9390-6000
or
9390-6010
ExacTime GPS Time Code and Frequency Generator

8500-0082

User's Guide

Rev. G

(June, 2000)

THE MASTERS OF TIME

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9390-6000 or 9390-6010
EXACTIME GPS TIME CODE AND FREQUENCY GENERATOR

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You will find your Option Descriptions in an envelope labeled "Option Descriptions." The envelope is attached to inside cover of this User's Guide.

CHAPTER ONE
GENERAL INFORMATION

1.0 INTRODUCTION

This User's Guide describes the installation and operation of the ExacTime 9390 Global Positioning System Time Code and Frequency Generator.

1.1 USER'S GUIDE SUMMARY

This User's Guide is divided into the following chapters:

Chapter One - General Information
This chapter includes a general description of the GPS Timing Unit and provides technical specifications.

Chapter Two - Installation
Describes initial inspection, preparation for use, interconnections to antenna/preamp, power connections, and signal interconnections.

Chapter Three - Operation
Describes the local operation of the unit.

Chapter Four - I/O Port Data Input/Output
Provides information on the protocol and data available through the RS-232C I/O port.

Chapter Five - Maintenance/Troubleshooting
Provides a guide to the maintenance and troubleshooting of this instrument. A description of the available adjustments is also provided.

Chapter Six - Parts Lists
Provides a list of parts (by Datum Part Number) of the items/materials in this unit. Customer specified options are not included in this Parts List.

Chapter Seven - Drawings
Includes the Top Assembly drawing of the ExacTime unit, and associated Assembly and Interconnect drawings. Customer specified options are not included in this Drawing List.

Option Descriptions
The Option Descriptions for the options included with this instrument are located in the envelope attached to the inside cover of this User's Guide.

Appendix A - ASCII Character Codes
Provides the cross reference of the ASCII character set to decimal, octal, and hexadecimal numbers.

Appendix B - Acronyms and Abbreviations
Provides a list of acronyms and abbreviations used in this User's Guide.

1.2 NAVSTAR/GPS DESCRIPTION

The Navstar/GPS satellite-based timing and navigation system consists of a constellation of high altitude satellites orbiting the earth every twelve sidereal hours, a group of ground-based control/monitoring stations and the user equipment which may be located on land, sea and/or air.

The GPS System was completed in the early 1990's and provides three dimensional positioning, velocity, and time, on a continuous world-wide basis. The constellation is comprised of twenty-one satellites and three spares. The satellites are located in six different orbital planes inclined approximately sixty degrees to the equator at altitudes of 10,400 miles above the earth.

The GPS Timing Unit determines time and frequency by measuring the time of arrival of the precise timing mark and measuring the Doppler effect from one satellite. A previously entered or determined position allows computation of the receivers time offset. An accurate timing mark (1pps) can be set, and an input 1pps pulse can be measured with respect to UTC. The satellite positions are known within a few meters and the satellite clocks are calibrated within a few nanoseconds so position can be computed within an absolute accuracy of better than 120 meters (with current selective availability).

The GPS signal transmitted from a satellite consists of two carrier frequencies. L1 at a frequency of 1575.42 MHz and L2 at a frequency of 1227.6 MHz. The L1 signal is modulated with both a precision (P) code and a coarse acquisition (C/A) code. The precision (P) code is available to authorized users only. The GPS Timing Unit operates on the C/A code.

Each satellite transmits a unique C/A code that reflects the satellite identity for acquisition and tracking. The C/A PRN code is a gold code of 1023 bits repeating at a one-millisecond rate.

The L1 and L2 frequency is also modulated with a fifty-bit-per-second data stream providing satellite ephemerides, system time, satellite clock behavior, and status information on all satellites. The data message is contained in a data frame that is 1,500 bits long.

Ground based control/monitoring stations track the satellites and provide an upload several times each day to provide a prediction of each satellites ephemeris and clock behavior for the next day's operation.

1.3 PRODUCT DESCRIPTION

The GPS Timing Unit operates on the civilian L-band (1575.42MHz) utilizing C/A (Coarse Acquisition) code transmissions to monitor time and frequency data from the Navstar satellite constellation. Time and frequency is determined from satellite transmissions and calculations referenced to USNO (United States Naval Observatory) through the GPS Master Clock system. This link provides traceability to USNO and all international time scales through the use of publications from NIST (National Institute of Standards Technology), USNO, and BIPM (Bureau of International Des Poids et Measurements) in Servres, France.

The unit automatically acquires and tracks satellites based on health status and elevation angle. Time and frequency monitoring requires only one satellite, once accurate position data has been acquired or entered. In "AUTO" mode, and the "4-SV" mode, four satellites are required for the GPS Timing unit to do three dimensional (latitude, longitude, and altitude) position fixes. In the "3-SV" mode, only three satellites are required to do two dimensional (latitude and longitude) position fixes.

The basic GPS Timing Unit includes the GPS Main Module, an antenna/preamp and a coaxial cable for interconnection. A corrected 1pps output signal and a 10MHz Sine Wave are provided in the basic GPS Timing Unit configuration. An RS-232 I/O Port is also provided in the basic configuration which can be used to control the unit as well to get data from the unit. The basic unit has an LCD Display and a keyboard. It generates IRIG B Serial Time Code, and has the capability of measuring the time interval difference between the GPS 1pps and an externally input 1pps. Optional features such as additional output codes and/or frequencies, an RS-232 printer port, external frequency input or single or triple event log are available to meet specific requirements. Refer to the GPS Option/Connector Configuration sheet located at the beginning of this manual for the options supplied with this instrument. The Option Descriptions are in the envelope attached to the inside cover of this User's Guide.

1.4 SPECIFICATIONS

The electrical, physical, and environmental specifications for the 9390 are listed below.

1.4.1 GPS SUBSYSTEM

Time Accuracy
Better than 100nS relative to UTC with six or more satellite averaging with 95% confidence.

Position Accuracy
< 100 feet latitude, 100 feet longitude, and 250 feet altitude with current SA. Accuracy improved to better than thirty feet after twenty-four hours of automatic position averaging in static position.

Maximum Velocity
400 meters/second.

Tracking Channels
Six parallel.

Receiver Frequency
L1 1.575 GHz, C/A Code.

Acquisition Time
Time to first fix is less than two minutes with outputs operational in less than five minutes with timing accuracy better than two μS and frequency accuracy better than 1E-8. Full system accuracy (100nS) provided within one hour.

1.4.2 TIMING OUTPUTS

Rear panel BNCs J4 through J9 can output a 10MHz sine wave, various pulse rates, or alarm outputs. The following is the standard output configuration for the rear panel BNC connectors. To change the outputs from the factory set standard configuration, see the paragraph titled "Timing Outputs" in Chapter Two and the paragraph titled "Optional Pulse Rate Outputs" in this section of the User's Guide. Each output is via a 50Ω driver.

