NR3606
10MHz Frequency Reference, 6 Channel OCXO, GNSS Locked, 3 Channel Sine, 3-Channel PPS, Plus a PPS-LVDS Channel and a 10 MHz LVDS

Table of Contents

Safety

This product has been designed and manufactured to recognized safety standards and rules.

This product is a sophisticated electronic instrument that should be installed and operated by highly trained professionals.

Installation of this equipment should comply with all local electrical codes.

Utilization of this equipment in a manner inconsistent with the operating instructions can be dangerous.

DANGER

There are no user-serviceable parts within the unit. Removal of the cover to access interior parts will expose the user to dangerous voltages.

DANGER

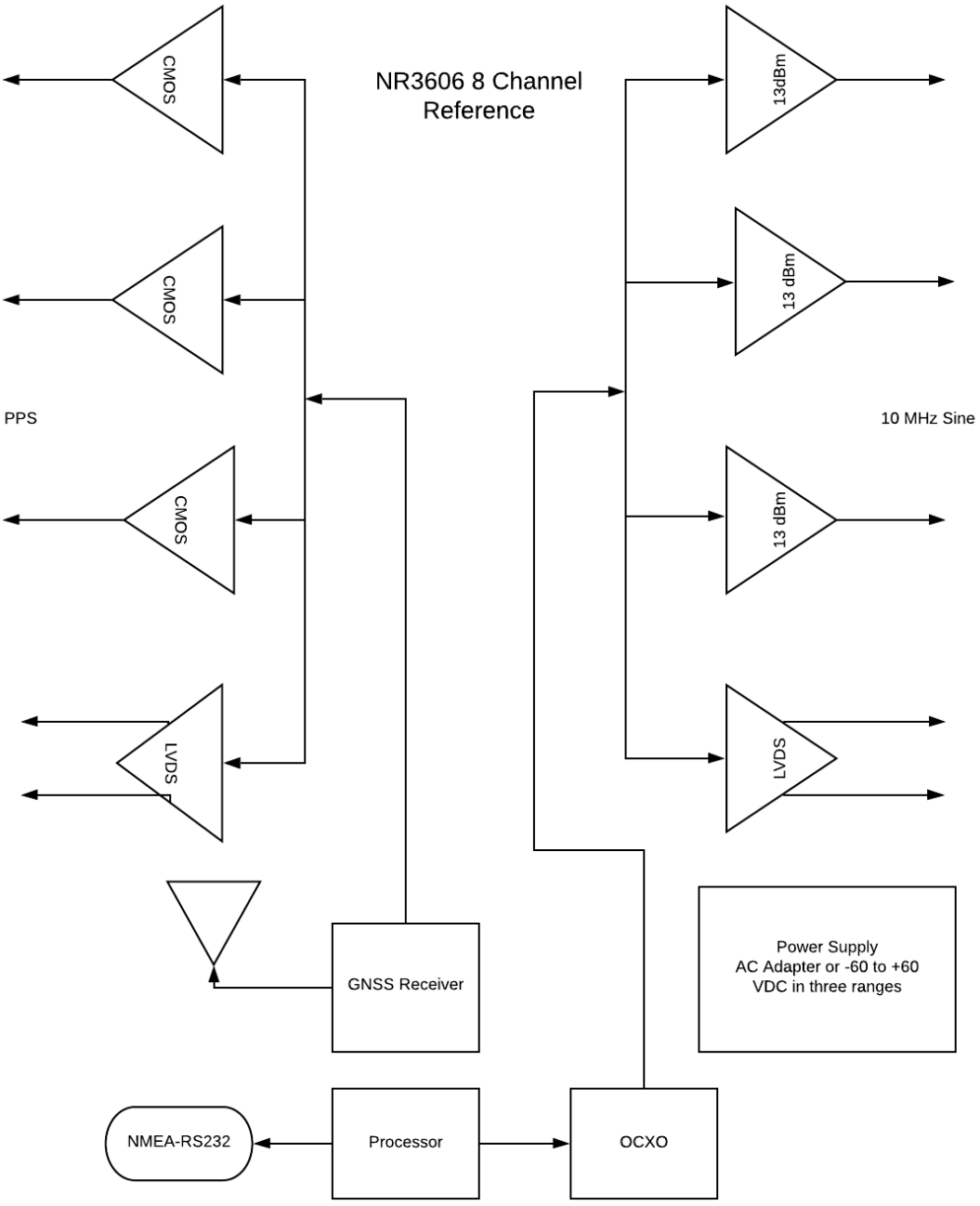
The unit may be powered from more than one power source. Care must be taken to be certain all power sources are removed before installation or during removal of the equipment.

DANGER

The unit must be operated with a secure earth ground to the chassis. The electrical path for earth ground is through the power connector. The power switching device that controls power to the equipment must never interrupt the chassis ground connection.

The equipment contains complex electronic components that can be damaged by electrostatic discharge. Observe all recognized standards for the handling of complex electronic devices to avoid high voltage discharge to the equipment. Be certain the equipment chassis and operator are at equipotential before handling the equipment.

Summary


NR3606 8 Channel
Reference
CMOS
CMOS
CMOS
LVDS
PPS
13dBm
13 dBm
13 dBm
LVDS
10 MHz Sine
GNSS Receiver
Power Supply
AC Adapter or -60 to +60
VDC in three ranges
NMEA-RS232
Processor
OCXO

The NR3606 is a versatile OCXO based reference platform that can be configured to meet a wide range of applications:

OCXO based NR3606-O reference that is stable to 5ppb/day. The OCXO selected is a low phase noise reference. The unit will synthesize a PPS signal from the 10 MHz OCXO.

GNSS locking-NR3606-OG -The OCXO can be continually locked to the GNSS. The 26 channel GNSS receiver offers improved robustness with concurrent reception of GPS and GLONASS. Supports GPS, GLONASS, SBAS and QZSS. The OCXO is actively controlled by a mixed-signal phase lock loop. The NR3606-OG continually monitors temperature and aging such that, when the unit goes into holdover or loses GNSS lock, the output frequency reverts at the last known locked frequency value. The calibration feature continually monitors the correction coefficients developed through GNSS timing information. These are sampled multiple times per day and stored in non-volatile memory and in the event of a GNSS loss, the saved coefficients are applied to the OCXO. This effectively eliminates long-term crystal drift.

Power- the NR3606 can be powered from an external DC power source that ranges from -60 to +60 Vdc < 5 watts This is accomplished in three ranges:

12VDC (10 to 15VDC)

24VDC (20 to 30VDC)

48VDC (40 to 60VDC)

There is also a power adapter available that can provide the required power and can accept global AC power:

The unit is also reverse polarity protected by using an internal diode bridge.

The internal DC to DC converter completely isolates the power ground from the signal ground to minimize power noise from interfering with the output signals.

Outputs: The NR3606 has a total of:

3- 10 MHz outputs. These can be 1 Vrms sine outputs or three 10 MHz square outputs at 5 volt CMOS levels. Either configuration can drive a 50 Ohm load.

3-PPS outputs- these can be set at the factory to drive either 3.3 or 5 volt CMOS levels into 50 Ohms.

1- LVDS output 10 MHz square
1- LVDS output PPS

The LVDS ports may also be configured to be RS422.

LVDS mating connector:

DigiKey Part Number 277-1965-ND

Manufacturer Phoenix Contact

Manufacturer Product Number 1762208

Description TERM BLOCK PLUG 3POS STR 5.08MM

RS232 this serial port provides NMEA data and unit status. The NR3626-O/G can accept user commands which will provide specific status and performance feedback, and which may be customized by the user. Many of the settings can be saved in non-volatile flash memory.

Commands that are handled by the GPS receiver are passed through to the GPS, and the responses returned. This allows the user to make all adjustments to the unit via a single serial port.

Controls and Indicators

Front Panel

This section describes the functionality of the front panel controls and indicators.

LEDs

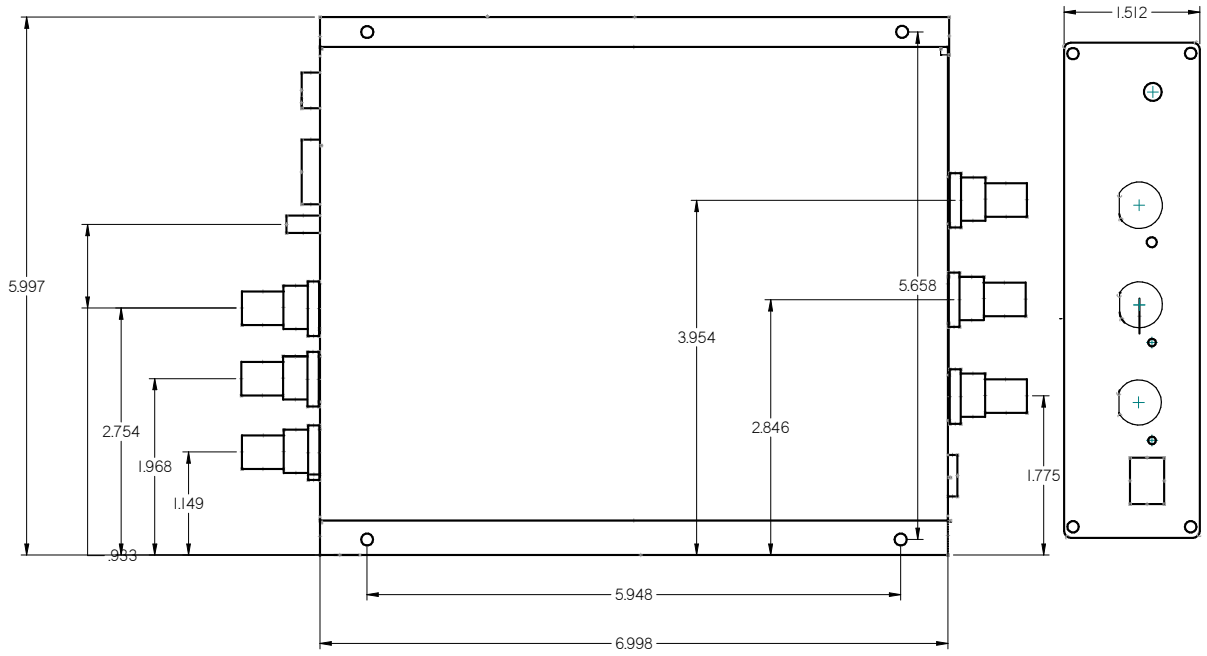
Four front panel LEDs provide a quick indication of the NR3606 status.

The **STATUS** indicator will illuminate solid green if both GNSS receivers have acquired GPS lock and are actively controlling the respective modules.

There are three channel status indicators that will illuminate solid green if no faults are detected.

Input/Output Connectors/Mechanical

All versions of the NR3606



GPS Ant - SMA connects to the GPS ant - provides 3.3 VDC 25mA max.

PPS - BNC - one pulse per second

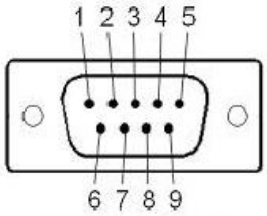
10MHz sine - sine or CMOS output BNC

RS232 - standard NMEA output NMEA-0183

RS232 DB9

An RS232 port is provided for local setup, and status monitoring. The embedded processor provides status strings, as well as command responses. Configuration and status commands are detailed in the Programmer's Manual Section 5.0.

RS232 Serial Port: Rear Panel Pin Connections



Male DB-9

The DB9 now contains the NMEA serial lines, System Alert (set of relay contacts).

