User's Manual

NanoSync Model 380-100-02

GPS Synchronized
Time and Frequency Module

Document 380-8046

Rev C

WARRANTY

FEI-Zyfer's standard warranty is for one year unless otherwise agreed upon by contract or purchase order. Warranty terms and conditions are explained in the Standard Terms and Conditions of Sale provided with the quotation.

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DATE	REVISIONS
25 May 2004	Rev A: Changed contact information on page iv
18 Oct 2006	Rev B: In par 2.3.1.1 added explanation for the use of 50 Ohm and 75 Ohm impedance antenna cable. In par. 2.3.1.2 updated In-Line Amplifier details.
8 Feb 2008	Rev C: Update with FEI-Zyfer's new address, phone numbers and current logo.

CONTACT INFORMATION

FEI-Zyfer, Inc (North America)

Technical Support:	Phone	(714) 933-4003
		(888) 886-7465 (USA only)
	Fax	(714) 933-4001
	Email	techsupport@fei-zyfer.com
Sales:	Phone	(714) 933-4002
	Fax	(714) 933-4001
	Email	sales@fei-zyfer.com
Data Sheets:	http://www.fei-zyfer.com/	
RMA Numbers:	Phone	(714) 933-4000
	Fax	(714) 933-4001

Shipping Address for Repairs/Returns:

FEI-Zyfer, Inc.
Attention: RMA ####
7321 Lincoln Way
Garden Grove, CA 92841-1428
USA

Please obtain a Returned Material Authorization (RMA) number prior to returning a product to FEI-Zyfer, Inc.

Table of Contents

Section 1 General Information

1.1 DESCRIPTION 1

1.2 FUNCTIONS 2
1.2.1 Reference Pulse Output (1PPS / 1PP2S) 2
1.2.2 10 MHz Output 2
1.2.3 Serial Control Port 2
1.2.4 Antenna Input 2
1.2.5 Power Input 2

1.3 DETAILS OF OPERATION 3
1.3.1 Warm-Up 3
1.3.2 Cold Start 3
1.3.3 Warm Start 3
1.3.4 Disciplining 4
1.3.5 Time Locked 4
1.3.6 Holdover 4
1.3.7 Recovering 5
1.3.8 Position Averaging 5

Section 2 Getting Started

2.1 INTRODUCTION 7

2.2 GETTING ASSISTANCE 7

2.3 PREPARING FOR USE 7
2.3.1 Installing the Antenna System 8
2.3.1.1 Antenna Cable 8
2.3.1.2 In-Line Amplifier 9
2.3.1.3 Lightning Protection 10
2.3.1.4 Weather Proofing 10

2.3.2 Connecting the Antenna Input 11

2.3.3 Connecting the DC Input Power 11

2.3.4 Connecting the Serial Control/Monitor Port 11

2.4 POWERING-UP THE INSTRUMENT 12

2.5 COMMUNICATING WITH THE INSTRUMENT 13
2.5.1 Configuring the Control Port 13

Table of Contents (continued)

2.6 CUSTOMIZING THE OPERATION 14
2.6.1 Set Antenna Delay Compensation 14
2.6.2 Set System Offset 15
2.6.3 Disable/Enable Satellite Tracking 15
2.6.4 Select Automatic Determination of Antenna Position 16
2.6.5 Accelerate Synchronization Process 16
2.6.6 Set Local Time Rather than UTC or GPS Time 17
2.6.7 Enable/Disable Reference Pulse Output 17
2.6.8 Select Reference Pulse Output Rate 18
2.6.9 Select Reference Pulse Output Polarity 18
2.6.10 Reset Internal GPS Receiver 18
2.6.11 Configuring the Option Outputs 19

2.7 MONITORING THE OPERATION STATUS 20
2.7.1 Using the Windows User Interface Application Software 20
2.7.2 RS-232 Command Overview 24

Section 3 Specifications

3.1 INTRODUCTION 27

3.2 MECHANICAL 27

3.3 ENVIRONMENTAL 27

3.4 POWER REQUIREMENTS 28
3.4.1 -01 Input Power Configuration 28

3.5 ELECTRICAL SIGNALS 29
3.5.1 10 MHz Output 29
3.5.2 Reference Pulse Output 30
3.5.3 Control Interface Port 31
3.5.4 Discrete Output 32
3-5.5 Antenna Interface 32

3.6 OPTIONAL ANTENNA KIT 32

Supplemental: Declaration of Conformity 33

The configuration of your instrument is as marked on the instrument's identification label. Two configuration dependent suffix numbers follow the basic model number 380. The first suffix number is designates the type of *OSCILLATOR* installed, and the second number designates the *INPUT POWER* configuration.

Note: At present, only one type of oscillator is available and only one input power configuration is available.

In this document, the *INPUT POWER* configuration dash (-) number is referenced in manual *Section 3, Specifications.*

The complete Model Number of a standard instrument is:

380 – 100 – 02

The instrument configuration suffix numbers are as follows:

NanoSync CONFIGURATION	
OSCILLATOR	
-100	Standard Stability Quartz (OCXO)
INPUT POWER	
-02	+12 VDC +/-5% Regulated (Non-Isolated Input)

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Section 1 General Information

1.1 DESCRIPTION

This document contains information pertaining to NanoSync Time and Frequency Module Model 380-100-XX. The instrument is configured to provide accurate timing and frequency output signals synchronized to UTC through signals transmitted by the GPS satellites.

The installed application code allows for sending the following back-to-back commands within a 100 ms period: $TIME, $TIME, $ANTD. This pattern can be repeated every 5 seconds, for a total test time of 30 minutes.

The instrument has four threaded inserts to facilitate mounting to a user supplied mounting plate or enclosure.

Connection to an external GPS antenna is normally made through a SMB to TNC connector adapter cable.

NOTE: Individual NanoSync units do not come supplied with an antenna, antenna cable, or adapter cable. These components can be purchased separately from FEI-Zyfer.

Operation is automatic and self-calibrating. Methods of controlling and monitoring the performance are provided via an RS-232 I/O interface. The instrument consists of:

- A Global Positioning System (GPS) receiver
- A disciplined oscillator

The instrument provides:

- A flash ROM to simplify firmware upgrades
- One TTL level reference pulse output signal, the rate of which can be set by the user to one pulse per second (1PPS) or one pulse every even second (1PP2S). The pulse edge can be set by the user to the rising or falling edge on-time
- One 10 MHz sinusoid frequency output signal
- One RS-232 I/O control and monitor computer interface port
- Two "hardware" status signals

Available Accessories:

- GPS antenna kit (antenna, pipe thread adapter, and 50 ft cable)
- SMB to TNC adapter cable
- Long length and low loss antenna cable

1.2 FUNCTIONS

The following paragraphs describe the functions of the instrument's input/output signals.

1.2.1 Reference Pulse Output (1PPS / 1PP2S)

One high accuracy reference pulse output port is provided. The rate and on-time edge of the pulse can be set by the user to one pulse per second (1PPS) or one pulse every even second (1PP2S), with either the rising or falling edge on-time with UTC 1 PPS. The signal is derived from the internal oscillator. Normally, the signal is not present until the instrument has locked to GPS 1 PPS; however, the user can enable the output to be present at all times. When locked, the signal is traceable to Coordinated Universal Time (UTC) through GPS. When GPS lock is lost, the signal continues to be generated with the same accuracy as the internal oscillator.

1.2.2 10 MHz Output

One 10 MHz sinusoid output port is provided, traceable to UTC (USNO) through GPS. The internal GPS disciplined oscillator generates the signal. When GPS lock is lost, the oscillator enters a coasting mode during which a special algorithm compensates for the oscillator aging and temperature effects, using data learned while locked to GPS and during factory calibration.