1.4.2.1 J4 - TRACKING

This CMOS output level is "low" when the unit is actively acquiring data from one or more satellites and is "high" when the unit is not acquiring data from any satellite.

1.4.2.2 J5 - LOCKED

When this CMOS output level is "low" (LOCKED), the 1pps output is divided down/down counted from the internal 10MHz Oscillator. The DAC voltage controls the 10MHz oscillator from which the 1PPS is derived. When this CMOS output level is "high" (i.e., not locked), the 1pps is constantly being corrected (jammed) to on time using the 1PPS from the GPS Receiver Module. In this mode, the 1PPS output can jump.

1.4.2.3 J6 - 1PPS

This output is a thirty to fifty μsec wide pulse at CMOS levels. The rise and fall times are ≤ 6 nanoseconds. It is positive (rising) edge on time, within ±100 nanoseconds relative to either UTC or GPS with six or more satellite averaging with 95% confidence.

1.4.2.4 J7 - 10MHz SINE WAVE

This output has a nominal amplitude of one volt RMS into a 50Ω load.

Note: The output amplitude of the 10MHz sine wave is dependent on the internal time base. This amplitude specification is for the Voltage Controlled Temperature Compensated Crystal oscillator.

1.4.2.5 J8 - IRIG B (AC)

This output is Amplitude Modulated IRIG B122 Serial Time Code. This output is available only after the unit has tracked satellites and set time.

Carrier	1KHz
Modulation Ratio	3:1
Amplitude	Three volts peak-to-peak on the Mark Pulse

Note: Some units may output a modified IRIG B per IEEE Std. 1344 that has data in the Control Function bit area. Refer to Table One at the end of this chapter for the Control Function Bit Assignments.

1.4.2.6 J9 - IRIG B (DC)

This output is Pulse Width Modulated IRIG B002 Serial Time Code at CMOS levels. This output is available only after the unit has tracked satellites and set time.

1.4.2.7 J11 – PRINTER OUTPUT PORT

This DB9 connector can output data to an RS232 compatible serial printer or terminal.

It can be configured to operate in the Standard RS232 output or the One Second RS232 ASCII Burst Mode output. For the operation and configurations, refer to Chapters Three and Four.

1.4.2.8 OPTIONAL PULSE RATE OUTPUTS

The following is a list of optional pulse rate outputs available for selection on BNC connectors J4-J9. They are positive (rising) edge on-time. The majority of these rates have a 80/20 duty cycle with the exception of the 10MHz and the 5MHz which are square waves, and the 1PPM which is 40/20.

10MHz	5MHz	1MHz
100KHz	10KHz	1KHz
100Hz	10Hz	1Hz
.1Hz	1PPM	

For further clarification and/or configuration of the above outputs, See Section 2.6.3 of Chapter Two.

1.4.3 ACCURACY

The accuracy of the pulse rates listed in Section 1.4.2.7 is the same as that in Section 1.4.2.3.

1.4.4 TIMING INPUTS

1.4.4.1 J10 - 1PPS INPUT (TIME INTERVAL MEASUREMENT) or EXTERNAL FREQUENCY MEASUREMENT or SINGLE EVENT LOG

Time Interval Measurement
Used to measure the time interval between the internally generated GPS 1PPS and an external 1PPS input. The resolution of this measurement is 10 nanoseconds. At power-up, this feature is DISABLED. If enabled, the measurement is displayed on the Second Menu Screen. Refer to Chapter Three. Also see paragraphs entitled, "Enable Time Interval," "Disable Time Interval," and "Request Time Interval," in Chapter Four of this User's Guide.

External Frequency Measurement
Frequency Range
1Hz to 10MHz (discrete, whole numbers - not fractional parts).

Input Wave Form From 1Hz to 10MHz
Rectangular or square wave (minimum pulse width fifty nanoseconds).
Amplitude Range:

Logic "0" +0.2V ±0.2VDC
Logic "1" +2.4V to +15VDC

Input Wave Form From 100KHz to 10MHz
Sinusoidal Amplitude Range: 1 - 5 volts peak-to-peak

Single Event Log
This option provides the capability of logging the time occurrences of up to 256 events from one input. A pulse on the event input will cause the time to be logged/stored on either the rising (positive going) or falling (negative-going) edge of the input pulse. The edge designated as on time is programmable via the front panel keyboard or remotely via the RS-232 I/O. Each event will have a defining number from zero to 255 and the channel identifier.

The event memory can be read and/or cleared via the RS-232 I/O. Refer to Chapter Four of this User's Guide. If the inputs exceed 256 events (occurrences), the new data will be lost. If two events occur less than ten milliseconds apart, it is possible that one of the events may be lost. This will be reported as a missed event in the status code when the data is output. This event log option can also be enabled or disabled. Refer to Chapter Four of this User's Guide.

The event time resolution is from hundredths of nanoseconds through hundreds-of-days.

1.4.5 J12 RS-232 I/O INTERFACE

Full remote control of all operating functions in a complete ASCII protocol. Baud rate, parity, word length, and stop bits are selectable. See paragraph titled, "Fourth Menu Screen – RS232 I/O Configuration" in Chapter Three of this User's Guide. A description of the remote control functions is contained in Chapter Four.

1.4.6 INTERNAL TIME BASE

This unit can have one of three internal time bases depending on customer requirements. Unless otherwise specified, the following are the specifications for the oscillators used as the internal time base - not the specifications of the unit's 10MHz sine wave output.

1.4.6.1 VOLTAGE CONTROLLED TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR with the following specifications:

Output Frequency/Waveform
10MHz Sine Wave.

Output Amplitude of Crystal Oscillator
1.0 volt peak-to-peak minimum clipped sine wave into 20KΩ load. Harmonics -20dBc maximum.

Aging Rate
±1.0PPM maximum per year.

Phase Noise
The following specifications are for the 10MHz sine wave output available on rear panel BNC connectors J4-J9:

1Hz	-72 dBc/Hz
10Hz	-98 dBc/Hz
100 Hz	-126 dBc/Hz
1KHz	-136 dBc/Hz
10KHz	-136 dBc/Hz
100 KHz	-136 dBc/Hz

Temperature Range and Stability
±1.0PPM from -30° to +75°C.

Adjustment Range
±3.0PPM minimum by internal manual trimmer.

Voltage Control
±3.0PPM minimum from +0.5 to +4.5 VDC.

1.4.6.2 LOW NOISE OVEN OSCILLATOR with the following specifications:

Output Frequency/Waveform
10MHz Sine Wave.

