datum

Installation & Operation Manual

LIMITED 1 YEAR WARRANTY

The seller warrants that each article of goods sold by it will at the time of shipment be free from defects in materials furnished and workmanship performed by the seller. This warranty and seller s liability are limited to either granting credit or repairing or replacing, at seller s option, with reasonable promptness after return to seller of any article which is disclosed to seller s satisfaction to be defective, and only if said article is returned to the seller promptly after discovery of such defect and in no event later than 12 months (or such other time period as may be specified in writing as a warranty period for a particular article) from the date of delivery thereof. Normal transportation charges in connection with an article returned shall be at the seller s expense, but only if the seller is responsible under the terms of this warranty. This warranty does not extend to any article which has been subject to misuse, neglect, or accident, nor does it extend to any article which has been repaired or altered by other than the seller. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND THE RIGHTS AND REMEDIES PROVIDED HEREIN ARE EXCLUSIVE AND IN LIEU OF ANY OTHER RIGHTS OR REMEDIES. IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL DAMAGES.

DATUM will be happy to answer any application or usage questions which will enhance your use of the unit. Please address your requests or correspondence to: DATUM - Irvine, 3 Parker, Irvine, CA 92618-1605,
Attention: Sales Department. In the U.S.A. call. 1-800-337-2866, or (949) 598-7600, Fax: (949) 598-7650.
E-mail: TechSupport.irvine@datum.com

Visit our web site at www.datum.com

European customers may contact: Datum GmbH, Fichtenstr 25, 85649 Hofolding, Germany, Tel: +49.(0)8104.6624.0; Fax: +49.(0)8104.6624.28.

Datum — Proprietary

Notice
Every effort was made to ensure that the information in this document was complete and accurate at the time of printing. However, the information presented here is subject to change.

Applicable Patents
This product is protected under the following U.S.patent numbers: 5,457,430, 5,489,821, and patents pending.

Trademarks
STARLOC II is a registered trademark of Datum.
Other trademarked terms may appear in this document as well. They are marked on first usage.

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List of Illustrations

About this Document

Purpose

This document provides basic recommendations for applications using Datum's STARLOC II Plus® Rubidium oscillator. These guidelines are of necessity generic, as specific product requirements vary from application to application.

Technical Support and Warranty Coverage

Warranty and non-warranty repair support for the STARLOC II Plus® is provided by Datum Irvine's Customer Support group. Designer technical support is provided by application engineering from the Irvine facility's Marketing department during the design process.

Scope

This material consists of a brief description of STARLOC II Plus® design supported by diagrams, description of environmental issues, installation guidelines, required mating connectors, and unit operation. This document is available in both a hardcopy and in Adobe Acrobat Reader (.pdf) electronic format.

Intended Audience

This document is intended for engineers and telecommunications professionals who are designing, installing, operating or maintaining time, frequency, and synchronization systems having a requirement for a small GPS disciplined time and frequency reference.

Prerequisite Skills and Knowledge

To use this document effectively, the user should have a good understanding of digital telecommunications technologies and analog frequency generation and synthesis techniques.

SECTION ONE

1.1 Introduction

The STARLOC II Plus® is a precision GPS time & frequency reference unit in a small, low-cost, low-power package. The basic components of the unit are, Datum’s innovative X72 Rubidium Oscillator, a quartz oscillator and a Global Positioning System (GPS) receiver. An EMI sealed case is optional. With STARLOC II Plus®, it is now possible to reliably and economically achieve the precision time and frequency synchronization required by any base station, E911 location systems or high-speed digital networks.

1.1.1 Overview of Features and Applications

STARLOC II Plus® incorporates an advanced eight-channel GPS receiver, precision Rubidium oscillator, quartz oscillator and improved time synchronization technology. The unit’s GPS receiver receives L1 C/A coded signals from visible GPS satellites using an antenna/preamplifier unit, an integral part of the system. After the hardware has been properly installed and powered up, the system firmware begins collecting data to build the timing almanac and ephemeris for satellite coordinates. These data are used to create the initial reference position. Thereafter, the GPS receiver automatically acquires satellites as they become visible and accesses their data to perform the necessary position and timing calculations.

Figure 1-1. STARLOC II Plus® Precision GPS Time & Frequency Reference

1.1.2. Advantages of **SNAPSHOT**™ Technology

With proprietary SNAPSHOT™ technology, STARLOC II Plus® is capable of quickly performing a self-survey and locking system time, for each each unit in a network of STARLOC II Plus units, to within 20 nsec (RMS) of each other. In routine operation, only one GPS satellite need be visible in order to maintain system accuracy. This is especially important in a crowded urban environment where it is difficult to find ideal antenna locations with an unobstructed view of the sky. DATUM’s advanced T-RAIM algorithm constantly monitors the health of individual GPS satellites, so that a malfunctioning satellite does not negatively affect system accuracy.

During system operation, the GPS receiver disciplines the crystal (XO) oscillator. If the system loses GPS disciplining, the crystal oscillator alone will provide the timing and frequency reference functions. If the oscillator must operate without benefit of GPS disciplining, it begins “flywheeling” and enters what is known as “holdover” mode.

Optional PC Interface diagnostic software runs on a laptop which is connected directly to the unit at the cell site and allows the operator to monitor the operation of the STARLOC II Plus®. The system responds to user requests and displays six different data categories relating to maintenance, system status and operation, and site configurations.

1.1.3 The Global Positioning System (GPS)

GPS is a satellite-based radio navigation system designed by the US Department of Defense to provide continuous velocity, timing and three dimensional positioning information on a global basis.

To ensure a global coverage of any given point on earth, the GPS constellation consists of a minimum of 24 satellites in 6 different orbits forming a “birdcage” approximately 10,000 miles above the earth. Each satellite circles the earth twice a day in a 12 (sidereal) hour orbit emitting continuous timing and navigation signals.

When a STARLOC II Plus® is first powered up, four satellites must be visible on a continuous basis until the initial parameters for the site have been determined. After the site position, altitude and time have been established, only one satellite is required for the unit to establish and maintain precise timing. However, if more satellites are visible, the T-RAIM (Time Receiver Autonmous Integrity Monitoring) algorithm of the GPS receiver detects and removes from the solution those satellites that exceed a predetermined time threshold. This will protect against failed satellites that broadcast inaccurate GPS time and position solutions. This T-RAIM algorithm adds an extra level of system reliability to the timing application.

Since the accuracy of any position fix or velocity computation is directly proportional to the accuracy of the time reference employed, precision timing is the key element of the GPS concept. Each satellite transmits precise time and frequency information as uniquely encoded data transmissions derived from a precision on-board clock, which enables a receiver to determine the distance to the satellite by measuring the arrival time of the signal. Because each satellite broadcasts its own position data, three position dimensions and the site’s receiver clock bias can be derived from simultaneously tracking four satellites and their transmissions.

Satellite data transmissions include orbital parameters that describe the satellite’s position and allow identification of the position (in orbital coordinates) of any unknown receiver/antenna locations on the earth’s surface. These positions are given in a three-dimensional Cartesian coordinate frame defined by the Conventional Terrestrial System (CTS). Standard geodesy documents contain the formulas for transforming Cartesian coordinates into geodetic coordinates - latitude, longitude, and ellipsoidal height.