Pin

1 Optional PPS signal
2 NMEA - Tx
3 NMEA - Rx
4 no connection
5 GND
6 N/C
7 N/C
8 Alert relay contact #1
9 Alert relay contact #2

The optional PPS signal must be specifically requested at the time the product is purchased. Routing the PPS through the DB9 is offered as an option that enables more accurate timing for some applications.

The default settings for the rear panel RS232 port are 38400 baud, 8 bits, 1 stop bit, no parity.

Power

DigiKey Part Number 277-11343-ND

Manufacturer Phoenix Contact

Manufacturer Product Number 5447861

Description TERM BLOCK PLUG 2POS STR 3.81MM

Pin assignments

1. + positive power
2. – power return

The unit is designed to operate from 12 VDC (default) nominal power and is reverse polarity protected.

Power- the NR3606 can be powered from an external DC power source that ranges from -60 to +60 Vdc < 5 watts This is accomplished in three ranges:

12VDC (10 to 15VDC)

24VDC (20 to 30VDC)

48VDC (40 to 60VDC)

There is also a power adapter available that can provide the required power and can accept global AC power:

The unit is also reverse polarity protected by using an internal diode bridge.

The internal DC to DC converter completely isolates the power ground from the signal ground to minimize power noise from interfering with the output signals.

The unit ships with a wired pigtail if purchased without a power adapter.

Antenna

Antenna - SMA

SMA female antenna connection. Provides internal 3.5VDC power at <25mA max. The Novus NA103 pole mount antennas or the Novus NA106 magnetic mount antenna are recommended for optimal performance.

The receiver and companion elements generate the PPS and NMEA serial link. The serial link conforms to NMEA 0183 protocol. The 26 channel high-sensitivity, high-accuracy Multi-GNSS receiver supports TRAIM, GPS, GLONASS, QZSS, SBAS, Active Anti-Jamming and Advanced Multipath Mitigation Functions.

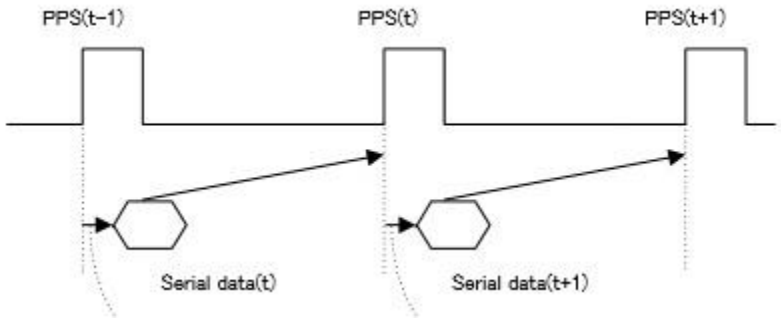
Typical Antenna Specs:

Frequency Band	1574 – 1607 MHz
Antenna Gain	2 dBic @ 90°
Amplifier Gain	@ 3.0Vdc: 26dB (typ)
Polarization	RHCP
Out-of-band Rejection	>60dBc @ f0 ± 50MHz
Impedance	50Ω
VSWR	2.0 Max

DC Input	2.8V - 6V
Noise Figure	<2.0dB
Power Consumption	25mA (typ)

PPS (Pulse Per Second)

The PPS (one Pulse Per Second) relationship with the NMEA data is shown below:



The serial data timing is for the next rising edge of the PPS pulse.

The PPS is selected by default from an internal synthesizer operated from the 10 MHz OCXO. This source is much more stable with pulse-to-pulse jitter below 1 ns while being within 100ns of the received PPS. If there is a need for the PPS directly from the receiver, the user can change the PPS output with the “$PPS” command as outlined in the Programmer’s Guide.

GNSS PPS Accuracy

15ns(1σ) (@-130 dBm)
50ns(1σ) (@-150 dBm)

The nominal accuracy of a PPS signal that is directly from the radio is on the order of 25 ns rms. The signal will also have ~5 ns of jitter. The jitter is due to the characteristics of the transmission channel - multi-path and other radio effects. The long-term accuracy of the PPS is excellent. There are numerous reference documents produced by NIST that define accuracy.

For those applications where the 5 ns of jitter is unacceptable, there is a more stable source. To solve the jitter problem, a stable oscillator is locked to the PPS and the output of the oscillator is then counted down to 1 Hz to have a jitter level that is dominated by the oscillator and associated electronics. PPS jitter can be improved from the 5 ns range to less than 1 ns

PPS Holdover

PPS holdover is concerned with the stability of the PPS when GNSS lock is lost. The circuitry discussed to improve jitter also improves holdover. If the oscillator is an OCXO - then a PPS drift of 5 to 10 ppb/day is achievable (< 1ms). A Rubidium source can be used to achieve drift rate well over an order of magnitude better than the OCXO.

Factory Default Settings:

The PPS is, by default, the OCXO derived pulse which is disciplined to the GNSS PPS. The pulse-to-pulse jitter on the disciplined PPS is better than 15ns RMS. With stable mode applied, the OCXO PPS is no longer disciplined, but is steered, to maintain pulse- to-pulse jitter of less than 1 ns.

The unit can be programmed to compensate for PPS errors due to cable length. A compensation factor of +/-100000 ns can be used. See attached Appendix A.

Pulse Width

The pulse width can be programmed from 1 to 500ms using the $PULSW command in the programming guide.

Output Drive

Connecting a PPS to a load is problematic at best. Connecting a 10 MHz sine to many devices is routine and the importance of matching load and cable impedances is well understood. The problems arise when connecting a PPS to a load in the same manner as a simple sine wave. A CMOS device will not drive a 50 Ohm load to required voltage levels. A PPS pulse with a rise and fall time of 5 ns is a much greater problem for a cable than a simple sine wave at 10 MHz. The 5ns edge requires almost an order of magnitude more bandwidth than a 10 MHz signal even though most consider the PPS to be a 1 Hz signal. To address this problem, Novus offers PPS products with a configurable output drive section. Please discuss your drive requirements with a Novus Application Engineer.

Not all products offer all configurations. Selecting the right drive for your load characteristics will assure accurate timing and reliability. An incorrect match can cause ringing and/or damage a device.

PPS Connectors

The PPS signal is available on the three BNC connectors and the three pin LVDS connector. The LVDS connector is labeled +-gnd this is meant to support a three wire twisted pair. The LVDS requires a 100 Ohm load at the client.

DigiKey Part Number 277-1965-ND

Manufacturer Phoenix Contact

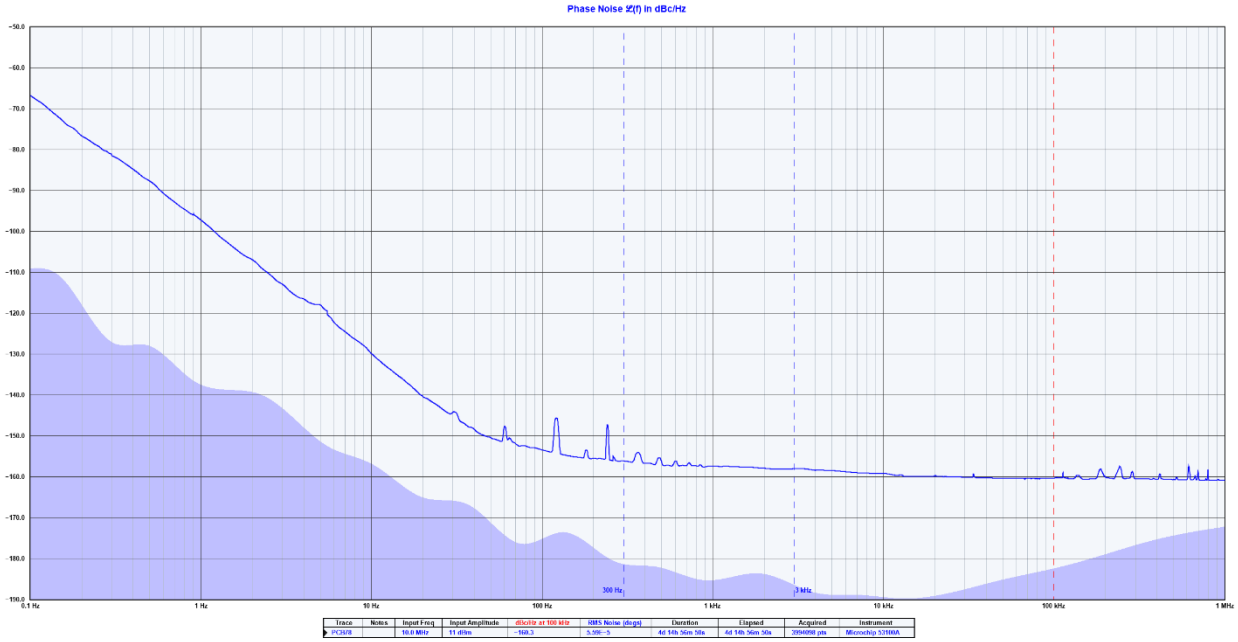
Manufacturer Product Number 1762208

Description TERM BLOCK PLUG 3POS STR 5.08MM

Phase Noise

Low phase noise contribution is achieved through careful PCB design, component selection and minimization of power supply noise.

Below is a typical phase noise performance for a 10 MHz reference application:

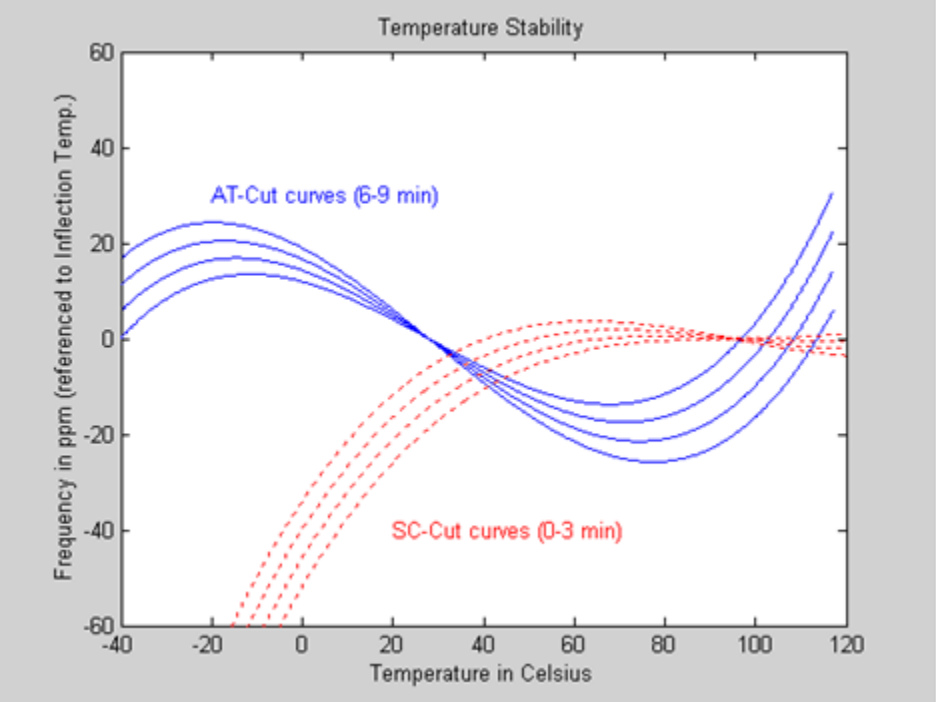


Crystal

Novus crystal-based frequency reference products are based upon either TCXO or OCXO technology. Temperature compensated crystal oscillators will normally use an AT cut crystal and electronically compensate the device with temperature. An OCXO device uses a SC (stress compensated) crystal and the part is held at a fixed temperature to minimize temperature drift.