1.2.3 Serial Control Port

A serial interface control port allows for communication with the instrument. This is accomplished by connecting an external device with suitable software to send and receive the proper commands for transmitting and receiving data. The port allows customizing the instrument's position solution, change the operating status, and retrieve operating status and data.

1.2.4 Antenna Input

A SMB type connector allows connection of the required antenna system to the instrument. A SMB to TNC connector adapter cable can be purchased separately from FEI-Zyfer to facilitate connection to an antenna cable terminated with a TNC type connector. A +5Vdc source is provided on the center conductor, which is intended to provide power to an external "active" antenna containing a low noise amplifier, such as the antenna that can be purchased separately from FEI-Zyfer.

1.2.5 Power Input

The instrument's DC input power is connected through a 3-contact connector (mating connector is supplied with the instrument).

1.3 DETAILS OF OPERATION

1.3.1 Warm-Up

After the *initial* application of power, a warm-up period is entered. During this period, the internal oscillator is stabilizing, the internal receiver defaults to the Position Averaging position mode and starts to "search the sky" for satellites. As soon as one satellite is acquired, the receiver starts to collect almanac and ephemeris data, and continuous to search for and acquire additional satellites. The receiver automatically determines the position of the instrument's external antenna. During the averaging period, the position (latitude, longitude and altitude) continuously improves making position calculations only when at least four satellites are tracked using data that meets certain criteria before it is used in the averaging calculations. After the position data is been averaged for a period of 1-hour, the position mode is automatically set the Known mode.

At *subsequen*t application of power the internal receiver attempts to determine the current position of the connected antenna. If the prior position solution mode was Known mode and the present position is verified to be within 300 meters of the position stored during the prior operation, then the position solution mode remains in Known. If the current antenna position is not within 300 meters of the stored position, the instrument automatically switches to the Position Averaging mode. If the prior solution mode was Position Averaging, then the instrument remains in Position Averaging. After the position data is been averaged for a period of 1-hour, the position mode is automatically set the Known mode.

As soon as the receiver has locked to GPS, the instrument begins the disciplining process of the internal oscillator to ultimately provide accurate frequency and time output signals, using the GPS signals as reference.

1.3.2 Cold Start

If the receiver is reset to the Cold Start mode (see RSTG command), the receiver’s current almanac and ephemeris is cleared, and the position solution mode of the receiver is set to Position Averaging. The starting antenna position data is the data that was present prior to the cold reset. The receiver starts to "search the sky" for active satellites. After a satellite is acquired, the receiver starts to collect a new almanac and ephemeris. This process could require 12 to 30 minutes to complete; however, the instrument normally achieves the Time Locked mode within 10 minutes.

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

1.3.3 Warm Start

If the receiver is reset to the Warm Start mode (see RSTG command), the current almanac, ephemeris, position mode, and antenna position data is maintained. The receiver starts to acquire available satellites almost immediately.

1.3.4 Disciplining

When the receiver tracks satellites, the internal oscillator is being corrected as needed to synchronize the timing and frequency output signals to UTC, and then maintain the specified accuracy of the output signals. A firmware estimator continuously compares the receiver 1 PPS output with the internally generated 1 PPS derived from the internal oscillator to determine the correction necessary to discipline the oscillator. The estimator filters out the short-term variations inherent in the GPS 1 PPS. The accuracy of the reference pulse output signal is indicated by the Time Figure Of Merit, TFOM (see TIME command).

Throughout the disciplining process, the instrument learns the aging characteristics of the oscillator for use during the Holdover mode. The aging characteristic initial learning period is 24 hours and continuous to be refined. In the event the unit's power is interrupted prior the completion of the initial learning period, the data is discarded and the learning process is restarted.

1.3.5 Time Locked

In the Time Locked mode, the instrument's time is synchronized to UTC through the disciplining process. The time and frequency will continue to be corrected as needed to maintain the specified accuracy of the output signals. *Prior to the first transition to Time Locked from Warm-Up, the 1PPS / 1PP2S output signal is disabled (Factory Default), unless the user has selected the output to be enabled all the time.*

1.3.6 Holdover

The Holdover mode is entered after out of range inconsistencies have been detected in the major time (days through seconds) or the internally generated 1 PPS, or if the internal receiver has lost lock with satellites.

In the first stage of this mode, the internal oscillator is coasting (i.e. -not being disciplined) to retain the accuracy of the output signals. The Time Figure Of Merit (TFOM) indicates the estimated timing output accuracy.

The time and frequency accuracy is maintained by applying corrections to the oscillator using temperature effect data obtained during factory calibration, and oscillator-aging characteristics learned while locked to GPS.

When operating in the Holdover mode for extended periods, the TFOM value changes according to the estimated time error computed from the oscillator frequency offset at the time Holdover was entered, the residual aging and temperature correction errors, and the duration of the Holdover period.

In the last stage of the mode, when the conditions needed to start the disciplining and synchronization process are met and then started, the instrument will automatically change to the Recovering mode or, if the timing error is less than 0.1 μs, directly to the Time Locked mode.

1.3.7 Recovering

In the Recovering mode, the internal oscillator is being corrected until the Time Locked criteria are met. Expect an eventual transition to the Time Locked mode (unless changing conditions prevent this; for instance, loss of tracked satellites or change of antenna cable delay selection).

1.3.8 Position Averaging

Accurate antenna position data is necessary to produce precise outputs. The antenna position is normally automatically computed by the instrument, but can also be set by the user.

In the Position Averaging mode (see TRMO command), the unit will average position fixes from the GPS engine for a minimum period of 1 hour. During the averaging process, the position values are continuously improving. The average position data is available using the PAVG command. At the completion of the averaging period, the unit automatically enters the Known Position mode.

Alternatively, the user may enter an accurately known position while in the Known Position mode (see TRMO & SPOS commands). Care must be taken when loading position, as an inaccurate position may degrade performance. If position fixes from the GPS engine are different from the entered position value by more than 300 meters, the unit will, after 1000 fixes (about 16 minutes), automatically enter the Position Averaging mode to compute a new position.

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Section 2 Getting Started

2.1 INTRODUCTION

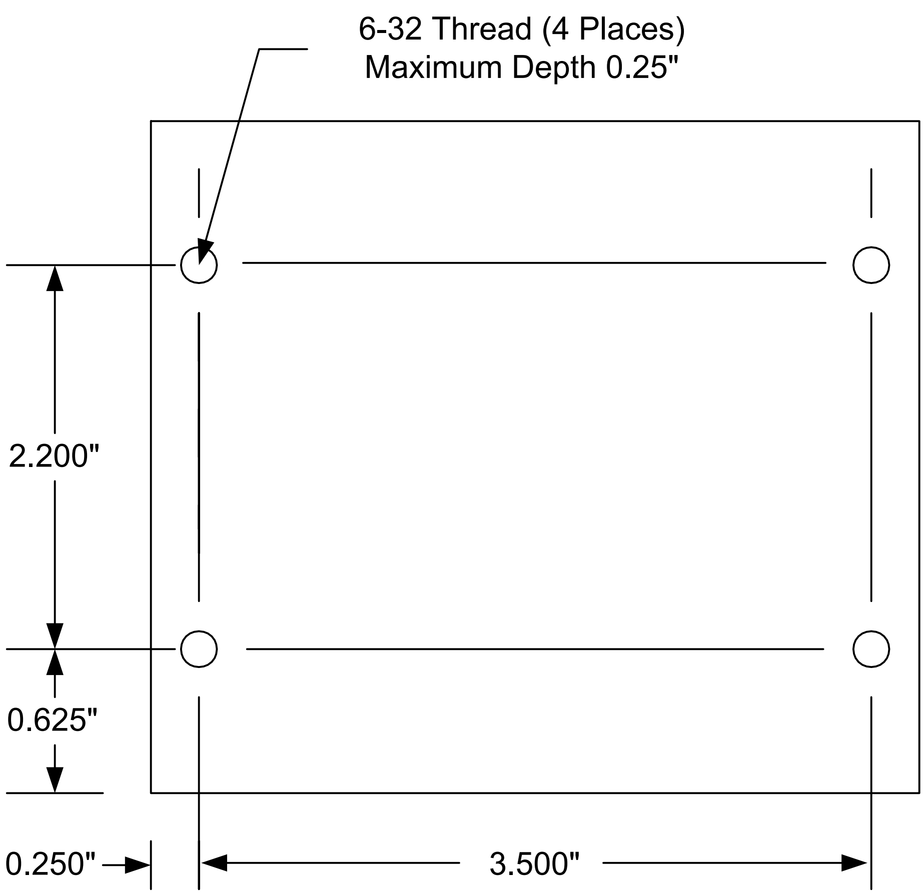
This section contains the step-by-step procedures to place the NanoSync in operation.

