

FEI-Zyfer

User's RS-232 Protocol

Document 380-8020

For the Use With
NanoSync Model 380
and
Portable Clock Model 382

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The communication protocol consists of command sentences where each command can be queried for a response or the command can be set up for an unsolicited response. Each message sentence is encased between ASCII '$' and '*' character. After the '*' delimiter, there is a 2-byte hexadecimal ASCII checksum followed by a carriage return and a linefeed. The checksum is calculated by X-ORing each successive byte in the message sentence between but not including the '$' and '*' characters. The checksum is not needed for sending commands to the unit. However, the unit will always include checksums in its sentences sent back through the communications port to the user.

Unsolicited Response

Several commands can have an unsolicited flag enabled. By enabling the unsolicited flag, the command will respond accordingly depending on when new information is available. Most of the unsolicited responses are driven by the GPS engine. Use the **UNSL** command to enable or disable unsolicited flag for a particular command. See the **UNSL** command for more information.

Queried Response

Queried responses are generated by sending the specified message to the user port. Each message has its own response characteristics. Several messages can be queried at one time for multiple responses. If for some reason a message sent has not been responded to after five seconds, it can be assumed that the message was not received by the unit.

Modem Operation

As of now the RS-232 protocol does not support modem operation. Nevertheless, you may connect a modem that has been setup to answer an incoming call. Please note that if unsolicited messages are enabled while the modem is waiting for a call, the modem may disconnect the call during the connection process. Thus, using the unit in a query mode is recommended.

Command Compatibily

The commands listed and described in this document are valid for most application code firmware versions. When commands are added to the application code, the code version is changed. Some commands are not available in earlier code versions. To update the code to the latest version, contact FEI-Zyfer technical support.

Programming Considerations

The communication protocol was designed for both terminal input and computer input. For this reason, an ASCII command set is used. Be aware that there are finite sized send and receive buffers in the unit (about 2048 bytes). If the buffer should get full, all remaining commands sent to the unit will be truncated. The default baud rate is 19200.

The following listing segment illustrates the decoding of the RS-232 command protocol. The target system is Windows 3.11 using Microsoft Visual C++ and the standard Windows communication interface. This is only a listing segment to illustrate the technique of building a command. It is not intended as a solution to a communication protocol driver.

```
////////////////////////////////////////////////////////////////////////////
// the following definitions define a typical command building sequence

#define STSEARCHING    1       // Searching for SOM
#define STGETDATA      2       // retrieving data
#define STCHECKSUM1    3       // getting checksum character #1 (MSNibble)
#define STCHECKSUM2    4       // getting checksum character #2 (LSN)

static char State = STSEARCHING;      // default - searching
static unsigned char Checksum = 0;    // default
static unsigned char GPSChecksum;     //

static char Command[300];             // command buffer
static int CmdI;                      // command index

////////////////////////////////////////////////////////////////////////////
// This function resides in the main frame as a 100 ms timer. Hence, the
// RS-232 communications is in polling mode.
void CMainFrame::OnTimer(UINT nIDEvent)
{
    char s[550];
    char c;
    int len,i;
    COMSTAT ComStat;

    ////////////////////////////////////////////////////////////////////////
    // Read characters from a buffer
    if((len = ReadComm(g_Sio.idComDev,s,512)) <= 0)
    {
        GetCommError(g_Sio.idComDev,&ComStat); // Clear the error MS says so.

        if(len == 0) return;   // no characters, then just leave
        len = abs(len);
    }


    ////////////////////////////////////////////////////////////////////////
    // Go through buffer and build a command
    for (i = 0; i < len; i++)
    {
        c = s[i];  // get character from our temporary buffer
        switch(State)
        {
            ////////////////////////////////////////////////////////////////
            case STSEARCHING:
                if(c == '$')
                {
                    State = STGETDATA;
                    Checksum = 0;
                    CmdI = 0;          // reset command index to 0
                }
            break;
```

```
        ////////////////////////////////////////////////////////////////
        case STGETDATA:
            if(c != '*')
            {
                Checksum ^= c;
                Command[CmdI++] = c;      // save data into command
                if(CmdI >= 256) State = STSEARCHING; // No more than 256
            }
            else
                State = STCHECKSUM1;
        break;

        ////////////////////////////////////////////////////////////////
        case  STCHECKSUM1:
            GPSChecksum = (c - '0');      // get msb of checksum
            if(GPSChecksum > 9) GPSChecksum -= ('A' - '9' - 1);
            GPSChecksum = GPSChecksum << 4;
            State = STCHECKSUM2;
        break;

        ////////////////////////////////////////////////////////////////
        case  STCHECKSUM2:

            c = (c - '0');         // get lsb of checksum
            if(c > 9) c -= ('A' - '9' - 1);
            GPSChecksum |= c;
            // Check checksum and process messages if CS is OK
            if(Checksum = GPSChecksum)
            {
                Command[CmdI] = '\0';

                // This is where you would parse the command string
                ProcessCommand(Command);  // process the command string
            }
            else
            {
                // Checksum error handling here
            }
            State = STSEARCHING;
        break;

    }   // end switch
}
CMDIFrameWnd::OnTimer(nIDEvent);  // MS VC++ stuff
```


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Alarm Register (output) ALRM

Query Command: $ALRM*<cr|lf>

Resonse: $ALRM,abcd*<cs|cr|lf>

Description: Reports the Alarm register status information. The ASCII characters in each field are a hexadecimal representation of the bits in the register.

Fields:

Symbol	Range	Description	
		Bit	Alarm status byte 1 hex bit definition if set
a	0 to F	0	Not used
		1	Not used
		2	Not used
		3	Not used
b	0 to F	0	TCXO DAC limit error
		1	No internal oscillator output
		2	Not used
		3	Not used
		Bit	Alarm status byte 2 hex bit definition if set
c	0 to F	0	FPGA error
		1	Non-Volatile parameters write error
		2	GPS communication error
		3	DAC limit error (Upper limit error: 62260) (Lower limit error: 3276)
d	0 to F	0	No satellites tracked > 30 minutes
		1	Antenna fault
		2	TFOM > 4
		3	RAM error

Non-Volatile: No

Alarm Bit Description:

TCXO DAC limit error	Sets when the internal GPS engine clock frequency control is near or at its maximum or minimum setting.
No internal oscillator output	Sets when the internal oscillator has failed.
No satellites tracked > 30 min	Sets when the GPS engine has not been able to track any satellites for more than 30 minutes.
Antenna fault	This fault is set if the antenna cable is either shorted or open.
TFOM > 4	This bit is set when the Time Figure of Merit is greater than 4 (time error is greater than 1 microsecond.
RAM error	The internal RAM is tested at power-up and this bit, when set, indicates that test failed.
FPGA error	The Field Programmable Gate Array (FPGA) device is downloaded at power-up. If this is unsuccessful, this bit will be set.
Nvparams write error	The non-volatile memory is provided for the storage of setup information. This bit is set if a write to the NV memory is unsuccessful.
GPS communication. error	This bit will set if communication with the GPS engine should fail.
DAC limit error	The DAC setting is close to or at its maximum or minimum setting limit. The DAC controls the frequency of the reference oscillator.