The TCXO implementation results in a temperature-stable reference in the single digit parts per million. An OCXO device affords a reference that is almost two orders of magnitude more stable than the TCXO.

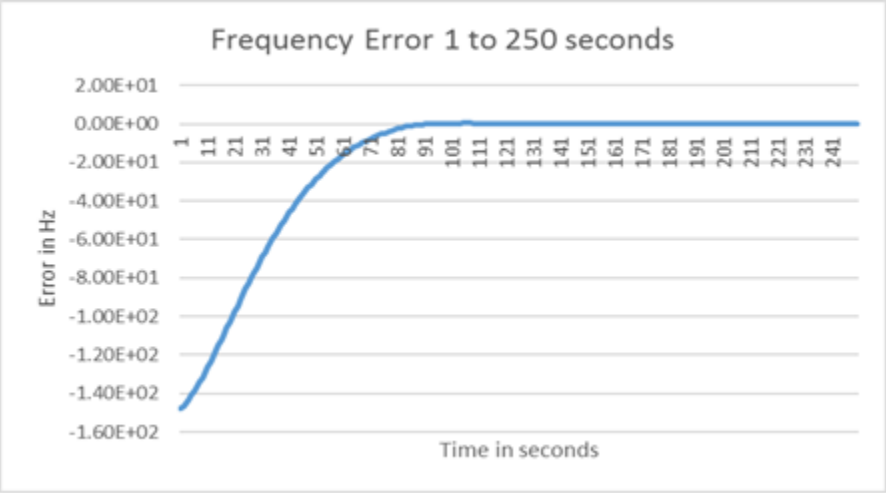
Comparison of an AT versus a SC Cut Crystal



Over a broad temperature range, an AT performs very well and much easier to compensate electronically. It is also a simpler crystal to manufacture than a SC cut device. For applications where a stability of a few ppm is acceptable, a TCXO can be a cost-effective alternative.

The SC cut results in a much higher Q device and achieves much lower phase noise than the AT cut. The device is also more sensitive to pressure and temperature variation and is mounted in a temperature-controlled hermetic chamber.

OCXO oven temperature is in the range of 90°C. The devices heat-up and become stable within ~ 5 minutes.



Calibration

The frequency is phase-locked to the GPS signal and no adjustment is required. The Auto-Calibration feature tunes the OCXO and stores the calibration coefficients in non-volatile memory.

For the NR3606-O product calibration may be required depending upon the application. The OCXO will drift with time and temperature. Drift of ±5ppb/day, ±50ppb/year is typical.Temp stability ±200ppb over the full temp range. OCXO's with better temp and time stability and if required, contact the factory.

Technical Specifications

3-Output 10 MHz BNC	10 MHz,1.0 Vrms ±0.2, into 50 Ohms, Sine or 5 Volt CMOS levels
	Default is sine output
1-LVDS	LVDS 10 MHz
LVDS connector	Digikey part number 277-1965-ND
Typical Standard Phase Noise	
1 Hz	-95
10 Hz	-130
100 Hz	-145
1000 Hz	-150
10kHz	-155
100kHz	-160
PPS	
Output Level	Three channels CMOS factory set to either 5 or 3.3 Volt levels.
	PPS levels must be selected at purchase. Default is 3.3 Volt.
Pulse Width	Default 200ms- may be changed via the serial port.
Drive level	50 Ohm load
1-LVDS	LVDS level
LVDS connector	Digikey part number 277-1965-ND
Remote interface & control	
Protocol	RS232 NMEA-0183
Connector	DB-9
Protocol	8-Bit plus stop bit
Standard Baud Rates	Selectable 38400, 57600, 115200, 230400 bps (default 38400)
GNSS receiver	GPS L1 C/A, GLONASS L1OF, QZSS L1 C/A, SBAS L1 C/A (Ready): Galileo E1B/E1C, QZSS L1S
Channels	26 channels (GPS, GLONASS, QZSS, SBAS)
Sensitivity	
GPS	Tracking: -161 dBm
	Hot Start: -161 dBm
	Warm Start: -147 dBm

	Cold Start: -147 dBm
	Reacquisition: -161 dBm
GLONASS	
	Tracking: -157 dBm
	Hot Start: -157 dBm
	Warm Start: -143 dBm
	Cold Start: -143 dBm
	Reacquisition: -157 dBm
	With Novus recommended antenna
Antenna with LNA	
Antenna power	3.5 Vdc, < 35 mA (on center conductor) (factory configurable to 5 Vdc)
Frequency	1574-1607 MHz
Nominal gain	2 dBic
Amplifier gain	26 dB
Noise figure	< 2.0 dB
Out-of-Band Rejection	Fo±50MHz=60 dBc, Fo±60 MHz
DC current	<25 mA@3.5 Vdc
DC input	Standard configuration is 12Vdc (9 to 15Vdc) Options- ±24Vdc (20 to 30Vdc), ±48vdc (40 to 60Vdc) AC Adapter available 100 to 240Vac, 50/60Hz
Power connector mate	Digikey 277-11343-ND

Environmental and Mechanical

Operating temperature	0 to 50°C non-condensing
Storage temperature	-40 to 70°C (extend temp range available)
Height	1.5”
Width	5.0” (exclusive of connectors)
Depth	7.0”
Weight	≈16oz.

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(b) after receiving return authorization –RMA- from NOVUS, the defective item is returned with transportation prepaid to NOVUS, Independence, Missouri, with transportation charges prepaid by Buyer …see RMA policy in Terms and conditions, and

(c) NOVUSs' examination of such unit shall disclose to its satisfaction that such defect(s) exist and have not been caused by misuse, neglect, improper installation, improper storage, unauthorized modifications, inadequate maintenance, operation outside the environmental specifications for the product, repair alteration, or accident. NOVUS assumes no risk or liability for results of the use of products purchased from it, including but without limiting the generality of the foregoing: (1) the use in combination with any electrical or electronic components, circuits, systems, assemblies or any other materials or substances; (2) unsuitability of any product for use in any circuit or assembly. Removal or tampering with tamper-proof label on merchandise will void warranty coverage unless with the written authorization from NOVUS

(d) an evaluation fee will be charged to Buyer to cover inspection and testing costs for any item returned by Buyer under this paragraph which is found to be within specifications and/or otherwise not the responsibility of NOVUS under the terms and conditions of this paragraph or any other part of this Agreement..

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Appendix A

GPS/GNSS Receiver Communications Specification NMEA-0183

Table of Contents:

1 Communication Specification

Signal Lines used:	TXD, RXD
Flow Control:	None
System:	Full Duplex Asynchronous
Speed:	Configurable, Default 38400 bps (*1)
Start Bit:	1 bit
Data Length:	8 bits
Stop Bit:	1 bit
Parity Bit:	None
Data Output Interval:	1 second

Character Codes used: NMEA-0183 Ver.4.10 data based

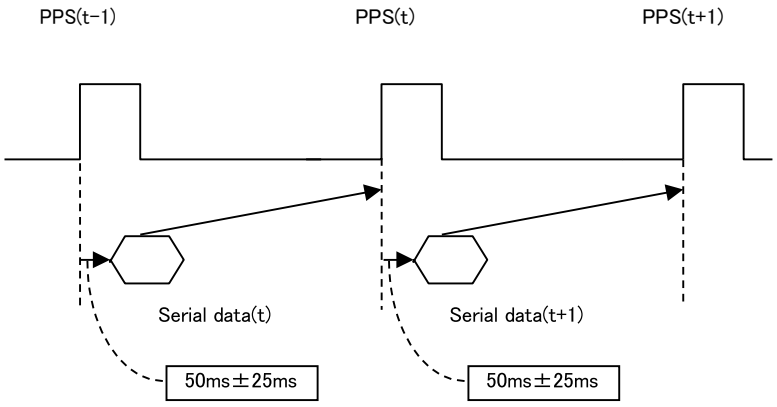
ASCII code (*2) Protocol: Input data
NMEA Standard
sentence NMEA
Proprietary
sentence
Output data
NMEA Standard
sentence NMEA
Proprietary
sentence

Note 1: Communication speed can be changed into 4800, 9600, 19200, 38400, 57600 or 115200 bps.
Please refer to section "UART1 – Serial Communication Port" for how to configure the communication speed. In case of using low baud rate, please adjust size of output sentence by NMEAOUT command and CROUT command to output all sentence within one second.

Note 2: "NMEA 0183 STANDARD FOR INTERFACING MARINE ELECTRONIC DEVICES Version 4.10" (NATIONAL MARINE ELECTRONICS ASSOCIATION, June, 2012)

2 Serial data output timing △4

The output timing of serial data is synchronous with PPS output timing. Serial data is begun to output in the 25ms to 75ms range after PPS is output.
The time of serial data indicates next PPS output timing.



3 NMEA Sentence Format

13.1 Standard Sentence Format:

$	<address field>	,	<data field>	…	*<checksum field>	<CR>	<LF>

5 bytes

Field	Description
$	Start-of Sentence marker
<address field>	5-byte fixed length. First 2 bytes represent a talker ID, and the remaining 3 bytes do a sentence formatter. All output sentences must begin with a "$" followed by a TalkerID. The relevant Talker IDs are GP for GPS, GN for GNSS, GL for GLONASS and GA for Galileo. For the sentences received from external equipment, the GT-87 accepts any talker ID. Talker ID "XX" found on the succeeding pages is a wildcard meaning "any valid talker ID".
<data field>	Variable or fixed-length fields preceded by delimiter ",”(comma). Comma(s) are required even when valid field data are not available i.e. null fields. Ex. ",,,,," In a numeric field with fixed field length, fill unused leading digits with zeroes.
*<checksum field>	8 bits data between "$" and "*" (excluding "$" and "*") are XORed, and the resultant value is converted to 2bytes of hexadecimal letters. Note that two hexadecimal letters must be preceded by"*", and delimiter "," is not required before *<checksum>. All output sentences have checksum. For input sentences, the resultant value is checked and if it is not correct, the sentence is treated invalid.
<CR><LF>	End-of-Sentence marker

4 Proprietary Sentence Format:

$	P	<maker ID>	<sentence type>	,	<data field>	…	*<checksum field>	<CR>	<LF>
		3 bytes	3 bytes						

Field	Description
$	Start-of-Sentence marker
P	Proprietary sentence identifier
<maker ID>	3-byte fixed length. GT-87's maker ID is "ERD" meaning eRide.
<sentence type>	Indicates the type of sentence.
<data field>	Variable or fixed-length fields preceded by delimiter ",”(comma). (Layout is maker-definable.)
<checksum field>	8 bits data between "$" and "*"(excluding "$" and "*") are XORed, and the resultant value is converted to 2 bytes of hexadecimal letters. Note that two hexadecimal letters must be preceded by "*", and delimiter "," is not required before *<checksum>. All output sentences have checksum. For input sentences, the resultant value is checked and if it is not correct, the sentence is treated invalid.
<CR><LF>	End-of-Sentence marker

5 Standard NMEA Output Sentences

The receiver supports eight standard NMEA output sentences (GGA, GLL, GNS, GSA, GSV, RMC, VTG and ZDA) per NMEA standard 0183 Version 4.10 (June, 2012).
By default, the RMC, GNS, GSA, ZDA, GSV and TPS sentences will be output every second. The sentences can be independently enabled and disabled using the $PERDCFG,NMEAOUT and/or $PERDAPI,CROUT command described later in this document, as well as use differing transmission rates.

The NMEA sentence descriptions in this sentence are for reference only. The sentence formats are defined exclusively by the copyrighted document from NMEA.

e*Ride* does populate all the fields described in the NMEA specification. Uncalculated fields are indicated as "Not Supported".