Output Amplitude of Crystal Oscillator
1.0 volt RMS into 50 ohms.

Aging Rate
$\pm 5 \times 10^{-10}$ per day, $\pm 5 \times 10^{-8}$ per year.

Temperature Stability
$\pm 1 \times 10^{-8}$ over a temperature range of –20°C to +75°C.

Operating Temperature
–20°C to +75°C.

Altitude
Sea level to +50,000 feet.

Electrical Tuning
±1PPM (minimum) / ±2PPM (maximum).

Control Voltage
0 to +6 volts.

Mechanical Frequency Adjust
±1PPM (minimum) / ±3PPM (maximum).

The following specifications apply to the selected 10MHz sine wave output at a +13 dbm level:

Harmonics
-45 dBc

Spurious Noise
>-70 dBc

Phase Noise

1Hz	-94 dBc/Hz
10Hz	-120 dBc/Hz
100Hz	-140 dBc/Hz
1KHz	-145 dBc/Hz
10KHz	-148 dBc/Hz
100KHz	-148 dBc/Hz

1.4.6.3 LOW PROFILE RUBIDIUM OSCILLATOR (LPRO) with the following specifications:

Output Frequency/Waveform
10MHz Sine Wave.

Output Amplitude of Crystal Oscillator
1.0 volt RMS into 50 ohms.

Aging Rate
$\leq 5 \times 10^{-11}$ per month, 5×10^{-10} per year.

Temperature Stability
$\pm 3 \times 10^{-8}$ over a temperature range of –20°C to +75°C.

Operating Temperature
–20°C to +70°C measured at the base plate.

Storage Temperature
-55°C to +85°C

Altitude
-200 feet to +20,000 feet.

Trim range
$\pm 1 \times 10^{-9}$

External (Electrical) Frequency Control
$\leq \pm 1 \times 10^{-9}$ at 0 volts.
$\geq \pm 1 \times 10^{-9}$ at +5 volts.

The following specifications apply to the selected 10MHz sine wave output at a +13 dbm level:
Harmonics
-42 dBc

Spurious Noise
>-80 dBc

Phase Noise

1Hz	-82 dBc/Hz
10Hz	-91 dBc/Hz
100Hz	-131 dBc/Hz
1KHz	-144 dBc/Hz
10KHz	-146 dBc/Hz
100KHz	-147 dBc/Hz

1.4.7 PRIMARY POWER

Using the Standard Power Supply.

Input Voltage	AC = 85 to 264 VAC (47-440 Hz) @ less than thirty watts. DC = +120 to 373 VDC
Input Frequency Range	47 to 440 Hz

Note: When using 120 VAC, install 1 Amp Line Fuses.
When using 220 VAC, install ½ Amp Line Fuses.
Fuses are found in the Shipping Kit.

1.4.8 DIMENSIONS

Chassis

Height	1.75 Inches (9390-6000) or 3.50 Inches (9390-6010).
Width	17 Inches.
Depth	12 Inches Maximum.

1.4.9 WEIGHT

ExacTime Unit	Approximately ten pounds.
Antenna/Preamp	Less than 1.5 pounds.

1.4.10 ENVIRONMENT

Operating Temperature

ExacTime Unit	Operating:	0°C to +50°C.
	Storage:	-20°C to +70°C.
Antenna/Preamp	-40°C to +85°C.	

Humidity

ExacTime Unit	95% (non-condensing) up to 40°C.
Antenna/Preamp	Unlimited.

1.5 ADDITIONAL SPECIFICATIONS

The following is additional information regarding the GPS RPU (Receiver Processing Unit) located within the GPS Time Code and Frequency Generator, and the antenna/preamp.

1.5.1 ANTENNA/PREAMP

The antenna/preamp satisfies performance requirements at altitudes of up to +59,000 feet.

1.5.2 GPS RPU AND ANTENNA

The GPS RPU (Receiver Processor Unit) and antenna/preamp set has burn-out protection which prevents damage from an RF signal at power densities of up to one watt at the antenna. The RF signal must be 100MHz out of band. The C/A band of 1575.42MHz has a bandwidth of 20.48MHz.

1.6 FUNCTIONAL CHARACTERISTICS

The following is a description of the functional characteristics of the GPS RPU.

1.6.1 ACQUISITION

The GPS RPU position fix, acquisition and tracking processes feature the ability to determine its own position (that of the antenna/preamp), not the TC&FG Module, utilizing a position averaging technique and assuming the unit has been set to the "AUTO," "3-SV," or "4-SV" mode. See "Third Menu Screen" in Chapter Three of this User's Guide for selection and an explanation of each MODE SELECTION using the front panel LCD and Keyboard. Mode selection may also be made via the RS-232 Interface. See the paragraph titled "Select Mode" in Chapter Four for mode selection using the RS-232 I/O.

The GPS RPU utilizes the high-6 mode of operation giving it the ability to track the highest six visible satellites. Almanac data determines which satellite(s) is/are the highest. The ability to track up to six satellites allows constant GPS signal reception without interrupting the signal processing while acquiring new satellites, even though the GPS constellation changes for various reasons, such as satellites coming into and going out of view of the antenna, or being declared UNHEALTHY.

Upon powering up the system, the unit begins a systematic search for satellites which are expected to be above the horizon. In this start-up mode of operation it uses the last position data stored in the battery backed RAM as a starting point. If it is in the "AUTO" mode, it will begin doing a position fix using position averaging. After 200 averages, the unit will have acquired its position and will switch automatically to the single satellite (1-SV) mode. The number of position averages is user selectable via the RS-232 I/O. See paragraph titled "Number of Averages" in Chapter Four.

If in the "3-SV" mode, the unit will use the last position data stored in battery backed RAM as a starting point to begin its systematic search for satellites. It will continue to do two dimensional (latitude and longitude) position fixes upon acquiring three satellites or more until the mode is changed.

If in the "4-SV" mode, the unit will use the last position data stored in battery backed RAM as a starting point to begin its systematic search for satellites. It will continue to do three dimensional position fixes (latitude, longitude, and altitude) upon acquiring four or more satellites until the mode is changed. If in the "1-SV" mode and a known position has been entered, the unit will use the position information stored in battery backed RAM as a starting point to begin its systematic search for satellites.

1.6.2 SIGNAL INTERRUPTION

During GPS ExacTime operation, should the signal from the satellites be interrupted, the antenna disconnected or blocked, the reacquisition time is dependent upon events during the interruption. For the first minute of the interruption, the GPS RPU continues to search for the last satellite signals to which it was locked. If the signal is regained during this minute, reacquisition will be almost immediate if the users velocity has not changed by more than fifty meters per second.