2.2 GETTING ASSISTANCE

If you need assistance or have any questions relating to setup or operation, contact Technical Support. Please refer to the CONTACT INFORMATION page for detailed information.

2.3 PREPARING FOR USE

Install the instrument into the desired location. The facilitate ease of installation in user's equipment, four mounting holes with 6-32 screw threads are provided on the instrument's bottom surface.



NANOSYNC MOUNTING DIMENSIONS

CAUTION!

When mounting instrument in an enclosure, make certain the maximum operating ambient temperature does not exceed 55º C.

Prior to use, the instrument must be connected to an antenna, DC power source, and to a compatible serial interface.

2.3.1 Installing the Antenna System

The system requires an antenna suitable for retrieving the GPS satellite signals.
Note: Special care must be taken when routing antenna cable near sources of potential interference, such as a power bus, high frequency antenna couplers, and other transmitting equipment.

The antenna mounting location should be free of any objects that might obstruct satellite visibility within 10º of the horizon. Obstructions that obscure significant areas of the sky will result in degraded performance of the unit. The antenna should be located at least 50 cm away from each other and any other GPS antenna. The antenna must be mounted with the connector side down.

Mount the antenna in the desired location. At the antenna, connect one end of the antenna cable to the antenna connector. Application of a weatherproofing compound to the antenna/cable connection is recommended to impede corrosion.

2.3.1.1 Antenna Cable

The antenna available from FEI-Zyfer has a minimum gain of 30 dB. This allows for a maximum antenna cable loss of 15 dB 1575 MHz.

Other lengths and types of cable can be used as long as the signal loss at 1575 MHz does not exceed 15 dB.

Caution: Not all coaxial cable exhibits the same amount of attenuation or shielding quality. These parameters can vary between manufacturers as well as manufacturer's type.

FEI-Zyfer has evaluated several manufactures and types of cable, and has found that Belden® type 9311 (RG-58), Belden® type 8267 (RG-213), Belden® type 9913 (RG-8), Belden® type 9104 (RG-59), and Times Microwave LMR type cable provide good performance.

The following table indicates the maximum length of recommended cable type when used with the antenna available from FEI-Zyfer.

Cable Type	Max. Length	Comments
RG-58 (Belden® 9311)	75 ft (23 m)	Loss 20 dB per 100 ft (30 m)
RG-213 (Belden® 8267)	125 ft (38 m)	Loss 12 dB per 100 ft (30 m)
RG-59 (Belden® 9104)	150 ft (46 m)	Loss 10 dB per 100 ft (30 m)
RG-8 (Belden® 9913)	250 ft (75 m)	Loss 6 dB per 100 ft (30 m)
LMR400 (Times Microwave)	275 ft (84 m)	Loss 5.4 dB per 100 ft (30 m)

For long runs it is necessary to use an In-Line Amplifier or low loss foam dielectric cable such the Heliax series manufactured by Andrew Corporation, Orland Park, IL, USA.

For extremely long runs a special up/down converter system can be used, such as the downconverter/upconverter system manufactured by Raven Industries (formerly Starlink Incorporated), Austin TX, USA. Versions are available for use with coaxial cable and also for use with fiber optic cable.

*Note: Most of the above recommended cables have 50 Ohm impedance. The RG-59 cable has 75 Ohm impedance. When using cable with 75 Ohm impedance a mismatch appears to exist between the cable and the antenna, and/or between the cable and the GPS receiver.

The primarily advantage of using 75 Ohm impedance cable is the improved signal levels at the frequencies of interest. (Note the maximum cable length between RG-58 and RG-59). The benefits of the increased signal level far outweigh any potential impedance mismatch issues.

2.3.1.2 In-Line Amplifier

In some cases it may be more cost effective to place an amplifier in the antenna cable system to make up for the signal attenuation caused by long cable runs.

Amplifiers are available from several manufacturers including Raven Industries (formerly Starlink Incorporated), Austin TX, USA, and FEI-Zyfer. The following tables list the characteristics of the amplifier available from FEI-Zyfer.

Amplifiers 0810427, 0810428, and 0810429 are configured with a female TNC connector at both the input side and the output side. This allows the amplifier to be installed in-line with the antenna cable.

Amplifiers 0810432, 0810433, and 0810434 are configured with a male TNC connector at the input side and a female TNC connector at the output side. This allows the amplifier to screw directly on to the GPS antenna without the need for additional cables. It also provides protection from the environment when the antenna is installed using a pipe that also surrounds the amplifier.

Parameter	P/N 0810402 Characteristics		
GPS Band	L1 (Fc = 1575.42 MHz)		
Gain (min) at Fc	0810427: 15 dB 0810432: 20 dB	0810428: 15 dB 0810433: 15 dB	0810429: 30 dB 0810434: 30 dB
Filter	>80 dB Attenuation @ 50 MHz from Fc		
Input Power	4.0 VDC to 15 VDC @ 22 ma max with voltage pass-through		
NF	< 3.5 dB		
Connector	0810427, 0810428, 0810429: TNC Male In/TNC Female Out 0810432, 0810433, 0810434: TNC Female In/TNC Female Out		

2.3.1.3 Lighting Protection

In areas where lightning is present, it is recommended to install a surge protector in the antenna system. Surge protectors are available from several manufacturers such as: Part number DGXZ+06FTF-A, GXZ+15TFTF-A,or 095-0518C-A from PolyPhaser Corporation, Minden, Nevada, USA, and part number P8AX09TNCWFF from Citel, Miami, Florida, USA. In order to be effective, the arrestor must be connected to earth ground using a very low-inductance conductor. The arrestor should be connected as close as possible to the point where the antenna cable enters the building. Contact the manufacturers for installation details.

2.3.1.4 Weather Proofing

The enclosure of most antennas is designed for exposure to all-weather conditions. However, care should be taken with the connectors and cable couplers, if used. These components should be shielded from the elements, or weather protected using butyl rubber tape. Weather proofing kit P/N 221213 is available from Andrew Corporation, Orland Park, IL 60462, USA. This kit includes butyl rubber and plastic tape. Instructions are included with the kit.

2.3.2 Connecting the Antenna Input

Connect the antenna system cable to the instrument's SMB connector labeled *ANT*.

2.3.3 Connecting the DC Input Power

Prior to connecting DC input power to the instrument, it is necessary to fabricate a cable using 18 AWG connecting wires (user supplied) and the 3-contact mating connector supplied in the instrument's shipping kit.