GPS satellites transmit codes on two L-band frequencies (L1 and L2). The secure precision (P) and coarse acquisition (C/A) codes are transmitted on the L1 frequency (1575.42 MHz). The L2 frequency (1227.6 MHz) is used for P code only. Access to the P code is restricted to authorized users.

Commercial receivers operate on the C/A code. A ground based system of antennas, master control stations, and monitor stations track the satellites through their broadcast signals as the satellites rise over the horizon. Data is uploaded at least once a day to provide a prediction of satellite ephemeris (orbital characteristics) and clock behavior for the next day's operation.

The precision of the GPS Master Control Station is traceable to UTC through the time standards at the United States Naval Observatory, USNO, Washington and the United States National Institute of Standards and Technology, NIST.

The unit receives the L1 C/A coded signals from the GPS satellites and, using them, automatically computes its position and maintains precise timing.

1.1.3.1 Acquisition of GPS Satellites

The GPS receiver normally operates in two modes: "ACQUIRE SAT/POSITION HOLD" or "POSITION FIX". In Position Fix mode, the GPS receiver requires 3 or more satellites to compute the site position and time. In Position Hold mode, the receiver needs only one satellite for timing purposes.

Upon powering-up the system, the unit begins operation configured in Position Fix mode. By default, the initial date and time will be incorrect. This forces the GPS receiver into a cold power-up state (cold start) and it begins searching the sky for all available satellites. After one satellite has been acquired, the date and time are set automatically from the satellite. When three or more satellites are tracked, automatic position computation is initiated. The firmware averages the receiver position for two minutes. The time interval to obtain the initial fix during a cold start is typically 15 minutes (with a maximum of 40 minutes).

At sites where four satellites are not visible simultaneously, the operator must enter the site position manually using DATUM's diagnostic software. Once the position fix has been entered, the STARLOC II Plus® switches to Position Hold mode.

1.2 STARLOC II Plus¤ Theory of Operation

1.2.1 System Initialization

The STARLOC II Plus¤ requires no outside assistance for normal operation, the system is capable of self-initialization and recovery from loss of power. Provisions have been added to store site-specific data in NVM and accept parameters via the serial interface for faster acquisition or higher accuracy. See Section 3 for information on Datum's Operation and Management software utility.

1.2.2 Series of Events – Standalone Mode

Following the application of power the STARLOC II Plus¤ performs a self-test. While the self-test is in progress the system is unable to accept external commands via the serial interface (refer to Section 3). Should the system fail self-test the user will be notified via a fault flag set in the Alarm Indicators field of the System Status page or by an inability to establish communication via the serial interface.

Once the self-test is complete the system will begin determining its location, this is accomplished via the self-survey function. The self-survey begins by averaging the first 10 3D position solutions derived from GPS. This averaged position is then used as the starting position for an on-going average. This averaging will continue for approximately four hours (factory default, can be user defined) with the rolling average position displayed in the Parameters window of the GPS receiver screen. The duration of the self-survey may exceed 4 hours as only valid 3D position solutions are accepted. Should satellite visibility drop below 4 and the system enter 2D position solution mode or less than 3 satellites for acquisition mode, the self-survey counter will not increment. Following the successful completion of a self-survey the three-dimensional position is stored in NVM for future use.

When the position of the system has been established the GPS receiver within the system enters a position-hold mode where Latitude, Longitude and Altitude are frozen. The system then aligns the system 1 PPS as precisely as possible with the 1 PPS derived from GPS. This is indicated as "overdetermined" Clock mode for the Receiver Mode within the Parameters window of the GPS Receiver screen. The estimated system accuracy can be monitored by viewing the PPS and Frequency Quality window on the System Status screen. In a nominal operating environment a display of ± 50 nsec offset for the PPS and ± 10 ppb for the 10 MHz indicate that the system has successfully aligned itself to GPS time and is disciplining normally.

1.2.3 External Aiding

In applications where compensation for delay caused by the RF connecting cable is required, the user has the option of calculating that delay and entering a correction value into the Set Device Controls pop-up window. This is accessed via the Control, Set Device Controls pull-down window. The default value is –2.4700E-007 to compensate for 100 feet of RF cable delay. To access this function Administrative Controls must be enabled (refer to Section 3).

The user also has the capability of entering a three-dimensional position in the form of Latitude, Longitude and Altitude referenced to WGS 84. It is recommended that this be done immediately after the completion of the self-test before GPS satellites are acquired. Once a position is entered the self-survey is terminated and the externally entered position used as the basis for time transfer. Care should be taken to ensure that this position is correct, as this data is not qualified by the unit as is a stored position.

1.2.4 Field Upgrade Capability Using Flash Memory

The STARLOC II Plus¤ contains Flash PROMs. This feature enables complete reprogramming of the unit in the field. This can be done locally via a laptop computer. All customers are notified via Email when a firmware upgrade is available. This notice includes a detailed description of the enhancements offered. Firmware upgrades are offered free of charge to customers with equipment under warranty.

1.3 STARLOC II Plus® SPECIFICATIONS

1.3.1 Electrical Specifications:

Inputs:
L1 GPS (1575.42 MHz) C/A code (from GPS antenna)
24 Vdc ±20% @ 33W

Outputs:
1 PPS TTL @ 50 ohms
10 MHz SINE @ 50 ohms, 13 dBm ±2 dB
+5V @ 80 ma for antenna Amp.
RS-232 for GPS time/status alarms

Accuracy:
Timing Preferred Application (Algorithm TP)
20 nsec RMS between units
Frequency Preferred Application (Algorithm FP)
<5E-11 measured instantaneously
<1E-12 (24 hour average)

Phase Noise @ 10 MHz

	Standard	Low Noise
1 Hz	<-90 dBc/Hz	<-100 dBc/Hz
10 Hz	<-120 dBc/Hz	<-125 dBc/Hz
100 Hz	<-130 dBc/Hz	<-145 dBc/Hz
1 KHz	<-145 dBc/Hz	<-150 dBc/Hz
10 KHz	<-150 dBc/Hz	<-155 dBc/Hz

Holdover[1]:
Standard = <1 µs over 12 hours
Extended Option = < 1 µs over 24 hours

Spurious:
Harmonic: <-30 dBc
Non-Harmonic: <-80 dBc

Timestamp Message:
Calendar date and time to 1 second using Datum Serial Interface Protocol

1.3.2 Environmental Specifications:

Operating Temperature:	0°C to +55°C
Storage Temperature:	-40°C to +85°C
Operational Altitude[2]:	-200 ft to 40,000 feet (12,200 meters)[2]
Operational Humidty:	<90%, non-condensing

1.3.3 Physical Specifications:

Size:	8.5” L X 4.0” W X 1.5” H (see Figure 1-2) (215.9mm L X 101.6mm W X 38.1mm H)
Weight:	~29 ounces (~822 grams)
Fault Indicators:	Software controlled/Power On LED (GRN)
Antenna Input:	TNC Connector
Outputs:	1 PPS and 10 MHz: BNC connectors RS-232: DB-9M ((DTE)
Warranty:	1 year (Consult factory for extended warranty)

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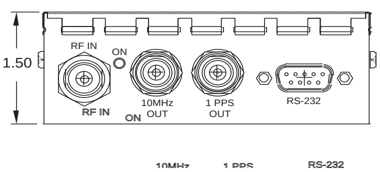
[1] Holdover refers to operation without GPS signals after an initial period of 8 hours of proper GPS reception in temperature controlled environment (+/- 3°C)