If the velocity has changed, the Doppler frequency has shifted. The GPS RPU must finish its search of previous satellite signals and will then expand the search to reacquire. The search time will depend on the amount of velocity change, but it is usually within fifteen seconds.

If the signal is regained within one minute, the expanding frequency search will already have begun cycling. In this case, reacquisition may require a few minutes depending upon where the RPU is in the frequency search when the signal is regained.

If the signal is regained within one hour, the same search must take place, then the new ephemeris data must be collected. In this case, reacquisition will occur within a few minutes.

The user should realize that obstructions, shading of the antenna, and satellite transmission interruptions can degrade the signal reception and length of acquisition times.

1.6.3 POSITION AND VELOCITY SOLUTION

The position and velocity, along with the time tag of the measurement, are digitally output from the RPU to the GPS ExacTime Processor. The position data is three dimensional and available in a latitude, longitude, and altitude (WGS-84) coordinate frame. The GPS solutions are computed at typically less than one second intervals.

1.6.4 DYNAMIC CAPABILITY

The following specifications are operational dynamic limits for GPS Timing Unit operation.

Velocity
The velocity of the user is limited to 400 m/sec for proper GPS Receiver operation.

Acceleration
User acceleration cannot exceed four 4g (39.2 m/sec^2).

Jerk
The rate of change of acceleration is not to exceed 20 m/sec^3.

1.6.5 RF JAMMING RESISTANCE AND BURN-OUT PROTECTION

The GPS RPU provides resistance to all forms of jamming whose effect results in jamming to signal power ratios of twenty-four dB or less as measured at the antenna/preamplifier interface when the input signal is at -163 dBm. The GPS RPU/antenna set provides burn-out protection to prevent damage at RF power densities up to one watt (CW) at the antenna, provided the signal is 100MHz out of the GPS frequency band.

1.6.6 SYSTEM STATUS AND DIAGNOSTICS

All digital circuitry is tested to the greatest extent possible at power-up. This includes testing the memory systems, and processors, as well as monitoring the performance of the channel processors. Should a failure occur in any of these areas, it will be available as status on the RS-232 I/O and will be displayed on the optional LCD Display as an error. Additionally, there is circuitry provided to monitor the satellite's signal strength. If at any time the satellite signal is low (or nonexistent), the message "Signal Level Low" will appear.

1.6.7 GPS SOLUTION MODES

The user may select one of three modes for position solutions.

- The 3-SV mode which is two dimensional (latitude and longitude).
- The AUTO mode, which is three dimensional (latitude, longitude, and altitude).
- The 4-SV mode, which is three dimensional (latitude, longitude, and altitude).

The AUTO mode, used when the unit is initially turned on, uses the three dimensional solution. A fourth mode is also available for single satellite tracking, which does no position solutions and is used for time-keeping and frequency measurements. See SELECT MODE in Chapter Three for front panel LCD and keyboard selection. See Chapter Four for MODE SELECTION using the RS-232 I/O.

When powered up in the AUTO mode, the unit will acquire some number of positions in the 4-SV mode calculating an average latitude, longitude, and altitude when there are at least four satellites in view. The factory set default number of averages is 200. These position averages are loaded into battery backed memory for future use. The number of positions used to calculate the averages is user selectable via the RS-232 I/O interface. Once the average position has been determined, the unit will switch to the 1-SV mode. This mode provides an averaged solution of the time information from as many satellites as the receiver is tracking. The minimum number of satellites is three and the maximum number is eight.

In the 4-SV or three dimensional mode, the system will select the best available four satellites based on Position Dilution Of Precision (PDOP) and provide a navigational solution in three dimensions (latitude, longitude, and altitude).

In the 3-SV or two dimensional mode, the system will navigate using an altitude defined by the user. This mode requires signals from three satellites. The navigation solution uses the pseudoranges for the three satellites plus altitude. The system will automatically select the best three available satellites based on the Horizontal Dilution of Precision (HDOP).

1.6.8 SYSTEM MASKS

System masks are limits that are established on specific operating parameters which can be tailored to the user application. The receiver will hold the previous MASK values in the battery backed RAM memory while not in operation. These values may be modified via the RS-232 I/O. See paragraph titled "ENTER MASK VALUES" in Chapter Four of this User's Guide for an explanation of how to select masks via the RS-232 I/O interface.

Elevation Angle (Elevation)
This mask is used to specify the elevation angle below which the use of satellites is prohibited. Signal integrity from satellites very low on the horizon can be degraded. Obstructions will block the signal. For land-based applications where there are local obstructions (foliage, buildings, etc.) system performance will be smoother with an elevation mask of fifteen to twenty degrees. For marine or aircraft applications, it is usually possible to use the satellites very close to the horizon, although the pitch/roll should be considered. The system default is that set by the user. Refer to Chapter Four, paragraph titled "ENTER MASK VALUES" for instruction on selecting elevation mask.

Signal Strength
This refers to the strength of the signal received from the satellite (not expressed in decibels). Below a value of three, the RPU may experience difficulty collecting data and possibly only track satellites intermittently. The system default is that set by the user. Refer to Chapter Four, paragraph titled "ENTER MASK VALUES" for instruction on selecting a signal level mask.

Position Dilution of Precision (PDOP)
This mask prevents the calculation of a navigational solution when the geometry of the satellites is such that the PDOP is greater than the specified value. The system default is set by the user. Refer to Chapter Four, paragraph titled "ENTER MASK VALUES" for instruction on remote selection of PDOP.

Table One

Control Function Bit Assignments

IRIG B Positive ID	Control Bit #	Designation	Explanation
P50	1	Year, BCD 1	Last two digits of year in BCD.
P51	2	Year, BCD 2	IBID.
P52	3	Year, BCD 4	IBID.
P53	4	Year, BCD 8	IBID.
P54	5	Not Used	Unassigned.
P55	6	Year, BCD 10	Last two digits of year in BCD.
P56	7	Year, BCD 20	IBID.
P57	8	Year, BCD 40	IBID.
P58	9	Year, BCD 80	IBID.
P59	N/A	P6	Position identifier number six.
P60	10	Leap Second Pending (LSP)	Becomes 1 up to 59 s BEFORE leap second insert.
P61	11	Leap Second (LS)	0 = add leap second, 1 = delete leap second.
P62	12	Not Used	
P63	13	Not Used	
P64	14	Time Offset Sign	Time offset sign 0 = +, 1 = -
P65	15	Time Offset - Binary 1	Offset from coded IRIG B time to UTC time. IRIG coded time plus time offset (including sign) equals UTC time at all times (offset will change during daylight savings).
P66	16	Time Offset - Binary 2	
P67	17	Time Offset - Binary 4	
P68	18	Time Offset - Binary 8	
P69	N/A	P7	Position identifier number.
P70	19	Time Offset - 0.5 Hour	0 = none, 1 = additional 0.5 h time offset
P71	20	Time Quality	4 bit code representing approx. clock time error 0000 = clock locked, maximum accuracy. 1111 = clock failed, data unreliable.
P72	21	Time Quality	
P73	22	Time Quality	
P74	23	Time Quality	
P75	24	PARITY	Parity on *all* preceding *data* bits.
P76	25	Not Used	Unassigned.
P77	26	Not Used	Unassigned.
P78	27	Not Used	Unassigned.
P79	N/A	P8	Position identifier number eight.