> *CAUTION: OBSERVE THE POLARITY OF THE INPUT VOLTAGE WHEN CONNECTING THE INPUT POWER. NO DAMAGE WILL RESULT IF THE POLARITY IS CONNECTED REVERSED, BUT AN INTERNAL FUSE MUST BE REPLACED.*

Depending on the instrument's input power configuration, the supplied power connector is either a 3-contact housing with wire crimp contacts (requiring a crimp tool), or a three contact "Euro" style plug with wire tension clamps (requiring no special tool, except a small blade screwdriver).

Refer to paragraph 3.4 for further input power and connector information.

Connect the DC input to the instrument's connector labeled *PWR* as follows:

DC INPUT POWER CONNECTOR PIN DESIGNATION	
PIN	FUNCTION
1	DC Supply (+)
2	Chassis Ground
3	DC Supply Return (-)

2.3.4 Connecting the Serial Control/Monitor Port

The control and monitor of the instrument's operation is accomplished through an RS-232 interface and two discrete monitor signals. Use a ‘straight pin to pin’ cable (DTE to DCE) to connect the instrument to a Personal Computer. Use a custom cable to connect the instrument to a computer *and* another control device.

Refer to paragraph 3.5.3 for detailed connector pin designations and signal descriptions.

Note: The required mating connector is a DE-9S “D-Subminiature” connector (not supplied with the instrument).

Connect the control/monitor device to the instrument’s connector labeled *CONTROL*.

2.4 POWERING-UP THE INSTRUMENT

Apply DC power to the instrument. The following sequence of events takes place:

- After a moment, the instrument runs through its self-test diagnostics.

- At the *initial* application of power*,* the instrument's internal receiver defaults to the Cold Start mode, the position solution defaults to the Position Averaging mode, the internal GPS receiver begins to "search the sky" for all available satellites, and then starts to acquire and track satellites.

- At *subsequen*t application of power the internal receiver attempts to determine the current position of the connected antenna. If the prior position solution mode was Known mode and the present position is verified to be within 300 meters of the position stored during the prior operation, then the position solution mode remains in Known. If the current antenna position is not within 300 meters of the stored position, the instrument automatically switches to the Position Averaging mode. If the prior solution mode was Position Averaging, then the instrument remains in Position Averaging. After the position data is been averaged for a period of 1-hour, the position mode is automatically set the Known mode.

- Further operation is automatic. As soon as the receiver has locked to the satellites, the disciplining of the internal timing and frequency start. After the instrument's internal timing and oscillator frequency have been adjusted sufficiently to provide accurate output signals, the instrument enters the Time Locked mode and, unless otherwise configured, *the 1 PPS output signal becomes available.* (See paragraph 2.6.7 to enable/disable the 1 PPS output).

  The elapsed time for each step varies, depending on the satellite visibility. When operating in the Position Averaging mode at power-up and with many satellites visible, the internal receiver may require up to 30 minutes to acquire satellites and calculate the coarse antenna position. The antenna position solution improves over a period of time through further averaging.

  In the event no satellites are tracked for two minutes or more, then the instrument enters the Holdover mode. As soon as the conditions are in place to start re-acquire time lock, the instrument enters the Recovering mode until the instrument enters the Time Locked mode.

2.5 COMMUNICATING WITH THE INSTRUMENT

Any computer with an RS-232 serial interface and suitable terminal emulation software (such as HyperTerminal) can be used to communicate with the instrument. Most computers have a terminal program installed, especially computers with Windows.

The instrument's operation can be monitored and changed via the commands listed in FEI-Zyfer Document 380-8020, NanoSync User RS-232 Communication Protocol.

Windows User Interface Application Program GPSMon, FEI-Zyfer P/N 373-3200, provides another method of communicating with the instrument. The program is supplied in the instrument’s shipping kit. All the user programmable functions and parameters can be quickly accessed through pull down menus.

The following paragraphs detail the communications by means of a terminal emulation program as well as the use of the Windows User Application program.

2.5.1 Configuring the Control Port

In order to communicate with the instrument, the computer's serial communication port configuration must be set the same as the instrument's settings. The instrument's settings cannot be altered. The default settings are:

Parameter	Default Setting
Baud Rate	19200
Parity	NONE
Data Bits	8
Stop Bits	1

2.6 CUSTOMIZING THE OPERATION

After the instrument is installed and operating, the user may elect to customize the installation as described below.

2.6.1 Set Antenna Cable Delay Compensation

For the most accurate timing, it is necessary to compensate for the signal delay caused by the antenna system. The delay is the sum of all signal delays between the antenna and the receiver. The major contributor is the delay caused by the antenna cable length. The typical amount of error is on the order of a few hundred nanoseconds.

Note: When the antenna cable delay is entered after the instrument has finished the Warm-Up mode, it may cause the instrument to switch to the Holdover mode, and cause an increase in the time required to enter the Time Locked mode. Therefore, it is recommended to set the antenna delay compensation during the instrument's Warm-Up mode.

Delay values for recommended cable types are listed in the following table.

CABLE TYPE	DELAY VALUE
Belden® 9311 (RG-58)	4.36 ns/m (1.33 ns/ft)
Belden® 8267 (RG-213)	4.99 ns/m (1.52 ns/ft)
Belden® 9104 (RG-59)	4.00 ns/m (1.22 ns/ft)
Belden® 9913 (RG-8)	3.90 ns/m (1.19 ns/ft)

In application where exact timing is required, calculate the systems cable delay by multiplying the actual cable length and the delay value from the above table.

For example, if the antenna system includes 50 feet of RG-59 cable, the total cable delay is: 50 m x 1.22 ns/ft = 61 ns. When entering the data, round off the delay value to the nearest nanosecond. Set the antenna delay compensation through the Windows User Application program's *Setup* pull down menu *Antenna Delay*, or:

> Set the antenna cable delay compensation using RS-232 command:
> $ANTD,61*<cr/lf>

Note: This command can also be used to compensate for system offsets external to the instrument. The maximum offset is +/-99,999 ns. Any programmed "+" offset causes timing outputs to occur sooner in time, and a "-" offset causes timing outputs to occur later in time.

2.6.2 Set System Offset

In some applications the user may wish to align the 1PPS/1PP2S output reference pulse to some other reference without changing the antenna cable delay compensation value. The system offset can only be set through the serial I/O port.

> Set the system offset value using RS-232 command:
> $OFST,X*<cr/lf>, where "X" is the offset value in nanoseconds.

The maximum offset is +/-99,999 ns. Any programmed "+" offset causes timing outputs to occur sooner in time, and a "-" offset causes timing outputs to occur later in time.

Example 1: $OFST,1475*<cr/lf>

In this command, the output pulse is offset by 1475 ns ahead of UTC 1 PPS.

Note: the "+" is not necessary for positive offset entries.

Example 2: $OFST,-2500*<cr/lf>

In this command, the output pulse is offset by 2500 ns behind of UTC 1 PPS.

Note: When the offset is entered after the instrument has finished the Warm-Up mode, it may cause the instrument to switch to the Holdover mode, and cause an increase in the time required to enter the Time Locked mode. Therefore, it is recommended to set the offset during the instrument's Warm-Up mode.

2.6.3 Disable/Enable Satellite Tracking

In some applications, the user may want to disable certain satellites from being tracked. RS-232 commands SATD and SATE can be used to disable and enable the tracking capabilities of satellites. Please refer to FEI-Zyfer Document 380-8020, NanoSync User RS-232 Communication Protocol for details.

2.6.4 Select Automatic Determination of Antenna Position

If the exact position of the antenna is not known, the user can select the Position Averaging mode (Factory default). The instrument will determine the antenna's position by averaging the position solution. At the completion of the averaging period, the instrument automatically switches to the Known Position mode, using the calculated refined position solution. The instrument needs to track a minimum of four satellites to operate in Position Averaging mode. Position solution data must meet certain criteria before it is used in the averaging calculations.

