various points, and handling these errors promptly is crucial for maintaining proper operation. If there is a need to reset the tilt measurement module, perform the following steps:

- Send the **insrtk reset** command to reset the module.
- Wait for 1 second after sending the reset command.
- Then, send the **insrtk init 1** command to re-initiate the initialization process.

The above process ensures that any issues are addressed by properly resetting the system and starting fresh from the initialization stage.

4.7.PPP Configuration Commands

This section introduces the PPP-related configuration commands for using PPP-B2b and Galileo HAS (High Accuracy Service).

PPP Configuration Commands:

```
log gpgga ontime 1
set ppp on/off
set pppfreq 1/5/10 //Refer to Table 2-5
set pppsourc b2b/has/bhs //Refer to Table 2-5
```

1Hz Output of B2b Navigation Message:

```
log b2brawnavsubframeb onchanged
```

Common PPP-B2b Post-Processing Data Commands:

```
log gpgga ontime 1
log b2brawnavsubframeb onchanged
log rangecmpb ontime 1
log bd2ephemb onchanged
log bd3ephemb onchanged
log gpsephemb onchanged
log ionutcb onchanged
log rtkpppmess ontime 1
```



NOTE :

The serial port baud rate for PPP-B2b post-processing data commands can be adjusted to 460800 or higher:

```
COM COM1 460800 //Set the baud rate for COM1 to 460800
```

1Hz Output of HAS Navigation Message:

```
log hasmess onchanged
```

Common HAS Post-Processing Data Commands:

```
log gpgga ontime 1
```

```
log hasmess onchanged
```

```
log rangecmpb ontime 1
```

```
log galephemb onchanged
```

```
log gpsephemb onchanged
```

```
log ionutcb onchanged
```

```
log rtkpppmess ontime 1
```

4.8.Precipitable Water Vapor Monitoring Configuration Commands

This section introduces the configuration commands for precipitable water vapor monitoring.

Configuration Commands:

```
set ppp on
```

```
set pppfreq 1/5/10 //Refer to Table 2-5
```

```
set pppsource b2b/has/bhs //Refer to Table 2-5
```

Log Commands:

```
log gppwv ontime 1 //Refer to Section 3.3.1.4.6
```

4.9.Earthquake monitoring Configuration Commands

This section introduces the configuration commands for earthquake monitoring. The earthquake monitoring feature is enabled by default, with a default solution frequency of 5 Hz. The default velocity threshold is automatically calculated by the program, but users can adjust it as needed via commands.

Configuration Commands:

```
SET SINOVAPOS <LAT> <LON> <HGT> //Refer to Table 2-5
```

```

SET PVTFFREQ <Param> //Refer to Table 2-5
SET PDPFFREQ <Param> //Refer to Table 2-5
SET SINOVATHRESH <E> <N> <U> //Refer to Table 2-5
SET SINOVARESET //Refer to Table 2-5
  
```

Log Commands :

```

log gplvm ontime 0.2 //Refer to Section 3.3.1.4.7
log gpldm ontime 0.2 //Refer to Section 3.3.1.4.8
log gpvam ontime 0.2 //Refer to Section 3.3.1.4.9
  
```

4.10. Ionospheric scintillation monitoring Configuration Commands

This section introduces the configuration commands for ionospheric scintillation monitoring.

Configuration Commands :

```

set ionoscib on //Refer to Table 2-5
Tst debug ionocalfreq 300 //set the calculation period to 300ms
  
```

Log Commands :

```

log ionoscib ontime 30 //The log period should be consistent
with the calculation period, Refer to Section 3.2.10.1
  
```

5. Appendix A. Technical Specifications

Please refer to the OEM board manual specifications on the **Qtalis** official website (www.qtalisgnss.com)

6. Appendix B. Firmware Update

Firmware updates, after being tested and validated, will be published on the company's official website. Users can download the latest firmware version to optimize the receiver's performance.



After completing the firmware update, wait for 3 seconds to ensure that the board completes all internal reconfigurations. After waiting 3 seconds, you can turn off the power and restart the board to use the new firmware. To verify if the firmware has been successfully updated, you can use '**log version**' command.

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