[2] Maximum operating temperature derated above 5,000 feet (1,525 meters)

Values are typical unless otherwise noted

J4	9 Pin D-Sub Male
Pin 1	24 VDC Input
Pin 2	RX (RS232)
Pin 3	TX (RS232)
Pin 5	GND
Pin 4,6,7,8,9	Not Connected
J7 (TNC)	Antenna RF Input
J1 (BNC)	1 PPS Output
J6 (BNC)	10 MHz Sine Out



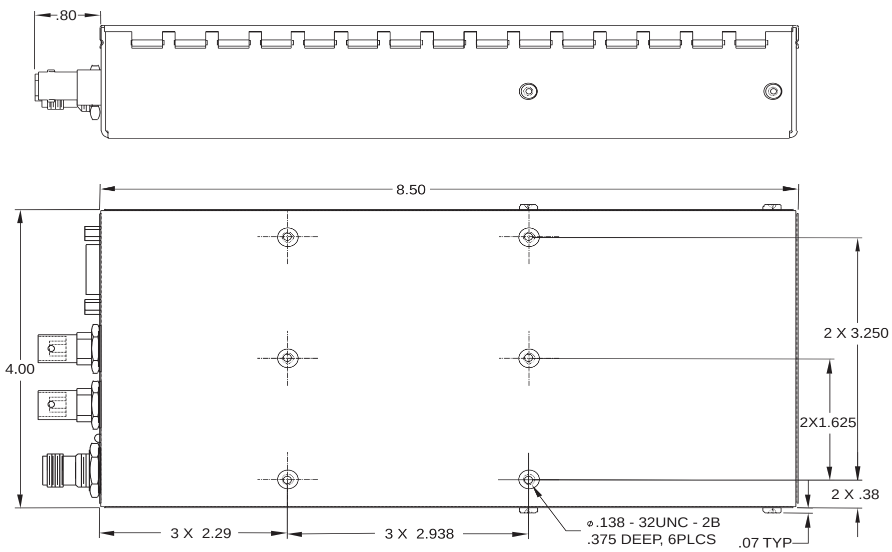


Figure 1-2 STARLOC II Plus® Outline Dimensions

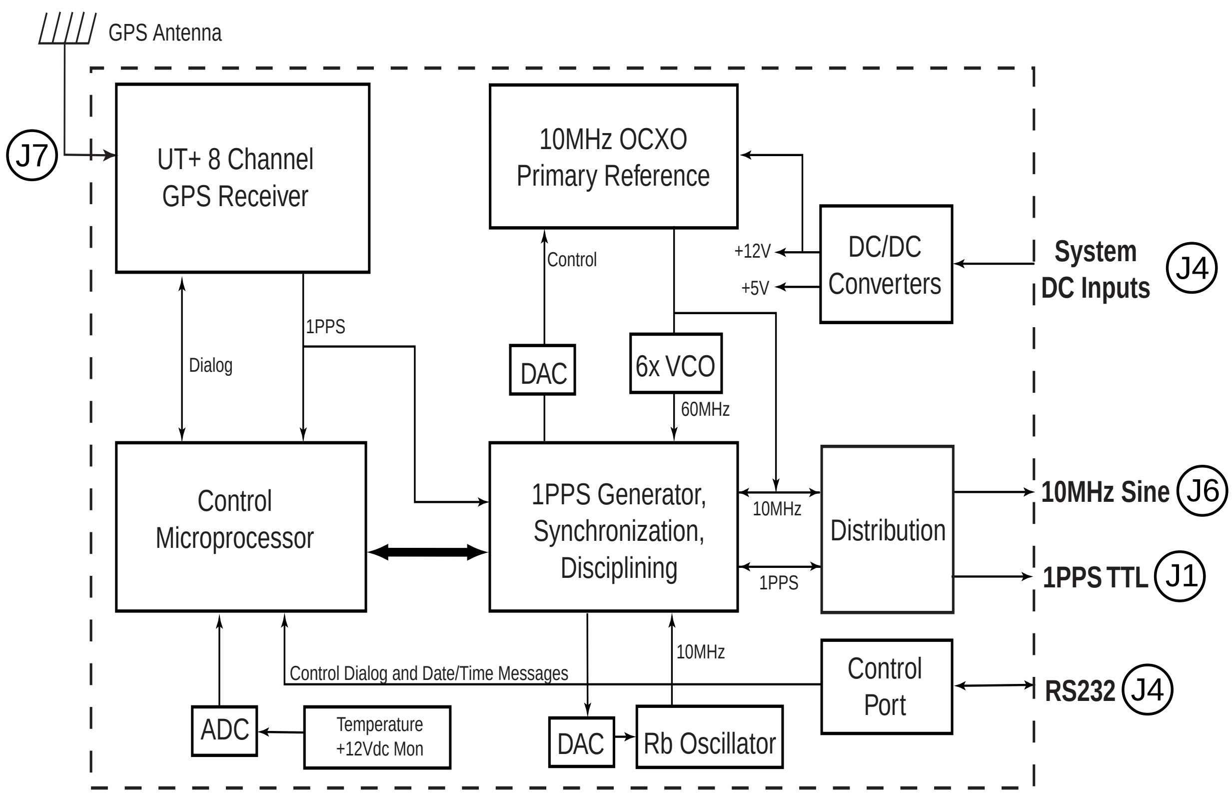


Figure 1-3 STARLOC II Plus® Simplified Block Diagram

SECTION TWO

2.1 Installation

2.1.1 GPS Antenna Guidelines

The GPS antenna is designed to receive transmission signals from a network of GPS satellites in orbit above the earth. In order for the GPS antenna to receive the transmission signal from the GPS satellite, the GPS antenna must have a direct line of sight to the satellite. The optimum site for the GPS antenna would provide an unobstructed view of the skyline in a 360 degree circle around the antenna installation site and have no obstructions above a 7 degree angle measured from a plane running through the antenna and a line of sight from the antenna to the top of the obstruction (see Figure 2-1).