CHAPTER TWO
INSTALLATION

2.0 INTRODUCTION

This section describes the unpacking, inspection, and installation of the GPS Timing Unit.

2.1 UNPACKING AND INSPECTION

The GPS Timing Unit is packaged in one shipping container. Inspect the unit for visible damage (scratches, dents, etc.). If the instrument is damaged, immediately notify both Datum Inc and the responsible carrier. Keep the shipping container and packing material for the carrier's inspection.

Note: When communicating with either Datum Inc or the responsible carrier regarding shipping damage, refer to the serial number. This number is located on the rear panel of the GPS Timing Unit.

2.2 RACK MOUNTING PROCEDURE

The GPS Timing Unit is designed for standard nineteen inch rack mounting.

Optional chassis slides are recommended if the unit is to be installed in an equipment rack. If slides are not used, a supporting bar or tray should be provided for the rear of the instrument. The chassis slides attach to the sides of the GPS Timing Unit. To mount it using the optional slide mounting kit, use the eight #6 self tapping screws provided in the kit.

General Cautions/Hazards to be considered when installing the GPS Timing Unit into an equipment rack:

- **Tmra** – The maximum recommended ambient temperature (Tmra) that this equipment is specified to operate in is 50°C.

- **Elevated Operating Ambient Temperature** – If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefor, consideration should be given to installing the equipment in an environment compatible with the maximum rated ambient temperature (Tmra).

- **Reduced Air Flow** - The equipment has no cooling fans and depends on convection for cooling. Installation in a rack may cause an excessive heat rise if sufficient air flow is not available. Installation should be such that the amount of air flow required for safe operation of the equipment is not compromised.

- **Mechanical Loading** – Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.

- **Circuit Overloading** – Consideration should be given to the connection of the equipment to the supply circuit and the effect that overloading of circuits might have on over current protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

- **Reliable Earthing** – Reliable earthing of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch circuit (e.g., use power strips).

2.3 ANTENNA/PREAMP INSTALLATION

The antenna/preamp is enclosed in a weatherproof housing suitable for permanent installation in an exposed location. The unit should be located with an unobstructed view of the horizon for optimum tracking conditions. The signal will not penetrate foliage. Multi-path signals may be generated from vertical surfaces, which are above the plane of the base of the antenna/preamp.

The antenna/preamp, which is designed for fixed ground or marine applications, requires no special ground plane, but a large metal surface below the antenna/preamp may reduce multi-path effects. The unit may be mounted on any level surface or on a vertical pipe having ¾ - 14 NPT threads. See Figures 2-1, and 2-4, "Antenna/Preamp Installation," for mounting.

*** * * CAUTION * * ***

A high powered radar beamed directly at the antenna/preamp may damage it and a signal within a few MHz of the carrier frequency may jam the GPS RPU.

2.4 ANTENNA/PREAMP INTERFACE CONNECTIONS

A fifty foot long RG-58A/U coaxial cable is provided to connect the antenna/preamp to the GPS Timing Unit. For cable lengths greater than seventy-five feet, an optional low loss coaxial cable (such as Belden 9913) must be used.

The antenna/preamp power is provided by the GPS Timing Unit via the coaxial cable. No additional cabling is required to power the antenna/preamp.

Cables attached to the antenna/preamp should be strain relieved and secured to some permanent fixture.

Cables attached to the antenna/preamp which are exposed to the elements should be wrapped with a weather-proof tape after being connected.

Cables from the antenna/preamp should be secured as required with cable clamps and should *not* put a strain on the antenna/preamp connector as it may damage the unit.

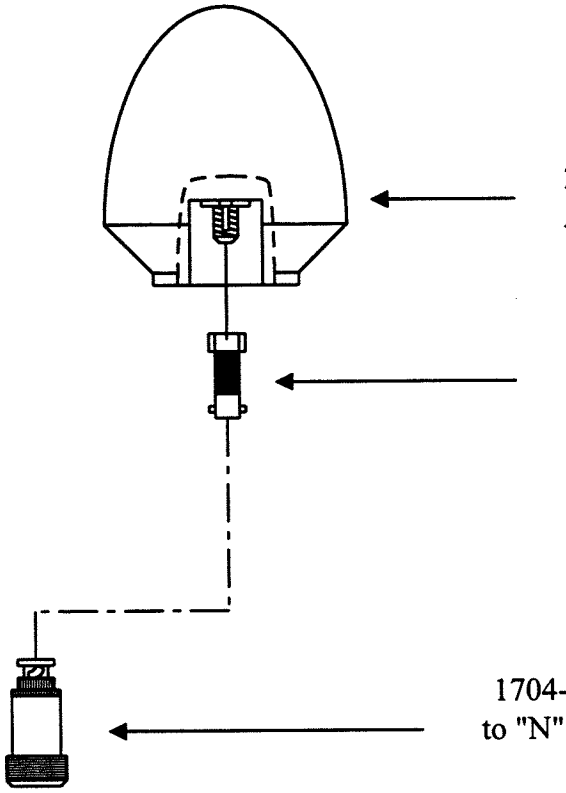
2.5 PRIMARY POWER CONNECTION

The GPS Timing Unit is operated from external AC power. The AC power specifications are listed in the specification section in Chapter One of this User's Guide.

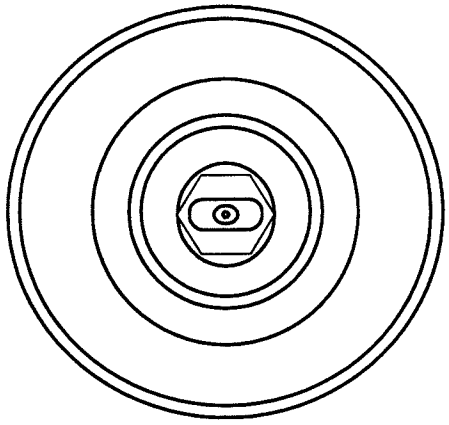
Note: Check the AC line fuses located in the power entry module on the rear panel and assure the correct fuse is installed for the AC Line voltage being used to power the unit. The AC line fuse should be 1 Amp for an AC input of 120 volts or ½ amp for an AC input of 220 volts.