Select the Position Averaging mode through the Windows User Application program's *Setup* pull down menu *Mode*, or

> Set the instrument to the *Position Averaging* mode using RS-232 command:
> $TRMO,P*<cr/lf>

Timing accuracy is slightly degraded while operating in the Position Averaging *mode even if the antenna remains stationary. This is due to the fact that the GPS receiver must not only compute time, but position as well.*

2.6.5 Accelerate Synchronization Process

In order to achieve steady state operation, the receiver must know the position of the antenna. The receiver is capable of automatically determining the antenna's position; however, to speed up the synchronization process while operating in a known location, the user can select the Known Position mode, and the exact position of the antenna (latitude, longitude, and altitude). If the antenna's position data is known to be accurate, select the Known Position mode through the Windows User Application program's *Setup* pull down menu *Mode,* or:

> Set the instrument to the *Known Position* mode using RS-232 command:
> $TRMO,K*<cr/lf>

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

After the Known Position mode has been selected, the accurate antenna position data must be entered through the Windows User Application program's *Setup* pull down menu *Antenna Position*, or:

> Set the antenna position latitude/longitude/altitude data using RS-232 command:
> $SPOS,33,48.6127,N,117,54.6167,W,234*<cr/lf>

In this example, the position is: Latitude N 33^{o}, 48.6127', Longitude W 117^{o}, 54.6167', and elevation 234 meters. *Note that the position is entered in degrees and decimal minutes,* ***not in degrees, minutes, and seconds format****.*

2.6.6 Set Local Time Rather than UTC or GPS Time

The instrument's output time can be expressed in UTC or GPS time, and can be adjusted for local time zone offset. The factory default setting is *UTC* without local offset. Changes in setting are non-volatile.

UTC is offset from GPS time by the number of accumulated leap seconds that have occurred since midnight of January 6, 1980 UTC. When operating in the GPS (or Local GPS) time mode, the instrument's current output time is in referenced to GPS time. When operating in the UTC (or Local UTC) mode, the output time is referenced to UTC.

The time reference mode and local time zone offset can be changed through the Windows User Application program's *Setup* pull down menu *Mode*, or:

> Set the local time offset from UTC time using RS-232 command:
> $TIMM,*M*,*h,m**<cr/lf>

Example 1: $TIMM,3,8,0*<cr/lf>

In this command, 3 selects local UTC time mode, and the time is offset +8 hours, 0 minutes from UTC. The offset value can range from -14 hours, 30 minutes to +14 hrs, 30 minutes.

Example 2: $TIMM,4,-12,30*<cr/lf>

In this command, 4 selects local GPS time mode, and the time is offset -12 hours, 30 minutes from UTC. The offset value can range from -14 hours, 30 minutes to +14 hrs, 30 minutes.

Example 3: $TIMM,2*<cr/lf>

In this command, 2 selects UTC time mode. Offset hours/minutes offset fields do not need to be selected; if they are selected, the hours/minutes data is ignored.

Daylight Saving Time - When the instrument is configured to generate Local UTC or Local GPS time, the local time offset must be changed by the user to compensate for Daylight Saving time.

2.6.7 Enable/Disable Reference Pulse Output

The output pulse can be selected to either be present all the time (*Enabled*), or only after the instrument has completed the Warm-Up mode (*Disabled*) and the pulse is accurate. The factory default selection is *Disabled.* Changes in selection are non-volatile.

The output pulse can be enabled/disabled through the Windows User Application program's *Setup* pull down menu *Ref Pulse Control Enable*, or:

> *Enable* the output pulse using RS-232 command:
> $PULE,1*<cr/lf>
>
> *Disable* the output pulse using RS-232 command:
> $PULE,0*<cr/lf>

2.6.8 Select Reference Pulse Output Rate

The rate of the output pulse can be selected to be one pulse every second (1PPS), or one pulse every even second (1PP2S). The factory default selection is *1PPS*. Changes in selection are non-volatile.

The rate of the output pulse can be selected through the Windows User Application program's *Setup* pull down menu *Ref Pulse Control Rate*, or:

Set the output pulse rate to *1PPS* using RS-232 command:
$PULR,1*<cr/lf>

Set the output pulse rate to *1PP2S* using RS-232 command:
$PULR,2*<cr/lf>

2.6.9 Select Output Pulse Polarity

The polarity of the output pulse can be selected to be either a positive going pulse with its leading (rising) edge on-time (synchronized) to UTC 1PPS, or a negative going pulse with its leading (falling) edge on-time. The factory default selection is *Positive* (+). Changes in selection are non-volatile.

The polarity of the output pulse can be selected through the Windows User Application program's *Setup* pull down menu *Ref Pulse Control Polarity*, or:

Set the output pulse polarity to *Positive* using RS-232 command:
$PULP,+*<cr/lf>

Set the output pulse polarity to *Negative* using RS-232 command:
$PULP,-*<cr/lf>

2.6.10 Reset Internal GPS Receiver

In the rare case that it is suspected that the receiver’s memory has been corrupted, causing erroneous results or no operation at all, the receiver should be reset. Two reset modes are available: *Cold Start* and *Warm Start*.

- *Cold Start* - Forces the receiver’s current almanac and ephemeris to be cleared, and sets the position solution mode of the receiver is set to Position Averaging. The starting antenna position data is the data that was present prior to the cold reset. The receiver starts to "search the sky" for active satellites. After a satellite is acquired, the receiver starts to collect a new almanac and ephemeris. This process could require 12 to 30 minutes to complete; however, the assembly normally achieves the Time Locked mode within 10 minutes. Cold Start the receiver through the Windows User Application program's *Setup* pull down menu *Mode*, or:

  Set the receiver to *Cold Start* using RS-232 command:
  $RSTG,C*<cr/lf>

- *Warm Start* - Forces the receiver to search for, acquire, and track satellites using the current almanac data and ephemeris, position mode and antenna position data. The time required to track satellites is up to a few minutes, depending on satellite visibility. Warm Start of the receiver cannot be done through the Windows User Application program'. It can only be commanded through the I/O port.

  Set the receiver to *Warm Start* using RS-232 command:
  $RSTG,W*<cr/lf>

2.7 MONITORING THE OPERATION STATUS

2.7.1 Using the Windows User Interface Application Software

Windows User Interface Application software GPSMon, FEI-Zyfer P/N 373-3200, provides a quick method of monitoring and changing the instrument's operation status. The application is easy to install and operate on computers running Windows 3.1, Windows 95, Windows 98, or Windows XP. (The program will not run under DOS).