GGA – Global Positioning System Fix Data Format:

$XXGGA	,	hhmmss.sss	,	ddmm.mmmm	,	a	,	dddmm.mmmm	,	a	,	x	,	xx	,
		1		2		3		4		5		6		7	

x.x	,	x.x	,	M	,	x.x	,	M	,	xxx	,	xxx	*hh	<CR>	<LF>
8		9		10		11		12		13		14			

#.	**Description**	**Range**
1.	UTC	
	"hh": hour	00 - 23
	"mm": minute	00 - 59
	"ss.sss": second	00.000 - 59.999
2-3.	Latitude	
	"dd": degree	00 - 90
	"mm.mmmm": minute	00.0000 - 59.9999
	"a": North/South	N or S
4-5.	Longitude	
	"ddd": degree	000 - 180
	"mm.mmmm": minute	00.0000 - 59.9999
	"a": East/West	E or W
6.	GPS Quality Indication	0 - 2 "0": Fix not available or invalid "1": Valid fix "2": DGPS positioning
7.	Number of satellites used for positioning	00 – 12 [*1]
8.	Horizontal dilution of precision (HDOP)	0.0-50.0
	Note: A null field is output while positioning is interrupted.	
9.	Altitude above/below mean sea-level (geoid)	
10.	Unit of Altitude, meter	M
11.	Geoidal height	
12.	Unit of Geoidal height	M
13.	Age of differential GPS data	n/a
14.	Differential reference station ID	n/a

Example:

$GPGGA,025411.516,3442.8146,N,13520.1090,E,1,11,0.8,24.0,M,36.7,M,,*66

UTC: 02:54:11.516 34 deg 42.8146 min N 135 deg 20.1090 min E

Status: Valid fix Number of satellites: 11 satellites HDOP: 0.8

Altitude: 24.0 meters high Geoidal height: 36.7 meters high

[*1] GPS, SBAS, QZSS only. Galileo and GLONASS are not counted. Upper limit is 12.

GLL – Geographic Position - Latitude/Longitude △6

Format:

$XXGLL	,	ddmm.mmmm	,	a	,	dddmm.mmmm	,	a	,	hhmmss.sss	,	a	,	a	*hh	<CR>	<LF>
		1		2		3		4		5		6		7			

#	Description	Range
1-2.	Latitude	
	"dd": degree	00 - 90
	"mm.mmmm": minute	00.0000 - 59.9999
	"a": North/South	N or S
3-4.	Longitude	
	"ddd": degree	000 - 180
	"mm.mmmm": minute	00.0000 - 59.9999
	"a": East/West	E or W
5.	UTC	
	"hh": hour	00 - 23
	"mm": minute	00 - 59
	"ss.sss": second	00.000 - 59.999
6.	Status △6	A or V "A": Data Valid "V": Data Invalid
7.	Position System Mode Indication	A, D or N "A": Autonomous "D": Differential "N": Data Invalid

Example:

$GPGLL,3442.8146,N,13520.1090,E,025411.516,A,A*5F
34 deg 42.8146 min N 135 deg 20.1090 min E
UTC: 02:54:11.516 Mode: Data Valid

GNS – GNSS Fix Data Format:

$XXGNS	,	hhmmss.sss	,	ddmm.mmmm	,	a	,	dddmm.mmmm	,	a	,	c--c	,	xx	,
		1		2		3		4		5		6		7	

x.x	,	x.x	,	x.x	,	x	,	x	,	x	*hh	<CR>	<LF>
8		9		10		11		12		13			

#.	Description	Range
1.	UTC	
	"hh": hour	00 - 23
	"mm": minute	00 - 59
	"ss.sss": second	00.000 - 59.999
2-3.	Latitude	
	"dd": degree	00 - 90
	"mm.mmmm": minute	00.0000 - 59.9999
	"a": North/South	N or S
4-5.	Longitude	
	"ddd": degree	000 - 180
	"mm.mmmm": minute	00.0000 - 59.9999
	"a": East/West	E or W
6.	Mode Indicator for each satellite system (GPS, GLONASS, Galileo)	"A": Autonomous "D": Differential "N": Data Invalid
7.	Number of satellites used for positioning	00 - 32
8.	Horizontal dilution of precision (HDOP)	0.0 - 50.0
	Note: A null field is output while positioning is interrupted.	
9.	Altitude above/below mean sea-level (geoid)	
10.	Geoidal height	
11.	Age of differential GPS data	n/a
12.	Differential reference station ID	n/a
13.	Navigation Status Indicator	S, C, U or V "S": Safe "C": Caution "U": Unsafe "V": Not Valid

Example:

$GNGNS,004457.000,3442.8266,N,13520.1235,E,DDN,22,0.5,40.6,36.7,,,V*60
UTC: 00:44:57.000 34 deg 42.8266 min N 135 deg 20.1235 min E
Status: Data Valid (GPS: differential, GLONASS: differential, Galileo: Invalid)
Number of satellites: 22 satellites HDOP: 0.5
Altitude: 40.6 meters high Geoidal height: 36.7 meters high
Navigation Status Indicator: Not Valid

GSA – GNSS DOP and Active Satellites △4

Format:

$XXGSA	,	a	,	a	,	xx	,	xx	,	xx	,	…	,	xx	,	x.x	,	x.x	,	x.x	,	h	*hh	<CR>	<LF>
		1		2		3		4		5		6-13		14		15		16		17		18			

#	Description	Range
1.	Operational mode	M or A "M": 2D/3D fixed mode "A": 2D/3D Auto-switching mode
2.	Mode	1 - 3 "1": No fix "2": 2D fix "3": 3D fix
3-14.	Satellite Numbers used for positioning Note: A null field is output unless a satellite is available.	01 - 99
15.	PDOP Note: A null field is output unless 3D-positioning is performed.	0.0 - 50.0
16.	HDOP Note: A null field is output while positioning is interrupted.	0.0 - 50.0
17.	VDOP Note: A null field is output unless 3D-positioning is performed.	0.0 - 50.0
18.	GNSS System ID	n/a

Example:

$GNGSA,A,3,09,15,26,05,24,21,08,02,29,28,18,10,0.8,0.5,0.5,1*33
$GNGSA,A,3,79,69,68,84,85,80,70,83,,,,,0.8,0.5,0.5,2*30

2D/3D Auto-switching mode, 3D fix
Satellite used: 09, 15, 26, 05, 24, 21, 08, 02, 29, 28, 10, 79, 69, 68, 84, 85, 80, 70, 83
PDOP: 0.8 HDOP: 0.5 VDOP: 1.5

Notes: △4

- To adds extra fields to the GPGSA NMEA string to show more than 12 satellites used in the fix, please input "$PERDAPI,EXTENDGSA,num*hh<CR><LF>". num is Number of fields for satellites used in the fix. Acceptable values are: 12-16. Default num is 12. By creating more fields for satellites used in the fix, the PDOP/HDOP/VDOP values shift by num12 fields.
- Satellite number means the follow.

Satellite number from 01 to 32 indicates GPS (01 to 32)
Satellite number from 33 to 51 indicates SBAS (120 to 138)
Satellite number from 65 to 92 indicates GLONASS (slot 01 to slot 28)
Satellite number from 93 to 99 indicates QZSS (193 to 199)

GSV – GNSS Satellites in View △4

Format:

$XXGSV	,	x	,	x	,	x	,	xx	,	xx	,	xxx	,	xx	,	xx	,	xx	,	xxx	,	xx	,
		1		2		3		4		5		6		7		8		9		10		11	

xx	,	xx	,	xxx	,	xx	,	xx	,	xx	,	xxx	,	xx		h	*hh	<CR>	<LF>
12		13		14		15		16		17		18		19		20			

#	Description	Range
1.	Total number of messages	1 - 4
2.	Number of messages	1 - 4
3.	Number of satellites in line-of-sight	00 - 14
4.	1st Sat. ID number	01 - 99
5.	1st Sat. elevation angle (degree)	00 - 90
6.	1st Sat. azimuth angle (degree)	000 - 359
7.	1st Sat. SNR (Signal/Noise Ratio) (dB)	00 - 99
8-11.	2nd Sat. Details	
12-15.	3rd Sat. Details	
16-19.	4th Sat. Details	
20.	Signal ID	

Example:

$GPGSV,4,1,14,15,67,319,52,09,63,068,53,26,45,039,50,05,44,104,49,1*6E
$GPGSV,4,2,14,24,42,196,47,21,34,302,46,18,12,305,43,28,11,067,41,1*68
$GPGSV,4,3,14,08,07,035,38,29,04,237,39,02,02,161,40,50,47,163,44,1*67
$GPGSV,4,4,14,42,48,171,44,93,65,191,48,,,,,,,,1*60
$GLGSV,3,1,09,79,66,099,50,69,55,019,53,80,33,176,46,68,28,088,45,1*76
$GLGSV,3,2,09,70,25,315,46,78,24,031,42,85,18,293,44,84,16,246,41,1*7A
$GLGSV,3,3,09,86,02,338,,,,,,,,,,,,1*45

Not fixed
Message number
Total number of message

<checksum><CR><LF> is output right after the last satellite data output.

Notes: △4

- In this sentence, a maximum of four satellite details is indicated per each output. Five or more satellite details are output in the 2nd or 3rd messages. When there is an item which is not fixed in the satellite details, a null field is output. When there are only one to four satellite details, <checksum><CR><LF> is issued immediately after Sat. SV#, Sat. elevation angle, Sat. azimuth angle and SNR.
- Satellite number means the follow.

Satellite number from 01 to 32 indicates GPS (01 to 32)
Satellite number from 33 to 51 indicates SBAS (120 to 138)
Satellite number from 65 to 92 indicates GLONASS (slot 01 to slot 28)

Satellite number from 93 to 99 indicates QZSS (193 to 199)

RMC – Recommended Minimum Navigation Information △6

Format:

$XXRMC	,	hhmmss.sss	,	a	,	ddmm.mmmm	,	a	,	dddmm.mmmm	,	a	,	x.x	,
		1		2		3		4		5		6		7	

x.x	,	ddmmyy	,	x.x	,	a	,	a	,	a	*hh	<CR>	<LF>
8		9		10		11		12		13			

#	*Description*	*Range*
1.	UTC "hh": hour "mm": minute "ss.sss": second	 00 - 23 00 - 59 00.000 - 59.999
2.	Status △6	A or V "A": Data valid "V": Data not valid
3-4.	Latitude "dd": degree "mm.mmmm": minute "a": North/South	 00 - 90 00.0000 - 59.9999 N or S
5-6.	Longitude "ddd": degree "mm.mmmm": minute "a": East/West	 000 - 180 00.0000 - 59.9999 E or W
7.	Speed (kts)	
8.	True Course (degree)	
9.	Date "dd": date "mm": month "yy": last two digits of the year	
10.	Magnetic declination Note: A null field is output unless magnetic declination information is available.	
11.	Correction direction of magnetic declination Note: A null field is output unless magnetic declination information is available.	
12.	Positioning System Mode Indication	A, D or N "A": Autonomous "D": Differential "N": Data Invalid
13.	Navigation Status Indicator	S, C, U or V "S": Safe "C": Caution "U": Unsafe "V": Not Valid

Example:

$GNRMC,012344.000,A,3442.8266,N,13520.1233,E,0.00,0.00,191132,,,D,V*0B
UTC: 01:23:44.000 Differential 34 deg 42.8266 min N 135 deg 20.1233 min E
Speed: 0.0 kts True Course: 0.0 degrees UTC Date: Nov 19, 2032

VTG – Course Over Ground and Ground Speed Format:

$XXVTG	,	x.x	,	T	,	x.x	,	M	,	x.x	,	N	,	x.x	,	K	,	a	*hh	<CR>	<LF>
		1		2		3		4		5		6		7		8		9			

 # Description Range

1-2. True Course (degree)
"T" (meaning TRUE) T

3-4. Magnetic Direction
"M" (meaning Magnetic Direction) M
Note: A null field is output unless magnetic direction information is available.