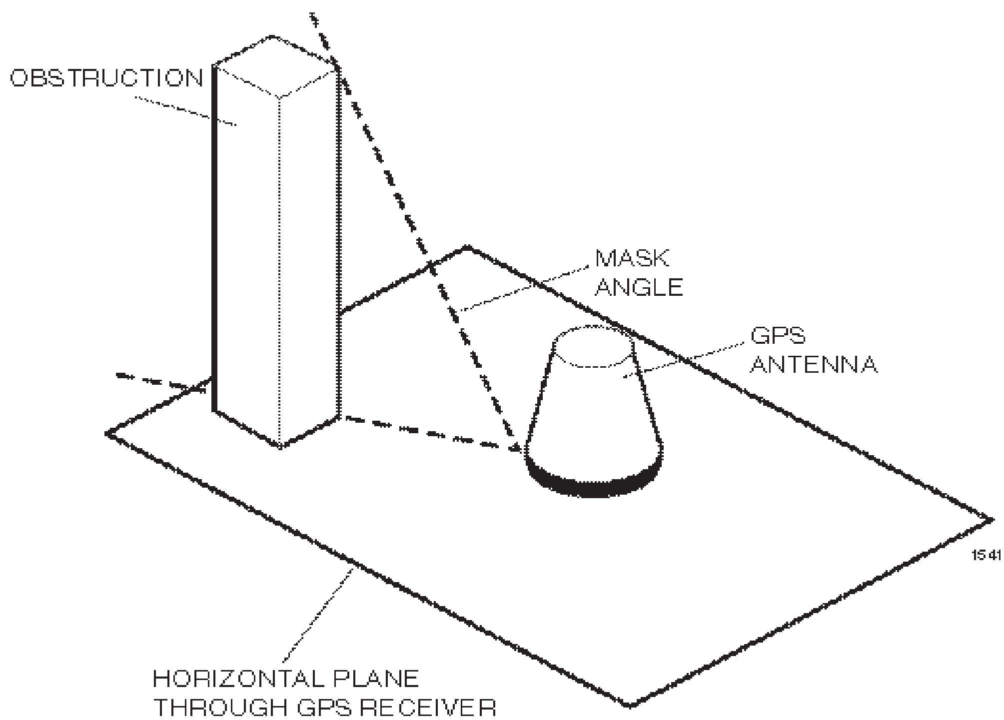


Figure 2-1. Mask Angle Definition

This angle measured from the horizon to the top of an obstruction is generally referred to as the mask angle. Under typical conditions, a satellite will be observable by the GPS antenna when the mask angle is 7 degrees or less, and there are no obstructions between the satellite and the GPS antenna. The GPS antenna installation site should be selected so that no more than 25% of the sky is "masked" by obstructions such as buildings, mountains, etc. and there is a stand pipe, or mast, or other appropriate mounting location available for the GPS antenna kit.

Another consideration for the GPS antenna site is that there are no antennae, microwave dishes or other sources of RF radiation nearby that could affect reception.

2.1.2 GPS Antenna Installation

The GPS antenna must be mounted in an unobstructed location away from tall buildings and trees that would block its view of the horizon (and the GPS satellites passing overhead). The roof of a structure or an antenna tower are ideal locations. It is important that the GPS antenna be mounted so that it is vertical. Bolt the antenna bracket to a center cross member, or to a sidearm. Sidearms extending the antenna three to six feet away from the tower will reduce the influence of the tower mast on the antenna’s reception.

Cables should be secured with corrosion-resistant hardware and incorporate service loops for strain relief. The cable can be attached to the tower by means of beam clamps, butterflies, donuts, snap-in clamps, etc. The method is dictated by the type of tower used. Attach cable mounting hardware every three feet for both vertical and horizontal runs. To prevent water from following the cable into the structure entry port, allow enough slack for a drip loop. In areas where snow and ice may be present, a horizontal ice bridge mounted above where the cable crosses from the tower to the structure entry port will prevent damage from ice chunks falling off the tower.

In climates where electrical storms occur, a Polyphaser® lightning arrestor can be installed according to the manufacturer’s instructions (included with the arrestor) and grounded to a single point ground window inside the structure.

Refer to the GPS Antenna Installation Guide included in the shipping container of the antenna and to Figure 2-2.

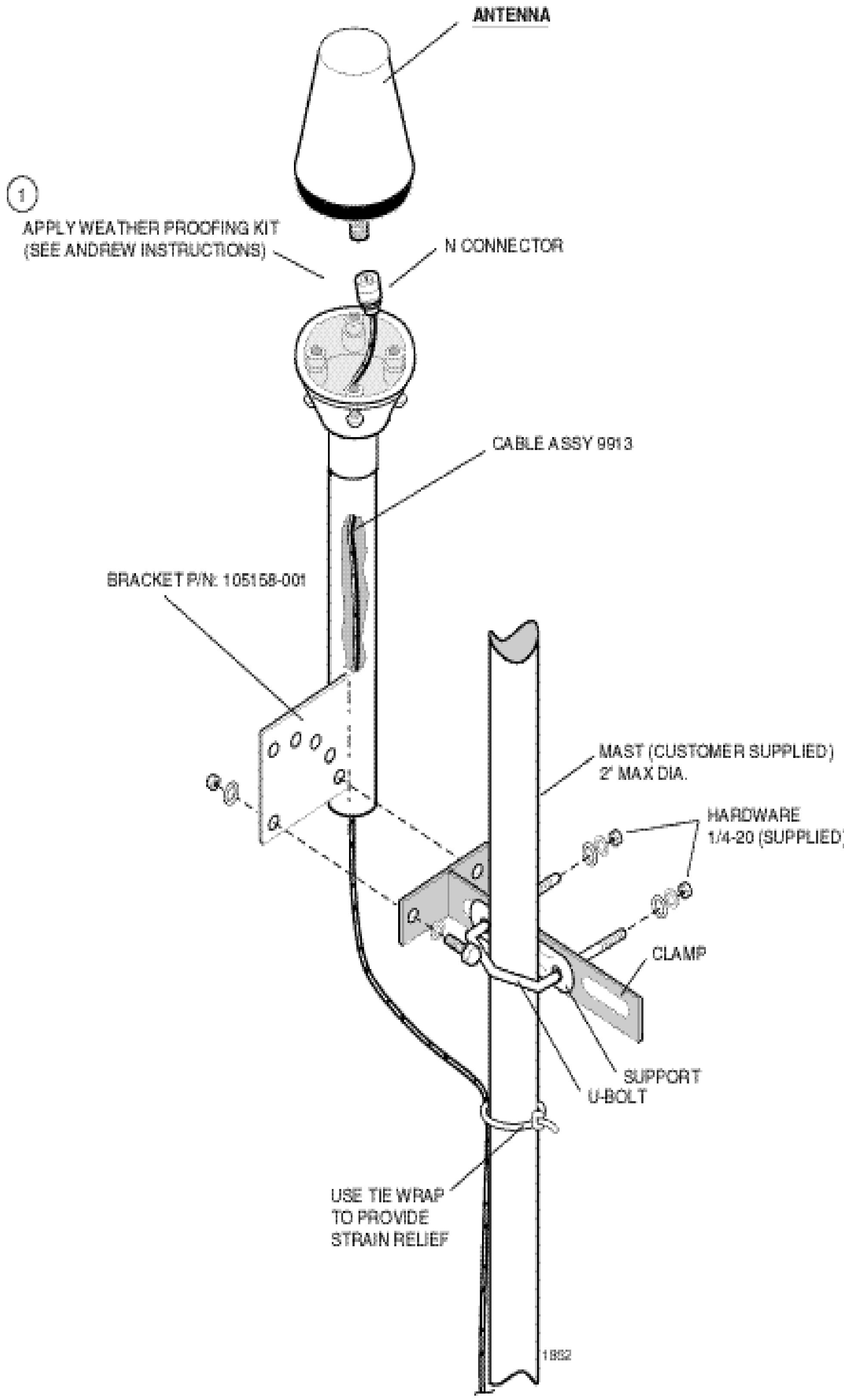


Figure 2-2. GPS Antenna Installation

2.2 Setting up the STARLOC II Plus®

2.2.1 Unpacking the unit

Use proper ESD precautions when unpacking the unit. It is shipped in a static protected bag inside a foam container. A CD-ROM containing the Operations and Management System Software is also included. Check the unit for damage. If damage is found, examine the shipping container. Contact the shipper if the unit appears to have been damaged during shipment. Do not discard the shipping carton until the shipper has an opportunity to make an examination.

2.2.2 Checking contents

Compare the contents of the shipping carton against your sales order and the shipping invoice to make sure you have received a complete shipment. If you find a shortage, contact Datum Sales Department. Have your sales order number available.

The GPS antenna cable (if ordered) is shipped separately from the unit.