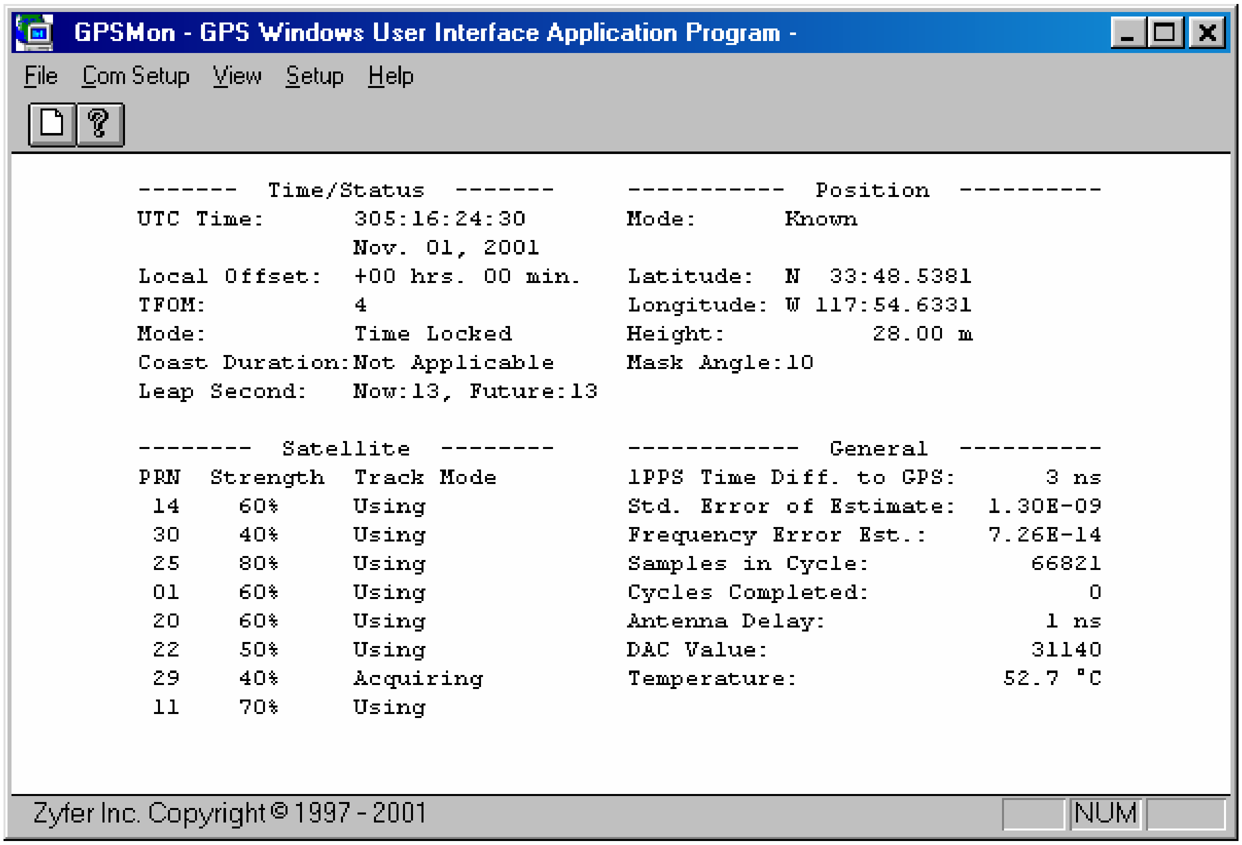


Figure 2-1 Sample Operation Status Screen

The status screen has four major sections:

- Time/Status
- Position
- Satellite
- General

The Time/Status section of the screen shows the current time and date, Local Offset (time zone), the reference Time *(UTC or GPS),* the Time Figure of merit (TFOM), the operation Mode, and the Leap Second status.

The *Time* message indicates the reference of the displayed time: GPS, UTC, Local GPS, or Local UTC. The user can change the reference time through the Windows User Interface Application program's *Setup* pull down menu *Mode*.

Local Offset indicates the time difference, in hours and minutes, between the selected reference time (UTC or GPS) and the local time. The user can change the local offset through the Windows User Application program's *Setup* pull down menu *Mode*.

TFOM (Time Figure of Merit) indicates the accuracy of the instrument's pulse output. The following table lists the TFOM values that could be displayed along with the corresponding time error.

TFOM Value	Time Error	TFOM Value	Time Error
4	to ≤ 1 µs	7	> 100 µs to ≤ 1 ms
5	> 1 µs to ≤ 10 µs	8	> 1 ms to ≤ 10 ms
6	> 10 µs to ≤ 100 µs	9	> 10 ms

Mode indicates the current operation mode: Warm Up, Time Locked, Coasting, or Recovering.

- *Warm Up* indicates that the instrument has not achieved initial GPS lock since its power was applied. During the first ten minutes after power-up, the internal oscillator is warming up and the internal receiver is acquiring satellites.
- *Time Locked* indicates that the instrument's major and minor time (days through seconds) is locked to GPS, and the internal oscillator is being disciplined.
- *Recovering* indicates that the instrument is adjusting its internal timing or the frequency of the oscillator until the conditions for time lock are met.
- *Coasting* indicates that the instrument has lost satellite lock and is waiting for conditions needed to allow the recovery process from Coasting (Holdover) to Time Locked. The time and frequency accuracy is maintained by applying corrections to the oscillator using temperature effect data obtained during factory calibration, and oscillator-aging characteristics learned while locked to GPS.

Coasting Duration indicates the duration of the present coasting period. The duration is expressed in days *(d)*, hours *(h)*, and minutes *(m)*. When the instrument operates in the Time Locked or Recovering mode, *Not Applicable* is indicated.

The *Leap Second* message indicates, in seconds, the current difference (*Now*) and the *Future* difference between UTC and GPS. If the future value is different than the current value, it indicates that a leap second is scheduled to be added (or subtracted) in the near future. Normally, when a leap second is scheduled to occur, it is added (or subtracted) on June 30th or December 31st at midnight UTC.

The Position section of the screen shows the position solution *Mode*, the *Latitude*, *Longitude*, and *Height* of the external antenna.

Mode indicates whether the instrument is set to the Position Averaging or Known Position mode. The user can change the mode through the Windows User Application program's *Setup* pull down menu *Mode*.

- *Position Averaging* indicates that the antenna's position is being determined automatically. The position is surveyed using data from the orbiting satellites. After surveying for a minimum of 1 hour, the position solution mode automatically changes to Known mode. *Complete in: HH:MM:SS* indicates the time remaining in the averaging process.
- *Known* indicates that the user has provided the antenna position, or the position has been found through the Position Averaging process. This mode should only be used when the system is operating in a stationary location.

Latitude, Longitude, Height indicate the antenna position coordinates used by the instrument. During the Position Averaging mode, the indicated coordinates are the estimated average latitude, longitude, and height. When operating in the Known Position mode, the coordinates are normally those that were automatically determined by the instrument at the completion of the Position Averaging period. The user can enter or change the coordinates through the Windows User Interface Application program's *Setup* pull down menu *Antenna Position*.

The Satellite section of the screen indicates the satellite tracking status and signal strength of the (predicted) visible satellites.

PRN indicates the assigned unique pseudo random noise (PRN) code of the satellite.

Strength indicates the strength of the signal, expressed in percentage from 0% to 100%. Signal strength less than 10% is considered a weak signal that may not be sufficiently strong enough for the instrument's receiver to acquire the satellite(s).

Track Mode indicates how the satellite is being utilized. Three modes could be displayed: Acquiring, Using, and Searching.

- *Acquiring* indicates that information is being read from the satellite
- *Using* indicates that the data received from the satellite is used by the instrument to provide time and position information, and is used to synchronize and discipline the internal oscillator.
- *Searching* indicates that the instrument is attempting to track the satellite.

The General section of the screen shows performance and the status conditions of the 1PPS (or 1PP2S) timing output and the frequency output. In addition, the value of the DAC controlling the instrument's oscillator, and the user selected antenna delay value is shown. For informational purpose, the instrument's internal temperature is also displayed.

1 PPS Time Diff. to GPS indicates the phase difference between the instrument's output pulse (PPS or 1PP2S) and the 1PPS from the GPS receiver output. Typical values range from -100 ns to +100 ns after the internal oscillator is stabilized, while operating in the Known Position mode. When operating in the Position Averaging mode, the typical values range from -300 ns to +300 ns. It is not unusual to have higher values during Position Averaging and the early stages of the oscillator-disciplining period.

Note: This does not necessarily indicate that the instrument's 1PPS or 1PP2S output is in error. Instantaneous timing differences are often the result of Selective Availability or other causes. In other words, the instrument's instantaneous time output may be more precise than the GPS receiver's instantaneous 1 PPS output.

