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Model 560-5202
GPS OPTION FOR THE 560-5203-X OSCILLATOR

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SECTION ONE

1. FUNCTIONAL DESCRIPTION

1.1. OVERVIEW

The 560-5202 GPS card is an option for the 560-5203-X Oscillator card. The specifics of this GPS option rear card will be discussed, as well as the affects of this card on the 560-5203-X Oscillator front card. The combination of the two cards will be called GPS/Oscillator in this manual. Refer to the 560-5203-X manual for details regarding the Oscillator card Aux Ref mode. The Oscillator card can be configured to use both GPS and Aux Ref modes (DIP switch).

The 560-5202 GPS option card may be factory configured to use either the standard TrueTime GPS antenna, which allows antenna cable lengths of up to 150 feet, or the TrueTime downconverter antenna, which allows cable lengths of up to 1500 feet. When the downconverter option is ordered, the 560-5202 GPS card part number becomes 560-5202-1 to distinguish between the two types.

The GPS option provides a means to steer and lock the 560-5203-X Oscillator to a GPS (UTC) reference. The GPS option provides timing for the Oscillator card which then has the ability to output the timing signals 1 PPS and IRIG-B (AM) to timing bus lines on the 56000 backplane. The 560-5202 GPS option card also provides a serial communications port from the Oscillator card 87-902 XL2 module.

1.2. PURPOSE OF EQUIPMENT

The purpose of the GPS card is to provide accurate time, frequency, and position to the 560-5203-X Oscillator card. This information is derived from Coarse Acquisition (C/A) Link 1 (L1) signals transmitted by the NAVSTAR Global Positioning System (GPS) satellites. The 560-5202/ 560-5203 GPS/Oscillator is usable on a world-wide basis.

The GPS function is completely automatic in satellite acquisition and time and frequency synchronization. When the unit is first installed or if the unit is moved more than 100 km, acquisition time (lock) is shortened if the operator enters a position through the user serial port that is accurate to better than 100 kilometers or approximately one degree in latitude and longitude.

The 560-5202 GPS receiver will operate when the satellites are 10 degrees above the horizon and their signals are not obstructed. Whenever entered position information is less accurate than 10 meters, the GPS/Oscillator will first have to accurately ascertain its antenna position by tracking four or more satellites and performing a long term (24 hours) average of position fixes in order to maintain time and frequency accuracy and stability within specification. From that point on, the

GPS/Oscillator will require only one satellite (above 10 degrees) to maintain valid time and frequency. However, operation to specified stability requires four or more satellites.

1.3. 560-5203-X GPS DISCIPLINING MODE

The GPS Oscillator disciplining option requires the 560-5202 GPS card to be installed directly behind the 560-5203-X Oscillator card. The GPS DIP switch on the 560-5203-X should be turned ON to enable GPS fault status reporting to the front panel LED and to the 560-5179-1 Fault Monitor CPU card. When the GPS mode is used in conjunction with the Aux Ref mode, GPS mode has local oscillator disciplining priority.

While GPS satellite data is available, the GPS/Oscillator's 87-902 subassembly (piggybacked onto the 560-5203-X oscillator card) controls the local oscillator via a 16 bit DAC in such a way as to phase lock its output to UTC.

1.4. 560-5203-X GPS + AUX REF MODE

The 560-5203-X Oscillator card provides accurate time and frequency whenever one or more satellites are in view, with optimal performance when four or more satellites are in view. If the Aux Ref mode is also enabled, when satellite outages do occur, the 560-5203-X Oscillator card will switch to the Aux Ref mode. The measurements that are made on the Aux Ref source are used to control the local oscillator via a 16 bit DAC in such a way that it is frequency locked to the Aux Ref input. During periods when the Aux Ref input controls the Oscillator, the rate that the time and frequency outputs diverge from UTC is governed by these parameters:

1) The accuracy of the Aux Ref frequency at the time of the outage.

2) The ambient temperature change during the outage period and the temperature coefficient of the Aux Ref frequency.

3) The inherent drift or aging rate of the Aux Ref frequency as a function of time.

Should the Aux Ref input not be present, then the 560-5203-X Oscillator will flywheel in the same manner as it would if the Aux Ref mode were not implemented or if it were disabled.

1.5. 560-5202 CARD SPECIFICATIONS

PHYSICAL SPECIFICATIONS

Dimensions:	1.6”w X 4.4”h X 5.0”d (4 cm X 11 cm X 13 cm)
Weight:	Approximately ½ pound (¼ kg)
Card slots:	2 (rear card type)

ENVIRONMENTAL SPECIFICATIONS

Operating temp:	0° to +50°C
Storage temp:	-40° to +85°C
Humidity:	Up to 95% relative, non-condensing
Cooling Mode:	Convection

POWER REQUIREMENTS

Voltage:	18-72 Vdc	
Power:	3 W	(560-5202 standard antenna)
	4.8 W	(560-5202-1 downconverter antenna)

1.6. ANTENNA SPECIFICATIONS

The 560-5202 card has an antenna feed line fault circuit that will detect when the feed line is opened or shorted. When an antenna feed line fault is detected, the antenna fault status LED will illuminate (RED). The antenna feed line fault status is also communicated to the 560-5203-X Oscillator card which in turn communicates the fault to the 560-5179-1 Fault Monitor CPU card.

NOTE: Shorted antenna feed lines require that the short and the antenna load be removed from the 560-5202 antenna BNC to restore feed line power.

Operating Temperature:	
Antenna or Downconverter:	-40° to +70° C (-40° to +158° F)
Storage Temperature:	
Antenna or Downconverter:	-55° to +85° C (-67° to +185° F)
Humidity:	
Antenna or Downconverter:	100%, condensing
Antenna Size:	2.625 in. dia. x 1.5 in. (6.67 cm. dia. x 3.81 cm.)
Downconverter Size:	2.625 in. dia. x 8.6 in (6.67 cm. dia. x 21.84 cm.)
Humidity:	Up to 95% relative, non-condensing
Cooling Mode:	Convection

Antenna Weight: (Including mtg. nipple)	0.70 lb (.318 Kg)
Downconverter Weight: (Including mtg. nipple)	2.35 lb (1.067 Kg)
Antenna Cable, RG-59:	Standard length = 50 ft. 1.2 lb (.545 Kg)
Downconverter Cable, RG-58:	Available lengths = 150 - 1500 ft. 2.7 lb (1.23 Kg) per 100 ft.

NOTE: Both the standard antenna and the optional downconverter Units are mounted on a 12 in. long PVC nipple with 3/4" Male Pipe Thread (MPT) on both ends. The above specified overall lengths of the antenna and downconverter units are therefore increased by approximately 11.25 inches when the mounting nipple is included.

1.7. TIMING/FREQUENCY PERFORMANCE SPECIFICATIONS

All performance specifications are valid when the antenna's geodetic position is known within 10 m in WGS-84 and four or more satellites are being tracked under the current conditions of Selective Availability (SA) as experienced at product release in March of 1994. **When operating with the 560-5203-0 Oscillator card (TCXO local oscillator), all covers must be in place in order to meet the stated stability specifications.** During periods without SA, timing performance is improved to the ±100 nS level.

The GPS/Oscillator core receiver specifications are:

Frequency:	1575.42 MHz (L1 signal).
Code:	Coarse Acquisition (C/A) code.
Tracking:	Up to six satellites.
Acquisition Time:	Less than 2 min. if satellites visible, position correct within 100 km. Position errors greater than 100 km may require 15 min. or longer, with satellites visible.
Single Fix Position Accuracy:	Within 25 m (SEP) referred to WGS84 when sequentially tracking four (4) or more satellites with a PDOP $\leq$ 6. 100 meters (2 dRMS) if SA is enabled.
24 Hour Averaged Position Accuracy:	< 10 m.

The GPS/Oscillator timing specifications are:

1 PPS Output Accuracy:	GPS Time ±150 nS UTC-USNO ±150 nS
IRIG-B AM Output Accuracy:	10 uS to UTC

1.8. SERIAL PORT SPECIFICATIONS

The 560-5202 GPS card provides a male 9-pin D connector (DB-9P) serial, asynchronous, bi-directional data port to the 87-902 XL2 module. The mating D connector is a female 9-pin (DB-9S). The transmitted data from this port is available in both RS-232 and RS-422 signal levels. The received data on this port may be configured for either RS--32 or RS-422 signal levels (selected by a DIP switch on the 560-5203-X card).

The RS-232 output is compatible electrically and mechanically with the EIA Standard RS-232C as described for **data terminal equipment (DTE)**.

Messages are sent and received using ASCII coded characters. The serial port specifications are as follows:

Data:	Time, day of year through milliseconds, in ASCII characters, output once per second or on request. Also special functions as listed in SECTION THREE.
Data Rate:	9600 bps
Data Bits:	8
Parity:	none
Stop Bits:	1
Connector:	Male 9-pin D subminiature.

Pin Assignment:

PIN	SIGNAL DESCRIPTION
1	No connection
2	RxD (RS-232)
3	TxD (RS-232)
4	No connection
5	Signal Ground
6	RIN- (RS-422)
7	RIN+ (RS-422)
8	TOUT- (RS-422)
9	TOUT+ (RS-422)

1.9. TIMING OUTPUTS

Two timing outputs are available from the 560-5203-X Oscillator card when the GPS option is installed -- 1 PPS and IRIG-B (AM). Both of

these outputs may be connected to timing lines on the 56000 backplane using 560-5203-X DIP switch SW3.

The 1 PPS output may be connected to the IN1 timing bus by switching SW3-1 ON or to the IN2 timing bus by switching SW3-2 ON. Only one timing bus should be driven by the 1 PPS timing signal from the card. The two different timing bus lines (IN1 and IN2) allow for a second Oscillator to provide a secondary 1 PPS signal to the 56000 system.

The IRIG-B amplitude modulated output may be connected to the IN3 timing bus by switching SW3-3 ON or to the IN4 timing bus by switching SW3-4 ON. Only one timing bus should be driven by the IRIG-B signal from the card. The two different timing bus lines (IN3 and IN4) allow for a second Oscillator to provide a secondary IRIG-B signal to the 56000 system.

1 PPS SPECIFICATIONS

The rising edge of the 1 PPS coincides with the start of the second. The duty cycle is 50%. If no satellites are being tracked, the 1 PPS will be as stable as the 560-5203-X Oscillator. This output is valid whenever the GPS/Oscillator has an accurate position and is tracking at least one satellite. Due to the fast edge rate of the 1 PPS it is advisable to turn on the backplane timing line terminator switch for the selected output (50 ohms).

Duty cycle:	50%
On time edge:	Rising
Amplitude:	TTL Levels into 50 ohms (5 Vpp no load)
Drive:	ACMOS

IRIG-B (AM) SPECIFICATIONS

The primary purpose of the IRIG-B time code output is to provide frequency and timing to the 560-5151 NTP card and to drive slave displays manufactured by TrueTime. It is not necessary to terminate this signal with the backplane terminator 50 ohm switch.

When using this code to drive other than TrueTime products, it should be noted that four bits in the "control functions" portion of the IRIG-B code encode the TIME QUALITY INDICATORS. Refer to Section 3.8 of this manual for a full description of this modified IRIG-B code.

Time Code:	Amplitude-Modulated IRIG-B
Carrier:	1 KHz
Amplitude:	2.8 ±.3 Vpp high, 0.8 ±.1 Vpp low into 50 ohms
	5.0 ±.5 Vpp high, 1.5 ±.2 Vpp low into 1K ohms

1.10. CARD COMPATIBILITY

Location must be directly behind the 560-5203-X Oscillator card.

560-5203-0,-1,-2
Single Oscillator 560-5202 = slot 1

560-5203-0,-1,-2
second Oscillator 560-5202 = slot 3

560-5203-3
Single Oscillator 560-5202 = slot 2

560-5203-3
second Oscillator 560-5202 = slot 4

SECTION TWO

2. INSTALLATION / SETUP

2.1. 560-5202 INSTALLATION

Install the 560-5202 GPS option card directly behind the 560-5203-X Oscillator card. Locate the antenna or downconverter outside with an unobstructed view of the sky. Connect the coax cable between the antenna and the antenna input connector. A BNC connector (AUX REF) is provided on the rear panel to connect an external frequency reference. Refer to the following setup section for DIP switch selection regarding the AUX REF input. If serial communications are desired, make the necessary connections to equipment after referring to the serial interface information in SECTION ONE.

2.2. HOT SWAPPING

All cards, input cables and output cables are hot swappable. It is not necessary to remove chassis power during insertion or removal. Hot swapping and reference-source changes are abrupt, the effects difficult to characterize; however, the system is designed to protect against permanent effects and minimize temporary effects of these events.

The effect of a reference-source change (GPS to Aux Ref or vice-versa) has very little affect the Oscillator. Hot swapping of an Oscillator affects the system in varying ways depending upon whether the Oscillator is configured to drive REFA, REFB, or REFC. These effects are discussed in individual card manuals.

2.3. REMOVAL AND INSTALLATION

CAUTION: Individual components on this card are sensitive to static discharge. Use proper static discharge procedures during removal and installation.

To remove the 560-5202 card, loosen the retaining hardware at the top and bottom of the assembly, then firmly pull on any connector on the rear panel. Slide the card free of the chassis. Refer to the SETUP section for any required switch settings or set them identically to the card being replaced. Reinstall the card in the chassis by sliding it in slowly, avoiding contact between the bottom side of card and the adjacent card panel, until it mates with the connector. Seat the card firmly to avoid contact bounce. Secure the screws at the top and bottom of the card assembly.

2.4. 560-5202 ANTENNA FAULT LED

The antenna fault RED LED illuminates immediately at hot-insertion and remains active until an antenna is connected to the antenna input BNC.

2.5. 560-5203-X FRONT PANEL LED

The Oscillator card has a bicolor RED/GREEN LED mounted to the front panel. When GPS mode is enabled on the 560-5203-X card, the front panel LED will indicate GPS faults with blinking (1 PPS) RED. When Aux Ref mode is enabled on the 560-5203-X card, the front panel LED will indicate Aux Ref faults with blinking (1 PPS) ORANGE. When both GPS and Aux Ref modes are enabled, the GPS faults have priority (blinking RED). When GPS fault conditions have been removed, the Aux Ref fault conditions will the be displayed (if any) by the LED. The front panel LED has the following states due to various fault conditions:

NOTE: Aux Ref faults are suppressed when the Aux Ref mode is disabled (560-5203-X AUX DIP switch OFF). GPS faults are suppressed when the GPS mode is disabled (560-5203-X GPS DIP switch OFF).