Antenna cable delay value (input/output) ANTD

Setup Command: $ANTD,N*<cr|lf>

Query Command: $ANTD*<cr|lf>

Resonse: $ANTD,N*<cs|cr|lf>

Description: Allows the user to read or set the GPS antenna cable delay compensation. This command parameter will compensate for the delay due to varying antenna cable lengths. The parameter is in nanoseconds and the resolution is 1 ns. Typical antenna delay can be approximated to be about 1.22 ns per foot or 4.00 ns per meter when using cable such as Belden 9104. If the antenna cable is 50 feet (15 meters) in length, the Antenna Delay should be set for 62 ns.

Positive values cause the timing outputs to occur sooner in time, and negative values cause the outputs to occur later in time.

Note: Refer to User's Manual Section 2 for additional cable delay information.

Fields:

Symbol	Range	Description
N	±00000 to ±99999	Nanoseconds delay (offset)

Example: $ANTD,234*<cr|lf>

Resonse: $ANTD,+00234*< cs|cr|lf>

This example the antenna cable delay is set to 234 nanoseconds.

Non-Volatile: Yes

Factory Default: 0 ns

DAC value (output) DACV

Query Command: $DACV*<cr|lf>

Resonse: $DACV,N*<cs|cr|lf>

Description: The DAC value is the electronic frequency control setting for the reference oscillator. It is provided for reference only. The unit will automatically control the DAC value to remove frequency and time errors. A DAC value of 32768 represents the center control voltage for the oscillator. As the oscillator ages the DAC value will gradually (over years) migrate to one end or the other of its range.

Description: Reports the DAC value.

Fields:

Symbol	Range	Description
N	0 - 65535	DAC value
		Frequency/DAC step resolution: 1.2E-11 minimum 1.8E-11 maximum

Non-Volatile: Yes

Drift (Oscillator Aging) DRFT

Query Command: $DRFT*<cr|lf>

Resonse: $DRFT,NEee*<cs|cr|lf>

Description: Reports the estimated 24-hour frequency drift (aging) of the oscillator. The data is available 2 hours and 15 minutes after the last power-up and is updated every 10 seconds (assuming normal satellite tracking). Since the estimate is an average value, it improves with time. The drift estimate is used when the unit operates in the Holdover mode to compensate the frequency and timing output(s) for the natural oscillator drift. Only after 8 hours of normal operation is the data used.

Fields:

Symbol	Range	Description
N	-9.99E-99 to 9.9E-99	Estimated average frequency error

Example: $DRFT,3.21E-11*

During normal operation, this example indicates that the unit's oscillator has a estimated frequency drift rate (aging) of 3.21E-11. The value is updated every 10 seconds.

During Holdover, this example indicates the last drift estimate. (The value is constant).

Non-Volatile: Not applicable

Estimator Frequency Error, last value (output) EFER

Query Command: $EFER*<cr|lf>

Resonse: $EFER,NEee*<cs|cr|lf>

Description: Valid only during Time Lock. Reports the estimated running average of the frequency offset between the internal oscillator and GPS. The average is the exponential average with an equivalent averaging time of 24 hours. The value is updated every 10 seconds when GPS data is available (Time Locked and Recovering modes). Since this output is an average value, it will be inaccurate during the first few hours after power-up and disciplining.

Fields:

Symbol	Range	Description
N	-9.99E-99 to 9.9E-99	Estimated average frequency error

Non-Volatile: No

Estimator Standard Deviation (output) ESSD

Query Command: $ESSD*<cr|lf>

Resonse: $ESSD,NEee*<cs|cr|lf>

Description: Reports the most recently calculated Time Deviation (TDEV), of the oscillator versus GPS. The TDEV is calculated with an observation time equal to the current Time/Frequency control loop averaging time. TDEV is defined in IEEE Standard 1139 and has universally been adopted in T1/E1 wireline synchronization. Typically, the TDEV value is in the order of 20 ns for instruments configured ovenized quartz oscillators. In instruments configured with a TCXO, the TDEV value is significantly higher. The value is updated once per every time loop constant. The time loop constant varies from 25 to 2500 seconds for ovenized oscillators, depending on the error corrections being applied.

Fields:

Symbol	Range	Description
N	0.00E+00 to 9.99E-99	Time deviation (TDEV)

Non-Volatile: Not applicable

Factory Reset (input) FACTORYRESET

Setup Command: $FACTORYRESET*<cr|lf>

Resonse: None

Description: This command causes the unit to set the non-volatile memory with factory-preset values and then initiates a boot reset. This will cause the unit to undergo an initialization that is similar to a power-up initialization. During that initialization, the preset values are installed. This operation is performed before the unit is shipped from the factory and would not normally be required once installed.

CAUTION - this operation will affect normal operation, including disruption of any or all of the following: GPS satellite tracking, reference oscillator frequency, 1 PPS output timing and status information. The table below lists the factory presets.

Register(s)	Factory Default Setting
Antenna Position	Same as previous position
Position Mode	Position Averaging (Survey)
Time Source	UTC time
Local Time Offset	0 hrs, 0 min
1PPS /1PP2S Output Pulse Rate	1PPS
1PPS /1PP2S Output Pulse Width	2 ms
1PPS /1PP2S Output Pulse Enable/Disable	Disabled during Warm-Up
1PPS /1PP2S Output Pulse Polarity	Normal, rising (+) edge on-time
1PPS /1PP2S Output Pulse Offset	0 ns
Antenna Cable Delay Compensation	0 ns
Satellite Tracking Enable/Disable Status	All satellites enabled to be tracked
Satellite Tracking Elevation Mask Angle	10°

Non-Volatile: Set to the above factory presets

Note: This command initializes the same default settings as command PRESET1. For alternate default settings, refer to command PRESET2.