5-6. Speed (kts)
"N" (meaning knot) N

7-8. Speed (km/h)
"K" (meaning km/h) K

9. Positioning System Mode Indication A, D or N
"A": Autonomous
"D": Differential
"N": Data Invalid

Example:

$GNVTG,0.00,T,,M,0.00,N,0.00,K,D*26
True Course: 0.00 degrees Speed: 0.00 kts, 0.00 km/h Mode: Differential

ZDA – Time & Date Format:

$XXZDA	,	hhmmss.sss	,	xx	,	xx	,	xxxx	,	xxx	,	xx	*hh	<CR>	<LF>
		1		2		3		4		5		6			

#	**Description**	
1.	UTC: Time	
	"hh": hour	00 - 23
	"mm": minute	00 - 59
	"ss.sss": second	00.000 - 59.999
2.	UTC: Day of Month	01 - 31
3.	UTC: Month	01 - 12
4.	UTC: Year	1999 - 2099 △3
5.	Local Zone Hours	(+/-) 00 - 23
6.	Local Zone Minutes	00 - 59

Example:

$GPZDA,014811.000,13,09,2013,+00,00*7B
UTC: 01:48:11.000 13th September, 2013

6 Proprietary NMEA Input Sentences

These sentences are input commands for the protocol of this receiver.

GNSS – Satellite System Configuration △4 △8

Format:

$PERDAPI	,	GNSS	,	talkerID	,	gps	,	glonass	,	galileo	,	qzss	,	sbas	*hh	<CR>	<LF>
		1		2		3		4		5		6		7			

Num	Contents	Range	Default	Remark
1	GNSS	-	-	Command Name
2	talkerID	AUTO, LEGACYGP or GN △8	AUTO	AUTO: GLGSV is omitted in case of no glonass. GPGSV is omitted in case of no GPS, SBAS and QZSS. LEGACYGP: GL and GN sentence is omitted. GN: GLGSV is output even if no glonass. GPGSV is output even if no GPS, SBAS and QZSS.
3	gps	0 or 2	2	GPS mode △3
4	glonass	0 or 2	2	Glonass mode △3
5	galileo	0	0	Galileo mode (unimplemented)
6	qzss	0 or 2	2	Qzss mode △3
7	sbas	0, 1 or 2	1	Sbas mode △2

Example:

$PERDAPI,GNSS,AUTO,2,2,0,2,2*41
Use: GPS, GLONASS, QZSS, SBAS
Mask: Galileo

Notes: △4

- This command controls which Global Navigation Satellite Systems are used by the receiver. The mode can be set to 0 or 2 for each satellite system. User can also set SBAS mode to 1. Mode 0 means to disable the system.

Mode 1 means to enable tracking only (do not use in position fix etc).

Mode 2 means to enable tracking and use the in position fix calculation.

- In GT-87, default setting of SBAS mode is 1, because to use calculation data of SBAS tends to reduce the accuracy of 1PPS. Therefore although GT-87 becomes to differential fix, SBAS is not appeared in GSA sentence in default setting.
- The response which is inserted current value to each field is obtained by receiving an effective command for setting or inputting a command which is omitted the fields after Command Name, that is, $PERDAPI,GNSS,QUERY*18.
- "Sbas only configuration" and "No tracking configuration" are not accepted.

$PERDAPI,GNSS,AUTO,0,0,0,0,2*43

$PERDAPI,GNSS,AUTO,0,0,0,0,1*40

$PERDAPI,GNSS,AUTO,0,0,0,0,0*41

- Cold restart (time also be cleared) is run when satellite system configuration is changed from/to glonass only fix configuration. In the others configuration, hot restart is run.

FIXMASK – Setting of Positioning and Satellite Mask △4

Format:

$PERDAPI	,	FIXMASK	,	mode	,	elevmask	,	Reserve1	,	snrmask	,	Reserve2	[,
		1		2		3		4		5		6	

Prohibit SVs (GPS)	,	Prohibit SVs (GLONASS)	,	Prohibit SVs (Galileo)	,	Prohibit SVs (QZSS)	,	Prohibit SVs (SBAS)]	*hh	<CR>	<LF>
7		8		9		10		11			

Num	Contents	Range	Default	Remark
1	FIXMASK	-	-	Command Name
2	mode	USER	-	Fixed Value
3	elevmask	0 to 90	0	Elevation mask (in degree) Only SVs whose age is within this threshold are used in the position fix calculation.
4	Reserve1	0	0	Reserve field
5	snrmask	0 to 99	0	Signal level mask (in dB-Hz) Only SVs above this mask are fixed.
6	Reserve2	0	0	Reserve field
7	Prohibit SVs (GPS)	32BIT (HEX)	0	GPS Satellite number mask Each bit represents one SVID. The GPS satellites indicated by this field are not used in the position fix calculation. Lowest order bit means SV=01. Highest order bit means SV=32. △4
8	Prohibit SVs (GLONASS)	28BIT (HEX)	0	GLONASS Satellite number mask Each bit represents one SVID. The GLONASS satellites indicated by this field are not used in the position fix calculation. Lowest order bit means SV=65. Highest order bit means SV=92. △4
9	Prohibit SVs (Galileo)	20BIT (HEX)	0	Galileo Satellite number mask Each bit represents one SVID. This field is unimplemented. △4
10	Prohibit SVs (QZSS)	7BIT (HEX)	0	QZSS Satellite number mask Each bit represents one SVID. The QZSS satellites indicated by this field are not used in the position fix calculation. Lowest order bit means SV=93. Highest order bit means SV=99. △4
11	Prohibit SVs (SBAS)	19BIT (HEX)	0	SBAS Satellite number mask Each bit represents one SVID. The SBAS satellites indicated by this field are not used in fix. Lowest order bit means SV=33. Highest order bit means SV=51. △4

Example:

$PERDAPI,FIXMASK,USER,10,0,37,0,0x92,0x01,0x00,0x00,0x20000*50

Elevation mask: 10 degrees
Signal level mask: 37 dBHz
GPS mask: GPS (BIT2 = SVID 2), GPS (BIT5 = SVID 5) and GPS (BIT9 = SVID 9)
GLONASS mask: GLONASS (BIT1 = SVID 65)
SBAS mask: SBAS (BIT18 = SVID 50)

Notes:

- It is applied not only to First Fix or the time of a positioning return but to all the positioning.
- It is omissible after the 7th field.
- The response which is inserted current value to each field is obtained by receiving an effective command for setting or inputting a command which is omitted the fields after Command Name, that is, $PERDAPI,MASK,QUERY*50.

PPS – Setting of PPS (Pulse per second) △4 Format:

$PERDAPI	,	PPS	,	type	,	mode	,	period	,	pulse width	,	cable delay	,
		1		2		3		4		5		6	

polarity	[,	PPS accuracy threshold]	*hh	<CR	<LF>
7		8			

Num	Contents	Range	Default	Remark
1	PPS	-	-	Command Name
2	type	LEGACY GCLK	LEGACY	PPS type
3	mode	0 to 4	4	PPS mode 0: Always stop 1: Always output 2: Output only during positioning more than one satellite 3: Output only when TRAIM is OK 4: Output only when estimated accuracy is less than estimated accuracy threshold which is 8th field on this command.
4	period	0 to 1	0	PPS output interval 0: 1PPS (A pulse is output per second) 1: PP2S (A pulse is output per two seconds)
5	pulse width	1 to 500	200	PPS pulse width (ms)
6	cable delay	-100000 to 100000	0	PPS cable delay (ns) Plus brings delay PPS. Minus brings forward PPS.
7	polarity	0 to 1	0	PPS polarity (LEGACY PPS is rising edge only) 0 : rising edge 1 : falling edge
8	PPS accuracy threshold	5 to 9999	1000	PPS estimated accuracy threshold This threshold is used for mode 4. △4

Example:

$PERDAPI,PPS,LEGACY,1,0,200,0,0,25*29

Type: LEGACY PPS Mode: Always output

1PPS Pulse width: 200 ms cable delay: 0 ns

Polarity: rising edge of PPS is synchronous with UTC time.

PPS estimated accuracy threshold is 25nsec.

Notes: △4

- LEGACY PPS setting is output legacy PPS which is not synchronized with frequency which is output from GCLK pin, but which is output immediately after first fix in case of cold start.
- GCLK PPS setting is output GCLK PPS which synchronized with frequency which is output from GCLK pin, but it takes some to become GCLK PPS steady after first fix (typically, 1~2 minutes after fist fix). User can confirmed whether GCLK PPS is steady by GCLK accurate field of TPS4 sentence.
- User can choose GPS, UTC (USNO) and UTC (SU) as alignment of PPS by TIMEALIGN command. The default is UTC (USNO). As for details, please refer to the page of TIMEALIGN command.
- The condition of PPS synchronization is the follow.

[1] GPS alignment

PPS mode	Before first fix	After first fix
0	OFF	OFF
1	Sync with RTC	Sync with GPS
2~4	OFF	Sync with GPS

[2] UTC (USNO) alignment (default)

PPS mode	Before first fix	After first fix	After taking UTC (USNO) parameter from GPS
0	OFF	OFF	OFF
1	Sync with RTC	Sync with GPS	Sync with UTC (USNO)
2~4	OFF	Sync with GPS	Sync with UTC (USNO)

[3] UTC (SU) alignment

PPS mode	Before first fix	After first fix	After taking UTC (SU) parameter from GLONASS
0	OFF	OFF	OFF
1	Sync with RTC	Sync with GPS	Sync with UTC (SU)
2~4	OFF	Sync with GPS	Sync with UTC (SU)

- About PPS estimated accuracy, please refer to the page of CRX (TPS2) sentence.

RESTART - Restart command △4 Format:

$PERDAPI	,	RESTART	,	restart mode	*hh	<CR>	<LF>
		1		2			

Num	Contents	Range	Default	Remark
1	RESTART	-	-	Command Name
2	restart mode	HOT WARM COLD FACTORY	-	Restart mode

Example:

$PERDAPI,RESTART,COLD*08
Mode: cold restart

Notes: △4
- As for the differences depending on the restart mode, please refer to the page of "Backup of the Receiver Parameters (for BBRAM)".
- The data which is stored by FLASHBACKUP command in Flash is not cleared even if FACTORY restart is occurred.
- Power off/on of GT-87 corresponds to hot restart when it is within 4 hours after last fix.
- Power off/on of GT-87 corresponds to warm restart when it is over 4 hours after last fix.

TIME – Setting of time information △4

Initial time is configured. The setting of time is effective only within the case that time is not decided by other factors. A setting of a millennium which is the times of GPS week rollover is received also after time decision.