SOLID RED = Local power supply failure

BLINKING RED = the following GPS faults:

1. Antenna feed line fault.
2. GPS receiver fault.
3. +5Vmon fault (from the 560-5202 card)
4. 87-902 PLL not locked. This PLL must be locked for Oscillator disciplining to occur.

If Aux Ref mode is enabled:

BLINKING ORANGE = the following Aux Ref faults:

1. Primary Aux Ref source not connected.
2. Secondary (when enabled) Aux Ref source not connected.

SOLID ORANGE = no GPS or Aux Ref (if enabled) faults and the local Oscillator has not yet locked.

GREEN (or OFF) = no GPS or Aux Ref (if enabled) faults and the Oscillator is locked to GPS (or to the Aux Ref source if GPS is not viable). The GREEN LED enable switch SW2-8 on the 560-5203-X (GRN) must be ON for the GREEN LED to illuminate. When the GREEN enable switch is OFF, the GREEN indication is replaced by LED OFF.

2.6. 560-5202 SETUP

The 560-5202 card provides a BNC named AUX REF that may be used to input an external frequency reference to the system (refer to the 560-5203-X manual). This Aux Ref Oscillator disciplining input may be directed to any of 56000 frequency bus lines. If Aux Ref mode is enabled and this BNC is used for the Aux Ref input, set SW1 to the desired frequency bus. NOTE: If 7F or 8F is selected (Input mode), be sure to set the backplane terminator switches 7, 8 ON (50 ohms).

SW1	REFA	REFB	REFC	7F	8F
1	**ON**	OFF	OFF	OFF	OFF
2	OFF	**ON**	OFF	OFF	OFF
3	OFF	OFF	NOT USED	OFF	OFF
4	OFF	OFF	OFF	**ON**	OFF
5	OFF	OFF	OFF	OFF	**ON**
6	NOT USED				
7	NOT USED				
8	NOT USED				

2.7. 560-5203-X SETUP

The 560-5203-X card must be set to enable GPS mode. SW2-1 (GPS) on the Oscillator card enables GPS mode.

560-5203-X GPS ENABLE (GPS)	
SW2-1	ON

2.8. RS-232 / RS-422 SELECT

The 560-5203-X card has a user serial port that is output to the DB9 male connector on the 560-5202 card. The user must decide whether to use RS-232 or RS-422 communication. The transmit side of these two formats are output in parallel, the receive (from the user) side must be selected with SW3 switch 7 or 8 (422 or 232).

RS-232 / RS-422 SELECT		
SW3	RS-422	RS-232
7	ON	OFF
8	OFF	ON

2.9. TIMING OUTPUTS SELECT

1 PPS AND IRIG-B (AM) timing signals are available from the 560-5203-X Oscillator card when operated in GPS mode. The user must decide whether to connect the output(s) onto the 56000 backplane timing bus lines. SW3 switch positions 1, 2, 3, and 4 allow the timing signals to be connected to the backplane bus. NOTE: SW3 positions 5 and 6

support an output signal that is only used for special requirements and is normally not used -- SW3 positions 5 and 6 must be OFF or there could be a conflict on timing bus lines IN5 and IN6.

The 1 PPS output may be connected to the IN1 or to the IN2 timing bus. The IRIG-B amplitude modulated output may be connected to the IN3 or to the IN4 timing bus.

Only one bus should be driven from either timing source -- the two different bus lines for each signal allow for a second (redundant) GPS controlled Oscillator to provide the secondary timing signals. If the two timing outputs are not used, SW3 positions 1, 2, 3, 4, 5, 6 must be OFF.

PRIMARY TIMING		
SW3	**1 PPS**	**IRIG-B**
1	ON	ON
2	OFF	OFF
3	ON	ON
4	OFF	OFF

SECONDARY TIMING		
SW3	**1 PPS**	**IRIG-B**
1	OFF	OFF
2	ON	ON
3	OFF	OFF
4	ON	ON

2.10. GPS REFERENCE

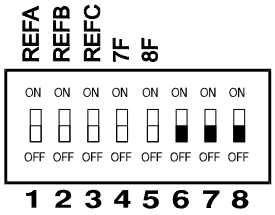
Upon power-up, the 560-5203-X Oscillator locks to the GPS reference from the 560-5202 GPS rear card. The process involves local oscillator warm-up and steering. Initial lock-up time, which varies with temperature, is typically less than 15 minutes. Prior to GPS lock, the Oscillator output is enabled but the Oscillator FAULT is active (indicated by front panel LED = ORANGE). Once locked, the LED fault condition is deactivated (indicated by front panel LED = GREEN or OFF). If the GPS disciplining reference is lost, the Oscillator switches to the Aux Ref mode (if enabled) or flywheels at the current frequency.

2.11 DETAILED STATUS VIA CPU

The Fault Monitor CPU has access to detailed 560-5202 card status. When the CPU card provides the verbose mode serial report, fault status is available in a 2-byte format, with each binary nibble displayed as a hexadecimal (HEX) character.
The Verbose report displays the Fault status. In this context, a reported fault indicates a problem. The Machine report, when used, reports the current status (settings) of the switches and faults in hexadecimal characters. Together, they pinpoint problems and help the technician view the switch settings on the cards.

560-5202 Switch Settings

(fill in the switch positions after configuring the card)



Aux Ref input select switch -- select only one -- ON is enabled

- ☐ REFA
- ☐ REFB
- ☐ REFC
- ☐ 7F
- ☐ 8F

SECTION THREE

3. OPERATION

3.1. STARTUP

Within a few seconds after power-up, the GPS/Oscillator will output elapsed time from power-on via the serial port (see serial Function F08). Note that serial inputs will be ignored until the F08 output is terminated with a CTRL-C character (Hex 03). If satellites are visible, the output time will switch from elapsed time to UTC time within a few minutes.

The GPS/Oscillator is placed into AUTO mode (see serial Function 53) automatically and it will not phase lock its local oscillator to the received time signal until it has computed a 3-D position. You may wait up to 15 minutes for the GPS/Oscillator to independently ascertain its position by acquiring four satellites, or you may speed up the process by using Function 50 to enter the approximate location to an accuracy of 1 degree (about 100 km) or better.

When the GPS/Oscillator has phase locked its oscillator to the GPS signals and has set its 1 PPS output to the specified accuracy, the terminating character of the serial Function F08 continuous time output string will change from a "?" to a "space" at this time. If satellites are visible and the GPS/Oscillator has an accurate position, lock should be achieved in less than fifteen minutes (oscillator dependent).

3.2. GPS/OSCILLATOR OPERATION

The Model 560-5202/560-5203-X (GPS/Oscillator) Time and Frequency Receiver provides extremely accurate TIME and FREQUENCY that is traceable to the UNITED STATES NAVAL OBSERVATORY (USNO) by use of the NAVSTAR Global Positioning System (GPS).

3.3. SATELLITE ACQUISITION

Time to first satellite acquisition is dependent upon many factors. The following paragraphs describe some of the possible events which affect satellite acquisition times. Note that satellite visibility at the receiver site will affect acquisition times.

If the time and frequency module was tracking satellites immediately prior to a momentary power interruption, satellite reacquisition will be almost immediate with valid UTC time available within 180 seconds.

If the current position is unknown or in error by more than 100 Km, acquisition typically requires from 3 to 15 additional minutes to locate current antenna position, reacquire satellite almanac and ephemeris data,

and deliver UTC time. Refer to the AUTO MODE paragraph later in this section for operational details.

If internal time and/or almanac data is lost, the time to first satellite acquisition will depend upon which satellites are visible at the time of power-on. The GPS/Oscillator will attempt to acquire satellites not knowing which satellites are visible. The satellite search will be expanded until a satellite is acquired. After first satellite acquisition, time will be acquired from the satellite and the receiver will return to normal operation. This procedure may take as little as 3 minutes to as long as 15 minutes depending upon current satellite visibility.

3.4. OPERATIONAL MODES

The GPS/Oscillator operates under one of three modes: AUTO, SURVEY, and TIME. Each mode is described below. Use Serial Function F53 to change from one mode to another or to determine the current mode. Refer to "SERIAL FUNCTION F53 - OPERATIONAL MODE ENTRY/REQUEST" in this section. The out-of-the-box default mode is AUTO. The default on subsequent power-up will be the mode used at the previous power-down.

3.4.1. AUTO MODE

AUTO mode offers a painless solution to GPS receiver start-up and operation. Under AUTO mode, no user input is required to properly complete a GPS/Oscillator site installation. AUTO mode requires a minimum of 4 satellites in order to complete the installation process.

After time and frequency module installation or whenever it is desired to reinstall the GPS/Oscillator, select AUTO MODE to begin the installation process.

AUTO mode consists of 3 major processes: 1) Current Position Search, 2) Current Position Averaging and Refinement, and 3) Invocation of Time Mode. Time and Frequency data and output signals are available throughout this process, however optimal accuracy and stability are not achieved until step 2) has been completed. With good satellite visibility this occurs following about twenty-four hours of averaging.

Current Position Search: Immediately after invoking AUTO mode, the GPS/Oscillator clears the position average and the GPS receiver non-volatile memory and begins a satellite search. **Since invocation of AUTO mode does clear the average position, the time and frequency outputs may be disturbed. Care should be taken not to needlessly invoke the AUTO mode.**

The satellite search begins with 8 satellites. After several minutes, a second set of satellites is searched. The process continues until a satellite is acquired.

Immediately after acquisition, data lock is attempted and the satellite Doppler compensation (the change in the 1.575 GHz frequency due to the apparent satellite velocity, for terrestrial based receivers, typically 0 to ±5 KHz) is adjusted until data can be read from the satellite.

After data lock, GPS time is acquired to the 20 mS level of accuracy, and almanac data loading for the entire constellation begins. At this time the Serial F53 command returns "F53 AUTO: 1 SATS".

During the data loading process, additional satellites are searched. When a second satellite is acquired and data lock is achieved, the Serial F53 command returns "F53 AUTO: 2 SATS". At this time, the position of the GPS/Oscillator may be placed in the proper hemisphere, narrowing the search for possible SV's.

When a third satellite is acquired, a unique position solution exists given an assumed ellipsoid height near 0 meters. At this time, the Serial F53 command returns "F53 AUTO: 3 SATS". With this position, the remaining visible SV's are determined based on the almanac and the time and are acquired rapidly. Once a 3-D position fix has been determined, synchronization to UTC begins and the first stage of AUTO Mode has ended. At this time Serial F53 command returns "F53 AUTO: # SATS", where # is the number of SV's being tracked.

Current Position Averaging and Refinement: After completing the first current position search phase of AUTO mode, AUTO mode automatically begins averaging position fixes, providing an increasingly more accurate and stable time and frequency reference position. The quality of the timing and frequency outputs will improve until a terminal average of approximately twenty-four hours duration has been obtained. At this time, the GPS/Oscillator returns "F53 TIME: # SATS" in response to the Serial F53 command.

Invocation of TIME Mode: After the position average is complete, the AUTO mode switches the time and frequency module to TIME mode and the averaged position will be used for all future timing solutions. TIME mode inhibits further surveying. The auto installation process is concluded.

The GPS/Oscillator will remain in TIME mode and will power-up in TIME mode using the averaged position after a power outage. However, after powering up in TIME mode, if the computed positions consistently differ from the previously stored average position by more than 1 Km for a significant period of time, the GPS/Oscillator will automatically reinitialized itself to AUTO mode and re-establish the position. Otherwise, operator intervention would be necessary to re-invoke AUTO mode.

3.4.2. SURVEY MODE

When in the SURVEY operational mode the GPS/Oscillator will repeatedly calculate position and time based on the unaveraged position. The position solutions are not averaged, and multiple satellite averaging techniques for reducing the effects of SA on the time solution are not employed. This mode of operation is appropriate in dynamic or pseudo-static platform applications. Strictly stationary users should use the far more accurate and stable TIME mode. **The specified time and frequency performance levels may not be met when the GPS/Oscillator is operating in SURVEY mode.**

There are two dynamics choices for SURVEY operation: STATIC and DYNAMIC. STATIC should be used when the mode of operation is pseudo-static, i.e. the unit is periodically transported to a new location and then stationary operation is performed at the new location. In this mode, the GPS core receiver will easily maintain lock under the dynamics experienced during ground transport and will quickly provide accurate time and frequency once at the new site. This mode also supports operation with a single satellite once the position at the new site has been determined. However, if operation while moving is important and the possibility of satellite obstruction exists, STATIC should not be selected as erroneous time and frequency steering data could be used while only a single satellite is visible.

DYNAMIC should be selected when operation is truly dynamic and might possibly include high acceleration or velocity such as might be experienced on-board tactical aircraft. In this mode, satellite visibility must be complete and fall-back to single satellite operation is not supported.

3.4.3. TIME MODE

When in the TIME operational mode, the GPS/Oscillator disables updating of the reference position average and computes timing solutions based on either the previously averaged position or a reference position which has been input via Serial Function F56. However, each position fix update is tested against the reference position to detect possible relocation of the receiver and antenna during the last power off period. If the GPS/Oscillator determines that it has been moved by more than 1 km, it will automatically set itself into the AUTO mode of operation.

Up to six satellites are used for timing solutions, enabling significant reduction of the effects of Selective Availability on the stability and accuracy of the timing and frequency outputs and measurement data. These satellites are chosen to be the highest ones currently available.

3.5. TIME QUALITY INDICATION

Whenever the GPS/Oscillator is not tracking satellites, the timing accuracy of the time and frequency module will be dependent upon the accuracy and stability of the 560-5203-X oscillator or if Aux Ref mode is

enabled, of the external disciplining oscillator. In GPS mode only, time error accumulates depending upon the stability of the oscillator used (560-5203-X) and the accuracy to which it was set prior to loss of GPS steering information. When GPS and Aux Ref modes are used, the stability and accuracy of the external oscillator determines the time drift.

The GPS/Oscillator continually calculates an estimate of the "worst-case time error". When the receiver is tracking satellite signals and is operating from a known position, the worst-case error is 200 nS. If lock with all satellite signals is lost, the Serial F53 command returns "F53 MODE: 0 SATS", where "MODE" is the current operating mode, i.e. AUTO, SURVEY, TIME.

If the time quality indicator character is enabled (see serial Function F11) then the time string returned by either serial Function F08 or F09 will indicate the worst-case time error with a different character for each of four thresholds. The user may enable, disable and set these thresholds using serial Function F05. As shipped these indicators are enabled and the default thresholds are:

First threshold	= 1 uS
Second threshold	= 10 uS
Third threshold	= 100 uS
Fourth threshold	= 1000 uS

New threshold values entered are retained upon power-down and are the new defaults upon subsequent power-ups.

3.6. SERIAL INTERFACE

The user serial port can be connected to a terminal or computer. These instructions assume that a terminal is connected. The serial connection, data format and Functions are explained in the following section.