Frequency Output Select (input/output) FSEL

Setup Command: $FSEL,F*<cr|lf>

Query Command: $FSEL*<cr|lf>

Resonse: $FSEL,F*<cs|cr|lf>

Description: Allows the user to read and set the configuration of the programmable frequency generator output port on the Pulse Rate/Frequency option board (Option 1 and 2). This output is available on Output 1 only. The PCTL command should be set to enable this output as required (Output 1 control).

Fields:

Symbol	Value	Description
F	1 - 250	Frequency selection (Hz)

Non-Volatile: Yes

Factory Default: 250

Compatibility: NanoSync with Pulse Rate/Frequency Output Option 1 or 2

Holdover Integrity (output) HINT

Query Command: $HINT*<cr|lf>

Resonse: $HINT,HF,R1,R2,R3,R4*<cs|cr|lf>

Description: Reports the holdover integrity flag and reason status flags that indicate why the unit is in holdover.

Fields:

Symbol	Range	Description
HF	0/1	When set, holdover parameters computed*
R1	0/1	Holdover flag 1 - when set, TCXO PLL not locked
R2	0/1	Holdover flag 2 - when set, No GPS data
R3	0/1	Holdover flag 3 - when set, Raw fix bad
R4	0/1	holdover flag 4 - when set, Bias data bad
		*In order for this flag to be set, a minimum holdover parameter computation time of 8 hours is required.

Non-Volatile: Not applicable

GPS / UTC Time Difference (output) LEAP

Query Command: $LEAP*<cr|lf>

Resonse: $LEAP,P,F*<cs|cr|lf>

Description: Reports the present and future difference in seconds between GPS time and UTC time.

Fields:

Symbol	Range	Description
P	00 to 99	Present difference in seconds between GPS and UTC time
F	00 to 99	Future difference in seconds between GPS and UTC time Note: If the Present and Future difference value is the same, then no Leap second event is pending. If the difference value is greater or smaller, then a Leap second event is pending.

Non-Volatile: Yes with conditions. The unit stores the current leap second count in non-volatile memory. It will be loaded at power-up if no potential leap second boundary date was crossed while the power was off. A leap second can occur 4 times per year on a leap second boundary date. The unit will store the current time in non-volatile memory every 3 hours. At power-up, the time stored is compared with the date received from the satellites to determine if a leap second boundary date was crossed. If a boundary was not crossed, the leap second count is still valid.

Factory Default: 00 Present Leap Seconds and 00 Future Leap Seconds

Elevation Mask Angle (input/output) MANG

Setup Command: $MANG,N*<cr|lf>

Query Command: $MANG*<cr|lf>

Resonse: $MANG,N*<cs|cr|lf>

Description: Sets and reports the GPS elevation mask angle. Satellites that fall below the elevation mask angle are not used. The recommended value for the mask angle is 10 degrees. Raising the elevation mask angle will force the receiver to use satellites that are higher in the sky. This can reduce inference with obstacles such as buildings. Interference from such obstacles may induce multi-path problems. It is not recommended to set the mask angle above 15 degrees.

Fields:

Symbol	Range	Description
N	5 - 90	Mask angle in degrees

Non-Volatile: Yes

Factory Default: 10 degrees

Manufacturer Identification (output) MANI

Query Command: $MANI*<cr|lf>

Resonse: $MANI,ZYFER*<cs|cr|lf>

Description: Reports the manufacturer identification for the unit.

Not Time-locked Counter (output) NTLC

Query Command: $NTLC*<cr|lf>

Resonse: $NTLC,N*<cs|cr|lf>

Description: Reports the consecutive number of seconds the unit has been out off time-lock or recovering. The 'not-time-locked-count' only increments when the unit is in the holdover or recovery mode. The count resets to 0 when time lock is achieved again.

Fields:

Symbol	Range	Description
N	2^{32}	Number of seconds out of time-lock or recovering.

Non-Volatile: Not applicable

Output Offset (input/output) OFST

Setup Command: $OFST,N*<cr|lf>

Query Command: $OFST*<cr|lf>

Resonse: $OFST,N*<cs|cr|lf>

Description: Allows the user to read or set the offset between the Reference Pulse (1PPS / 1PP2S) output and UTC 1PPS, independently from the antenna cable delay compensation. The parameter is in nanoseconds and the resolution is 1 ns.

Positive values cause the pulse to occur sooner in time, and negative values cause the pulse to occur later in time.

The assumption is made that the unit has been corrected for delays caused by the connected antenna system (see command ANTD for cable delay compensation).

Fields:

Symbol	Range	Description
N	-99999 to +99999	Output offset value in nanoseconds

Example 1: $OFST,500*<cr|lf>

Resonse: $OFST,+00500*< cs|cr|lf>

This example will cause the pulse to occur 500 ns ahead of UTC 1PPS.

Example 2: $OFST,-200*<cr|lf>

Resonse: $OFST,-00200*< cs|cr|lf>

This example will cause the pulse to occur 200 ns behind UTC 1PPS.

Non-Volatile: Yes

Factory Default: 0 ns

Position Average Status (output) PAVG

Setup Command: $PAVG,D,M,H,$D_1$,$M_1$,$H_1$,A*<cr|lf>

Query Command: $PAVG*<cr|lf>

Resonse: $PAVG,D,M,H,$D_1$,$M_1$,$H_1$,A,S*<cs|cr|lf>

Description: This command reports the current latitude, longitude and altitude of the antenna and the averaging sample count. Accurate position is necessary to produce outputs that have been compensated for the effects of Selective Availability (SA). The instrument computes this position.

In the Position Averaging mode (see TRMO command), the unit will average position fixes from the GPS engine for 1 hour (sample count = 3600 seconds). When the averaging period is complete, the unit automatically enters the Known mode.

To operate in the Known mode sooner, the user can use the SPOS command to enter an accurate position. To enter position data, the unit must first be in the Known mode (see TRMO & SPOS commands).