Format:

$PERDAPI	,	TIME	,	time of date	,	day	,	month	,	year	*hh	<CR>	<LF>
		1		2		3		4		5			

Num	Contents	Range	Default	Remark
1	TIME	-	-	Command Name
2	Time of date	00 to 23 00 to 59 00 to 59	0	UTC (Hour) UTC(Minute) UTC(Second)
3	day	1 to 31	22	UTC (Date)
4	month	1 to 12	8	UTC (Month)
5	year	2013 to 2099	1999	UTC (Year) △3

Example:

$PERDAPI,TIME,021322,24,11,2020*64
Time: 02:13:22 on 24th November, 2020

Notes: △4
- This command is needed to input correct date within +/- 1 year.
- Under normal conditions, User needs not to set initial time because time is decided by satellite navigation data.
- As for GPS week rollover timing and GT-87 week rollover timing, please refer to the follow.

event	date	GPS week
GPS week rollover timing (1st) **default time of date of GT-87**	**1999/08/22**	**1024**
GPS week rollover timing (2nd)	2019/04/07	2048
rollover timing of GT-87	**2032/08/15**	**2745**
GPS week rollover timing (3rd)	2038/11/21	3072
…		
operable time limit of GT-87	**2099/12/31**	**6260**

[In case that GT-87 does not have glonass]

GT-87 can keep outputting correct date after 2032/08/15 during power distribution.
GT-87 will output 2012/12/30 after 2032/08/15 unless user sets correct date by TIME command after user turns off GT-87 and also turns off backup current for BBRAM.

[In case that GT-87 has glonass]

GT-87 can adjust millennium automatically in the timing of first fix of glonass and outputs correct date until 2099/12/31 without user setting even if user turns off GT-87 and backup current.

TIMEZONE – Local Zone Time △4

This sentence is reflected to ZDA sentence (not only local zone field but also UTC time field).

Format:

$PERDAPI	,	TIMEZONE	,	sign	,	hour	,	minute	*hh	<CR>	<LF>
		1		2		3		4			

Num	Contents	Range	Default	Remark
1	TIMEZONE	-	-	Command Name
2	sign	0 to 1	0	GMT sign "0" shows positive, "1" shows negative.
3	hour	0 to 23	0	GMT (Hour)
4	minute	0 to 59	0	GMT (Minute)

Example:

$PERDAPI,TIMEZONE,0,9,0*69

As GMT offset, display time is carried out +9:00.

Notes: △4

- In UTC (SU) alignment, GMT offset is changed to +3:00 automatically.

SURVEY – Position Mode △1 Format:

$PERDAPI	,	SURVEY	,	position mode	[,	sigma threshold	,	time threshold]
		1		2		3		4

[,	latitude	,	longitude	,	altitude]]	*hh	<CR>	<LF>
	5		6		7			

Num	Contents	Range	Default	Remark
1	SURVEY	-	-	Command Name
2	position mode	0 to 3	2	0: Normal NAV (navigation) mode 1: Position Survey SS (self survey) mode 2: Position Survey CSS (continual self survey) mode 3: Position-hold TO (time only) mode
3	sigma threshold	0 to 255	0 △3	Sigma threshold (m) which changes automatically to position-fixed. (When the threshold value is 0, it is not used.)
4	time threshold	0 to 10080	480 (8hours) △3	Time threshold (minute) which changes automatically to position-fixed. (When the threshold value is 0, it is not used.)
5	latitude △1	-90 to 90	0	Latitude for hold position in TO mode. (degree) A positive number means the north latitude and a negative number means the south latitude. This field can be set only when position mode is 3.
6	longitude △1	-180 to 180	0	Longitude for hold position in TO mode. (degree) A positive number means the east longitude and a negative number means the west longitude. This field can be set only when position mode is 3.
7	altitude △1	-1000 to 18000	0	Altitude for hold position in TO mode. (m) This field can be set only when position mode is 3.

Example:

$PERDAPI,SURVEY,1,10,1440*74

Mode: SS mode Sigma Threshold: 10 Time Threshold: 1440

$PERDAPI,SURVEY,3,0,0,37.78700,-122.45100,31.5*53

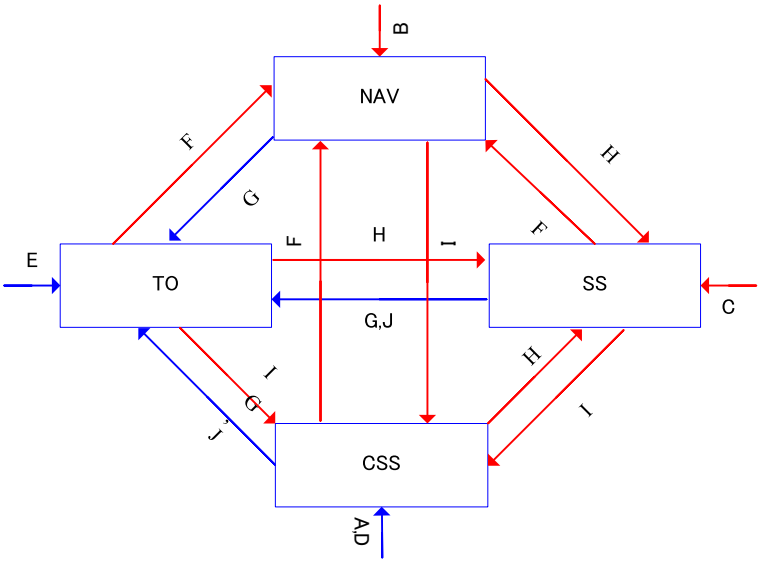
Mode: TO mode Sigma Threshold: 0 Time Threshold: 0

Fixed position: 37.78700 degrees north 122.45100 degrees west Altitude: 31.5 m

Notes:

- It is omissible after the 3rd field.
- When the position mode is "1", a position is re-calculated after power supply OFF/ON. Please use it, when the antenna position may change before power supply OFF.
- When the position mode is "2", after power supply OFF/ON, the estimated position that calculated before power supply OFF is kept, and the position is updated. By using it when the antenna position does not change after the power supply OFF, the time for changing to Position-hold mode can be shortened.
- In order to change automatically to Position-hold mode, it is necessary to set to Survey mode.
- If both sigma threshold and time threshold are configured, the position mode changes to Position-hold mode when either is fulfilled. When the threshold value is 0, it is not used.
- The displayed position may differ a little from the configured position due to conversion error.

- Hot start is occurred when survey mode is shift to NAV mode. △1



Flow chart about position mode

	Transition condition	Whether keep or not survey position and number of times of survey process
A	After first power on, or after factory restart (default)	Discard
B	After power on in case that last mode is "SURVEY,0".	Discard
C	After power on in case that last mode is "SURVEY,1".	Discard
D	After power on in case that last mode is "SURVEY,2".	Keep
E	After power on in case that last mode is "SURVEY,3".	Keep
F	"SURVEY,0" command	Discard
G	"SURVEY,3" after self survey position is fixed. "SURVEY,3" with user's hold position.	Keep
H	"SURVEY,1" command	Discard
I	"SURVEY,2" command	Discard

J	The condition of survey is satisfied. [*] Position mode is always started by time only mode if TO mode by this condition and power off.	Keep

FREQ – Setting of GCLK FREQUENCY △2△7 Format:

$PERDAPI	,	FR	,	mode	,	freq	[,	duty	,	offset]	*hh	<CR>	<LF>
		1		2		3		4		5			

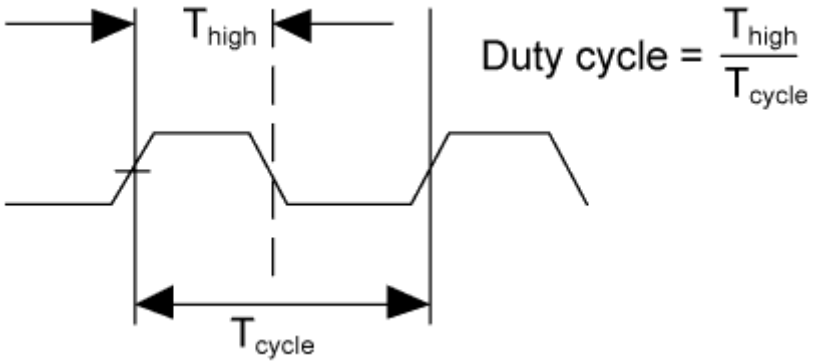
Num	Contents	Range	Default	Remark
1	FREQ	-	-	Command Name
2	mode	0 to 1	0	0 : stop 1 : output
3	freq	4000 to 40000000	10000000 (10MHz)	frequency[Hz]
4	duty △2	10 to 90 △7	50	duty cycle [%]
5	offset △2	0 to 99	0	phase delay in cycle [%] from GCLK-PPS edge

Example:

$PERDAPI,FREQ,1,10000000*47
Mode: output
Frequency: 10MHz

Notes:

- It is omissible after the 4th field.
- The response which is inserted current value to each field is obtained by receiving an effective command for setting or inputting a command which is omitted the fields after Command Name, that is, $PERDAPI,FREQ,QUERY*11.
- Duty cycle is derived from Thigh / Tcycle in the follow figure. △2
- User can stock current FREQ command setting on Flash by FLASHBACKUP command.



DEFLS – Setting of default leap second △4 △6 Format:

$PERDAPI	,	DEFLS	,	sec	[,	mode]	*hh	<CR>	<LF>
		1		2		3			

Num	Contents	Range	Default	Remark
1	DEFLS	-	-	Command Name
2	sec	0 to 32	16	Default leap second
3	mode	AUTO or FIXED	AUTO	AUTO: default leap second is updated automatically after taking leap second from satellites. FIXED: default leap second is kept as user setting.

Example:

$PERDAPI,DEFLS,16,AUTO*27

Default leap second: 16 second (this value is updated automatically).

Notes:

- It is omissible after the 3rd field.
- This value is used before leap second is confirmed by other factors which are to take UTC (USNO) parameter which is broadcasted from GPS or to take time difference between GPS and GLONASS.
- GT-87 can store current DEFLS command setting in Flash by FLASHBACKUP command.
- Cold restart (time also be cleared) is run when this command is run. △6

TIMEALIGN – setting of time alignment ▵4 Format:

		1		2			
$PERDAPI	,	TIMEALIGN	,	mode	*hh	<CR>	<LF>

Num	Contents	Range	Default	Remark
1	TIMEALIGN	-	-	Command Name
2	mode	1 to 3	2	1 : GPS alignment 2 : UTC(USNO) alignment 3 : UTC(SU) alignment

Example:

$PERDAPI,TIMEALIGN,2*31
UTC (USNO) alignment

Notes:

- Please note that mode 0 is invalid value.
- User can store current TIMEALIGN command setting on Flash by FLASHBACKUP command.
- This command is used to set output time alignment and 1PPS alignment.

[1: GPS alignment]

- Leap second is not applied to output time even if GT-87 already has leap second.
- PPS is output in synchronization with GPS even if GT-87 already has UTC parameter.
- In Glonass only mode, correct default leap second is needed to output correct time.

[2: UTC (USNO) alignment]

- Leap second is applied to output time.
- PPS is output in synchronization with GPS before taking UTC (USNO) parameter from GPS.
- PPS is output in synchronization with UTC(USNO) after taking UTC (USNO) parameter from GPS.
- In Glonass only fix, because GT-87 can't take UTC (USNO) parameter from GLONASS, PPS is kept to output in synchronization with GPS.

[3: UTC (SU) alignment]

- Leap second is applied to output time. And, GMT offset is set as +3:00.
- PPS is output in synchronization with GPS before taking UTC (SU) parameter from GLONASS.
- PPS is output in synchronization with UTC(SU) after taking UTC (SU) parameter from GLONASS.
- In GPS only fix, because GT-87 can't take UTC (SU) parameter from GPS, PPS is kept to output in synchronization with GPS.

Restriction:

Output time

	GPS only fix setting	GLONASS only fix setting	GPS + GLONASS setting
GPS alignment	OK	**accurate default leap second is required [*1]**	OK
UTC(USNO) alignment	OK	OK	OK
UTC(SU) alignment	OK	OK	OK

PPS

	GPS only fix setting	GLONASS only fix setting	GPS + GLONASS setting
GPS alignment	OK	OK	OK
UTC(USNO) alignment	OK	**NG**	OK
UTC(SU) alignment	**NG**	OK	OK

[*1] In GPS alignment and GLONASS only fix setting, to output correct output time, user needs to set accurate default leap second by DEFLS command.