If the unit is undamaged and as ordered, you are ready to begin the installation.

2.2.3 Site Considerations

General guidelines are presented below to help with the installation. Also refer to publications similar to the ones listed below, they may prove useful during your site planning stage:

> QUALITY STANDARDS, Fixed Network Equipment Installations, Motorola publication R56, Systems Center Engineering, 1301 E. Algonquin Road, Schaumburg, IL 60196
>
> Bulletin 37916C, Grounding Kits, Type 204989, ANDREW Heliax® Products (included with kit).
>
> Bulletin 237196, Ground Kits for Heliax® FSJ1 and LDF2 Coaxial Cable, ANDREW Heliax® Products (included with kit).

2.2.3.1 Buildings, Equipment Cabinets and Grounding Systems

Structures housing telecommunications equipment should have a concrete foundation and a wood or concrete floor whose surface has been sealed to prevent equipment contamination from dust, dirt, and other airborne particulates. Remember, when calculating the weight of new equipment to consider the rated load carrying capacity of the structure. Minimum floor load capacity should be 300 pounds per square foot.

Equipment cabinets need to be bolted securely to the floor and arranged in such a way as to provide a wide and stable footprint for earthquake protection. Center mount cabinets can be fitted with outriggers and bolted to the floor. Top supports are important to prevent cabinets from toppling over on personnel. If a potential hazard of water entry exists at the site, cabinets can be anchored to *Uni-strut* rails or wooden pedestals to elevate them above the floor.

Grounding of the structure and the antenna is necessary to protect equipment and personnel. An external ground ring with a grounding system attached to the antenna tower ground ring with one or more conductors is recommended. The optimum grounding system for the structure places a ground rod at each corner of the building (2 feet out from the building foundation) and every 15 feet between these corner rods. Rods should be placed at a minimum depth of 18 inches below either the finished grade or below the freeze line (whichever is the greater depth). The top and bottom of antenna cables should be grounded to either a tower member or tower down conductor to create a lightning path toward earth. Follow local codes and install grounding kits per the manufacturer’s instructions (included in the kits).

2.2.3.2 Power Requirements

When planning for site electrical design, present and future power loading should be considered. AC power requirements should be determined before construction. Continuous load should not exceed 80% of the electrical wire rating.

2.2.3.3 Heating, Cooling and Ventilation Requirements

Equipment operating within its design environment is less likely to experience failures. Structures should be insulated and have air handling equipment capable of maintaining an ambient temperature range of +41° to +86°F (+5° to 30°C). Humidity should be controlled so that it is neither too low (causing ESD problems) or excessively high (causing moisture condensation on electrical equipment).

2.2.3.4 Cabling Issues

Cable tray systems of adequate strength and rigidity provide support and protection for cable runs. Adding expansion connectors between the trays will accommodate thermal expansion and contraction of the system. Supports should be located within 2 feet of either end of an expansion connector. Cable trays and ladders can extend through walls and floors as long as the openings are firestopped with an approved technique that maintains the fire resistance rating of the structure.

Cables should have broad service loops and strain relief. This keeps cables loose and gives them a better appearance.

Do not place cable trays in such a way as to block building sprinkler systems or smoke detectors, or under lights or other electrical fixtures.

Cables should be routed neatly with a 2 inch gap (minimum) between conductor bundles. Group cables according to type so that RF lines are not mixed in with ground or control and interconnect lines.

When cables enter the building from the outside, a weatherproof port assembly should be used. This should consist of a waveguide entry plate and boot assembly. Typical commercial antenna ports will have 1 to 12 entry ports per plate. If it is necessary to insulate the opening, two plates can be installed, on the inner and outer walls with foam insulation between the plates. Two sets of cable boots are needed with this type of installation. Unused ports must be sealed with blank caps.

To prevent electrical interference, ports that introduce antenna cables should not be used to pass lighting power (to antenna lights) or building ground and control cables.

2.3 Mounting The STARLOC II Plus® unit

The **STARLOC II Plus®** has six mounting holes for #6-32 screws. Screws should not exceed 3/8 inch in length. The baseplate acts as a heatsink, transferring excess heat into the mounting surface. The safe operating temperature range is 0°C to +55°C. The internal environment for the unit (i.e., OEM case) must have no vertical airflow and a minimum horizontal airflow of 15 feet per minute.

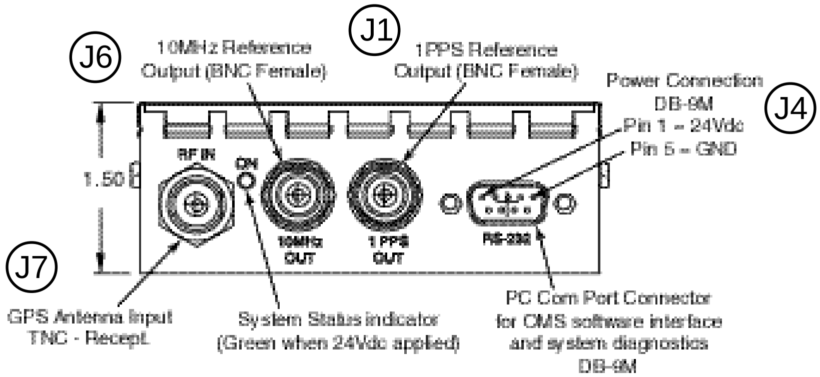
2.4 Connecting cables to the STARLOC II Plus® unit

The unit has four connectors on its front panel. They are as follows:

The GPS input is the connector marked RF IN. This connector receives the L1 GPS (1575.42 MHz) C/A code. Attach this cable first.

There are two output connectors. The 10 MHz out is through a BNC connector. This is a Sine output @ 50 ohms, coherent with 1 PPS. The 1 PPS output is through a BNC connector @ 50 ohms. The leading edge of the pulse is synchronized to UTC. The pulse shape may be affected by the distributed capacitance of the interface cable.

The connector marked RS-232 is a DB-9 connector used for an external PC interface for the Operations and Management software (Refer to Section 3 of this manual). Input power is also applied through this connector. For this reason, the RS-232 cable should be connected after all other connectors have been installed to avoid accidental damage to the unit. Input power is rated at 24Vdc +/- 20%.



J4	9 Pin D-Sub Male
Pin 1	24 VDC Input
Pin 2	RX Serial Data Input (RS232)
Pin 3	TX Serial Data Output (RS232)
Pin 5	GND
Pin 4,6,7,8,9	Not Connected