Fields:

Symbol	Range	Description
D	0 - 89	Latitude degrees
M	0.0 - 59.9999	Latitude minutes
H	N or S	Hemisphere
D_1	0 - 179	Longitude degrees
M_1	0.0 - 59.9999	Longitude minutes
H_1	E or W	Hemisphere
A	-400.00 to 18000.00	Altitude in meters
S	000000 to 003600	Number of samples taken

Non-Volatile: Yes (if operating in the Known Position mode)

Output Signal Port Control (input/output) PCTL

Setup Command: $PCTL, S1,S2,S3,S4*<cr|lf>

Query Command: $PCTL*<cr|lf>

Resonse: $PCTL,S1,S2,S3,S4*<cs|cr|lf>

Description: Allows the user to read and setup the output connector control on the Pulse Rate/Frequency option board (Option 1). This command allows the user to control signal outputs 1 through 4 on the multi-pin connector. Each output is selectable to be always OFF, always ON or output disabled (OFF) during Warm-up period.

Fields:

Symbol	Value	Description
S1	0 - 2	Output 1 control (see table below)
S2	0 - 2	Output 2 control (see table below)
S3	0 - 2	Output 3 control (see table below)
S4	0 - 2	Output 4 control (see table below)

Value	Description
0	Always OFF
1	Always ON
2	Output disabled (OFF) during Warm-up

Non-Volatile: Yes

Factory Default: 2

Compatibility: NanoSync with Pulse Rate/Frequency Output Option 1 or 2

Preset to UTC(input) PRESET1

Setup Command: $PRESET1*<cr|lf>

Resonse: None

Description: This command causes the unit to set the non-volatile memory with preset values and then initiates a boot reset. This will cause the unit to undergo an initialization that is similar to a power-up initialization. During that initialization, the preset values are installed.

CAUTION - this operation will affect normal operation, including disruption of any or all of the following: GPS satellite tracking, reference oscillator frequency, 1 PPS output timing and status information. The table below lists the presets.

Register(s)	Default Setting
Antenna Position	Same as previous position
Position Mode	Position Averaging (Survey)
Time Source	UTC time
Local Time Offset	0 hrs, 0 min
1PPS /1PP2S Output Pulse Rate	1PPS
1PPS /1PP2S Output Pulse Width	2 ms
1PPS /1PP2S Output Pulse Enable/Disable	Disabled during Warm-Up
1PPS /1PP2S Output Pulse Polarity	Normal, rising (+) edge on-time
1PPS /1PP2S Output Pulse Offset	0 ns
Antenna Cable Delay Compensation	0 ns
Satellite Tracking Enable/Disable Status	All satellites enabled to be tracked
Satellite Tracking Elevation Mask Angle	10

Factory Default: Yes. (Unless otherwise directed in Acceptance Test Procedure)

Non-Volatile: Yes. Set to the above presets

Note: This command initializes the same default settings as command FACTORYRESET. For alternate default settings, refer to command PRESET2 and PRESET3.

Preset to GPS (input) PRESET2

Setup Command: $PRESET2*<cr|lf>

Resonse: None

Description: This command causes the unit to set the non-volatile memory with preset values and then initiates a boot reset. This will cause the unit to undergo an initialization that is similar to a power-up initialization. During that initialization, the preset values are installed.

CAUTION - this operation will affect normal operation, including disruption of any or all of the following: GPS satellite tracking, reference oscillator frequency, 1 PPS output timing and status information. The table below lists the presets.

Register(s)	Default Setting
Antenna Position	Same as previous position
Position Mode	Position Averaging (Survey)
Time Source	GPS time
Local Time Offset	0 hrs, 0 min
1PPS /1PP2S Output Pulse Rate	1PPS
1PPS /1PP2S Output Pulse Width	1 ms
1PPS /1PP2S Output Pulse Enable/Disable	Enabled during Warm-Up
1PPS /1PP2S Output Pulse Polarity	Normal, rising (+) edge on-time
1PPS /1PP2S Output Pulse Offset	0 ns
Antenna Cable Delay Compensation	0 ns
Satellite Tracking Enable/Disable Status	All satellites enabled to be tracked
Satellite Tracking Elevation Mask Angle	10°

Factory Default: No. (Unless otherwise directed in Acceptance Test Procedure). See PRESET1 or FACTORYRESET for factory default settings.

Non-Volatile: Yes. Set to the above presets

Note: For alternate default settings, refer to command FACTORYRESET, PRESET1 and PRESET3.

Preset to UTC(input) with command integrity check PRESET3

Setup Command: $PRESET3*<cr|lf>

Resonse: None

Description: This command causes the unit to set the non-volatile memory with preset values and then initiates a boot reset. This will cause the unit to undergo an initialization that is similar to a power-up initialization. During that initialization, the preset values are installed.

The preset values installed are the same values as installed with the PRESET1 command. *The only difference between the PRESET1 and PRESET3 is the following:*

Commands will only reply in the affirmative when a command has been accepted. Any invalid command received, or commands with invalid parameters, or command parameters outside of normal range will render a non reply.

CAUTION - this operation will affect normal operation, including disruption of any or all of the following: GPS satellite tracking, reference oscillator frequency, 1 PPS output timing and status information. The table below lists the presets.

Register(s)	Default Setting
Antenna Position	Same as previous position
Position Mode	Position Averaging (Survey)
Time Source	UTC time
Local Time Offset	0 hrs, 0 min
1PPS /1PP2S Output Pulse Rate	1PPS
1PPS /1PP2S Output Pulse Width	2 ms
1PPS /1PP2S Output Pulse Enable/Disable	Disabled during Warm-Up
1PPS /1PP2S Output Pulse Polarity	Normal, rising (+) edge on-time
1PPS /1PP2S Output Pulse Offset	0 ns
Antenna Cable Delay Compensation	0 ns
Satellite Tracking Enable/Disable Status	All satellites enabled to be tracked
Satellite Tracking Elevation Mask Angle	10

Factory Default: Preset1 (Unless otherwise directed in Acceptance Test Procedure). See PRESET1 or FACTORYRESET for factory default settings.

Non-Volatile: Yes. Set to the above presets

Note: This command initializes the same default settings as command FACTORYRESET. For alternate default settings, refer to command PRESET2.

Product ID (output) PRID

Query Command: $PRID*<cr|lf>

Resonse: $PRID,I,P,S*<cs|cr|lf>

Description: Reports the product ID, short string description, and serial number.