- In this graph, QZSS is treated as GPS.

FLASHBACKUP – Setting of backup in Flash 4 Format:

$PERDAPI	,	FLASHBACKUP	,	type	*hh	<CR>	<LF>
		1		2			

Num	Contents	Range	Default	Remark
1	FLASHBACKUP	-	-	Command Name
2	type	0x00 to 0x07 (HEX)	0x00	Target of backup Each bit represents one command setting 0x01 : FREQ command setting 0x02 : DEFLS command setting 0x04 : TIMEALIGN command setting 0x00 means that flash backup is initialised.

Example:

$PERDAPI,FLASHBACKUP,0x03*4E

Current setting of FREQ and DEFLS command is stored in flash.

Notes:

- This data stored in Flash is erased when software update.
- This data stored in Flash is not erased by factory cold restart.
- Hot start is occurred when this command is input.
- Please don't turn off GT-87 during this command is sent.

Restriction:

GT-87 has two ways to backup data.

[1] BBRAM

BBRAM is RAM which is available to store data as long as backup current is impressed. GT-87 can store ephemeris data, almanac data and configuration which user sets by commands etc in BBRAM, and the data is not erased even if GT-87 is turned off.

The backup timing of BBRAM is every second. The data is cleared when user inputs RESTART command and/or user turns off backup current.

[2] FLASH

GT-87 can store FREQ command setting, DEFLS command setting and/or TIMEALIGN command setting in flash when user inputs FLASHBACKUP command. The data is not erased even if GT-87 is turned off or RESTART command. The data is cleared when user inputs FLASHBACKUP command or software update.

If GT-87 has different backup data between BBRAM and Flash, BBRAM data have a priority over flash. In this case, when the data of BBRAM is invalid because that backup current is turned off, Flash data is applied.

CROUT – Setting of CR Output Format:

$PERDAPI	,	CROUT	,	type	,	rate	*hh	<CR>	<LF>
		1		2		3			

Num	Contents	Range	Default	Remark
1	CROUT	-	-	Command Name
2	type	N,M,W,X,Y,Z	W,X,Y,Z	Output CR sentence [*] Alphabets of outside range are reserved.
3	rate	W,X,Y,Z : 0 to 255 N,M : 0 to 1	1	W,X,Y,Z : 1-255:Update interval of the sentence (sec) 0: The sentence(s) is/are stopped. N,M : 1: Sentence(s) is/are output every event occurred. 0: The sentence(s) is/are stopped.

Example:

$PERDAPI,CROUT,W,1*4E
CRW (TPS1) sentence is output every second.

$PERDAPI,CROUT,XZ,3*19
CRX (TPS2) sentence and CRZ(TPS4) sentenced are output every 3 seconds.

$PERDAPI,CROUT,W,0*4F
CRW (TPS1) sentence is stopped.

$PERDAPI,CROUT,N,1*57
CRN sentence is output every event occurred.

Notes:

- "M" or/and "N" can be output only in case that baud rate is 115200bps. △1

7 CFG – Setting of Application Software

NMEAOUT – Standard NMEA Output △9

Format:

$PERDCFG	,	NMEAOUT	,	type	,	interval	*hh	<CR>	<LF>
		1		2		3			

Num	Contents	Range	Default	Remark
1	NMEAOUT	-	-	Command Name
2	type	[*1]	-	Standard NMEA sentence [*1] GGA, GLL, GNS, GSA, GSV, RMC, VTG, ZDA, ALL△9. (ALL means all sentences from GGA to ZDA.)
3	Interval	0 to 255	-	Update interval of the sentence (sec) When the value is "0", the sentence is output only once. After that, the sentence is stopped.

Example:

$PERDCFG,NMEAOUT,GGA,2*57
Interval: 2 seconds

$PERDCFG,NMEAOUT,GSV,0*56
GSV sentence is output only once. After that, GSV sentence is stopped.

UART1 – Serial Communication Port Format:

$PERDCFG	,	UART1	,	baud	*hh	<CR>	<LF>
		1		2			

Num	Contents	Range	Default	Remark
1	UART1	-	-	Command Name
2	baud	4800, 9600, 19200, 38400, 57600 or 115200	38400	Baud rate (bps)

Example:

$PERDCFG,UART1,115200*65
Baud rate: 115200 bps

Notes:

- When the setting of the serial communication port is changed by this command, ACK sentence is output by the baud rate which was being used.

- In case of using low baud rate, please adjust size of output sentence by NMEAOUT command and CROUT command to output all sentence within one second.

SYS – PVT System

1.2 VERSION – Software Version

Format:

$PERDSYS	,	VERSION	*hh	<CR>	<LF>
		1			

Num	Contents	Range	Default	Remark
1	VERSION	-	-	Command Name

Example:

$PERDSYS,VERSION*2C

GPIO – General Purpose Input/output Format:

$PERDSYS	,	GPIO	*hh	<CR>	<LF>
		1			

Num	Contents	Range	Default	Remark
1	GPIO	-	-	Command Name

Example:

$PERDSYS,GPIO*67

8 Proprietary NMEA Output Sentences

This sentence is a protocol only for our company. It starts from "$PERD" which shows that it is an original sentence.

ACK – Output the Command Reception Check Format:

$PERDACK	,	command	,	sequence	,	subcommand	*hh	<CR>	<LF>
		1		2					

Num	Contents	Range	Default	Remark
1	command	-	-	First field of received command
2	sequence	-1 to 255	0	The number of times successful for the reception. It is added 1 whenever it succeeds in command reception, and 0 to 255 is repeated. When command reception is failed, -1 is returned.
3	subcommand	-	-	Second token of input command

Example:

$PERDACK,PERDAPI,-1,PPS*72

PERDAPI,PPS command input is failed.

Notes:

- As for the command, check sum must be effective before ACK is sent.

9 CR – eRide GNSS Core Library Interface

CRW(TPS1) – Output Time Transfer Info per Second (Date and leap second) △4△5 Format:

$PERDCRW	,	TPS1	,	Date & Time	,	time status	,	update date	,	present LS	,
		1		2		3		4		5	

future LS	,	pps status	*hh	<CR>	<LF>
6		7			

Num	Contents	Range	Default	Remark
1	TPS1	-	-	Command Name
2	Date & Time	14-byte fixed length	19990822000000	Present date and time year, month, day, hour, minute, second
3	time status	0 to 2 (1byte)	0	Present time status of output sentence 0: RTC 1: GPS (GT-87 doesn't apply leap second or has only default leap second) 2: UTC (GT-87 has confirmed leap second and applies it.)
4	update date	14-byte fixed length	00000000000000	Leap second update schedule year, month, day, hour, minute, second This date indicates zero when no leap second update schedule.
5	present LS	-31 to +32 (3byte)	+16 △5	Present leap second received from satellites
6	future LS	-31 to +32 (3byte)	+00	Future leap second received from satellites
7	pps status △4	0 to 3 (1byte)	0	Present pps is synced with the follow. 0:RTC 1:GPS 2:UTC(USNO) 3:UTC(SU)

Example:

$PERDCRW,TPS1,20120303062722,2,20120701000000,+15,+16,2*09

Present date: 2012/03/03 06:27:22
Time status: present time of output sentence is sync with UTC.
Leap second update schedule: 2012/7/1 00:00:00
Current leap second: +15
Future leap second: +16

Pps status: present pps is sync with UTC (USNO)

Notes:

- This command is output every second.
- Present LS is current leap second. This is updated in the timing of leap second update schedule.
- $PERDAPI,CROUT,W,0*4F stops outputting this command.
- Update data indicate zero when no update schedule.

Restriction:

About time status

alignment	Before first fix	After first fix	After taking confirmed leap second
GPS	RTC	GPS	GPS
UTC(USNO)	RTC	GPS	UTC
UTC(SU)	RTC	GPS	UTC

About leap second which is used to adjust output time

alignment	Before first fix	After first fix	After taking confirmed leap second
GPS	0	0	0
UTC(USNO)	Default leap second	Default leap second	confirmed leap second
UTC(SU)	Default leap second	Default leap second	confirmed leap second

GT-87 takes confirmed leap second when GT-87 takes UTC (USNO) parameter which is broadcasted from GPS or takes time both GPS and GLONASS.

CRX(TPS2) – Output Time Transfer Info per Second (PPS) Δ4 Format:

$PERDCRX	,	TPS2	,	pps status	,	pps mode	,	pps period	,	pulse width	,	cable delay
		1		2		3		4		5		6

,	polarity	,	pps type	,	estimated accuracy	,	Sawtooth	,	pps acc threshold	*hh	<CR>	<LF>
	7		8		9		10		11			

Num	Contents	Range	Default	Remark
1	TPS2	-	-	Command Name
2	pps status	0 to 1 (1byte)	0	Output status of 1PPS 0: 1PPS OFF 1: 1PPS ON
3	pps mode	0 to 4 (1byte)	4	PPS mode 0: Always stop 1: Always output 2: Output only during positioning more than one satellite 3: Output only when TRAIM is OK 4: Output only when estimated accuracy is less than estimated accuracy threshold
4	period	0 to 1 (1byte)	0	1PPS output interval 0: 1PPS (A pulse is output per second) 1: PP2S (A pulse is output per two seconds)
5	pulse width	001 to 500 (3byte)	200	1PPS pulse width (ms)
6	cable delay	-100000 to +100000 (7byte)	+000000	1PPS cable delay (ns)
7	polarity	0 to 1 (1byte)	0	0 : rising edge 1 : falling edge
8	pps type	0 to 1 (1byte)	0	0 : LEGACY PPS 1 : GCLK PPS
9	estimated accuracy	0000 to 9999 (4byte)	0	1PPS estimated accuracy. (ns)
10	Sawtooth	-1.760 to +1.760 (6byte)	+0.000	Sawtooth correction (ns)
11	pps acc threshold	0000 0005 to 9999 (4byte)	1000	PPS estimated accuracy threshold (ns) This threshold is used for pps mode 4. 0 means that this threshold is not used.

$PERDCRX,TPS2,1,2,0,200,+001000,0,0,0005,+0.000,1000*29

PPS status: PPS ON (1)
PPS mode: during on fix (2)
PPS period: 1PPS (0)
PPS pulse width: 200ms
PPS cable delay: +1000ns
Polarity: rising edge
Type: LEGACY PPS
Estimated accuracy: 5ns
Sawtooth: +0.000ns
PPS estimated accuracy threshold: 1us

Notes:

- This command is output every second.
- $PERDAPI,CROUT,X,0*40 stops outputting this command.
- Output Values of period, pulse width, polarity are switched by pps type (LEGACY or GCLK).
- PPS estimated accuracy means estimated difference between PPS of GT-87 and GPS, UTC (USNO) or UTC (SU) timing which user sets by TIMEALIGN command. This is not guarantee value, but user can use this value to get a rough idea.
- Sawtooth means correction value under the resolution of GT-87, that is, about 3.5 ns.
- Sawtooth value is applied to prior to the one second PPS.