3.6.1. RS-232/RS-422 CONNECTION

The male 9-pin D connector (DB-9P) mounted to the 560-5202 panel is the GPS/Oscillator user port. Refer to manual SECTION ONE for the pinout and protocol of this port.

3.6.2. SERIAL FUNCTION LIST

Initially at power-up, the serial port outputs time once per second as described in Function F08 until it receives a control-C character (HEX 03). Then any of the following commands may be used:

COMMAND	FUNCTION
F01	Time Zone Entry/Request
F02	12/24 Hour Format Entry/Request
F03	Time/Date Entry/Request
F05	Time Quality Enable/Setup
F08	Continuous Time Once Per Second Enable
F09	Time on Request Enable
F11	Time Output Format Entry/Request
F13	Worst-case Time Error Request
F18	Software Version Request
F29	External Frequency Measurement
F50	Position Entry/Request
F51	Cable Delay Entry/Request
F52	Distribution Cable Delay Entry/Request
F53	Operational Mode Entry/Request
F55	Altitude Units Entry/Request
F56	Average Position Entry/Request
F60	Satellite List Request
F65	Satellite Select
F66	Daylight Savings Enable
F68	Current Year Entry (GPS epoch management)
F69	Select Local/Standard/GPS/UTC time
F71	Oscillator Statistics Request
F72	Fault Status
F73	Request Alarm Status
F79	Warm Start

3.6.3. GENERAL INPUT AND OUTPUT FORMAT

Data may be sent to or requested from the Serial port by using various function commands and ASCII character strings. In general those functions which request status or data fit the form:

F<FUNC#><CR>

where

F	=	ASCII character F or f.
<FUNC>	=	two-digit function number.
<CR>	=	ASCII carriage return character (Hex 0D).

The format for both data input and data output strings is:

F<FUNC#>[<SEP><FIELD>]<LT>

where

F	=	ASCII character F or f.
<FUNC>	=	function number.
<SEP>	=	one or more separator characters: either space, comma or tab.
<FIELD>	=	data entry or request.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.
[ ]	=	encloses a phrase that is repeated as often as necessary.

Output strings from the Serial port are kept to fixed lengths whenever possible. This means that numeric values will often contain many leading blanks. Numeric values are right justified so that the least significant digit is always in the same position in the string. Quantities that can be positive or negative will have a sign even if positive. This is done to simplify the task of programming computer systems that receive the data. The formats of the output strings are designed so that it is possible to request the state of a function and save the response string. Later that string can be sent to the unit to restore the original state of that function.

Input strings sent to the unit may be of variable length. The number of separators between fields may be varied. Numeric values may be entered with or without leading zeros. Where a sign is allowed, it may be omitted for positive quantities. String fields (such as "on" or "off") may be entered in upper or lower case, as can the "F" that starts all Serial commands. All commands may be ended with a carriage return alone or by a carriage return line feed combination. Some fields of some commands are optional, and may be replaced by a semicolon. If a field is so replaced, the corresponding value will be left unchanged.

Incorrect entry may result in an error message as described under "SERIAL ERROR MESSAGES" in this section. Correct entries are acknowledged with OK<CR><LF>.

3.6.4 SERIAL ERROR MESSAGES

The Serial port will respond with the message "ERROR 01 VALUE OUT OF RANGE" if the input string was in the correct format but contained a value, probably numeric, that was out of the range of acceptable values. Refer to the paragraphs explaining the function in use for the correct range of values.

Sample entry: F01 13:00<CR>
Response: ERROR 01 VALUE OUT OF RANGE<CR><LF>

The Serial port will respond with the message "ERROR 02 SYNTAX" if it receives a string in an incorrect format.

Sample entry: F03 LOCAD<CR>
Response: ERROR 02 SYNTAX<CR><LF>

The Serial port will respond with the message "ERROR 03 BAD/MISSING FIELD" if the input string lacks a required field. Refer to the paragraph in this section explaining the function in use.

Sample entry: f50 n 38d23'51.3" w 122d42'53.2"<CR>
Response: ERROR 03 BAD/MISSING FIELD<CR><LF>

The Serial port will respond with the message "ERROR 05 NO SUCH FUNCTION" if the function number requested is not implemented.

Sample entry: F40<CR>
Response: ERROR 05 NO SUCH FUNCTION<CR><LF>

3.7. SERIAL FUNCTION DESCRIPTIONS

3.7.1 SERIAL FUNCTION F01 - TIME ZONE ENTRY/REQUEST

Use Serial Function F01 to select or determine the time zone offset. To request the offset send F01<CR> to the Serial port. The port will respond with the following character string:

F01<SEP><SIGN><HH>:<MM><LT>

where

F	=	ASCII character F.
01	=	function number.
<SEP>	=	one or more separator characters: either space, comma or tab.
<SIGN>	=	either no character or + for positive offsets or - for negative offsets.
<HH>	=	one - or two-digit hours offset from +12 to -12 hours.
:	=	ASCII character for a colon.
<MM>	=	two-digit minutes offset.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F01<CR>
Response: -4:30<CR><LF>

To set the time zone offset send a character string with the following format:

Sample entry: F01 -8:00<CR>
Response: OK<CR><LF>

Sample Request: F01<CR>
Response: -8:00<CR><LF>

3.7.2 SERIAL FUNCTION F02 - 12/24 HOUR FORMAT ENTRY/REQUEST

Use Serial Function F02 to request or set the time display format. To determine the format send F02<CR> to the Serial port. The port will respond with the following character string:

F02<SEP><HH><LT>

where

F	=	ASCII character F.
02	=	function number.
<SEP>	=	one or more separator characters: either space, comma, or tab.
<HH>	=	12 or 24.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F02<CR>
Response: F02 12<CR><LT>

To select 24 hour format, send the following character string:

Sample entry: F02 24<CR>
Response: OK<CR><LF>

3.7.3 SERIAL FUNCTION F03 - TIME/DATE ENTRY/REQUEST

Use Serial Function F03 to enter or request time and date. To request time and date send F03<CR> to the Serial port. The port will respond with the ASCII character string:

F03<SEP><TYPE><SEP><mm>/<dd>/<yy><SEP><HH>:<MM>:<SS><LT>

where

F	=	ASCII character F.
03	=	function number.
<SEP>	=	one or more separator characters: either space, comma or tab.
<TYPE>	=	either LOCAL or UTC.
<mm>	=	one- or two-digit month.
/	=	ASCII character slash.
<dd>	=	one- or two-digit day.
<yy>	=	two-digit year.
<HH>	=	one- or two-digit hours.
:	=	ASCII character for a colon.
<MM>	=	two-digit minutes.
<SS>	=	two-digit seconds.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F03<CR>
Response: F03 UTC 01/07/99 02:48:29<CR><LF>

Sample entry: F03 LOCAL<CR>
Response: F03 LOCAL 01/07/99 7:48:29<CR><LF>

Sample request: F03 UTC<CR>
Response: F03 UTC 01/07/99 2:48:29<CR><LF>

To set the time zone offset send a character string with the format above to the Serial port. Either the date MM/DD/YY or the time HH:MM:SS may be omitted if they are replaced with a semicolon (;). Only valid dates are acceptable.

The following entry sets the local date and time.

Sample entry: F03 LOCAL 10/3/03 20:07:04<CR>
Response: OK<CR><LF>

The following entry uses semicolons to omit the time type and date fields, thus setting the UTC time, and leaving the date unchanged.

Sample entry: F03 ;; 3:06:48<CR>
Response: OK<CR><LF>

3.7.4 RESERVED

3.7.5 SERIAL FUNCTION F05 - TIME QUALITY ENABLE/SETUP

Use Function F05 to enable or disable the time quality indicators or to set the four worst-case-error thresholds. The Serial output string indicates the time quality. Refer to "SERIAL FUNCTION F08 - CONTINUOUS

TIME ONCE PER SECOND" for a description of the time quality indication in the Serial time output string. As shipped the time quality indicators are enabled and the thresholds are set to 1000 nS, 10000 nS, 100000 nS and 1000000 nS. The unit will retain the values in use at power-down and use them for subsequent power-ups.

To determine if the indicators are enabled and what the thresholds are, send F05<CR> to the Serial port. The port will respond with the ASCII character string:

F05<SEP><STATE><SEP><FLAG><SEP><FLAG><SEP><FLAG><SEP><FLAG><LT>

where

F	=	ASCII character F.
05	=	function number.
<SEP>	=	one or more separator characters: either space, comma or tab.
<STATE>	=	ON or OFF.
<FLAG>	=	error threshold in nanoseconds, 1 to 11 digits with or without leading zeros.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F05<CR>
Response: F05 ON 00000000100 00000001000 00000010000 00000020000

To enable, disable or set the thresholds of the time quality indicators send a character string with the following format:

Sample: F05 ON 00000000100 00000001000 00000010000 00000020000
Response: OK<CR><LF>

Acceptable threshold value range: 00000000010 nS to 40000000000 nS.

Sample entry: F05 ON 100 200 500 1000
Response: OK<CR><LF>

Note that although leading zeros are not required for data entry they will be included in any data response.

3.7.6 THRU 3.7.7 RESERVED

3.7.8 SERIAL FUNCTION F08 - CONTINUOUS TIME ONCE PER SECOND ENABLE

Elapsed time from turn-on will output once per second at the Serial port if command string F08<CR> is sent to the port prior to acquisition of satellite signals. Time-of-year will output once per second after acquisition of satellite signals. Character transmission is continuous with the end of the stop bit of one character coinciding with the beginning of the start bit of the next character. The time output string format may be changed with Serial Function F11. The default output string format is:

<SOH>DDD:HH:MM:SSQ<CR><LF>

where

<SOH>	=	ASCII Start-of-Header character (HEX 01).
<CR>	=	ASCII Carriage Return character (HEX 0D).
<LF>	=	ASCII Line Feed character (HEX 0A).
DDD	=	day-of-year.
HH	=	hours.
MM	=	minutes.
SS	=	seconds.
:	=	colon separator.
Q	=	time quality character.

The time quality character may be a:

SPACE	indicates a worst-case error less than threshold 1
.	indicates a worst-case error greater than or equal to threshold 1.
*	indicates a worst-case error greater than or equal to threshold 2.
#	indicates a worst-case error greater than or equal to threshold 3.
?	indicates a worst-case error greater than or equal to threshold 4.

The time quality character prior to satellite signal acquisition will be "?". Refer to SERIAL FUNCTION F13-WORST-CASE-TIME ERROR REQUEST. The carriage return character <CR> start bit begins on the second, +0 to +1 bit time or $\pm$1 mS, which ever is larger. Time will continue to output once per second until the port receives a CONTROL-C character (HEX 03). Until it receives a CONTROL-C the port will ignore all other input.

3.7.9 SERIAL FUNCTION F09 - TIME ON REQUEST ENABLE

When the Serial port receives the command string F09<CR> it waits for a request in the form of an upper-case ASCII character T to output the time-of-day string. After a T is received, the current time is saved (with a resolution of 1 mS) in a buffer and is then transmitted to the port. The port will continue to respond with time-of-day each time it receives a T until this function is canceled by sending a CONTROL-C character (HEX 03) to the port (all other input will be ignored until then). The default output string is as follows:

<SOH>DDD:HH:MM:SS.mmmQ<CR><LF>

where

<SOH>	=	ASCII Start-of-Header character (HEX 01).
<CR>	=	ASCII Carriage Return character (HEX 0D).
<LF>	=	ASCII Line Feed character (HEX 0A).
DDD	=	day-of-year.
HH	=	hours.
MM	=	minutes.
SS	=	seconds.
mmm	=	milliseconds.
:	=	colon separator.
Q	=	time quality character. Refer to Function 08 for values.

Sample entry: F09<CR>
Second entry: T
Response: <SOH>128:20:30:04.357*<CR><LF>

3.7.10 RESERVED

3.7.11 SERIAL FUNCTION F11 - TIME OUTPUT FORMAT ENTRY/REQUEST

Use Serial Function F11 to request or enter the time output string format that is used by Serial Functions F08 and F09.

The format upon power-up will be the format that was in use just before power-down. To request the return of the present format send F11<CR> to the Serial port. The string returned will contain X's in the positions that are omitted in the time output string.

When shipped, the format string will be set to the "null" string, causing the strings of the F08 and F09 outputs to take on their default values.

EXAMPLE F08: <SOH>DDD:HH:MM:SSQ<CR><LF>
(Once per second time output mode)

NOTE: Milliseconds are never present in the output of F08 mode regardless of the format string entered with F11.

EXAMPLE F09: <SOH>DDD:HH:MM:SS.mmmQ<CR><LF>
(Time on demand output mode)

where

<SOH>	=	ASCII Start-of-Header character (HEX 01).
<CR>	=	ASCII Carriage Return character (HEX 0D).
<LF>	=	ASCII Line Feed character (HEX OA).
DDD	=	day-of-year.
HH	=	hours.
MM	=	minutes.
SS	=	seconds.
.	=	ASCII decimal point.
mmm	=	milliseconds.
:	=	colon separator.
Q	=	time quality character position. characters for this position are: < >, <.>, <*>, <#> and <?>

If non-volatile memory (EEPROM) is corrupted the format string will be set to the "null" string.

When the unit returns the current format string in response to "F11<CR>" (as shown in the following example) the first character after the "F11" is always a blank and is not part of the format string but is only a separator.

Sample request: F11<CR>
Response: F11 <CR><LF>

The following text assumes that the format has been previously set to DDD::MMmSSQ.

Sample request: F11<CR>
Response: F11 DDD:XX:MMmSSXXXXQ<CR><LF>

This means that the response from F09 would be:

<SOH>122::24m55*<CR><LF>

To omit a character, other than <SOH> <CR> or <LF>, from the output string send a string of the form:

F11<SEP>DDD:HH:MM:SS.mmmQ<CR>

with an upper case "X" in place of the character that you wish to omit. The <SOH>, <CR> and <LF> characters in the output strings of F08 and F09 are not subject to control by F11. <SEP> is one character only, either a space, comma or tab. Any character other than an upper case "X" in a numeric position will not affect the output of that position. The colons (:)

or decimal point (.), however, may be replaced with any single ASCII character except null (HEX 00), carriage return, or line feed.

Sample entry: F11 XXXXXXXMMMSSS.mmmX<CR>
Response: OK<CR>
F08 string output: <SOH>12M34S<CR><LF>
F09 string output: <SOH>12M34S.567<CR><LF>

The above format means that days hours and the first two colon separators are suppressed and the third and fourth separators are "M" and "S".

Sample entry: F11,HHH;XX;mm:SS,mmmQ<CR>
Response: OK<CR>
F08 string output: <SOH>123;;55:45*<CR><LF>
F09 string output: <SOH>123;;55:45,678*<CR><LF>

The above format means that hours are deleted, the first two separators are semicolons instead of colons and the third separator is a comma instead of a period.