If this unit is provided with a power supply other than the standard, its specifications will be found in the Option Description envelope located on the inside cover of this User's Guide.

Figure 2-1
Antenna/Preamp Installation



* Unless otherwise specified.



1. Material* PVC or CPVC Schedule 80, Gray Color.

2.6 GPS TIMING UNIT INTERFACE CONNECTIONS

The GPS Timing Unit interface connections consist of cabling to the antenna/preamp assembly from J2 on the unit's rear panel, the RS-232 I/O port J12 (if used), and the time and frequency inputs and outputs and/or other optional inputs or outputs.

2.6.1 RS-232 I/O INTERFACE J12

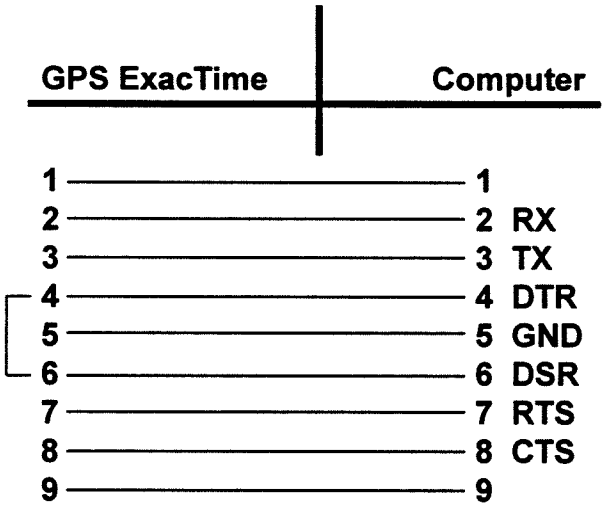
This port provides the basic read/write mode of operation.

Before connecting a peripheral device to this port, read the manual accompanying the product and be aware of the necessary precautions. Determine the BAUD rate, parity word length, stop bits, and interconnections with the equipment.

This I/O port is configured as a DCE, and is intended to be used by intelligent peripherals such as a computer. It supports full duplex communications and operates in a demand/response mode. The RS-232 I/O port uses a standard DB-9 I/O connector with the pin configuration shown in Figure 2-2.

The RS-232 protocol is described in Chapter Four in the paragraph titled "Information."

Figure 2-2
RS-232 I/O Cable Pin Assignments



***Note*:** Pin Four is connected to Pin Six inside the GPS Unit.

The RS-232 I/O interface uses a standard PC compatible one-to-one cable using nine Pin D type connectors.

2.6.2 PRINTER OUTPUT PORT J11

This connector can output data to an RS232 compatible serial printer or terminal. It can be configured to output data in the Standard configuration or the One Second ASCII Burst Mode Output. Refer to Chapter Three (Tenth Menu Screen) for more specific details on configuration and operation.

Connector configuration:

1 ——— NOT USED
2 ——— NO CONNECTION
3 ——— TX (Data Out)
4 ——— NOT USED
5 ——— GROUND
6 ——— NOT USED
7 ——— NO CONNECTION
8 ——— NO CONNECTION
9 ——— NOT USED

2.6.3 TIMING OUTPUTS

Various timing output signals can be provided on the rear panel BNC connectors J4 through J9. The selection of these outputs is made using jumper pins/blocks on the GPS Main Assembly 35002, as shown in Figure 2-3, and the front panel keyboard, or via the RS-232 I/O.

To check or reconfigure these outputs via the front panel keyboard see the paragraph titled "Configuration of Rear Panel BNC Connectors J4-J9" in Chapter Three of this User's Guide.

To check or reconfigure these outputs via the RS-232 I/O, see the paragraphs titled "Request MUX Outputs," and "Set MUX Output" in Chapter Four of this User's Guide.

The standard configuration is as follows:

J4 Tracking (TTL)*	Jumper J14 7 and 8, and J24 1 and 2.
J5 Locked (TTL)**	Jumper J15 7 and 8, and J25 1 and 2.
J6 1pps	Jumper J16 1 and 2.
J7 10MHz Sine Wave	Jumper J17 5 and 6.
J8 IRIG B (AC)	Jumper J18 3 and4, and J28 1 and 2.
J9 IRIG B (DC)	Jumper J19 1 and 2, and J29 1 and 2.
J10 1pps Input	(Time Interval Measurement).

* Tracking output is low when unit <u>is</u> tracking, high when unit is <u>not</u> tracking.
** Locked output is low when unit <u>is</u> locked, high when unit is <u>not</u> locked.

For additional pulse rate selections available on BNC connectors J4-J9, see Chapter One of this User's Guide.

Configurations other than the standard above will be found in the Option Description envelope located on the inside cover of this User's Guide.

2.6.4 1PPS INPUT

A 1pps pulse can be input on a rear panel BNC connector labeled J10. This input can be utilized when making time interval measurements between the internal corrected GPS 1pps and an external 1pps input pulse. This is a multipurpose input that may also be optionally utilized to record an event or accept a frequency for external measurement purposes.