Fields:

Symbol	Description
I	Product ID, where: 015 = NanoSync TCXO 016 = NanoSync OCXO
P	Product name (ASCII). See N symbol
S	9-Digit serial number

Example 1: $PRID,016,NanoSync OCXO,380001000*<cs|cr|lf>

This example indicates a NanoSync with an OCXO that has S/N 380001000

Example 2: $PRID,016,NanoSync OCXO,000000123*<cs|cr|lf>

This example indicates a NanoSync with an OCXO that has S/N 123

Non-Volatile: Not applicable

Pulse Enable Control (input/output) PULE

Setup Command: $PULE,N*<cr|lf>

Query Command: $PULE*<cr|lf>

Resonse: $PULE,N*<cs|cr|lf>

Description: Allows the user to read the output enable status, and enable/disable the 1PPS / 1PP2S output during Warm-Up.

Fields:

Symbol	Value	Description
N	0	Pulse output disabled during Warm-Up
	1	Pulse output always enabled

Non-Volatile: Yes

Factory Default: Always enabled

Pulse Polarity Control (input/output) PULP

Setup Command: $PULP,N*<cr|lf>

Query Command: $PULP*<cr|lf>

Resonse: $PULP,N*<cs|cr|lf>

Description: Allows the user to read and select the polarity of the "on-time" edge of the 1PPS / 1PP2S output.

Fields:

Symbol	Value	Description
N	+	Rising (leading) edge of the output pulse "on-time" with UTC 1 PPS.
	-	Falling (leading) edge of the output pulse "on-time" with UTC 1 PPS.

Non-Volatile: Yes

Factory Default: Rising edge "on-time"

Pulse Rate Control (input/output) PULR

Setup Command: $PULR,N*<cr|lf>

Query Command: $PULR*<cr|lf>

Resonse: $PULR,N*<cs|cr|lf>

Description: Allows the user to read and select the rate of the 1PPS / 1PP2S output.

Fields:

Symbol	Value	Description
N	1	One pulse every second (1PPS)
	2	One pulse every even second (1PP2S)

Non-Volatile: Yes

Factory Default: 1 PPS

Pulse Width Control (input/output) PULW

Setup Command: $PULW,N*<cr|lf>

Query Command: $PULW*<cr|lf>

Resonse: $PULW,N*<cs|cr|lf>

Description: Allows the user to read and select the pulse width of the 1PPS / 1PP2S output.

Fields:

Symbol	Value	Description
N	-2	Pulse width is 20 microseconds
	-1	Pulse width is 10 microseconds
	+1 to +999	Pulse width in milliseconds*
		*Note: "+" not require in write command

Non-Volatile: Yes

Factory Default: 2 milliseconds

Almanac Data (output) PUTD

Query Command: $UNSL, PUTD, 1*<cr|lf>

Resonse: $PUTD,82,S,W,B1,B2,B3,B4,B5,B6,B7,B8,B9,B10,B11,B12,
B13,B14,B15,B16,B17,B18,B19,B20,B21,B22,B23,B24,B25,
B26,B27,B28,B29,B30*<cs|cr|lf>

Description: Continuously retrieves the Almanac data for a Specific SV ID.

Fields:

Symbol	Range	Description
S	1 - 32	Specific SV ID
W	0 - 1024	GPS week number
B1-30	0 - 255	Almanac Data for a is defined as follows: Contains 240 bits of sub-frame 1, 2, or 3 data as defined in word 1 to word 10 of the 30-bit word (excluding the 6-bit parity). Byte 1, 2, 3: contains 24 bits of word 1 Byte 4, 5, 6: contains 24 bits of word 2 Byte 7, 8, 9: contains 24 bits of word 3 Byte 10, 11, 12: contains 24 bits of word 4 Byte 13, 14, 15: contains 24 bits of word 5 Byte 16, 17, 18: contains 24 bits of word 6 Byte 19, 20, 21: contains 24 bits of word 7 Byte 22, 23, 24: contains 24 bits of word 8 Byte 25, 26, 27: contains 24 bits of word 9 Byte 28, 29, 30: contains 24 bits of word 10 Refer to the GPS-ICD-200 for further details.

Non-Volatile: Not applicable

Factory Default: Portable Clock Model 382: Unsolicited at application of input power.
NanoSync model 380: User selected.

Report Satellite Almanac Health (output) RSAH

Query Command: $RSAH*<cr|lf>

Resonse: $RSAH,NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN*<cs|cr|lf>

Description: Reports the health of all 32 satellites. This information is obtained from the broadcast almanac.

Fields:

Symbol	Range	Description
N	0 or 1	Satellite status, where: 0 = Unhealthy 1 = Healthy

Non-Volatile: Not applicable

Rate Output Select (input/output) RSEL

Setup Command: $RSEL,R*<cr|lf>

Query Command: $RSEL*<cr|lf>

Resonse: $RSEL,M,R*<cs|cr|lf>

Description: Allows the user to read and setup the programmable pulse rate generator outputs on the Pulse Rate/Frequency option board (Option 1). Output 2, 3 and 4 on the multi-pin connector produce a programmable rate signal. The user can select the specific output and the desired rate period in seconds. The PCTL command should be set to enable these outputs as required (Output 2 - 4 control).

Fields:

Symbol	Value	Description
M	2 - 4	Output select
R	1 - 9999	Rate selection period in seconds

Non-Volatile: Yes

Factory Default: 1

Compatibility: NanoSync with Pulse Rate/Frequency Output Option 1 or 2

Reset GPS receiver (input) RSTG

Setup Command: $RSTG,N*<cr|lf>

Resonse: $RSTG,N*<cs|cr|lf>

Description: Resets GPS receiver with either a cold start (force collection of new almanac and ephemeris) or warm start (restart receiver, maintain current almanac and ephemeris).

Fields:

Symbol	Range	Description
N	W or C	Reset mode, where W = Warm start C = Cold start

Example 1: $RSTG,W*<cr|lf>

Resonse: $RSTG,W*<cs|cr|lf>

Resets the GPS receiver so that it will still maintain current almanac and ephemeris.

Example 2: $RSTG,C*<cr|lf>

Resonse: $RSTG,C*<cs|cr|lf>

Causes the receiver to “search the sky”, acquire active GPS satellites and download a new almanac and ephemeris. This could require 10 to 20 minutes to complete.

Note: The unit's output time data is disrupted for a few seconds after the 'cold start' is initiated.

Non-Volatile: Not applicable

Satellite Signal Quality (output) SIGQ

Query Command: $SIGQ*<cr|lf>

Resonse: $SIGQ,S,N,C,S,N,C,S,N,C,S,N,C,S,N,C,S,N,C,S,N,C,S,N,C*<cs|cr|lf>

Reports satellite PRN, signal strength and tracking mode.