If the format string entered with F11 is terminated early with a carriage return, the remaining characters are enabled and assume their default values.

Sample entry: F11<TAB>XXX|<CR>
Response: OK<CR>
F08 string output: <SOH>|10:45:01*<CR><LF>
F09 string output: <SOH>|10:45:01.234*<CR><LF>

The above format means that days are deleted, the first separator is a vertical bar and all other characters are enabled and assume their default values.

When entering a new format string the character after "F11" is required but is ignored. To enter a "null" format string send "F11" followed by a space, followed by a carriage return.

Sample entry: F11 <CR>
Response: OK<CR>
F08 string output: <SOH>DDD:HH:MM:SSQ<CR><LF>
F09 string output: <SOH>DDD:HH:MM:SS.mmmQ<CR><LF>

The above format means that all characters and separators are enabled and assume their default values.

If the current format string is "null", F11 will return a space character followed by a carriage return.

Sample entry: F11<CR>

Response: F11 <CR>

The format string below explicitly enables all characters and has the same effect as a "null" format string:

Sample entry: F11 DDD:HH:MM:SS.mmmQ<CR>
Response: OK<CR>
F08 string output: <SOH>DDD:HH:MM:SSQ<CR><LF>
F09 string output: <SOH>DDD:HH:MM:SS.mmmQ<CR><LF>

3.7.12 RESERVED

3.7.13 SERIAL FUNCTION F13 - WORST-CASE TIME ERROR REQUEST

Use Serial Function F13 to request the estimated worst-case time error. The worst-case time error while tracking satellites is always 00.000000200 seconds. Time error begins to accumulate when the receiver loses contact with the satellite signal. The GPS/Oscillator calculates the worst-case time error based on the stability of the time base in use, either the local or external oscillator, and the time elapsed since loss of lock. The Serial port will report this calculated error when it receives the string F13<CR> and responds with the following ASCII character string:

F13<SEP><ERROR><CR><LF>

where

F	=	ASCII character F.
13	=	function number.
<SEP>	=	one or more separator characters; either space, comma or tab.
<ERROR>	=	calculated worst-case error in seconds
<CR>	=	carriage return character.
<LF>	=	line feed character.

Sample request: F13<CR>
Response: F13 02.000000000<CR><LF>

3.7.14 THRU 3.7.17 RESERVED

3.7.18 SERIAL FUNCTION F18 - SOFTWARE VERSION REQUEST

Use Serial Function F18 to obtain information about the current version of the software installed in the unit.

Send the string:

F18<CR>

The unit will respond with a string no longer that 80 characters.

example:

TRUETIME Mk III sys ver 2.002 GPS-XL2 ver 8010v001<CR><LF>

This string indicates that the system software is version 2.002, and the time and frequency module-specific software is 8010v001.

3.7.19 THRU 3.7.28 RESERVED

3.7.29 SERIAL FUNCTION F29 - EXTERNAL FREQUENCY MEASUREMENT

This function allows the user to monitor the Aux Ref input frequency vs. the GPS reference. Use Serial Function F29 to set the measurement mode, measurement interval and the input frequency parameters (input frequency must always be set to 1 MHz) and to view the current settings and the measurement data.

This function provides the ability to very accurately measure the frequency of the externally applied Aux Ref signal with respect to the disciplined GPS/Oscillator. Note that the Aux Ref disciplining frequency which may be 1, 5 or 10 MHz is converted by the 560-5203-X card to 1 MHz.

The resolution of the measurements is 2.4 parts in 10^{-10} divided by the Measurement Interval. The range of fractional frequency offset from the nominal input frequency which may be measured is $\pm$500 PPM. The Measurement Interval may be specified in integer seconds over the range of 1 to 100,000 seconds.

Note that the accuracy of the frequency measurement is based on the accuracy and stability of the disciplined GPS/Oscillator over the measurement interval. Short interval measurements on very high stability oscillators (i.e. Cesium) will tend to measure the GPS/Oscillator instead of the oscillator under test. The following specifications show the stability of the different GPS/Oscillator types after the GPS/Oscillator has ascertained an accurate position and is operating in Time mode.

TCXO	1×10^{-9}	@ 1 sec	Ovenized	1×10^{-11}	@ 1 sec
	3×10^{-10}	@ 10 sec	Quartz	5×10^{-11}	@ 10 sec
	3×10^{-10}	@ 100 sec		1×10^{-10}	@ 100 sec
	1×10^{-12}	@ 100,000 sec		1×10^{-12}	@ 100,000 sec
Quartz	1×10^{-11}	@ 10 sec		3×10^{-11}	@ 10 sec
	1×10^{-11}	@ 100 sec		7×10^{-12}	@ 100 sec
	1×10^{-12}	@ 100,000 sec		1×10^{-12}	@ 100,000 sec

Function 29 offers three modes of operation:

OFF	--	No measurements are reported in this mode.
QUERY	--	Measurements are reported only when requested in this mode.
PERIODIC	--	Measurements are continuously output at the specified interval until a CTRL-C is sent.

The measurement technique uses a heterodyne phase error multiplier approach to achieve high resolution at short sample periods. An important feature of this implementation is that "zero dead time" frequency measurements are performed. In essence the position in GPS/Oscillator internal time of a zero crossing of the externally applied frequency being measured is recorded, or "timestamped", once per measurement interval with 240 picosecond resolution. (In the QUERY mode of operation, the reception of the measurement request string causes a timestamp to be performed, rather than at a fixed repetitive rate as in the PERIODIC mode of operation). In addition, the number of zero crossings between successive timestamps is also recorded.

When it is time to perform a measurement, either because the selected interval in PERIODIC mode has elapsed or a QUERY mode measurement request has been received, the previous measurement timestamp is subtracted from the current one and the difference is divided by the number of zero crossings between these two timestamps. This result is the average period of the external frequency being measured over the interval. The reciprocal of this period is then compared to the nominal frequency to determine the fractional frequency offset. The timestamp reported with the resulting measurement is the ending timestamp of the two phase readings used to make the measurement. Since this ending timestamp is now the beginning timestamp for the next measurement, there is no "dead time" present in the measurements.

The reported timestamp resolution is sufficient to allow integrating the fractional frequency offset measurements to fully recover the relative phase of the external frequency source being measured versus the disciplined GPS/Oscillator.

To view the current settings, send a character string of the form:

F29<CR>

where

F	is the ASCII character "F"
29	is the function number
<CR>	is the ASCII carriage return character, HEX 0D

The Serial port will respond with:

F29<SEP><MODE><SEP><FREQ><SEP><INTERVAL><CR><LF>

where

<SEP>	is a separator character, either space, comma or tab.
<MODE>	is either OFF, QUERY or PERIODIC.
<FREQ>	is the input frequency in MHz, either 1, 5 or 10. (Must be 1 MHz). This field is not sent if the mode is OFF.
<INTERVAL>	is the measurement interval in seconds, a decimal integer in the range of 1 to 100000. This field is not sent if the mode is OFF or QUERY.

To configure Function F29, send a string in this format:

F29<SEP><MODE><SEP><FREQ><SEP><INTERVAL><CR>

If the MODE being set is OFF, then the Serial port will respond with:

OK<CR><LF>

Otherwise, the Serial port will respond with:

F29<SEP><TIMESTAMP><SEP><MODE><SEP><FREQ><SEP><INTERVAL><CR><LF>

where

<TIMESTAMP>	is dayofyear:hours:minutes:seconds.subseconds in this fixed field format: ddd:hh:mm:ss.nnnnnnnnn

This timestamp is the initial phase timestamp which will be used to compute the first fractional frequency offset measurement which will follow either from a QUERY or PERIODIC update.

In the PERIODIC mode of operation, measurements are continually output at the specified measurement interval until a CTRL-C character (HEX 03) is received. Reception of the CTRL-C character automatically sets the F29 mode to OFF. In PERIODIC mode, all characters sent to the GPS/Oscillator will be ignored until CTRL-C is received. This mode is suitable for long term automated observation of the performance of an

external frequency standard or for the calibration of free running timebase oscillators.

In the QUERY mode of operation, a measurement is computed and output each time that this string is received:

F29<SEP>F<CR>

where

F is the ASCII character "F".

In this mode, the measurement interval is the time in integer seconds between receptions of the above string. This mode is useful in matching the data rate of some other process which is concurrently being logged and is not necessarily periodic or synchronized with the GPS/Oscillator.

The measurement returned in either the QUERY or PERIODIC modes is sent in this format:

F29<SEP><TIMESTAMP><SEP><FFO><CR><LF>

where

<FFO>	is fractional frequency offset of the input frequency relative to its nominal frequency in this fixed field scientific notation format: sX.XXXXXXXXXXEsXX
Sample command:	F29 PERIODIC 1 100<CR>
Response:	F29 124:23:08:10.000956789 PERIODIC 1 MHZ 100 SEC<CR><LF>
Result:	A 1 MHz input frequency is continually measured and reported at 100 second measurement intervals.

Sample measurement sent either from PERIODIC mode or on request from QUERY mode:

F29 123:21:37:56.000894320 -2.89345678245E-04<CR><LF>

3.7.30 THRU 3.7.49 RESERVED

3.7.50 SERIAL FUNCTION F50 - POSITION ENTRY/REQUEST

Use Serial Function F50 to enter or request the current antenna position. Since Function F50 returns the most recent fix computed by the GPS core module, not the long term averaged position which is calculated during the AUTO mode of operation and reported via Serial Function F56,

its use is mainly for initializing the approximate position of the GPS core module at new installations.

The out-of-the-box default for position is that of the TrueTime factory in Santa Rosa, California. The position on subsequent power-ups will be the same as it was on the previous power-down. To determine the present position send F50<CR> and the Serial port will respond with the following continuous one line string:

F50<SP><SIGN><SP><DEG>d<MIN>'<SEC>"<SP><SIGN><SP>
<DEG>d<MIN>'<SEC>"<SP><SP><SP><SP>or<ALT><UNITS><SP>
pdop<SP><PDOP><LT>

where

F	=	ASCII character F (f or F for input string).
50	=	function number.
<SP>	=	ASCII space character.
<SIGN>	=	N or S for latitude; E or W for longitude; or + or - for longitude, latitude or altitude (-) corresponds to S or W. or no character, <SP> for + altitude.
<DEG>	=	two-digit degrees for latitude or three-digit degrees for longitude.
d	=	ASCII character d (d or D for input string). (Always d in output string).
<MIN>	=	two-digit minutes.
'	=	ASCII character '(' m or M for input string). (Always ' in output strings).
<SEC>=	two-digit seconds.	
"	=	ASCII character "(" s or S for input string). (Always " in output string).
<ALT>	=	altitude in feet or meters.
<UNITS>	=	unit of altitude, either a M or m for meters or F or f for feet depending on the units selected with keypad Function 55 or Serial Function F55.
<PDOP>	=	3 or 4 digit value of the position dilution of precision.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F50<CR>
Response: F50 N 38d23'51.3" W 122d42'53.2" 58m pdop 2.69<CR><LF>

To enter a position send a character string with the following format. Latitude, longitude, or altitude may be omitted in the string provided they are replaced with a semicolon (;) character. The altitude units may be feet or meters.

Sample entry:	f50 n 38d23'51.3" w 122d42'53.2" 10m<CR>
equivalent:	F50 + 38D23M51.3S + 122D42M53.2S +10M<CR>
Response:	OK<CR><LF>
Sample request:	F50<CR> (after sending above string)
Response:	F50 N 38d23'51.3" W 122d42'53.2" 10m pdop 2.69<CR><LF>
Sample entry:	f50;;40m (with values from example above)
equivalent:	F50 ; ; 40M (no change to latitude or longitude - altitude now 40m)
Response:	F50 N 38d23'51.3" W 122d42'53.2" 40m pdop 2.69<CR><LF>

NOTE: Altitude must be included in the position entry string - either a value or a (;) must be entered or a syntax error will occur (causing the entered string to be ignored).

3.7.51 SERIAL FUNCTION F51 - ANTENNA CABLE DELAY ENTRY/REQUEST

Use Serial Function F51 to enter or request the cable delay. The default is 60 nS. Typical delays for RG-58 and RG-59 cables are approximately 1.3 nS/foot. The value is held in EEPROM. **When the downconverted antenna is being used, 200 nS should be <u>subtracted</u> from the cable delay entered here.** To determine the present value send F51<CR> to the Serial port. The port will respond with the ASCII character string in the following format:

F51<SEP><SIGN><DELAY>ns<LT>

where

F	=	ASCII character F (f or F for input string).
51	=	the function number.
<SEP>	=	one or more space characters.
<SIGN>	=	either + or -
<DELAY>	=	1 to 9 digit delay from +001000000 nS to -001000000 nS.
ns	=	nanoseconds (ns or NS for input string).
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.
<SP>	=	ASCII space character.

Sample request: F51<CR>
Response:

F51<SP><SP><SP><SP><SP><SP><SP><SP>+60ns<CR><LF>

To enter a 1 millisecond cable delay send the following character string:

Sample entry: F51<SP>1000000NS<CR>
Response: OK<CR><LF>

Sample request: F51<CR> (using entry from above)
Response: F51<SP><SP><SP>+1000000ns<CR><LF>

3.7.52 SERIAL FUNCTION F52 - DISTRIBUTION CABLE DELAY ENTRY/REQUEST

Use Serial Function F52 to enter or request the distribution cable delay for compensating the timing outputs for delays between the GPS/Oscillator and the point of use of the timing signals. Antenna cable delay compensation should not be performed using this function. Use Function F51 for antenna cable delay. The default is 0 nS. Typical delays for RG-58 and RG-59 cables are approximately 1.3 nS/foot. The value is held in EEPROM. *Positive delays entered here will advance the GPS/Oscillator timing outputs while negative delays will retard them.*

To determine the present value send F52<CR> to the Serial port. The port will respond with the ASCII character string in the following format:

F52<SEP><SIGN><DELAY>ns<LT>

where

F	=	ASCII character F (f or F for input string).
52	=	the function number.
<SEP>	=	one or more space characters.
<SIGN>	=	either + or -
<DELAY>	=	1 to 9 digit delay from +001000000 nS to -001000000 nS.
ns	=	nanoseconds (ns or NS for input string).
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.
<SP>	=	ASCII space character.