Figure 2-3
GPS Main Assembly 35002

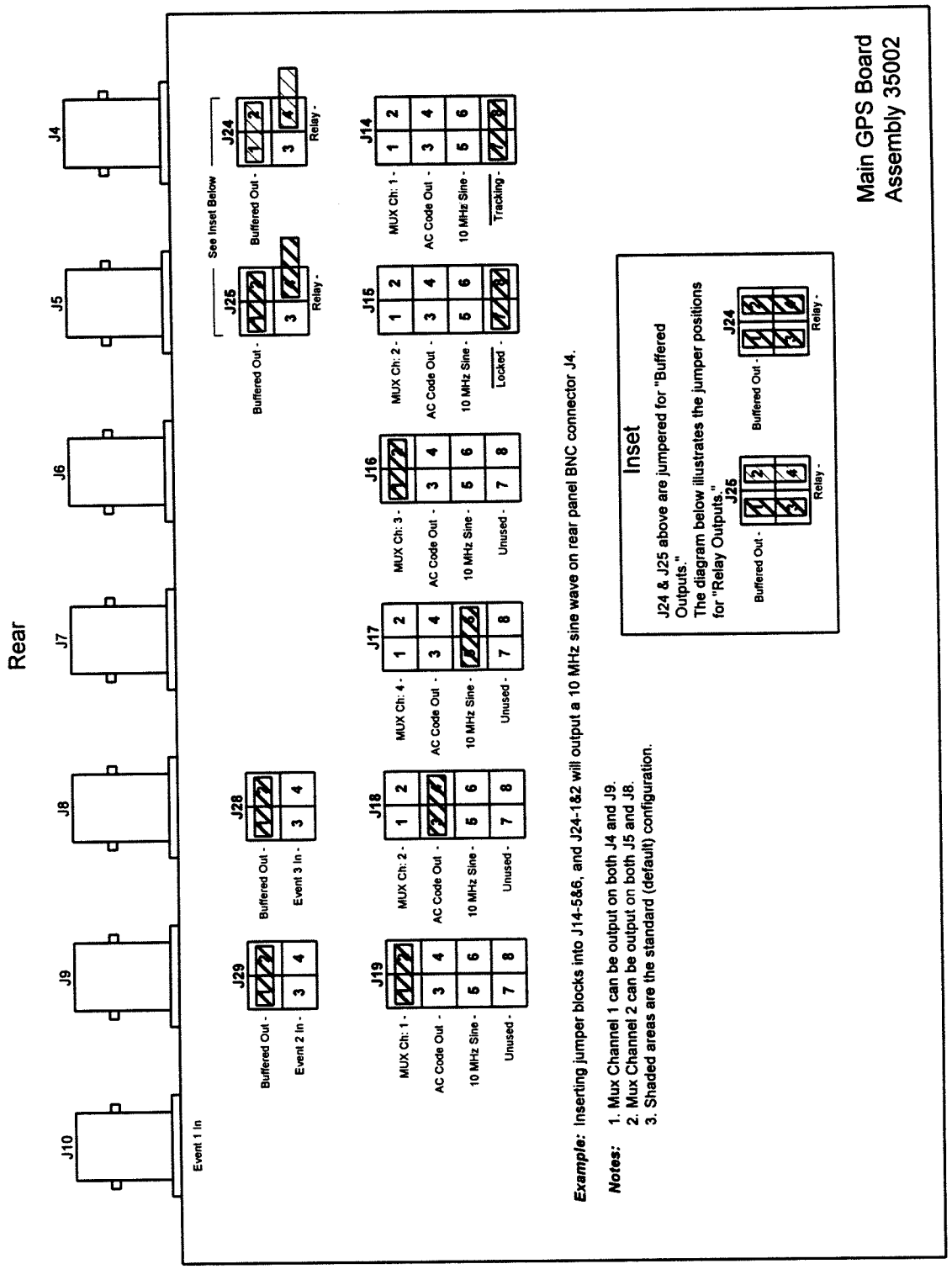
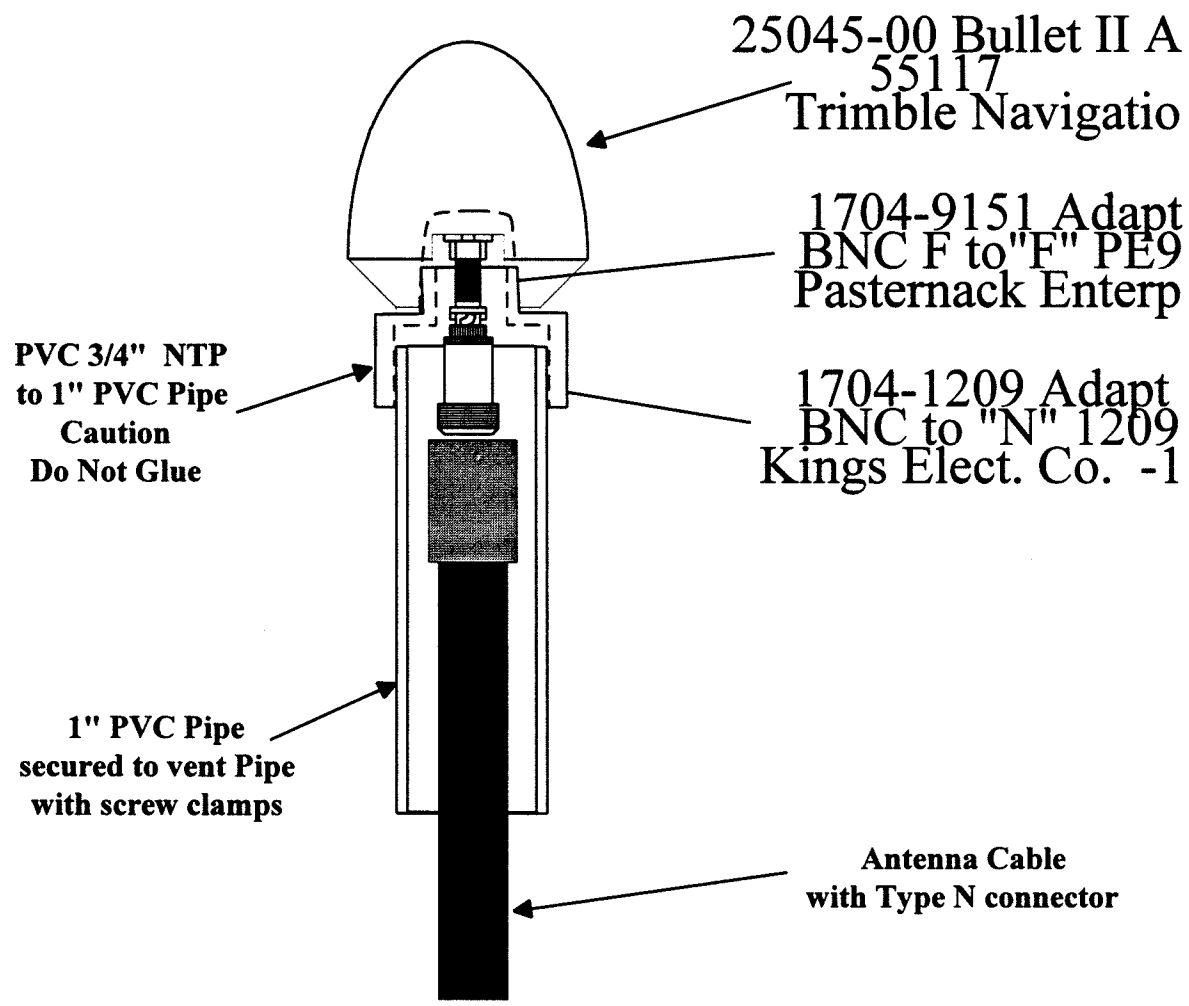


Figure 2-4
Antenna/Preamp Installation



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CHAPTER THREE
OPERATION

3.0 INTRODUCTION

This chapter describes the operation of the basic GPS ExacTime. Operating instructions for the optional features are contained in the Option Description envelope attached to the inside cover of this User's Guide.

3.1 OPERATIONAL STEPS

The following are the initial installation steps necessary for the operation of your unit:

- Connect the appropriate input/output cables and components including as a minimum the power cable and the antenna and antenna cable.

- Apply power to the unit. Initially the front panel TRACKING and LOCKED LED's will flash and the POWER LED will illuminate. This signifies that the microprocessor and associated circuitry have been initialized correctly and are operating.