Std Error of Estimate indicates 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 with ovenized quartz oscillators. The value is updated once per every time loop constant. The time loop constant varies from 25 to 2500 seconds, depending on the error corrections being applied.

Frequency Error Est. indicates the 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. Since this output is an average value, it will be inaccurate during the first few hours after power-up and disciplining.

The frequency error shown is the averaged error over the number of measurements indicated by *Samples Completed* number. After the completion of the first 24-hour measurement cycle, the measurement indicates the most recent 24-hour averaged frequency error value, and is updated every 10-seconds when GPS data is available (Time Locked and Recovering modes). The *Cycles Completed* number indicates the total number of completed 24-hour measurement cycles.

DAC Value is the control value sent to the instrument's DAC (Digital to Analog Converter) that controls the oscillator. The number ranges from 0 to 65535.

Antenna Delay displays the user-entered value that is used to compensate for the antenna system propagation delay.

Temperature indicates the measured internal temperature of the instrument.

2.7.2 RS-232 Command Overview

Besides using the GPSMon Windows User Interface Application program (FEI-Zyfer P/N 373-3200), the operation status can also be monitored (and changed) via the serial interface control/status port by commands listed in FEI-Zyfer NanoSync User RS-232 Communication Protocol Document 380-8020. Some examples are:

TRMO Query Command - This command returns the status of the active position solution mode: *Position Average,* or *Known Position.* (Through this command, the position solution mode can also be changed, and through command SPOS the position data can be entered).

- ***Position Averaging*** - This is the default mode at initial power-up, and when the internal receiver is in the Cold Start mode. In the Position Averaging mode, the instrument automatically determines the antenna position. Accurate antenna position data is required to deliver specified performance. At least four satellites must be tracked in order to obtain survey data.

  The instrument surveys the antenna position using data from the orbiting satellites. After surveying for 1-hour, the position solution mode automatically changes to *Known Position*.

- ***Known Position*** - This mode is automatically selected after the instrument has completed the position average computation and after application of power, if the position solution mode prior to the removal and restoration of power was also the Known Position mode. The user should only enter this mode if the user has entered accurate antenna coordinates.

PAVG Query Command - When operating in the Position Averaging mode, this command returns the current average surveyed antenna position data (Latitude, Longitude, and Altitude). When operating in the Known Position mode, the command returns the last average antenna position data that is being used to provide accurate time and frequency output signals.

SIGQ Query Command - This command returns Satellite Status information including *Satellite PRN number*, *Signal Strength*, and *Mode* (Searching, Acquiring, or Using).

SPOS Query Command - This command returns the antenna position data used by the receiver while operating in the Known Position mode. When operating in the Position Averaging mode, the returned data is the dynamic instantaneous position fix output from the receiver.

TIME Query Command - This command returns the following information: *Time* (Julian format), *Time Mode* (UTC, Local UTC, GPS, Local GPS), *Time Figure Of Merit* (TFOM), and *Operation Mode* (Warm-up, Time Locked, Holdover, or Recovering).

- ***Time*** - When the instrument is powered up, the time stored in the instrument may not be correct. The actual time will be valid after the instrument's GPS receiver has tracked one satellite.
- ***Time Mode*** - There are two basic ways to express time: GPS or UTC. GPS time is offset from UTC by the number of accumulated leap seconds that have occurred since midnight of January 6, 1980 UTC. It is possible to offset the GPS or UTC time to adjust for local time zone offset from UTC. When operating in the GPS (or Local GPS) mode, the instrument's current output time is in referenced to GPS time. When operating in the UTC (or Local UTC) mode, the output time is referenced to UTC. To change the Time Mode selection, refer to command TIMM.

  FEI-Zyfer recommends using the UTC or GPS mode without local offset to prevent temporary loss in time synchronization between systems operating in different time zones, caused by the daylight saving event.
- ***TFOM (Time Figure Of Merit)*** - Indicates the accuracy of the instrument's time and timing output. The following table lists the TFOM values with the corresponding Time Error.

TFOM Value	Time Error	TFOM Value	Time Error
4	to $\leq$ 1 μs	7	> 100 μs to $\leq$ 1 ms
5	> 1 μs to $\leq$ 10 μs	8	> 1 ms to $\leq$ 10 ms
6	> 10 μs to $\leq$ 100 μs	9	> 10 ms

  Normally, the TFOM is 4 while operating in the Known Position mode, and 4 or 5 when operating in the Position Averaging mode.
- ***Operation Mode*** - There are four operating modes: *Warm-up*, *Time Locked*, *Holdover (Coasting)*, and *Recovering.*
  - *Warm-up* - Indicates that the instrument has not achieved initial GPS lock since it was powered. During the first ten minutes after power-up, the internal oscillator is warming up and the internal receiver is acquiring satellites.
  - *Time Locked* - Indicates that the instrument's major and minor time (days through seconds) is locked to GPS, and the internal oscillator is being disciplined.
  - *Holdover (Coasting)* - Indicates that the instrument is waiting for conditions needed to start the recovery process from Holdover to Time Locked. The time and frequency accuracy is maintained by applying corrections to the oscillator using temperature effect data obtained during factory calibration, and oscillator-aging characteristics learned while operating locked the GPS.
  - *Recovering* - Indicates that the instrument is adjusting its internal oscillator until the Time Locked mode criteria are met.

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Section 3 Specifications

3.1 INTRODUCTION

The following paragraphs contain the specifications for the NanoSync.

3.2 MECHANICAL

The instrument's height is dependent on the configuration of the instrument. Refer to the *NanoSync Configuration* sheet in the beginning of this manual. If applicable, the mechanical specification of an instrument configured with an *Option* is located in the supplied applicable *Option Manual Supplement.* The following specifications apply only to standard instruments with different *Input Power* configurations.

Height ....1.25" (32 mm) maximum
Width..4.00" (102 mm) maximum
Depth (excluding protrusions) ....3.45" (88 mm) maximum
Weight... 0.7 lb (0.33 kg) maximum
Finish ....Brushed aluminum

3.3 ENVIRONMENTAL

Operating Altitude .... -60 m to 4000 m
Storage Altitude .... -60 m to 9000 m
Operating Temperature...-5º C to +55º C
Temperature Rate of Change ....±10º C/Hour maximum
Storage Temperature..-40º C to +85º C
Relative Humidity ....5% to 95%, non-condensing

3.4 POWER REQUIREMENTS

The instrument's input power is dependent on the configuration of the instrument. At the present time only one power option is available. The input power mating connector is supplied the shipping kit.

3.4.1 - 02 Input Power Configuration

Voltage.. +12 VDC, +/- 5%
Power (+25º C / Warm-up)... 5 W / 10 W maximum
Input Over-Current and Reverse Voltage Protection......................Internal fuse
Isolation ....None: - Input return connected to chassis/signal ground
Connector 3-Contact
Mating Connector and contacts ....Supplied
(Molex 39-01-4031 and 39-00-0039
Input Power Connector Pin Designation
Pin 1 ....+ DC Input (high side)
Pin 2 ....Chassis ground
Pin 3 .... - DC Input (return)

3.5 ELECTRICAL SIGNALS

3.5.1 10 MHz Output

One (1) 10 MHz source is provided. Unless otherwise stated, the specifications apply when the instrument is operating in the Known Position mode, the antenna's geodetic position is known within 25 meters, the antenna is in a fixed location, and the internal oscillator has been disciplined for at least three days.