Sample request: F52<CR>
Response:

F52<SP><SP><SP><SP><SP><SP><SP><SP>+50ns<CR><LF>

To enter a 1 millisecond cable delay send the following character string:

Sample entry: F52<SP>1000000NS<CR>
Response: OK<CR><LF>

Sample request: F52<CR> (using entry from above)
Response: F52<SP><SP><SP>+1000000ns<CR><LF>

3.7.53 SERIAL FUNCTION F53 - OPERATIONAL MODE ENTRY/REQUEST

Use Serial Function F53 to select the operational mode, either AUTO, SURVEY STATIC, SURVEY DYNAMIC or TIME. For an explanation of these modes refer to "OPERATIONAL MODES" earlier in this section. The power-up default is the mode in use at the previous power-down. To request the present mode send F53<CR> to the Serial port. The port will respond with the ASCII character string:

F53<SEP><MODE>:<SEP><#><SEP>SATS<LT>

where

F	=	ASCII character F.
53	=	function number.
<SEP>	=	one or more separator characters: either space, comma or tab.
<MODE>	=	AUTO, SURVEY STATIC, SURVEY DYNAMIC or TIME.
:	=	ASCII colon
<SEP>	=	space
<#>	=	number of SV's being tracked
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F53<CR>
Response: F53 SURVEY STATIC: 6 SATS<CR><LT>

To enter TIME mode send the following character string:

Sample entry: F53<SP>TIME<CR>
Response: OK<CR><LF>

Sample request: F53<CR>
Response: F53 TIME: 5 SATS<CR><LF>

3.7.54 RESERVED

3.7.55 SERIAL FUNCTION F55 - ALTITUDE UNITS ENTRY/REQUEST

Use Serial Function F55 to select the units of the altitude, either feet or meters. The out-of-the-box default is meters. The units upon subsequent power-ups will be the same as they were on the previous power-down. To request the units presently in use, send F55<CR> to the Serial port. The port will respond with the ASCII character string:

F55<SEP><UNITS><LT>

where

F	=	ASCII character F.
55	=	function number.
<SEP>	=	one or more separator characters: either space, comma or tab.
<UNITS>	=	FEET or METERS.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F55<CR>
Response: F55 METERS<CR><LF>

To select feet send the following character string:

Sample entry: F55<SP>FEET<CR>
Response: OK<CR><LF>

Sample request: F55<CR>
Response: F55 FEET<CR><LF>

3.7.56 SERIAL FUNCTION F56 - AVERAGE POSITION ENTRY/REQUEST

Use Serial Function F56 to enter or request the averaged, hence accurate, current antenna position. Its main use is to provide a means of setting an accurate, surveyed position for use in the TIME mode of operation. Positions provided to the GPS/Oscillator via Function F56 should be more accurate than 10 meters, otherwise better results may be obtained via AUTO mode, unless satellite visibility at the site is too poor to provide three dimensional positioning.

The out-of-the-box default for position is that of the TrueTime factory in Santa Rosa, California. The position on subsequent power-ups will be the same as it was on the previous power-down. An averaged position as returned via Function F56 which subsequently becomes in error by more than 1 Km, either due to transport of the receiver and antenna or error in the initial entry, will be cleared and recalculated automatically once positioning begins at the new site and the error is detected.

To determine the present position send F56<CR> and the Serial port will respond with the following continuous one line string:

F56<SP><SIGN><SP><DEG>d<MIN>'<SEC>"<SP><SIGN><SP>
<DEG>d<MIN>'<SEC>"<SP><SP><SP><SP or ->
<ALT><UNITS><SP><SOURCE><LT>

where

F	=	ASCII character F (f or F for input string).
56	=	function number.
<SP>	=	ASCII space character.
<SIGN>	=	N or S for latitude; E or W for longitude; or + or - for longitude, latitude or altitude (-) corresponds to S or W. or no character, <SP> for + altitude.
<DEG>	=	two-digit degrees for latitude or three-digit degrees for longitude.
d	=	ASCII character d (d or D for input string). (Always d in output string).
<MIN>	=	two-digit minutes.
'	=	ASCII character '(' m or M for input string). (Always ' in output strings).
<SEC>	=	two-digit seconds.
"	=	ASCII character "(" s or S for input string). (Always " in output string).
<ALT>	=	altitude in feet or meters.
<UNITS>	=	unit of altitude, either a M or m for meters or F or f for feet depending on the units selected with Serial Function F55.
<SOURCE>	=	the source of the position in one of two formats:

COUNT <NNNNN> / 90000
NNNNN is the total number of fixes in the average, 90000 is the total number of fixes required to complete the position average process.

ENTERED
Indicates that the current averaged position was obtained via operator entry.

<LT> = line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request: F56<CR>
Response: F56 N 38d23'51.3" W 122d42'53.2" 58m 49001/90000<CR><LF>

To enter a position send a character string with the following format. Latitude, longitude or altitude may be omitted in the string provided they

are replaced with a semicolon (;) character. The altitude units may be feet or meters. **The unit must be in TIME mode to enter the accurate position using F56.**

Sample entry:	f56 n 38d23'51.3" w 122d42'53.2" 10m<CR>
equivalent:	F56 + 38D23M51.3S + 122D42M53.2S +10M<CR>
Response:	OK<CR><LF>
Sample request:	F56<CR> (after sending above string)
Response:	F56 N 38d23'51.3" W 122d42'53.2" 10m ENTERED<CR><LF>
Sample entry:	f56;;40m (with values from example above)
equivalent:	F56 ; ; 40M (no change to latitude or longitude - altitude now 40m)
Response:	F56 N 38d23'51.3" W 122d42'53.2" 40m<CR><LF>

NOTE: Altitude must be included in the position entry string - either a value or a (;) must be entered or a syntax error will occur (causing the entered string to be ignored).

3.7.57 THRU 3.7.59 RESERVED

3.7.60 SERIAL FUNCTION F60 - SATELLITES LIST REQUEST

Use Serial Function F60 to request a list of all, current, tracked or bad satellites. To request the list send the string:

F60<SEP><TYPE><CR>

where

F	=	ASCII character F.
60	=	function number.
<SEP>	=	one or more separator characters: either space, comma or tab.
<TYPE>	=	ALL, CURRENT, TRACKED or BAD.
<CR>	=	carriage return character.

The Serial port will respond with a series of strings of the form

F60<SEP>prn NN good enabled tracked current sig level = +<LEVEL><CR><LF>

where

NN	=	two-digit satellite number.
<LF>	=	line feed character.
tracked	=	either present or absent.
current	=	either present or absent.

Sample request: F60 ALL<CR>
Response:

F60 prn 14 good enabled tracked current sig level = +12.00<cr><lf>
F60 prn 15 good enabled tracked current sig level = +8.55<cr><lf>
F60 prn 18 good enabled tracked current sig level = +8.73<cr><lf>
F60 prn 21 good enabled tracked sig level = +7.19<cr><lf>

3.7.61 THRU 3.7.64 RESERVED

3.7.65 SERIAL FUNCTION F65 - SATELLITE SELECT

Use Serial Function F65 to select specific satellites for the receiver to track or deselect satellites, i.e. instruct the GPS/Oscillator to ignore certain satellites. Send the string of the form:

F65<SEP><REQUEST>[<SEP>NN]<CR>

or

F65<SEP><REQUEST>ALL<CR>

where

F	=	ASCII character F.
65	=	function number.
<REQUEST>	=	either SELECT or DESELECT
<SEP>	=	one or more separator characters: either space, comma or tab.
NN	=	two-digit satellite number.
ALL	=	ASCII character string ALL.
[]	=	encloses a phrase that is repeated as often as necessary.
<CR>	=	carriage return character.

The Serial port will respond with an OK.

Sample entry: F65 SELECT 02 18 13<CR>
Response: OK<CR><LT>

Sample entry: F65<TAB> SELECT ALL<CR>
Response: OK<CR><LF>

Sample entry: F65 DESELECT 01 08<CR>
Response: F65 OK<CR><LF>

To determine which satellites are enabled (selected) and being tracked use Serial Function F60. Only those satellite numbers appearing on the Satellite List as displayed using F60 may be selected or deselected. Use of any other satellite number will result in the error message "ERROR 04 EXCLUSIVE USE".

NOTE: The time and frequency module requires 24 hours after turn on to complete the satellite list.

3.7.66 SERIAL FUNCTION F66 - DAYLIGHT SAVING ENABLE

Use Serial Function F66 to enable or disable or set the entry or exit times for DST. The initial out-of-the-box default is "Off". The default upon subsequent power-ups will be the selection in use just prior to the previous power-down.

To request the present status of the daylight saving enable, send F66<CR> to the serial port. The port will respond with the ASCII character string:

F66<SEP><STATE><LT>

where

F	=	ASCII character F.
66	=	function number
<SEP>	=	one or more separator characters: either space, comma or tab.
<STATE>	=	Off or Manual.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

If the DST function is in Manual, the port will respond with the longer string described below.

Sample request: F66<CR>
Response: F66 OFF<CR><LF>

To alter the state of the daylight saving enable send a character string with the format above to the serial port.

Sample entry: F66<SP>Off<CR>
Response: OK<CR><LF>

To place the DST function in Manual and set the DST entry and exit times send a continuous string of the form:

F66 MANUAL <IN HOUR><SEP><IN WEEK><SEP><IN DAY><SEP>
<IN MONTH><OUT HOUR><SEP><OUT WEEK><SEP>
<OUT DAY><SEP><OUT MONTH><LT>

where

<IN HOUR>	=	time to enter DST in 24-hour format.
<SEP>	=	one or more separator characters, either space comma or tab characters. For output strings this will be a single space character.
<IN WEEK>	=	which week to enter DST, 1, 2, 3, 4 or 0 (for last).
<IN DAY>	=	day of week to enter DST, 1 through 7 where Sunday is 1.
<IN MONTH>	=	month to enter DST, 1 through 12 where 1 is January.
<OUT HOUR>	=	hour to exit DST, in 24 hour format.
<OUT WEEK>	=	which week to exit DST, 1, 2, 3, 4 (or 0 for last).
<OUT DAY>	=	day in to exit DST, 1 through 7 where Sunday is 1.
<OUT MONTH>	=	month to exit DST, 1 through 12 where 1 is January
<LT>	=	line terminator, a carriage return and line feed for output strings, only a carriage return for input strings.

If desired, any item may be replaced with a semicolon, which will leave its value unchanged. If any of the items in an input string are invalid, an error message will be returned.

Sample Request:	F66<CR>
Response:	F66 MANUAL 02 1 1 04 02 0 1 10
Meaning:	Manual settings are in effect. The entry time is 02 a.m. on the first Sunday of April and the exit time is 02 a.m. on the last Sunday in October.

Sample Entry:	F66 MANUAL ; 0 ; ; ; ; ; ;<CR>
Response:	OK<CR><LF>
Meaning:	DST will now be entered on the last week of the month. All other parameters remain unchanged.

Sample Entry:	F66 MANUAL 4 2 2 3 13 4 6 11<CR>
Response:	OK<CR><LF>
Meaning:	DST will now be entered 04 a.m. on the 2nd Monday in March and exit DST at 01 p.m. on the 4th Friday in November.

3.7.67 RESERVED

3.7.68 SERIAL FUNCTION F68 - YEAR ENTRY (GPS EPOCH MANAGEMENT)

The GPS week number sent from the satellites has only 10 bits of precision, so that 1024 weeks from January 6, 1980 (GPS week 0) it rolls back to 0. To correctly calculate calendar dates after this roll point, firmware keeps track of the current year so that it can construct an absolute, non-rolling week number since January 6, 1980. The firmware has the current year embedded in code, and will properly handle dates through the year 2015. In addition, as the clock advances to each new year, the current year is updated and used in future calendar calculations, thus calculations beyond 2015 are handled properly. No user intervention is required as long as the current year saved in non-volatile memory (EEPROM) is intact, and so long as the clock runs locked to GPS at least once each 5 years to allow the year to be updated. If after 2015, the current year saved in non-volatile memory is lost, or the clock is not locked to GPS within 5 years of the last year saved in non-volatile memory, then Function 68 can be used to manually enter the current year. Years prior to 1996 are not accepted, and entering a future year may cause incorrect calendar date calculations.

To request the current year setting via Function 68, send the string:

Sample request: F68<CR>
Response: F68 1996<CR><LF>

To set the current year, send a string with the following format:

Sample entry: F68 1997<CR>
Response: OK<CR><LF>

3.7.69 SERIAL FUNCTION F69 SET LOCAL/STANDARD/GPS/UTC TIME

Four time types are available for use.

Local Time modifies UTC time to include Time Zone and Daylight Saving Time adjustments, if enabled by the user.

Standard Time modifies UTC time to include a fixed Time Zone adjustment.

GPS Time is defined by and derived directly from the GPS constellation with no leap second or other GPS to UTC corrections.

UTC Time is Universal Coordinated Time and differs from GPS Time by the addition of leap seconds and the A0 and A1 sub-second corrections.

Standard and **Local** time requires the setting of the local Time Zone offset with F01, (Set Time Zone).

Local time requires the setting of Daylight Saving Time with F66, (Daylight Saving Enable).

Use Serial Function F69 to request or set the time format. To request the current time type used in the clock, send F69<CR> to the Serial port. The port will respond with the following character string:

F69<SEP><HH><LT>

Sample Request:		F69<CR>
Response:		F69 STANDARD<CR><LF>
	or	F69 LOCAL<CR><LF>
	or	F69 UTC<CR><LF>
	or	F69 GPS<CR><LF>

To set the Time Type

F69<SEP><TT><LT>

where

F	=	ASCII character F.
69	=	function number.
<SEP>	=	one or more separator characters: either space, comma or tab.
<TT>	=	Time Type. Either STANDARD, LOCAL, GPS or UTC.
<LT>	=	line terminator, either a carriage return and line feed for output strings or a carriage return only for input strings.

Sample request:	F69 STANDARD<CR>
Response:	OK<CR><LF>

Sample request:	F69 UTC<CR>
Response:	OK<CR><LF>

3.7.70 RESERVED

3.7.71 SERIAL FUNCTION F71 OSCILLATOR STATISTICS REQUEST

Use Serial Function F71 to request the local oscillator's phase, frequency offset, drift rate and DAC value. The phase is the instantaneous error in seconds between the oscillator and the control loop zero servo point. The frequency offset is computed using an averaging time that is equal to the effective averaging time of the oscillator controller. The oscillator drift rate is computed using a 24 hour average and is the daily drift rate of the oscillator. The oscillator DAC value is the signed 16 bit integer which controls the DAC output voltage. It ranges from 32767 to -32768. Send

the string F71<CR> to the Serial port and it will respond with the continuous string:

F71<SP>phase=<SIGN><MULT>E<SIGN><EXP><SP>s<SP><SP>offset=
<SIGN><MULT>E<SIGN><EXP><SP><SP>drift=<SIGN><MULT>E<SIGN>
<EXP>/DAY<SP><SP>DAC=<SIGN><INT><CR><LF>

where

F	=	ASCII character F.
71	=	function number.
<SP>	=	ASCII space character.
<MULT>	=	multiplier, 4 digits with decimal point.
E	=	ASCII character E for exponent.
s	=	ASCII character s for seconds abbreviation
<SIGN>	=	- for negative or <SP> for positive.
<EXP>	=	2 digit exponent.
/DAY	=	ASCII characters, units of drift rate
<INT>	=	integer, 5 digits
<CR>	=	carriage return.
<LF>	=	line feed.