Fields:

Symbol	Range	Description
S	00 - 32	Satellite PRN number
N	0 - 9	Signal Strength/Quality, where: 0 = no signal and 9 represents full signal, and: 8, 9 = Very good 6, 7 = Good 4, 5 = Weak $\leq$ 3 = Not usable The signal strength value 'N' is calculated from the GPS receiver's Signal to Noise Ratio value (SNR) as follows: (SNR-25)/2.5, where SNR is expressed as dB/Hz.
C	0 - 2	Tracking mode, where: 0 = Searching 1 = Acquiring 2 = Using for navigation/timing

Non-Volatile: Not applicable

Set Approximate Position (input/output) SPOS

Setup Command: $SPOS,D,M,H,$D_1$,$M_1$,$H_1$,A*<cr|lf>

Query Command: $SPOS*<cs|cr|lf>

Resonse: $SPOS,D,M,H,$D_1$,$M_1$,$H_1$,A*< cs|cr|lf>

This command is used to set and retrieve the latitude, longitude and altitude of the unit's antenna. The GPS engine uses the position data, along with time and date information, to determine which satellites it will attempt to track. When operating in the Known Position (see TRMO command), the SPOS query command will retrieve the static antenna position data used by the receiver. When operating in the Known Position mode (see TRMO command), the user may use the SPOS setup command to enter an accurate position.

The antenna position data must be accurate. Inaccurate or incorrect values can result in reduced accuracy of the frequency and timing output signals, or prevent tracking of any satellites for a long period of time.

When operating in the Position Averaging mode (see TRMO command), the SPOS query command will retrieve the dynamic instantaneous position fixes from the receiver. These fixes are being used by the instrument's position averaging algorithm to compute accurate latitude, longitude and altitude of the unit's antenna position.

If the unit has been moved to a new location or the unit is first powered, and an accurate antenna position is not known, it is recommended to select the Position Average mode so that the instrument can calculate a new accurate position.

In the event power is applied to the unit, and the Known Position mode is asserted with incorrect position data, then, after 1000 fixes (about 16 minutes), the unit automatically switches to the Position Averaging mode and starts to compute a new position.

Fields:

Symbol	Range	Description
D	0 to 89	Latitude degrees
M	0.0 to 59.9999	Latitude minutes
H	N or S	Hemisphere
D_1	0 to 179	Longitude degrees
M_1	0.0 to 59.9999	Longitude minutes
H_1	E or W	Hemisphere
A	-400.00 to 18,000.00	Altitude in meters

Non-Volatile: Yes (if operating in the Known Position mode)

Select / Deselect Satellites (input/output) SSLT

Setup Command: $SSLT,S,N*<cr|lf>

Query Command: $SSLT*<cs|cr|lf>

Resonse: $SSLT,NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN*<cs|cr|lf>

Description: Allows the forced selection or de-selection of satellites, where N represents a single satellite. The left most "N" represents satellite Number 1 and the right most "N" represents satellite Number 32.

See commands SATD and SATE for an alternate method of disabling/enabling satellite tracking.

Fields:

Symbol	Range	Description
N	0-1	Satellite tracking status, where: 0 = Enabled to be tracked 1 = Disabled to be tracked

Non-Volatile: No. All satellites are enabled to be tracked.

Factory Default: All satellites are enabled to be tracked

System Status (output) STAT

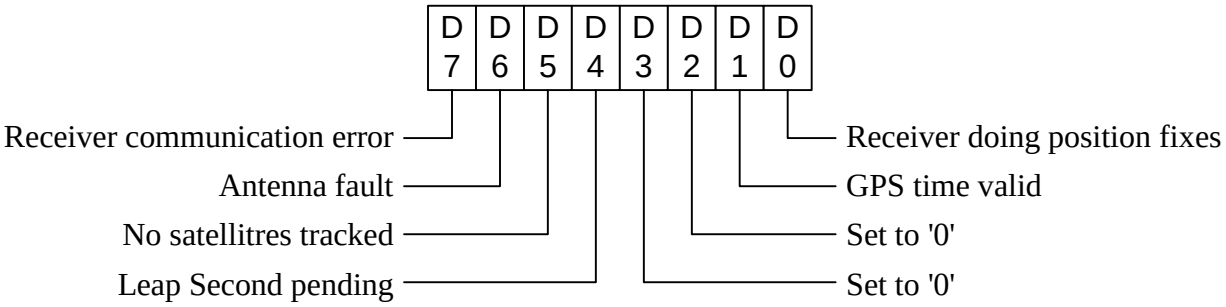
Query Command: $STAT*<cr|lf>

Resonse: $STAT,a,b,ChCl,DhDl,EhEl*<cs|cr|lf>

Description: Report system status information.

Fields:

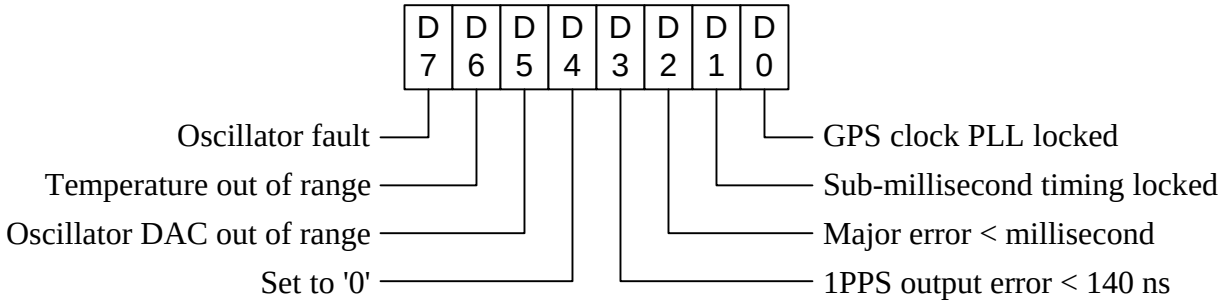
Symbol	Range	Description
a	0 to 8	Number of Satellites Tracked
b	0 to 7	Oscillator type installed 6 - Double Oven Quartz 7 - Single Oven Quartz
ChCl	0-9, A-F	GPS System Status Definition (Hex Decimal)



Example: $STAT,a,b,03,DhDl,EhEl*<cs|cr|lf>

In this command response the high nibble indicates no receiver communication error, no antenna fault, satellites are tracked, and no leap second is pending. The low nibble indicates the GPS time is valid and the receiver is doing position fixes.