Specifications

- Wave Shape .... Sinusoid
- Distortion
  - Harmonic .... -40 dBc
  - Non-Harmonic .... -80 dBc
- Amplitude .... $\geq$ 7 dBm into 50 Ω
- Coupling .... DC
- Protection
  - Terminating Impedance .... Infinity to short circuit
- Source Impedance .... 50 Ω nominal
- Connector Type .... SMA male
- Accuracy Error
  - Time Locked .... 1×10^{-12} (1-day average)
  - Holdover (Coasting) .... 0.8×10^{-10} / day at 95% probability (at ambient temperature change < ±10º C)
- Short Term Stability (Time locked or Holdover) (Allan Deviation)
  - 1 sec .... 3×10^{-11}
  - 10 sec .... 1×10^{-11}
  - 100 sec .... 1×10^{-10}
- Phase Noise .... -80 dBc/Hz @ 1 Hz
  - -100 dBc/Hz @ 10 Hz
  - -115 dBc/Hz @ 100 Hz
  - -135 dBc/Hz @ 1 kHz
  - -140 dBc/Hz @ 10 kHz to 100 kHz

3.5.2 Reference Pulse Output

One output pulse source is provided. *This output is normally enabled all the time, unless disabled during the Warm-Up period by the user through an external serial command.* Unless otherwise stated, the specification apply when the instrument is operating in the Known Position mode, the antenna's geodetic position is known within 25 meters, the antenna is in a fixed location, the proper antenna/cable delay has been selected. and the internal oscillator has been disciplined for at least three days.

Note: The output connector identification is either 1 PPS or 1 PPS/ 1 PP2S.

Specifications

Enable* .... User selectable to enable output
all the time or after Warm-Up
(Factory set to after Warm-Up)
Rate*...User selectable 1 pulse every second (1PPS)
or 1 pulse every even second (1PP2S)
(Factory set to 1PPS)
Wave Shape ....Pulse
Pulse Width.....................................User selectable 10 us, 20 us, 1 to 999 ms
(Factory set to 2 ms)
Synchronization Reference................................... GPS or UTC, user selected
(Factory set to UTC. Default to previous selection)
Synchronization* ....User selectable rising (leading) edge on-time
or falling (leading) edge on-time
(Factory set to rising edge on-time)
Output Drive
High Level.. $\geq$ +2.5 V into 50 Ω load
($\geq$ 4.5 V open circuit)
Low Level .... $\leq$ +0.2 V into 50 Ω load
Connector Type .... SMA male
Accuracy Error
Time Locked...0.3 µs (referenced to UTC)
0.1 µs at 95% probability
while tracking 4 or more satellites
Holdover (Coasting)
At ambient temperature change < ±10º C .... 7 µs / day
At full ambient temperature change .... 13 µs / day

3.5.3 Control Interface Port

The control and monitor of the instrument's operation is accomplished through an RS-232 interface and two discrete monitor signals. If both the RS-232 interface signals and the discrete monitor signals are to be connected, then a costume cable is required to connect a Personal Computer (PC) and/or another control device to the instrument's connector labeled *CONTROL*. The connections are as follows:

CONTROL INTERFACE CONNECTOR PIN DESIGNATION		
PIN	SIGNAL	DESCRIPTION
1,4	No Connection	
2	Output (TXD)	RS-232 OUTPUT
3	Input (RXD)	RS-232 INPUT
5,9	Ground	SIGNAL RETURN, GROUND POTENTIAL
6	TFOM (Timing Accuracy)	Timing accuracy status (Open Collector)
7	ALARM	Alarm status (Open Collector)
8	UNIT PRESENT (OUTPUT ENABLE)	+5 VDC through 4.7 kΩ resistor (If used as an input signal, then a low logic level disables 1 PPS and 10 MHz output)

There are two types of serial cable connection in the RS232 standard, DTE connections and DCE connections. DTE stands for Data Terminal Equipment and DCE stands for Data Communications Equipment. DTE connections are found on the serial port of a PC. A DCE connection is similar to a DTE connection except that the Transmit & Receive connections are switched. The instrument is considered DCE. Use a *straight* RS232 cable (pin to pin) to connect the instrument to a DTE device, such as a PC,

If a null modem cable is accidentally used, then the transmit line on each device will be connected to the transmit line on the other device and the receive lines will likewise be connected to each other. This results in the inability to communicate with the instrument!

3.5.3.1 Serial Input/Output Port

A bi-directional DCE RS-232 control interface port is provided for remote control and monitor of the instrument. The control interface port is accessible on the instrument's DE-9S (female) connector labeled *CONTROL* as follows:

Serial Interface Signal Details

Connector Type	9-Contact D-Subminiature
Signal Levels	Per RS-232C
Baud Rate	19200
Data Bits	8
Stop Bits	1
Parity	1
Handshake	None (Off)
Command Protocol	Per FEI-Zyfer Document 380-8020

3.5.3.2 Discrete Monitor Signals

Two discrete hardware status monitor output signals are provided:

TFOM – This is an open-collector output signal to indicate time output accuracy.

The signal requires an external pull-up resistor. It is pulled to ground potential when the instrument's estimated output timing error (TFOM) is $\leq$ 4.
The output becomes high impedance (open) when the instrument is operating with a TFOM > 4.

ALARM – This is an open-collector output signal to indicate the Alarm status of the instrument.

The signal requires an external pull-up resistor. It is pulled to ground potential when no alarms are detected in the instrument.

The output becomes high impedance (open) when the instrument has an alarm condition.

Discrete Signal Specifications

Circuit Type..Open collector NPN transistor
Pin 6 Function.. TFOM $\leq$ 4 = "On"
.... TFOM > 4 = "Open Circuit"
Pin 7 Function..No Alarm = “On”
.... Alarm = “Open Circuit”
"On" Sink Current... 100 ma maximum
"On" Voltage ....+0.3 VDC maximum
Open Circuit Voltage...+30 VDC maximum
Reverse Voltage ....-2 VDC maximum

3.5.5 Antenna Interface

A connector is provided to connect the GPS satellite signals, received by an external antenna, to the instrument's receiver. The center conductor of this connector can also be used to supply DC power to the antenna and, if used, to an in-line amplifier.

Connect Type...SMB
RF Input...15 dB to 25 dB @ 1575 MHz
Power Source for External Antenna......................+ 5 VDC, +/- 10% at 100 ma
Protection... short circuit to ground

3.6 OPTIONAL ANTENNA KIT

Optional antenna kit FEI-Zyfer P/N 0810384 includes a 50 ft (15 m) RG-59 coaxial cable, an antenna with internal low noise pre-amplifier, and a 1” OD pipe-mounting adapter.

Connector Type .... TNC female
Gain at 1575 MHz .... 38 dBi typical
30 dBi minimum at 90° elevation angle
Operating Temperature...-40º C to +85º C
Storage Temperature...-45º C to +90º C
Humidity..Outdoors / All-weather
Power Requirements .... +5 VDC, +/-10% at 30 ma maximum
(+5 VDC is supplied by the instrument)

Declaration of Conformity

Application of Council Directive: 89/336/EEC

Standards to which Conformity is declared:	EN61326: Class A Group 1 EN61000-4-2 EN61000-4-3
Manufacture's name:	FEI-Zyfer inc.
Manufacture's adderess:	1585 South Manchester Ave. Anaheim, CA 92802-2907 (714) 780-7685
Equipment description:	GPS Synchronized Time and Frequency Module
Epuipment class:	Laboratory, Measurement, & Process Control Equipment: Industrial Environment
Model numbers:	NanoSync 380-1XX-XX NanoSync 380-2XX-XX NanoSync II 380-3XX-XX NanoSync II 380-5XX-XX NanoSync II 380-6XX-XX

I the undersigned, hereby declare that the equipment specified above, conforms to the above Directive(s) and Standard(s)

Anaheim, CA
Place

Signature

Larry Mountford
Full Name

Mgr. Q.A.
Position

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