Sample request: F71<CR>
Response: F71 phase=-5.678E-09 s offset=-1.986E-07 drift= 6.013E-08/DAY DAC=-24567<CR><LF>

3.7.72 SERIAL FUNCTION F72 - FAULT STATUS

This function provides the current status of the basic faults in the GPS/Oscillator sub-systems. Currently, the status of the antenna, PLL synthesizer lock status and the GPS lock status are the only such faults being monitored. When the 560-5203-X is operated in GPS mode, the faults indicated here are reported to the 560-5179-1 Fault Monitor CPU card.

Send the string F72<CR> and the serial port will respond:

F72<SEP>Antenna: <ANT STATUS> PLL: <PLL STATUS> GPS: <GPS STATUS><CR><LF>

where

F	=	ASCII character F
72	=	function number
<SEP>	=	one or more separator characters: either space, comma or tab
<ANT STATUS>	=	OK, OPEN or SHORT
<PLL STATUS>	=	OK, UNLOCKED
<GPS STATUS>	=	LOCKED, UNLOCKED
<CR>	=	ASCII carriage return character
<LF>	=	ASCII line feed character

3.7.73 SERIAL FUNCTION F73 - REQUEST/SET ALARM STATUS/CONTROL

This function allows the user to control which conditions will signal an alarm through serial port interrogations of the GPS/Oscillator sub-assembly. The fault status flags can be read by the following command, regardless of whether the faults are enabled or not:

F73<CR>

which returns:

F73<SP>S12345678<SP>M12345678<SP>m12345678<CR><LF>

where:

F	=	ASCII character F	
7	=	ASCII character 7	
3	=	ASCII character 3	
<SP>	=	ASCII space character	
S	=	'S'	Status delimiter
1	=	'L'	Satellite Lock OK
		'U'	Unlock Spec Reached
2	=	'A'	Position Accurate, Full Accuracy and Stability When Locked
		'B'	Position Approximate, Slightly Degraded Accuracy and Stability When Locked
		'C'	Position Unknown, Highly Degraded Accuracy and Stability, Not Locked
		'D'	Position and Time Unknown, Not Locked
3	=	'A'	Auto Mode
		'T'	Time Mode
		'S'	Survey Mode
		'D'	Differential Mode (Special Option)
4	=	'0'	Number of Current Satellites used through '6'

5	=	'N'	No timing source
		'G'	GPS is timing source
		'F'	AUX REF is timing source
6	=	'-'	Currently not used
7	=	'-'	Currently not used
8	=	'-'	Currently not used
M	=	'M'	Major Alarm delimiter
1	=	'-'	PLL Synthesizer OK
		'P'	PLL Synthesizer Unlocked
2	=	'-'	Antenna OK
		'O'	Antenna Open
		'S'	Antenna Short
3	=	'-'	Receiver OK
		'R'	Receiver Fault
4	=	'-'	EEPROM Data OK
		'N'	EEPROM Data Fault
5	=	'-'	The minor alarm, 'Time Error Threshold Reached', has not persisted for Timeout seconds.
		'U'	The minor alarm, 'Time Error Threshold Reached', has persisted for Timeout seconds.
6	=	'-'	Currently not used
7	=	'-'	PLL AuxIntOsc OK (TCXO version only)
		'p'	PLL AuxIntOsc unlocked (TCXO version only)
8	=	'-'	Currently not used
m	=	'm'	Minor Alarm delimiter
1	=	'-'	Time Error Threshold Not Reached
		'U'	Time Error Threshold Reached
2	=	'-'	Tracking OK
		'T'	Not Tracking Satellites
3	=	'-'	Oscillator Tuning Voltage OK
		'X'	Oscillator Tuning Voltage Requires Adjustment
4	=	'-'	Not used
5	=	'-'	Unit has locked at least once.
		'a'	Unit has not locked since power on but is still within the user defined power-on time-out.
		'A'	Initial Acquisition Mode, unit has not yet locked since power on.
6	=	'-'	Aux Ref source OK
		'R'	Aux Ref source bad / not connected
7	=	'-'	Currently not used
8	=	'-'	Currently not used
<CR>			ASCII carriage return character
<LF>			ASCII line feed character

Sending

F73<SP>LATCH<CR>

will return

F73<SP>LATCH<SP>M12345678<SP>m12345678<CR><LF>

which shows the latched faults, if any, which have occurred since the last time that the latch was cleared. These may or may not continue to be present in the non-latched indications.

Sending

F73<SP>CLEAR<SP>ALARM<SP>LATCH<CR>

will clear the latched fault indicators.

The user can query or control which faults affect the alarm output by the following commands. When setting the mask, the letter 'E' enables the fault, the letter 'D' disables it, and a '-' leaves it unchanged.

Sending

F73<SP>MASK<CR>

returns:

F73<SP>MASK<SP>M12345678<SP>m12345678<CR><LF>

Sending

F73<SP>MASK<SP>M12345678<SP>m12345678<CR>

sets the alarm mask where the mask characters are:

M	=	'M'	Major Alarm delimiter
1	=	'E'	PLL Synthesizer Alarm Enabled
		'D'	PLL Synthesizer Alarm Disabled
2	=	'E'	Antenna Alarm Enabled
		'D'	Antenna Alarm Disabled
3	=	'E'	Receiver Alarm Enabled
		'D'	Receiver Alarm Disabled
4	=	'E'	EEPROM Data Alarm Enabled
		'D'	EEPROM Data Alarm Disabled
5	=	'E'	The minor alarm, 'Time Error Threshold Reached', has persisted for Timeout seconds, Alarm Enabled
		'D'	The minor alarm, 'Time Error Threshold Reached', has persisted for Timeout seconds, Alarm Disabled
6	=	'-'	Currently not used

7 = 'E' PLLAuxIntOsc Alarm Enabled (TCXO version only)
'D' PLLAuxIntOsc Alarm Disabled (TCXO version only)
8 = '-' Currently not used

m = 'm' Minor Alarm delimiter
1 = 'E' Time Error Threshold Reached Alarm Enabled
'D' Time Error Threshold Reached Alarm Disabled

2 = 'E' Tracking Alarm Enabled
'D' Tracking Alarm Disabled
3 = 'E' Oscillator Tuning Voltage Alarm Enabled
'D' Oscillator Tuning Voltage Alarm Disabled
4 = '-' Currently not used
5 = 'E' Initial Acquisition Mode Alarm Enabled
'D' Initial Acquisition Mode Alarm Disabled
6 = 'E' Aux Ref Alarm Enabled
'D' Aux Ref Alarm Disabled
7 = '-' Currently not used
8 = '-' Currently not used

The command returns:

OK<CR><LF> if successful.

NOTE: Although the user may set the F73 mask, there will be no change in the 560-5179-1 Fault Monitor CPU or 560-5203-X Oscillator front panel LED fault reporting. Only serial Function F73 faults will change.

The default F73 Alarm Mask settings for the GPS/Oscillator are as follows:

MEEEED-D- mEDD-DD--

Major Alarms	Default Major Mask	Minor Alarms	Default Minor Mask
1 PLL	E Enabled	1 Time Error	E Enabled
2 Antenna	E Enabled	2 Tracking	D Disabled
3 Receiver	E Enabled	3 Osc Tuning	D Disabled
4 EEPROM	E Enabled	4 not used	- not used
5 Timeout	D Disabled	5 Initial Acquisition	D Disabled
6 not used	- not used	6 Aux Ref	D Disabled
7 AuxIntOsc	D Disabled	7 not used	- not used
8 not used	- not used	8 not used	- not used

Other settings	Default Mask
Timeout delay	00000 s
Time Threshold	00000000000 ns
PowerOn m delay	00000 s

The time error threshold at which the time error fault is activated can be queried or set by the following command.

Sending

F73<SP>THRESHOLD<CR>

returns:

F73<SP>THRESHOLD<SP><nanoseconds><SP>ns<CR><LF>

where <nanoseconds> is the time error threshold in nsec.

Sending

F73<SP>THRESHOLD<SP><nanoseconds><CR>

sets the time error threshold and returns:

OK<CR><LF> if successful.

The timeout after which a time error fault becomes a timeout fault can be queried or set by the following command.

F73<SP>TIMEOUT<CR>

which returns:

F73<SP>TIMEOUT<SP><seconds><SP>s<CR><LF>

where <seconds> is the timeout in seconds, between 0 and 86400.

Sending

F73<SP>TIMEOUT<SP><seconds><CR>

sets the timeout and returns:

OK<CR><LF> if successful.

If a checksum error is detected while recalling settings from the EEPROM, an EEPROM data fault is indicated. This same fault is active if an attempt was made to recall EEPROM settings and default settings were created since no settings were found. In this case, an EEPROM fault is indicated and the operator should check all of the stored settings to verify that they are correct. After the operator has confirmed that all settings are correct, the following command can be used to cancel the error, so that future errors of this kind can be caught.

F73<SP>CLEAR<SP>EEPROM<SP>FAULT<CR>

clears the fault and returns:

OK<CR><LF>

3.7.74 THRU 3.7.78 RESERVED

3.7.79 SERIAL FUNCTION F79 - WARM START

This function issues a reset command to the Trimble GPS core module. It does not clear stored almanac and ephemeris data which are retained in battery-backed RAM on the GPS receiver card.

Send the string F79<CR> and the serial port will respond by initiating a warm start.

Sample: F79<CR>
Response: OK<CR><LF>

3.8. IRIG-B CODE FORMAT

Reference Figure 3-1. The level shifted, pulse-width modulated, serial format of IRIG-B is divided into three segments. The first segment encodes time-of-year in binary-coded-decimal (BCD) notation. The second segment encodes control functions. This segment is generally available for data of the user's choice. In the IRIG-B code output of the GPS/Oscillator, this segment may encode worst-case time error flags as explained below. The third segment sometimes encodes time-of-day in straight binary seconds (SBS) notation. This segment is not encoded by the GPS/Oscillator.

These three segments are contained within one "frame". The frame length for IRIG-B is 1 second long and contains 100 "elements" (pulses) each of which start every 10 milliseconds.

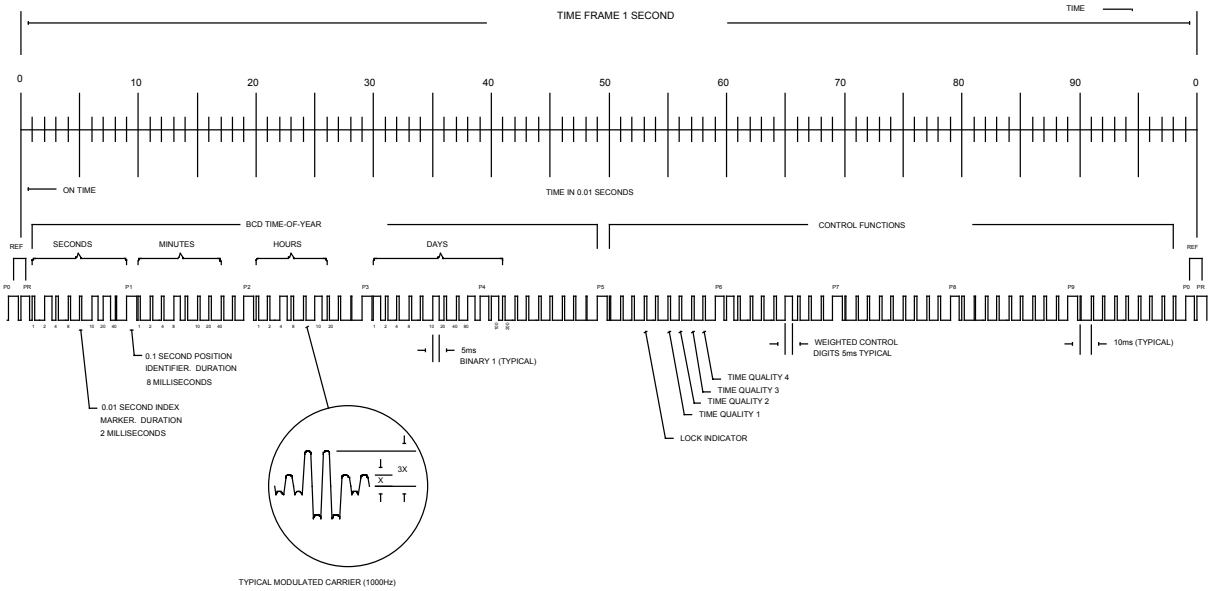
An element may represent either a binary zero, a binary one, a reference marker or a position identifier. A zero is 0.2 of the duration of an element, a one is 0.5 of the duration of an element and a position identifier or reference marker is 0.8 of the duration of an element. A reference marker locates the beginning of each frame and a position identifier marks the end of every ten elements. IRIG-B has ten position identifiers per frame.

The elements prior to position identifier P5 comprise the time-of-year segment. The first ten elements encode the seconds, the second ten elements encode the minutes and so on through days. Each element is a digit in a binary number with a place value sequence 1-2-4-8.

3.8.1. EMBEDDED WORST-CASE TIME ERROR FLAGS

Five flags are encoded in the control function segment of the IRIG-B code. The first flag encoded at element P5+40ms is the LOCK indicator. It is a binary 1 when the unit has lost contact with satellite signals. The second flag encoded at element P5+60ms is a binary 1 when the worst-case time error exceeds threshold 1 as described in "SERIAL FUNCTION 05 -TIME QUALITY ENABLE/SETUP". Element P5+70ms is a binary 1 when the worst-case time error exceeds threshold 2. Element P5+80ms encodes a binary 1 when the error exceeds threshold 3 and P5+90ms when the error exceeds threshold 4.

3.8.2 FIGURE 3-1 (IRIG-B)



IRIG-B TIME CODE FORMAT

SECTION FOUR

4. THEORY OF OPERATION

4.1. 560-5202 GENERAL INFORMATION

This section contains a detailed description of the circuits on the 560-5202 GPS card. The user should refer to the 560-5203-X manual for a more complete understanding of the Oscillator card. These 560-5202 circuit descriptions should be used in conjunction with the drawings in SECTION FIVE.