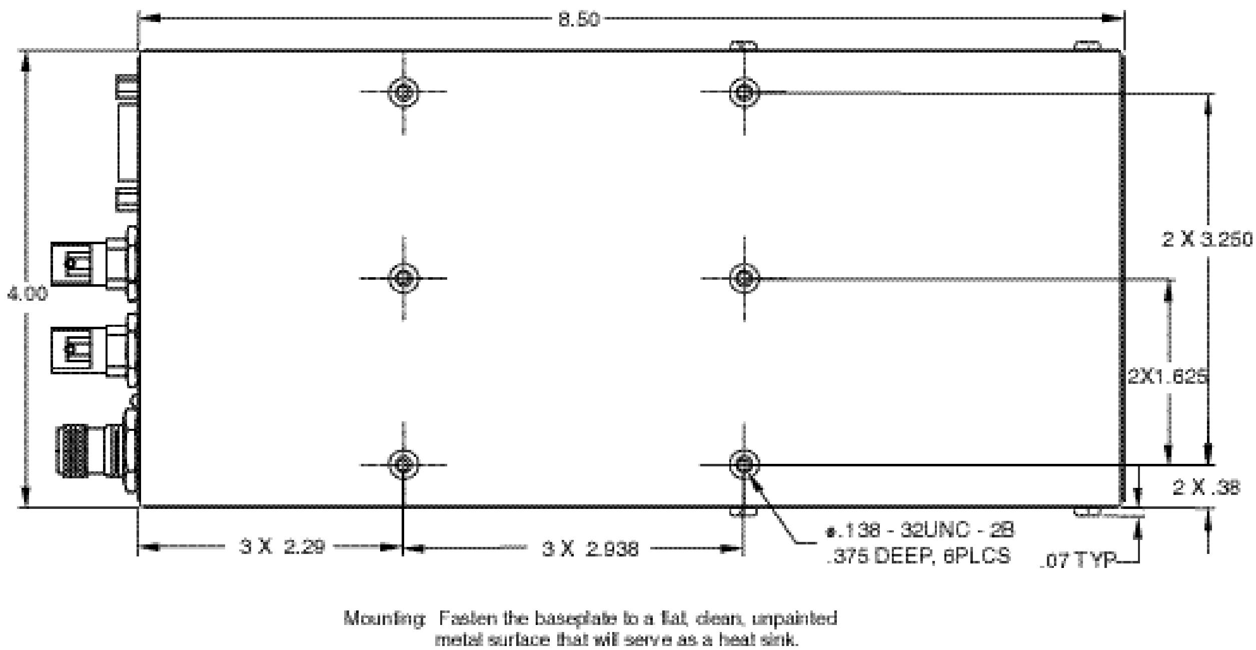


Figure 2-3. Cable Connections and Mounting of the STARLOC II Plus®

2.5 Unit Start-up

When power is applied, the unit starts up automatically, quickly performing a self-survey and locking to local system time. In routine operation, only one GPS satellite need be visible to maintain unit accuracy. This accomodates the obstruction crowded urban environment where it can be difficult to find antenna locations with a clear view of the sky. During operation, an advanced T-RAIM algorithm independently monitors the health of individual GPS satellites so that information from a malfunctioning satellite will not effect system accuracy.

2.6 System Operation

The STARLOC II Plus® operates automatically once it locks to GPS timing. It uses Datum's proprietary SNAPSHOT™ technology to allow a network of STARLOC II Plus7 units to lock system time to within 20 nsec (RMS) of each other while tracking a single GPS satellite when using Datum Timing Preferred Algorithm.

The operator sets-up, monitors, and makes adjustments to system (or network) parameters using the Operation and Management System (OMS) software included on a CD shipped with the unit. Use the instructions printed on the CD case insert to install the software. Refer to Section 3 of this manual for information on the features and operation of the OMS software.

An electronic file of this manual (in Adobe Acrobat pdf format) is included on the OMS CD-ROM should additional copies of the manual be required at the site. A postscript laser printer is recommended as the output device.

SECTION THREE

3.1 Installation/Diagnostic Tools

Users can choose between two software system status and diagnostic tools:

DATUM's Operation and Management Sytem Utility
or
DATUM's TimeKeeper Protocol Converter and Communications Interface

Either software can be used to install and set up, and control and monitor a STARLOC II Plus® unit.

3.2 TimeKeeper Protocol Converter and Communications Interface

The STARLOC II Plus® TimeKeeper firmware is compatible with the data and command packet structure of the most frequently used DOS-based binary interface protocol for configuring, monitoring and controlling a GPS disciplined clock for base station applications.

Refer to Appendix A for information on the supported command list.

3.3 Operations and Management System Utility

The Operation and Management System Utility is a system monitoring and setup tool developed by DATUM that operates in the Windows 95/98/2000 and NT environments. This utility provides screens (displayed on a PC connected to a STARLOC II Plus® unit or network of STARLOC II Plus® units) that allow the user to review the status of each unit, to run a diagnostic, and to view charts of the phase over time. Pull Down Menus allow the user to view system parameters and to make adjusments.

Input to the utility can be made by mouse or by keyboard. Function and keyboard keys allow menus and dialog boxes to be selected and exited.

If communication problems are encountered, reset the Com Port.

3.3.1 GUI Interface and Graphic Screens

Applicable Part Number:	STARLOC II Plus® 106420
Applicable Firmware:	Application Firmware Version 2.0 or higher
Host Computer Operating System:	Windows 95/98/2000 or Windows NT

The GUI Interface is capable of controlling up to 16 STARLOC II Plus® modules independently. The user has complete control with the ability to monitor or change all of the operating parameters of the system.

A description of the main graphic program screen and the various subscreens, and examples of each, is presented in the following pages.

Graphic Program Screens

Main Operating Window: – read only

The user selects which of the 16 possible STARLOC II Plus® modules to communicate with. The main operating window displays the status of all of the operation functions to be controlled and monitored.

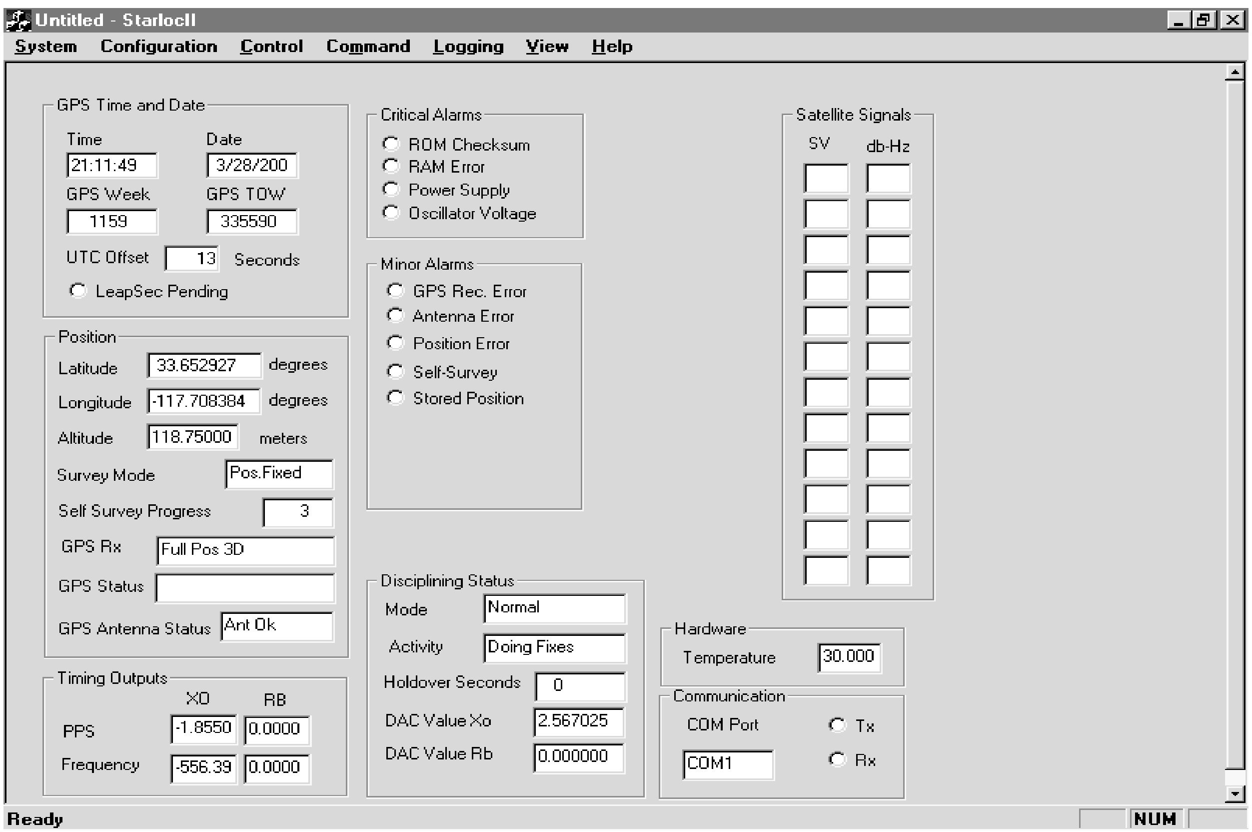


Figure 3-1. Primary Timing Screen

GPS Time and Date window: – read only

The Time and Date window displays the GPS timing data. Values include:

- GPS time of week in seconds
- GPS week number
- Current GPS time offset from UTC in seconds
- Current GPS date
- Current GPS time
- Leap Second Pending indication

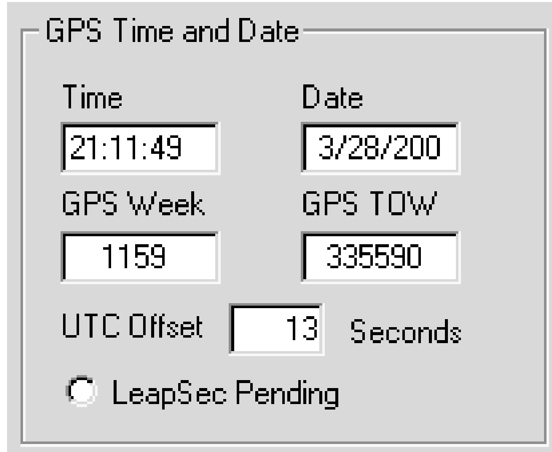


Figure 3-2. GPS Time and Date Window

Position window: – read only

The Position window displays the local site position data. Values include:

- Latitude and Longitude in degrees
- Altitude in meters
- Survey Mode
- Self Survey Progress
- GPS Receiver Mode
- GPS Status
- GPS Antenna Status

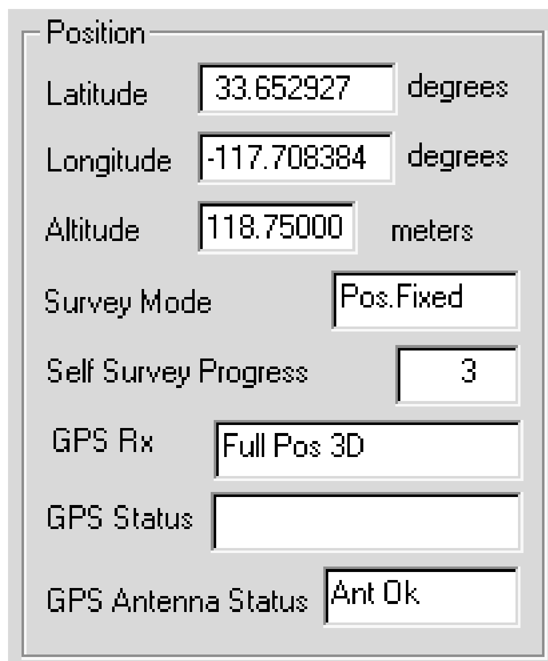


Figure 3-3. Local Position Window

Timing Outputs window: – read only

The Timing Outputs window displays the current values for XO and Rb PPS and Frequency.

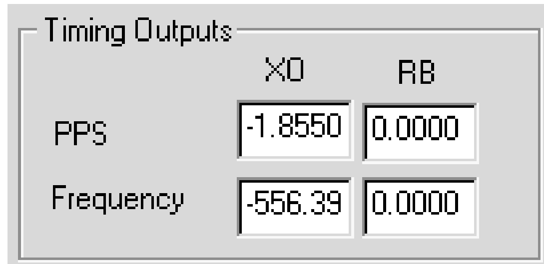


Figure 3-4. Timing Outputs Window

Critical Alarms window: – read only

The Critical Alarms window displays the status of those operating parameters that are critical to the correct functioning of the unit. Critical parameters include:

- ROM Checksum
- RAM Error
- Power Supply
- Oscillator Voltage

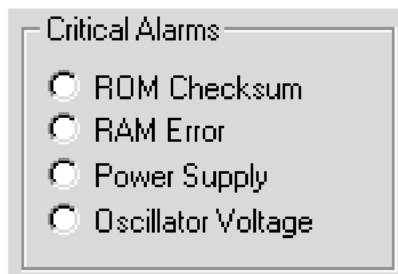


Figure 3-5. Critical Alarms Window

Minor Alarms window: – read only

The Minor Alarms window displays the status of those operating parameters that are important to monitor but are less than critical to the correct functioning of the unit. Minor alarm parameters include:

- GPS Receiver Error
- Antenna Error
- Position Error
- Self Survey
- Stored Position

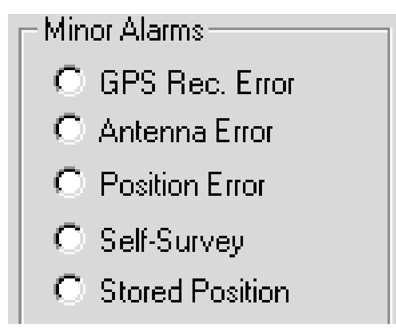


Figure 3-6. Minor Alarms Window

Disciplining Status window: – read only

The Disciplining Status window displays the current status of the disciplining function parameters. These parameter values include:

- Mode
- Activity
- Holdover Seconds
- DAC Value XO
- DAC Value Rb

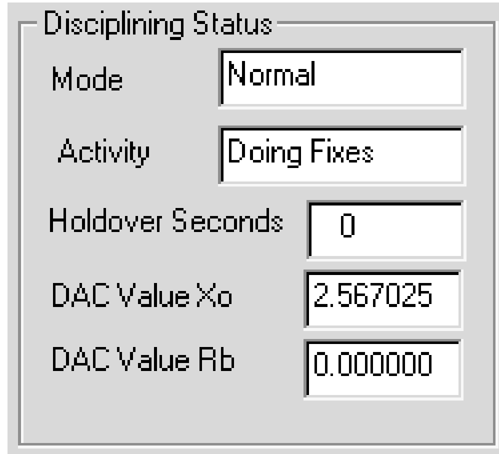


Figure 3-7. Disciplining Status Window

Hardware window: – read only

The Hardware Status window displays the current temperature status of the hardware in degrees C.

Figure 3-8. Hardware Window

Communication window: – read only

The Communication Status window displays the COM Port in use and the current states of the transmitter and receiver.

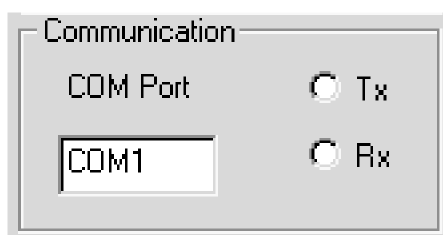


Figure 3-9. Communication Window

Satellite Signals window: – display only

The Satellite Signals window displays the current state of the SV and db-Hz for 12 satellites (or 12 Starloc II units?).