Corrected PPS [t-1] = output PPS [t-1] + Sawtooth value [t]

CRY(TPS3) – Output Time Transfer Info per Second (Survey & TRAIM) Format:

$PERDCRY	,	TPS3	,	pos mode	,	sigma	,	sigma threshold	,	time	,	time threshold	,
		1		2		3		4		5		6	

TRAIM solution	,	TRAIM status	,	Removed SVs	,	Receiver status	*hh	<CR>	<LF>
7		8		9		10			

Num	Contents	Range	Default	Remark
1	TPS3	-	-	Command Name
2	pos mode	0 to 3 (1byte)	2	Positioning mode 0: Normal 1: Survey mode (re-calculation for every power supply OFF/ON) 2: Survey mode(calculation continuously before and after power supply OFF/ON) 3: Position-hold mode
3	sigma	0000 to 1000 (4byte)	1000	Current variance value of survey position (m)
4	sigma threshold	000 to 255 (3byte)	000 △3	Sigma threshold (m) which changes automatically to position-fixed.
5	time	0 to 999999 (6byte)	000000	Current update times of survey position (sec). It is not updated at the time of positioning interruption.
6	time threshold	0 to 604800 (6byte)	028800 △3	Time threshold (sec) which changes automatically to position-fixed.
7	TRAIM solution	0 to 2 (1byte)	2	TRAIM solution 0: OK 1: ALARM 2: UNKNOWN, due to a. alarm threshold set too low b. insufficient satellites being tracked
8	TRAIM status	0 to 2 (1byte)	2	TRAIM status 0: detection and isolation possible 1: detection only possible 2: neither possible
9	removed SV	0 to 3 (2byte)	00	number of the removed satellite by TRAIM
10	Receiver status △3	10byte	0x00000000	Reserve field

$PERDCRY,TPS3,2,0003,001,002205,086400,0,0,00,0x00000000*68

Positioning mode: Survey mode (calculation continuously) (2)
Survey sigma: 3 [m]
Survey sigma threshold: 1 [m]
Survey time: 2205 [seconds]
Survey time threshold: 86400 [seconds]
TRAIM solution: OK (0)
TRAIM status: OK (0)
Removed SVs: 0
Receiver status: 0x00000000

Notes:

- This command is output every second.
- $PERDAPI,CROUT,Y,0*41 stops outputting this command.

CRZ (TPS4) – Output Time Transfer Info per Second (FREQUENCY) Δ3 Format:

$PERDCRZ	,	TPS4	,	freq mode	,	Freq status	,	GCLK accuracy	,	e	,	de	,
		1		2		3		4		5		6	

lock cnt	,	lockoff cnt	,	reserve	,	IDtag	GCLK setting 1	,	GCLK setting 2	*hh	<CR>	<LF>
7		8		9		10	11		12			

Num	Contents	Range	Default	Remark
1	TPS4	-	-	Command Name
2	freq mode	1 to 6 (1byte)	1	1: warm up 2: lock 3: hold over 4: free run 5: coarse mode 6: fine mode
3	Freq status	0 or 1 (1byte)	0	0: Not output 1: Output
4	GCLK accuracy	0 or 1 (1byte)	0	0: Not accurate 1: GCLK PPS and GCLK frequency are accurate
5	e	-999999 to +999999 (7byte)	-	Phase delay between LEGACY and GCLK PPS (no dimensional)
6	de	-999999 to +999999 (7byte)	-	Amount of change of phase delay (no dimensional)
7	lock cnt	0 to 999999 (7byte)	-	Duration time of Lock (sec)
8	lockoff cnt	0 to 999999 (7byte)	-	Duration time of holdover/free run (sec)
9	reserve	0x00 to 0xFF (6byte)	-	Reserve field
10	IDtag	(6byte)	-	Product name and last two digits of product version In case of GT-8777 of ” 4850466003” ➔ 8777 + 03 = 877703 In case of GT-87 of ” 4850466005” ➔ 8700 + 05 = 870005
11	GCLK setting 1	(4byte)	-	Reserve field
12	GCLK setting 2	(4byte)	-	Reserve field

$PERDCRZ,TPS4,1,1,0,+000000,+000000,+000000,+000000,000000,000000,0x15,0000*57
Freq mode: warm up
Freq status: output
GCLK accuracy: accurate

Notes:

- This command is output every second.
- $PERDAPI,CROUT,Z,0*42 stops outputting this command.

CRM – Measurement Data of GPS

Format:

$PERDCRM	,	time	,	sennum	,	maxsen	,	system	,	svid	,	reserve
		1		2		3		4		5		6

snr	,	adr	,	doppfreq	,	pseudorange	*hh	<CR>	<LF>
7		8		9		10			

Num	Contents	Range	Default	Remark
1	time	0 to 604799	-	GPS time of week
2	sennum	1 to 32	-	Sentence number
3	maxsen	1 to 32	-	Maximum number of sentences
4	system	1	-	GNSS system ID (1=GPS)
5	svid	1 to 99	-	Satellite number
6	reserve	1 to 3	-	Reserve field
7	snr	0 to 55	-	Signal to Noise Ration [dB-Hz]
8	adr	32bit	-	Accumulated Doppler Range [Cycles, LSB=-6]
9	doppfreq	32bit	-	Doppler Frequency [meters/sec, LSB=-12]
10	pseudorange	32bit	-	Pseudrange [meters, LSB=-6]

Example:

$PERDCRM,467055,9,10,1,18,2,40,251470,-225117,1630912949*4C

Notes:

- This sentence will be output as a set once per second and will contain measurements for all GPS systems.
- To output this sentence, please input "$PERDAPI,CROUT,M,1*54" when baud rate is 115200bps.

CRN – Navigation Data

Format:

$PERDCRN	,	system	,	svid	,	subframe data	*hh	<CR>	<LF>
		1		2		3			

Num	Contents	Range	Default	Remark
1	system	1	-	GNSS system ID (1=GPS)
2	svid	1 to 99	-	Satellite number
3	subframe data	10 words (60 strings)	-	Subframe data no parirt included

Example:

$PERDCRN,1,7,8B0B349809AC00424A2471C5FF9F27BB10C82EB5884CC987FFA50C0BF2A8*0C

Notes:

- For each GPS satellite decoding data, this string is output once every 6 seconds.
- For GPS, the subframe field is a hexadecimal representation of all 10 words of a subframe.
- If a word was not decoded or contained a parity error, the six characters associated with that word will be reported as "------".
- To output this sentence, please input "$PERDAPI,CROUT,N,1*57" when baud rate is 115200bps.

SYS – Answer of PVT System

7.3.1 ERSION- Software Version

Format:

$PERDSYS	,	VERSION	,	device	,	version	,	reserve1	,	reserve2	*hh	<CR>	<LF>
		1		2		3		4		5			

Num	Contents	Range	Default	Remark
1	VERSION	-	-	Command Name
2	device	-	-	Device Name
3	version	-	-	Version number
4	reserve1	-	-	Reserve field
5	reserve2	-	-	Reserve field

Example:

$PERDSYS,VERSION,OPUS7_SFLASH_ES2_64P,ENP622A1226410F,QUERY,N/A*1A

Notes:

- Character string of the device and version is free format.

GPIO- General Purpose Input/output Format:

$PERDSYS	,	GPIO	,	state	*hh	<CR>	<LF>
		1		2			

Num	Contents	Range	Default	Remark
1	GPIO	-	-	Command Name
2	state	H or L	-	GPIO state (H:High , L:Low)

Example:

$PERDSYS,GPIO,HHHHLLLL*4B

Notes:

- This first character represents GPIO 0 and the last character represents GPIO 8.

FIXSESSION- Fix Session ▵1 Format:

$PERDSYS	,	FIXSESSION	,	reserve1	[,	reserve2	,	reserve3]	*hh	<CR>	<LF>
		1		2		3		4			

Num	Contents	Range	Default	Remark
1	FIXSESSION	-	-	Command Name
2	reserve1	-	-	reserve field
3	reserve2	-	-	reserve field
4	reserve3	-	-	reserve field

Example:

$PERDSYS,FIXSESSION,ON,19015,19.015*7C

Notes:

- This string is sent when certain events occur. This is for *eRide* use only.

ANTSEL- Antenna selecting ▵1 Format:

$PERDSYS	,	ANTSEL	,	reserve1	,	reserve2	*hh	<CR>	<LF>
		1		2		3			

Num	Contents	Range	Default	Remark
1	ANTSEL	-	-	Command Name
2	reserve1	-	-	reserve field
3	reserve2	-	-	reserve field

Example:

$PERDSYS,ANTSEL,FORCE1L,1LOW*32

Notes:

- This string is sent when certain events occur. This is for *eRide* use only.

BBRAM - Battery Backup Random Access Memory ▵1 Format:

$PERDSYS	,	BBRAM	,	reserve1	[,	reserve2]	*hh	<CR>	<LF>
		1		2		3			

Num	Contents	Range	Default	Remark
1	BBRAM	-	-	Command Name
2	reserve1	-	-	reserve field
3	reserve2	-	-	reserve field

Example:

$PERDSYS,BBRAM,PASS*15

Notes:

- This string is sent when certain events occur. This is for *eRide* use only.

MSG – Event Driven Message ▵1 Format:

$PERDMSG	,	key	[,	string]	*hh	<CR>	<LF>
		1		2			

Num	Contents	Range	Default	Remark
1	key	-	-	Alphanumeric event indicator
2	string	-	-	Description of event

Example:

$PERDMSG,1A*06

Notes:

- This string is sent when certain events occur. Some strings are for *eRide* use only and contain only an alphanumeric key. Others provide user feedback and contain description of the event.

10 Backup of the Receiver Parameters (for BBRAM) △4

The parameters which this receiver has backed up are shown below.

Chart. Backup of the receiver parameter

CONTENTS	PARAMETER	HOT	WARM	COLD	FACTORY	POWER OFF/ON
Present time	Date & Time	YES	YES	YES	NO	YES
	Millennium	YES	YES	YES	NO	YES
Receiver's present position	Latitude	YES	YES	YES	NO	YES
	Longitude	YES	YES	YES	NO	YES
	Altitude	YES	YES	YES	NO	YES
Receiver's hold position[*1]	Latitude	YES	YES	YES	NO	YES[*3]
	Longitude	YES	YES	YES	NO	YES[*3]
	Altitude	YES	YES	YES	NO	YES[*3]
Ephemeris	Ephemeris data	YES	NO	NO	NO	YES[*2]
Almanac	Almanac data	YES	YES	NO	NO	YES

Chart. Backup of the receiver parameter of command

COMMAND NAME	PARAMETER	HOT	WARM	COLD	FACTORY	POWER OFF/ON
GNSS	GNSS setting	YES	YES	YES	NO	YES
FIXMASK	FIXMASK setting	YES	YES	YES	NO	YES
PPS	PPS setting	YES	YES	YES	NO	YES
TIMEZONE	GMT setting	YES	YES	YES	NO	YES
SURVEY	position mode	YES	YES	YES	NO	YES
	Sigma threshold for survey	YES	YES	YES	NO	YES
	Time threshold for survey	YES	YES	YES	NO	YES
	Current sigma for survey	YES[*3]	YES[*3]	YES[*3]	NO	YES[*3]
	Current time for survey	YES[*3]	YES[*3]	YES[*3]	NO	YES[*3]
FREQ	FREQ setting	YES	YES	YES	NO	YES
CROUT	CROUT setting	YES	YES	YES	NO	YES
DEFLS	Default leap sec	YES	YES	YES	NO	YES

TIMEALIGN	Time alignment	YES	YES	YES	NO	YES
FLASHBACKUP	Backup in flash	YES	YES	YES	YES	YES

Chart. Backup of the configure parameter of command

COMMAND NAME	PARAMETER	HOT	WARM	COLD	FACTORY	POWER OFF/ON
UART1	Baud rate of UART1	YES	YES	YES	YES	NO
NMEAOUT	NMEA output interval	YES	YES	YES	YES	NO

[*1] The position calculated by position survey mode or input by $PERDAPI,SURVEY,3. [*2] There is a time limitation (4 hours).
[*3] CSS (continues survey) mode or TO (time only) mode only

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