4.2. 560-5202 DESCRIPTION

The 560-5202 card is a GPS receiver that can be configured for use with a TrueTime standard GPS antenna (+5 Vdc) or with a TrueTime downconverter antenna (+12 Vdc). The GPS receiver is controlled by the 87-902 card that is part of the 560-5203-X GPS/Oscillator assembly. The GPS/Oscillator disciplines the local oscillator to the GPS reference.

4.3. POWER SUPPLIES

This card utilizes DC to DC converters to provide the required voltages from the system 48 Vdc. The power supplies are protected from overloads by a Polyswitch fuse device and a diode provides protection against polarity reversal of the input power. A PI section LC filter on the input of each converter reduces conducted emissions from the converters back into the mains. The input inductor and diode also minimize the effects of inrush current during hot-swapping. The output of each supply is filtered to reduce switching noise. The +12 Vdc converter supplies +12V power to the downconverter antenna (option) and also provides power to a DC-DC converter that supplies +5V power to the GPS receiver.

4.4. STANDARD ANTENNA / DOWNCONVERTER ANTENNA

The choice of the antenna type must be decided at the time of purchase due to the hardware changes that are required for each antenna type. The standard antenna is powered by +5 Vdc and can support an antenna feed line length of 150 feet. The downconverter antenna is powered by +12 Vdc and can support an antenna feed line length of 1500 feet. When the downconverter antenna option is ordered, a sticker will be attached to the 560-5202-1 GPS card to indicate that a downconverter antenna is required.

4.5. 560-5202 ANTENNA STATUS LED

An antenna status LED is provided on the 560-5202 panel that will turn RED when the antenna feed line = open or short. The LED will go OFF when the antenna is connected. The antenna open and short fault conditions are communicated to the 560-5203-X Oscillator card which provides a logic OR of these faults into one antenna fault.

When GPS mode is selected on the 560-5203-X Oscillator card, another fault that is detected is +5Vmon. The Oscillator card will detect this fault if the 560-5202's GPS receiver is not powered.

The antenna fault and the +5Vmon fault conditions are communicated to the 560-5179-1 Fault Monitor CPU card.

4.6. USER SERIAL PORT

The DB9 male connector provides a serial port from the 560-5203-X card. The 560-5203-X Oscillator card's serial port (RS-232 and RS-422) is only available with the 560-5202 GPS option card. RS-232 / RS-422 serial port selection (receiver) is made by a DIP switch located on the Oscillator card. Refer to SECTION ONE of this manual for the pinout of this serial port.

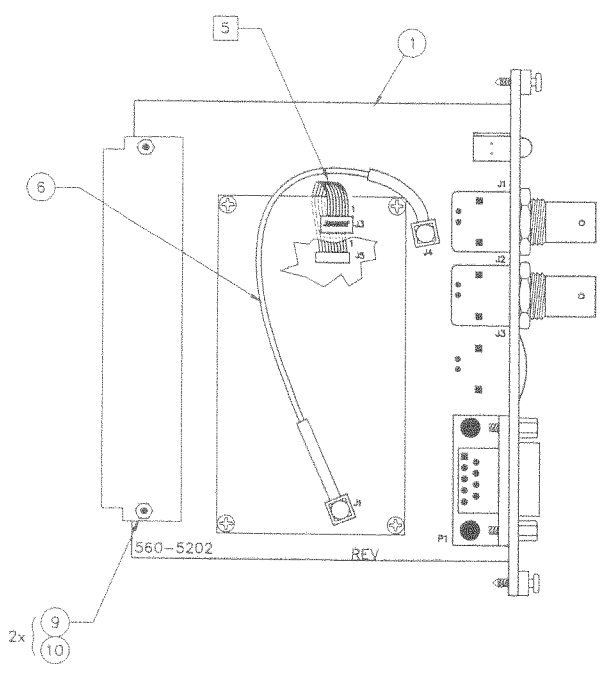
4.7. AUX REF INPUT

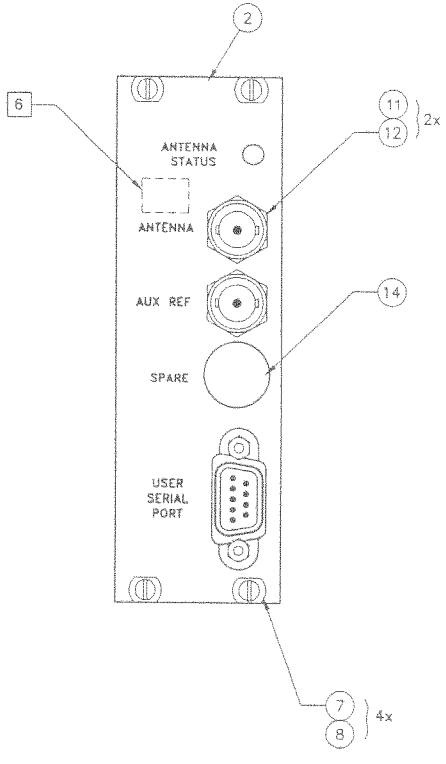
The 560-5202 card provides a BNC connector labeled AUX REF. The AUX REF BNC is a possible input connection point to one of the 56000 frequency buses (REFA, REFB, REFC, 7F or 8F).

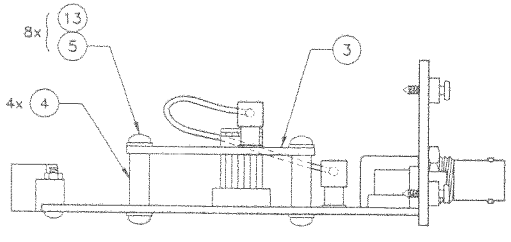
SECTION FIVE

5. DETAILED DRAWINGS

5.1. 560-5202 DETAILED DRAWINGS / BILL OF MATERIALS







6 LABEL "DOWN CONV REQD" USED ON 560-5202-1 ONLY.

5 PINS 9 & 10 OF 391-007 (J5) DO NOT CONNECT AT J3 OF CORE MODULE (ITEM 3).

NOTES: CONT.

FILENAME: \560\5202
DATE: 02-08-99

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2835 Duke Ct. Santa Rosa, CA 95407

SIZE	CODE IDENT NO.	DRAWING NO.	REV
B		560-5202	A

SCALE NONE

MAX * BILL OF MATERIALS * SINGLE-LEVEL EXPLOSION BY PART IDENTIFIER W/REFERENCE

PART IDENTIFIER	DESCRIPTION 1	DESCRIPTION 2	EFF DATE	ECN #	QTY/ASSY	UOM	REV LVL	REFERENCE DESCRIPTION
560-5202	ASSY 56K GPS (REAR CONN)	STANDARD +5V ANTENNA				EA		
								DR 12/99
0000-APPROVAL	PARTS LIST APPROVAL		000000		1.0000	EA		
0000-PL	PARTS LIST REV LEVEL		000000		1.0000	EA		REV A (02-08-99)
0000-PRINT	REFERENCE PRINT		000000		1.0000	EA		560-5202 REV A
0000-REV	PCB REV LEVEL HERE >>>>		000000		1.0000	EA		560-2202 REV 02
002S-000	RES 0805 0 OHM	CAL-CHIP RM10J000CT (NAV)	000000		1.0000	EA		R17
008S-102	RES 0805 1K OHM 1% 1/8W	CAL-CHIP RM10F1001CT(NAV)	000000		3.0000	EA		R14,22,23
008S-103	RES 0805 10K OHM 5% 1/8W	CAL-CHIP RM10J103CT (NAV)	000000		1.0000	EA		R5
008S-104	RES 0805 100K OHM 1% 1/8W	CAL-CHIP RM10F1003CT(NAV)	000000		2.0000	EA		R9,11
008S-241	RES 0805 240 OHM 5% 1/8W	CAL-CHIP RM10J241CT (NAV)	000000		1.0000	EA		R1
008S-273	RES 0805 27K OHM 5% 1/8W	CAL-CHIP RM10J273CT (NAV)	000000		1.0000	EA		R2
008S-471	RES 0805 470 OHM 5% 1/8W	CAL-CHIP RM10J471CT (NAV)	000000		2.0000	EA		R4,21
008S-472	RES 0805 4.7K OHM 5% 1/8W	CAL-CHIP RM10J472CT (NAV)	000000		4.0000	EA		R7,13,20,24
008S-473	RES 0805 47K OHM 5% 1/8W	CAL-CHIP RM10J473CT (NAV)	000000		3.0000	EA		R6,15,18
008S-510	RES 0805 51 OHM 5% 1/8W	CAL-CHIP RM10J510CT (NAV)	000000		2.0000	EA		R3,8
008S-561	RES 0805 560 OHM 5% 1/8W	CAL-CHIP RM10J561CT (NAV)	000000		1.0000	EA		R10
008S-6R8	RES 0805 6.8 OHM 5% 1/8W	CAL-CHIP RM10J6R8CT (NAV)	000000		1.0000	EA		R12
023-010-100	CAP AE 10UF 100V R	PANASONIC ECE-A2AU100	000000		1.0000	EA		C3
036S-NP0120	CAP 12PF NP0 100V 0805 5%	NIC NMC0805NP0120J100TR	000000		1.0000	EA		C12
036S-NP0220	CAP 22PF NP0 100V 0805 5%	NIC NMC0805NP0220J100TR	000000		1.0000	EA		C9
036S-NP0270	CAP 27PF NP0 100V 0805	NIC NMC0805NP0270J100TR	000000		1.0000	EA		C11
036S-NP0471	CAP 470PF NP0 100V 0805	NMC0805NP0471J100TR (NAV)	000000		1.0000	EA		C13
036S-X7R103	CAP .01UF X7R 50V 0805	CAL GMC21X7R103K50NT(NAV)	000000		2.0000	EA		C14,16
036S-X7R104	CAP .1UF X7R 100V 1210	NMC1210X7R104K100TR (NAV)	000000		1.0000	EA		C1
036S-X7R104-50	CAP .1UF X7R 50V 0805 10%	NIC NMC0805X7R104K50TR	000000		7.0000	EA		C5-7,15,18-20
037S-105	CAP 1UF 16V 3216 10%	NIC NTC-T105K16TRA	000000		1.0000	EA		C17
037S-106	CAP 10UF 25V 7343 10%	NIC NTC-T106K25TRD (NAV)	000000		1.0000	EA		C4
037S-107	CAP TANT 100UF 16V 7343	AVX TPSE107K016R0125	000000		2.0000	EA		C2,8
045S-.018UH	INDUCTOR .018UH 1008	NIC NIN-NC18NMTR (NAV)	000000		2.0000	EA		L2,3
045S-1.8	INDUCTOR 1.8UH 1812	TDK NLC1812-1R8K	000000		1.0000	EA		L1
045S-15UH	INDUCTOR 15UH 1812	NIC NIN-FB150KTR (BOMNAV)	000000		2.0000	EA		L4,5
045S-3.3UH	INDUCTOR 3.3UH 1210	NIC NIN-FA3R3KTR	000000		1.0000	EA		L8
045S-56UH	INDUCTOR 56UH 1210	NIC NIN-FA560KTR (NAV)	000000		1.0000	EA		L6
045S-8.2UH	INDUCTOR 8.2UH 1210	NIC NIN-FA8R2KTR	000000		1.0000	EA		L7
057-BAV99	DIODE, DUAL SWITCH SOT-23	PHILIPS BAV99	000000		2.0000	EA		CR1,CR2
057S-4002	DIODE 4002	ROHM RLR4002	000000		1.0000	EA		D1
058-020	LED	DIALIGHT 550-3007	000000		1.0000	EA		DS1
058S-001	LED RED X SML W RES SFMT	HP HLMP-6600-G0012	000000		1.0000	EA		DS2
065S-005	SWITCH DIP 8 HALF PITCH	AUGAT GDH08S	000000		1.0000	EA		SW1
069-003	RELAY REED SIP 5V 500 OHM	MAGNECRAFT #W117 SIP-6	000000		1.0000	EA		K1
175S-2N2222A	TRANSISTOR 2N2222A SOT-23	MOTOROLA MMBT2222AL	000000		2.0000	EA		Q3,8
175S-2N2907A	TRANSISTOR 2N2907A SOT-23	MOTOROLA MMBT2907AL	000000		6.0000	EA		Q1,2,4-7
178S-74HC4538	74HC4538 (16SO)	MOTOROLA MC74HC4538D NAV	000000		1.0000	EA		U4
178S-74HCU04	74HCU04 (14SO)	RCA CD74HCU04M	000000		1.0000	EA		U1
178S-NC7SZ08	UHS 2-INPUT AND GATE	NATL NC7SZ08M5X	000000		2.0000	EA		U2,3
223-138	SCREW SH CH ZN M2.5X10	SCHROFF #21100-138	000000		2.0000	EA		09

MAX * BILL OF MATERIALS * SINGLE-LEVEL EXPLOSION BY PART IDENTIFIER W/REFERENCE

PART IDENTIFIER	DESCRIPTION 1	DESCRIPTION 2	EFF DATE	ECN #	QTY/ASSY	UOM	REV LVL	REFERENCE DESCRIPTION
223-144	NUT M2.5	SCHROFF 21100-144	000000		2.0000	EA		10
223-379	SCREW CAP NP M2.5 X 11	SCHROFF #21100-379	000000		4.0000	EA		07
223-464	SLEEVE, STAINLESS	SCHROFF 21100-660	000000		4.0000	EA		08
240-002-002	SCREW PHMS 2-56 X 1/4 SS		000000		8.0000	EA		05
254-002	WSHR SPLIT #2	#2 LOCKWASHER	000000		8.0000	EA		13
255-002-005	SPCR 3/16HX F-F 2-56X.625	RAF 2059-256-A-O	000000		4.0000	EA		04
273-009	TERMINAL TEST POINT	COMP CORP PJ-201-25	000000		1.0000	EA		GND1
273-015	TERM TEST POINT (WHITE)	COMP. CORP TP-104-01-09	000000		3.0000	EA		TP1-3
274-009	PLUG HOLE NYL BLK 1/2 IN.	HEYCO 2643	000000		1.0000	EA		14
355-78SR105	DC-DC CONV +5V 7-30VDC	POWER TRENDS 78SR105SC	000000		1.0000	EA		PS2
355-UWR-12	DC-DC 18-72VIN +12V OUT	DATEL UWR-12/750-D48	000000		1.0000	EA		PS1
363-0.9LV	POLYSWITCH 0.9A (60 VOLT)	RAYCHEM RXE090	000000		1.0000	EA		F1
372-09P	CONN 9-P D-SUB RT ANG ML	AMP 748879-1 (BOM NAV)	000000		1.0000	EA		P1
372-609-003	JACK SOCKET SET OF 2	THOMAS & BETTS 609-003	000000		1.0000	EA		FOR P1
372-96RA	CONN,96-P FM DIN RT ANGLE	BERG 68353-296 (BOM NAV)	000000		1.0000	EA		J6
375-022	LOCKWASHER,BNC PC MT	AMP 1-329632-2	000000		2.0000	EA		11
375-023	NUT BNC PC MT	AMP 1-329631-2	000000		2.0000	EA		12
375-026	BNC, PCB MNT, LOW PROFILE	AMP 413879-1	000000		2.0000	EA		J1,2
381-015	CONN MCX JACK VERT PC MT	M/A-COM 5862-5002-10	000000		1.0000	EA		J4
381-MCX/MCX	COAX CABLE RG188 6 IN.	RT ANG MCX-RT ANG MCX	000000		1.0000	EA		06
391-007	CA STRIP 2MM IDC 3.5IN	TCMD-05-T-3.50-01-P10-R	000000		1.0000	EA		J5
560-1253	PLATE, 56K GPS REAR CARD	FAB/SCREEN	000000		1.0000	EA		02
560-2202	PCB 56K GPS (REAR CONN)	FAB	000000		1.0000	EA		01
87-CM3-3	CORE MODULE MOD		000000		1.0000	EA		03
LA	LABOR ASSEMBLY COST HRS		000000		0	EA		
LT	LABOR TEST COST HOURS		000000		0	EA		
OSV560-5202	OUTSIDE LABOR 560-5202	PCA	000000		1.0000	EA		