Fields:	**Symbol**	**Range**	**Description**
	DhDl	0-9, A-F	Control Loop Status Definition (Hex Decimal)



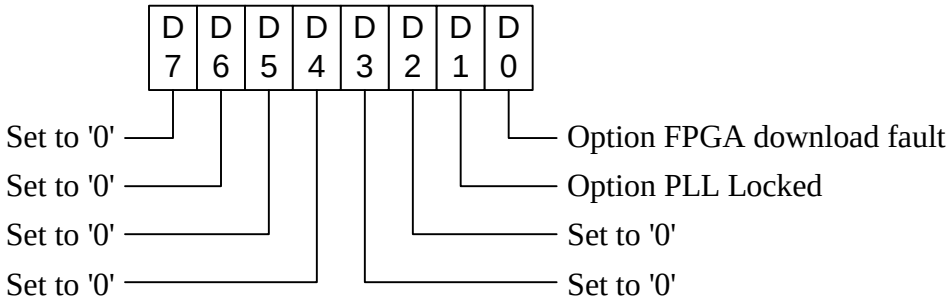
Example: $STAT,a,b,ChCl,0F,EhEl*<cs|cr|lf>

In this command response the high nibble indicates no faults, and the low nibble indicates the GPS clock PPL is locked, sub-millisecond is locked, major error is < millisecond, and the 1PPS output error is < 140 ns*.

*The error value depends on the number of satellites being tracked. The value shown is for 8 satellites. The value is calculated as follows:

Value = (200 ns) (√ 4/S), where S = number of satellites tracked.

Fields:	**Symbol**	**Range**	**Description**
	EhEl	0-9, A-F	Option Board Status Definition (Hex Decimal)



Example: $STAT,a,b,ChCl,DhDl,00*<cs|cr|lf>

In this command response the high nibble bits are set to default ‘0’. The low nibble bits 3 and 2 are set to default ‘0’, the option PPL is locked or no option is installed, and the option FPGA download was successful or no option is installed.

System Time (output) STIM

Query Command: $UNSL, STIM, 1*<cr|lf>

Response: $STIM,Y,D,H,M,S,m,T,O*<cs|cr|lf>

Description: Continuously reports the *GPS* time that the unit has calculated for the previous 1pps pulse. The output always is GPS time, independent of any local time settings or selection of time reference. (See command TIMM).

Fields:

Symbol	Range	Description
Y	to 9999	Year
D	1 - 366	Day of Year
H	0 - 23	Hours
M	0 - 59	Minutes
S	0 - 59	Seconds
m	1 - 4	Time Mode, where: 1 = GPS Time 2 = UTC Time 3 = LUTC (Local UTC) Time 4 = LGPS (Local GPS) Time
T	4 - 9	TFOM (See Time Figure of Merit table)
O	0 - 3	Operation Mode, where: 0 = Warm-up 1 = Time Locked 2 = Holdover (Coasting) 3 = Recovering 4 = (Not used) 5 = Oscillator Learning in progress

TFOM Value	Expected Time Error (ETE)
4	100 ns ETE ≤ 1 μs
5	1 μs < ETE ≤ 10 μs
6	10 μs < ETE ≤ 100 μs
7	100 μs < ETE ≤ 1 ms
8	1 ms < ETE ≤ 10 ms
9	10 ms < ETE

Time Figure of Merit (TFOM)

Non-Volatile: Not applicable

Factory Default: Portable Clock Model 382: Unsolicited at application of input power.
NanoSync model 380: User selected.

Time of Next Reference Edge (output) TCOD

Query Command: $TCOD*<cr|lf>

Resonse: $TCOD,Y,D,H,M,S,m,T,O*<cs|cr|lf>

Description: The start of the response message occurs 990 ms to 970 ms prior to the ***next*** one second mark. The time and date in the response is representative of the time at the ***next*** second mark. (The data fields contain the same information as in the response from the TIME command).

Fields:

Symbol	Range	Description
Y	To 9999	Year
D	1 - 366	Day of Year
H	0 - 23	Hours
M	0 - 59	Minutes
S	0 - 59	Seconds
m	1 - 4	Time Mode Where: 1 = GPS Time 2 = UTC Time 3 = LUTC (Local UTC) Time 4 = LGPS (Local GPS) Time 5 = Temperature Learning Process active
T	4 - 9	TFOM (See Time Figure of Merit table)
O	0 - 3	Operation Mode Where: 0 = Warm-up 1 = Time Locked 2 = Holdover (Coasting) 3 = Recovering 4 = (Not active) 5 = Temperature Learning Process active

TFOM Value	Expected Time Error (ETE)
2*	10 ns ETE ≤ 10 ns
3*	10 ns ETE ≤ 100 ns
4	100 ns ETE ≤ 1 μs
5	1 μs < ETE ≤ 10 μs
6	10 μs < ETE ≤ 100 μs
7	100 μs < ETE ≤ 1 ms
8	1 ms < ETE ≤ 10 ms
9	10 ms < ETE

Time Figure of Merit (TFOM)

*TFOM 2 and 3 are not applicable to Holdover and Recovering operation modes

Internal Temperature (output) TEMP

Query Command: $TEMP*<cr|lf>

Resonse: $TEMP,N, *<cs|cr|lf>

Description: Reports the internal temperature of the unit.

Fields:

Symbol	Range	Description
N	-25.0 to 125.0	Internal temperature in ^{o}C

Non-Volatile: Not applicable

Difference between GPS 1 PPS and oscillator 1 PPS (output) TIMD

Query Command: $TIMD*<cr|lf>

Resonse: $TIMD,N*<cs|cr|lf>

Description: Reports the estimated phase error between the 1 PPS and 10 MHz outputs versus UTC. It is computed by using a low pass filter on the difference measurement between the oscillator derived 1 PPS and the receiver 1 PPS output. The filter is equivalent to the control loop filter for controlling the oscillator. The error value is updated every 10 seconds when operating in the Time Locked or Recovering modes.

Description: Note: Not valid during Warm-up and Holdover.