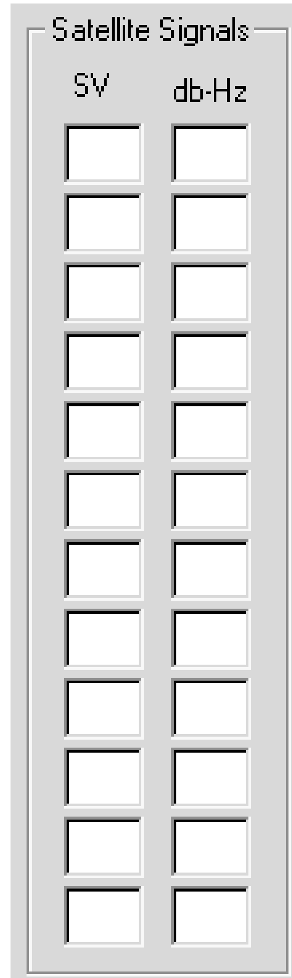


Figure 3-10. Satellite Signals Window

Pull Down Menus

Configuration Menu:

The Configuration Menu provides for the following operations:

- Messages
- Setup
- Communication

Control Menu:

The Control Menu provides for the following operations:

- Software Reset
- Hardware Reset
- Factory Reset
- Restart Self Survey

Command Menu:

The Control Menu provides for the following operations:

- Set 1PPS
- Enter Manual Hold
- Exit Manual Hold
- Set Osc. Control Voltage

Logging Menu:

The Control Menu provides for the following operations:

- Configure
- Start Logging

View Menu:

- Status Bar

Appendix A

TimeKeeper Communications Packet Structure

When a PC with a standard communications protocol is cabled to the StarLoc RS232 comm port the TimeKeeper firmware resident in the onboard processor will recognize and respond to typed ASCII commands. Each command (request) defines a single or multiple event function that calls for multiple events to be scheduled and or processed.

When a message is received and the message type determined the process begins; all message types are handled in an almost identical process. The Response Processor task receives a system message from the Parser input task. This message contains a pointer to a buffer that contains a data structure of type USER_MSG. Contained within the data structure is a command type, count and a character message buffer. The content of the message buffer will be the message received from the user interface. An example of the message structure is presented below.

```
typedef struct tagOUT_MSG
{
int       Cmd;
int       count;
int       NoResponse;
char msgbuf[200];
} OUT_MSG;
```

The response task uses the value stored in the data structure Cmd as a value to index to the specific command and its function code. Each command function calls the Command Manager function (CmdCoreMgrCmd) with a pointer to the received data structure. The Command Manager routine also uses the content of the Cmd value to index to the specific command routine. If the content of the message is determined to be a command, the data specific to this function will parse and reviewed for the operation that is to be performed. If the command has no processing requirements and no errors are detected a TRUE value is returned. If a response message is required, a specific command function will be called to build the response.

Each command has a response function. Each works the same way but will contain different data. An output message is allocated and a pointer to this message buffer is sent to the response function. The response function allocates a data structure specific to its function. The function type is stored in the data structure and the function CmdCoreMgrResp is called. The CmdCoreMgrResp routine uses the function type and indexes to the specific function routines. The contents of the data structure are then filled with the command specific data and returned the response function routine. The response function now has all of the data necessary to return a response message to the StarLoc II and the user's PC over the COM link. The response function builds the response message based on the received message type. The commands and response data are formatted into a serial message sequence and sent to the User Output task where it will be Que'd for transmission.

A list of supported ASCII commands is presented on the following pages.

Starloc ll Plus TimeKeeper ASCII Command List and Responses

Command - Description		Supported/Used?	Response
0x1E	Clear Battery Backup and Reset (No CMOS memory available)	Yes/Yes	System will Reset
	Factory Reset	Yes/Yes	Factory Reset copies system ROM defaults to NV RAM.
0x1F	Software Version	Yes/Yes	Response Packet 0x45
0x24	Request All in View Satellites	Yes/Yes	Response Packet 0x6D
0x25	Soft Reset	Yes/Yes	The system performs soft Reset.
0x27	Satellite Signal Levels	Yes/yes	Response Packet 0x47
0x29	Almanac Health	Yes/No	Response Packet 0x49
0x31	Set Accurate Initial Position (Cartesian data is not used)	Yes/No	Response Packet 0x42
0x32	Set Accurate Initial Position (Packet 0x4A is not supported, Data is in Radians)	Yes/Yes	Response Packet 0x43
0x34	One Satellite Mode	Yes/No	
0x35	IO Options (Packet 0x55 is not supported. Packet 0x5A is not supported.)	Yes/No	
0x37	Request Last Position Packet 0x56 is not supported Packet 0x57 is not supported	No/No	(Auto Command 0x8F-AC reports last position)

Command - Description		Supported/Used?	Response
0x38	Request Sat Data (Packet 0x58 not supported)	Yes/No	default zero data supplied.
0x39	Set or Request SV Disable Packet 0x59 is not supported.	Yes/No	default zero data supplied.
0x3A	Request last Raw Measurement	Yes/No	
0x3B	Request Current Status Packet 0x5B is not supported	Yes/No	default zero data supplied.
0x3C	Request Current Satellite	Yes/Yes	data is supplied in Packet 0x5C.
0x70	Filter Configuration	Yes/Yes	default zero data supplied.
0x83	Double Precision XYZ	Yes/Not enabled	
0x84	Double Precision LLA	Yes/Not enabled	
0xBB	Receiver Configuration	Yes/No	
0xBC	Set Port Configuration	Yes	Communicaton port assigned
0x8E-15	Set/Request Datum Command is supported but not used.	Yes/No	Packet 0x8F-15 return default 0 values
0x8E-41	Request Mfg Parameters .	Yes/Yes	Packet 0x8F-41 return and supplies NV Data
0x8E-42	Request Production Parameters	Yes/Yes	Packet 0x8F-42 return and supplies NV Data
0x8E-45	Revert Default Settings	Yes/Yes	Packet 0x8F-45 return and supplies NV Data.
0x8E-4A	Set PPS Characteristics	Yes/Yes	Packet 0x8F-4A return and supplies NV Data
0x8E-4C	Save Segment to EEPROM	Yes/Yes	Packet 0x8F-4C return and supplies NV Data

Command - Description		Supported/Used?	Response
0x8E-A0	Set DAC Value	Yes/Yes	Packet 0x8F-A0 return DAC values
0x8E-A1	10 MHz Sense	Yes/Yes	Packet 0x8F-A1 return default Rising edge
0x8E-A2	UTC/GPS Timing	Yes/Yes	Packet 0x8F-A2 return status
0x8E-A3	Issue Disciplining Commands	Yes/Yes	Packet 0x8F-A3 return command acknowledgement
0x8E-A4	Test Modes	Yes/Yes	Packet 0x8F-A4 return default zero values.
0x8E-A5	Packet Broadcast Mask Format 0 and Format 1 not supported, returns data zero	Yes/Yes	Packet 0x8F-A5 Solution
0x8E-A6	Request Mfg Parameters	Yes/Yes	Packet 0x8F-A6 return command
0x8E-A8	Request Mfg Parameters	Yes/Yes	Packet 0x8F-A8 returns disciplining data
0x8E-A9	Self Survey	Yes/Yes	Packet 0x8F-A9 returns system status.