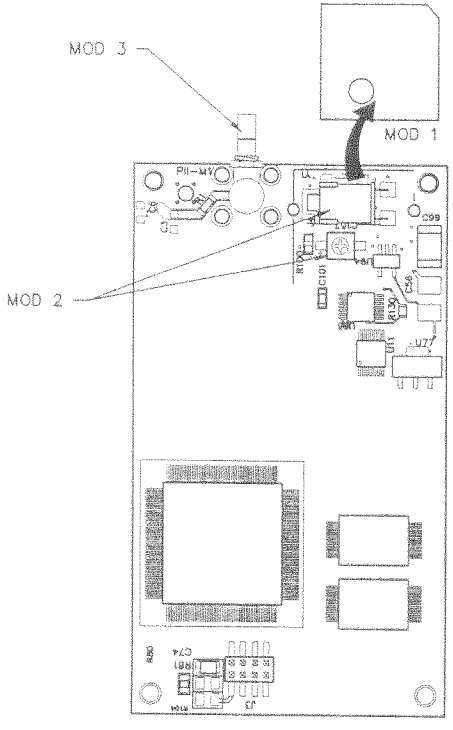
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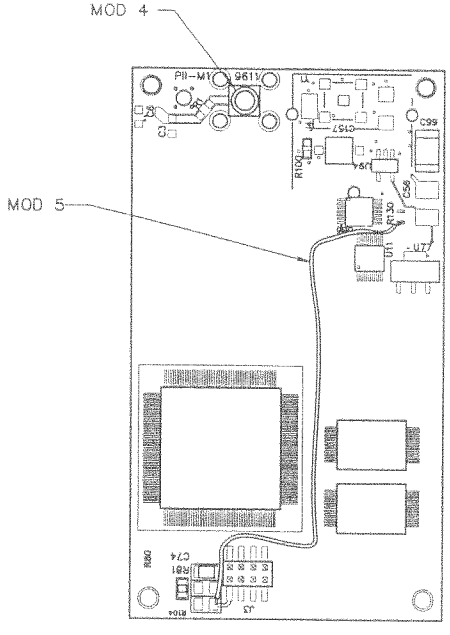
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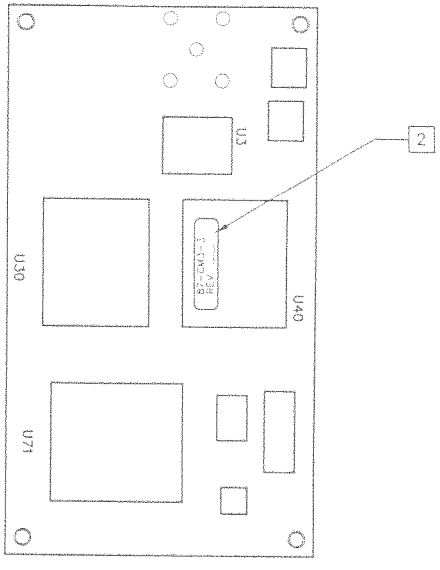
REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	BYPASSED U94	03/05/98	
B	CAR 971	06/24/98	MC



TOP VIEW





BOTTOM VIEW

[2] APPLY P/N REV LABEL WHERE SHOWN.

1. MODIFY 345-CM3 AS FOLLOWS:

MOD 1. REMOVE OSCILLATOR SHIELD.

MOD 2. REMOVE XTAL Y1, TRIMMER CAP C157, AND R130.

MOD 3. REMOVE SMB J1.

MOD 4. INSTALL MCX 381-015 IN J1 ON SIDE SHOWN.

MOD 5. ADD 30 AWG PRELEG WIRE (OR EQUIVALENT) FROM R104 PAD (CLOSEST TO J3) TO R130 PAD.

NOTES: UNLESS OTHERWISE SPECIFIED

CONTRACT NO.	
APPROVALS	DATE
DRAWN BY SEIFERT	4/97
CHECKED BY	
APPROVED BY MK	9/98
NEXT ASSY	

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CORE MODULE MODIFIED

SIZE	CODE IDENT NO.	DRAWING NO.	REV
B		87-CM3-3	B

SCALE NONE | SHEET 1 OF 1

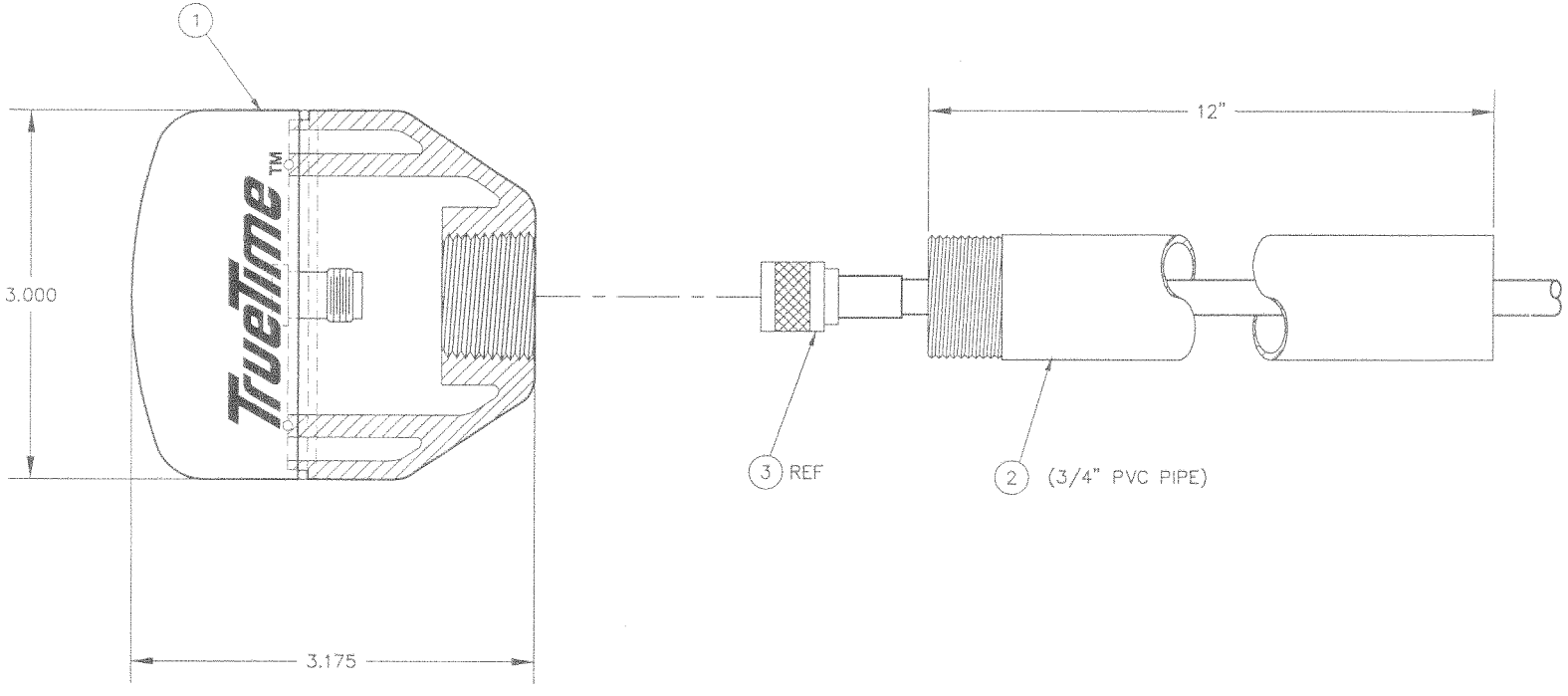
FILENAME: \87\CM3-3
DATE: 09-17-98

MAX * BILL OF MATERIALS * SINGLE-LEVEL EXPLOSION BY PART IDENTIFIER W/REFERENCE

PART IDENTIFIER	DESCRIPTION 1	DESCRIPTION 2	EFF DATE	ECN #	QTY/ASSY	UOM	REV LVL	REFERENCE DESCRIPTION
87-CM3-3	CORE MODULE MOD	PCI GPS				EA		
0000-APPROVAL	PARTS LIST APPROVAL		0000		1.0000	EA		RCM 7-16-98
0000-PL	PARTS LIST REV LEVEL		0000		1.0000	EA		REV B (07-15-98)
0000-PRINT	REFERENCE PRINT		0000		1.0000	EA		87-CM3-3 REV B
345-CM3	CORE MODULE 3 (SVEESIX)	TRIMBLE 34055-61	0000		1.0000	EA		
381-015	CONN MCX JACK VERT PC MT	M/A-COM OSX 5862-5002-10	0000		1.0000	EA		J1 (SEE NOTE ON DWG)
400-020	LABEL, EPROM 1/4 X 5/8 IN	BRADY, ECL-107-619	0000		0.0010	BX		
	MARK LABEL WITH 87-CM3-3 AND REVISION AND ADHERE TO CORE MODULE (SEE BOTTOM VIEW ON DWG).							
LA	LABOR ASSEMBLY COST HRS		0000		0	EA		
LT	LABOR TEST COST HOURS		0000		0	EA		

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REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



1. TO CONNECT CABLE DISASSEMBLE ANTENNA HOUSING BY REMOVING THE 4 SCREWS TO ACCESS THE TNC CONNECTOR.

NOTES: UNLESS OTHERWISE SPECIFIED

FILENAME: \100\42-612A
DATE: 11-23-98

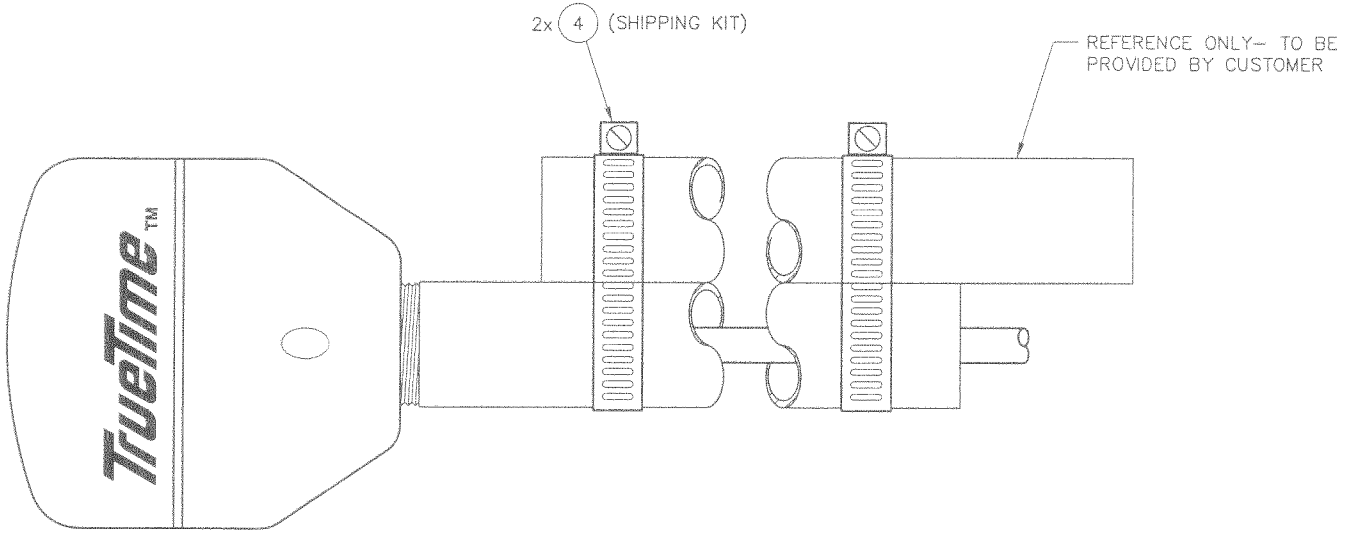
CONTRACT NO.		
APPROVALS		DATE
DRAWN BY	RNR	11/98
CHECKED BY		
APPROVED BY	MJK	11/98
NEXT ASSY		

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FINAL ASSEMBLY PATCH ANTENNA

SIZE	CODE IDENT NO.	DRAWING NO.	REV
B		142-612	N/C

SCALE NONE SHEET 1 OF 2



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SIZE	CODE IDENT NO.	DRAWING NO.	REV
B		142-612	N/C
SCALE NONE			SHEET 2 OF 2

FILENAME: \100\42-612B
DATE: 11-19-98

MAX * BILL OF MATERIALS * SINGLE-LEVEL EXPLOSION BY PART IDENTIFIER W/REFERENCE

PART IDENTIFIER	DESCRIPTION 1	DESCRIPTION 2	EFF DATE	ECN #	QTY/ASSY	UOM	REV LVL	REFERENCE DESCRIPTION
142-612-50	ASSY ANTENNA PATCH +5V	50 FT RG59				EA		
0000-APPROVAL	PARTS LIST APPROVAL		000000		1.0000	EA		DR 12/98
0000-PL	PARTS LIST REV LEVEL		000000		1.0000	EA		REV N/C (12-18-98)
0000-PRINT	REFERENCE PRINT		000000		1.0000	EA		SEE 142-612
142-612	ASSY ANTENNA PATCH +5V		000000		1.0000	EA		
340-50-5	COAX CABLE TNC-BNC 50 FT. RG-59		000000		1.0000	EA		
LA	LABOR ASSEMBLY COST HRS		000000		0	EA		
LT	LABOR TEST COST HOURS		000000		0	EA		

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