Fields:

Symbol	Range	Description
N	-999999999 to 999999999	Time difference in nanoseconds

Non-Volatile: Not applicable

Time (output) TIME

Query Command: $TIME*<cr|lf>

Resonse: $TIME,Y,D,H,M,S,m,T,O*<cs|cr|lf>

Description: Reports the current time that the unit has calculated. The time and date in the message is representative of the time at the last second mark. The time and date are referenced to GPS or UTC, with or without local time offset. (See command TIMM for time reference and local time offset selection). The start of the response message is asynchronous, with its starting edge anywhere between the prior and the next one second mark.

Fields:

Symbol	Range	Description
Y	To 9999	Year
D	1 - 366	Day of Year
H	0 - 23	Hours
M	0 - 59	Minutes
S	0 - 59	Seconds
m	1 - 4	Time Mode Where: 1 = GPS Time 2 = UTC Time 3 = LUTC (Local UTC) Time 4.= LGPS (Local GPS) Time 5.= Temperature Learning Process active
T	4 - 9	TFOM (See Time Figure of Merit table)
O	0 - 3	Operation Mode Where: 0 = Warm-up 1 = Time Locked 2 = Holdover (Coasting) 3 = Recovering 4 = (Not active) 5 = Temperature Learning Process active

TFOM Value	Expected Time Error (ETE)
2*	10 ns ETE ≤ 10 ns
3*	10 ns ETE ≤ 100 ns
4	100 ns ETE ≤ 1 μs
5	1 μs < ETE ≤ 10 μs
6	10 μs < ETE ≤ 100 μs
7	100 μs < ETE ≤ 1 ms
8	1 ms < ETE ≤ 10 ms
9	10 ms < ETE

Time Figure of Merit (TFOM)

*TFOM 2 and 3 are not applicable to Holdover and Recovering operation modes

Time Mode (input/output) TIMM

Setup Command: $TIMM,M,LH,LM*<cr|lf>

Query Command: $TIMM*<cr|lf>

Resonse: $TIMM,M,LH,LM*<cs|cr|lf>

Description: Allows the user to set or read back the time mode.

Fields:

Symbol	Range	Description
M	1 - 4	Time Mode Where: 1 = GPS 2 = UTC 3 = LUTC (Local UTC Time) 4 = LGPS (Local GPS Time)
LH	00 to ±14	Local offset in hours
LM	00 to 59	Local offset in minutes

Non-Volatile: Yes

Factory Default: 2,00,00

Time Recovery Mode (input/output) TRMO

Setup Command: $TRMO,X*<cr|lt>

Query Command: $TRMO*<cr|lf>

Resonse: $TRMO,X*<cs|cr|lf>

Description: Allows the user to select or read back Time Recovery Mode of operation.

Fields:

Symbol	Range	Description
X	P, K	Time recovery mode. Where: P = Position Averaging K = Known Position

In the Position Averaging mode the instrument uses 3-D latitude, longitude, and elevation values generated by the GPS engine's position fixes to continuously compute an averaged position over a 1-hour period. At the end of the period, the unit will automatically enter the Known mode using the averaged values. During the averaging process, the continuously improving position value is used to determine accurate time and frequency. The average position can be read using the PAVG query command.

In the Known mode the user can read the position, and can directly enter latitude, longitude, and altitude data using the SPOS command. Care must be taken when entering position data, as an inaccurate position may degrade performance. The new position will not immediately be updated in the structure accessed by this command; therefore, the value returned will reflect the previous value for about 2 seconds.

In the event power is applied to the unit, and the Known Position mode is asserted with incorrect position data, then, after 1000 fixes (about 16 minutes), the unit automatically switches to the Position Averaging mode and starts to compute a new position.

If the unit has been moved to a new location or the unit is first powered, and an accurate antenna position is not known, it is recommended to select the Position Average mode so that the instrument can calculate a new accurate position.

Non-Volatile: Yes

Factory Default: P (Position Averaging/Survey mode)

Unit Identification (output) UNID

Query Command: $UNID*<cr|lf>

Resonse: $UNID,P,R,D,S,F*<cs|cr|lf>

Description: Reports the product model number, revision, date of manufacture, serial number, and firmware version of installed application code.

Fields:

Symbol	Description
P	Part number (Up to 12-digit ASCII string maximum)
R	Revision (Up to 12-digit ASCII string maximum)
D	Date of manufacture (Up to 12-digit ASCII string maximum)
S	Serial Number (9 digit numeric)
F	Firmware version of installed application code

Example 1: $UNID*<cr|lf>

Resonse: $UNID,380040001,N/C,0219,380000001,1.05.00*<cs|cr|lf>

This example indicates P/N: 380040001, Rev: N/C, Date of Manufacture: Year 2002 Week 19, S/N: 380000001, Firmware version: 1.05.00

Example 2: $UNID,380-400-01,N/C,0315,000001000,1.15.00*<cs|cr|lf>

This example indicates P/N: 380-400-01, Rev: N/C, Date of manufacture: Year 2003 Week 15, S/N: 1000, Firmware version: 1.15.00*<cs|cr|lf>

Non-Volatile: Yes

Unsolicited flag (input) UNSL

Setup Command: $UNSL,S,C*<cr|lt>

Resonse: $UNSL,S,C*<cs|cr|lf>

Description: Sets or clears the unsolicited flag for a particular command.

Fields:

Symbol	Range	Description
S	Alphanumeric	Four character command
C	0, 1	1 = Enable unsolicited flag 0 = Disable unsolicited flag

Note: To disable multiple messages from output, use the following command: $UNSL,XXXX,0*<cr|lf>

Non-Volatile: No

The following table describes all commands that have unsolicited flags:

Interval in Seconds				
1	**2**	**5**	**10**	**30**
ESSD	GDOP	AZEL	ANTD	NTLC
ESSN	RSAH	TEMP*	TRMO	SSLT
PAVG	STAT		TIMI	ESTP
SIGQ	TIMD			HEFE
TIME*				HETE
DACV*				HEST
EFER				HINT
STIM**				LEAP
PUTD**				

** For use with Portable Clock Model 382

Current Firmware Version (output) VERS

Query Command: $VERS*<cr|lf>

Resonse: $VERS,V,D,G1/G2,P,O*<cs|cr|lf>

Description: Reports the current version number

Fields:

Symbol	Range	Description
V	X.XX.XX	Application Program Version
D	Month Day Year	Application Program Date
G1/G2	X:XX/XX:X	GPS Engine Firmware: G1 = Navigation Processor version G2 = Signal Processor
P	380-3001	Application Program Number
O	00 - 09	Option board type 00 = No option installed 01 = Option 1, etc

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