- The unit will then start to track satellites (refer to the First Menu Screen – this chapter). When the first satellite is acquired, the TRACKING LED will illuminate signifying that the unit is tracking satellites.

- The message "GPS Time Not Acquired" will be displayed until the unit receives the Leap Second information. At that point, the unit will set time and the message "OSC Stabilizing XX" will be displayed.

- The unit will then progress through a series of oscillator stabilization steps (Step 10 through 1). Once the oscillator has sufficiently stabilized, the LOCKED LED will illuminate and the 1 PPS output will be coherent with the internal, disciplined 10MHz oscillator.

  Note: If the unit stops tracking satellites at any point after initial power-up, the TRACKING LED will be turned off. At that time, an internal elapsed time counter will be started and the short term oscillator stability will be stored in memory. Based upon a calculation of the elapsed time and the oscillator stability, the LOCKED LED will remain illuminated until the 1PPS drifts off more than 700 nanoseconds. This will be at least .5 to 1.5 hours.

- On a first time installation, it is necessary to get your position (actually the position of the antenna) into the unit. However, before starting this process, it is necessary to become familiar with at least the first three LCD menu screens. Refer to Sections 3.3.1 through 3.3.3 of this chapter.

- If your position is known and accurately surveyed, see paragraph titled "Initialization (Known Position)."

- If your position is unknown, see paragraph titled "Initialization (Unknown Position)."

3.1.1 INITIALIZATION (UNKNOWN POSITION)

Apply Power. Set the SELECT MODE to "AUTO" if it is not already in the "AUTO" mode. See paragraph titled "Select Mode" under "Third Menu Screen" in this section for mode selection. Within ten minutes, assuming four satellite availability, the TRACKING LED will illuminate indicating that the unit is tracking and has set time.

After an initial warm-up and an oscillator stability check/delay, the unit will begin doing position averaging. The number of averages is set to the default number of 200 but is user selectable via the RS-232 I/O Interface. See paragraph titled "Number of Position Averages" in Chapter Four of this User's Guide. A position fix takes approximately two seconds, so the position averaging itself could take about ten minutes.

Initial warm-up time is affected by the ambient temperature, and the length of time the unit has been off.

If the LOCKED front panel LED does not illuminate within one hour, check the DAC value displayed on the SECOND MENU SCREEN, and/or the status displayed on the FIRST MENU SCREEN, or via the RS-232 I/O interface (see Chapter Four, paragraphs titled "Request DAC Value," and "Print Time, Status, Error Code, and Satellite Vehicle Numbers" respectively). If DAC value number has approached either one of its extremes (00000 or 65535), or if the STATUS is S14, OSCILLATOR STABILIZING, the internal oscillator needs to be nulled/calibrated. Refer to the "Internal Oscillator Calibration" procedure in Chapter Five of this User's Guide.

Once the unit has accomplished its position averaging, the unit will switch to the single satellite (SV1) mode. At this time, the 1pps will be coherent with the internal disciplined 10MHz oscillator and the front panel LOCKED LED will illuminate.

3.1.2 INITIALIZATION (KNOWN POSITION)

Apply Power. Set the SELECT MODE to "1-SV" single satellite mode. See paragraph titled "Select Mode" under the THIRD MENU SCREEN in this chapter for mode selection.

Enter the known position (latitude, longitude, and altitude) of the GPS antenna. See paragraph titled "Set Position" in this chapter.

After an initial warm-up and an oscillator stability check/delay, the unit will set time and begin "tracking" satellites.

The length of time the unit has been OFF and the ambient temperature affect the initial warm-up time.

If the LOCKED LED on the front panel does not illuminate within one hour, check the DAC value, displayed on the SECOND MENU SCREEN, or via the RS-232 I/O interface (see paragraphs titled "Request DAC Value," and "Print Time, Status, Error Code, and Satellite Vehicle Numbers," respectively, in Chapter Four). If the DAC value number has approached either one of its extremes, (00000 or 65535) or if the STATUS is S14, OSCILLATOR STABILIZING, the internal oscillator needs to be nulled/calibrated. Refer to the internal oscillator calibration procedure in Chapter Five of this User's Guide.

When the oscillator has been stabilized, and the front panel LOCKED LED illuminates, the 1pps will be coherent with the internal disciplined 10MHz oscillator.

3.2 OPERATIONAL CHARACTERISTICS

The standard internal time base is a voltage controlled temperature compensated 10MHz crystal oscillator. When the disciplining feature is ENABLED, its frequency is controlled/corrected to the internal GPS 1pps using a DAC (Digital to Analog Converter). Disciplining of the oscillator occurs only when it is ENABLED and used as the unit's time base, and when the GPS ExacTime is actively tracking a satellite. During periods when there are no satellites in view or when the unit isn't tracking, the last DAC value is retained, and the unit continues to operate normally. The outputs are then as accurate as the drift/aging rate of the oscillator. See Chapter Four, paragraphs titled "Enable Disciplining," and "Disable Disciplining" in this User's Guide for enabling and disabling disciplining.

Disciplining is ENABLED by default when the unit is powered.

3.3 LIQUID CRYSTAL DISPLAY

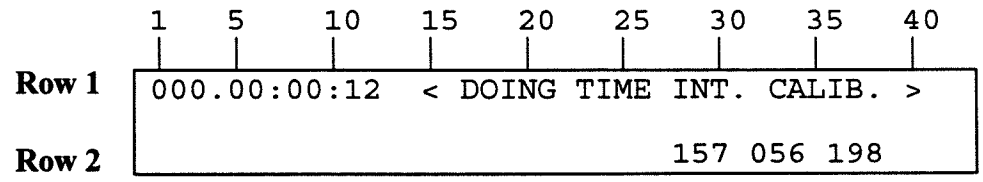
The front panel LCD Display contains two rows of forty characters per row. It displays at least ten separate MENU screens that are changed by pushing the front panel MENU keyboard switch.

3.3.1 FIRST MENU SCREEN

When power is first applied to the TC&FG, the LCD displays the unit's ID followed by four digits that correspond to the serial number of the unit. After approximately 5 seconds, the display then switches to the First Menu Screen.

Note: If you have just installed revised/upgraded firmware or performed a "Cold Reset" (see Chapter Five), an additional extra screen will be displayed in front of your First Menu Screen. This screen will only appear the first time power is applied to your unit after a Cold Reset or the new firmware has been installed. After that, the normal First Menu Screen will appear. This additional screen is shown below:

Column:



This internal, automatic Time Interval Calibration is necessary to get accurate nanosecond time interval resolution. In the example above, 157 is the high value, 056 is the low value, and 198 is the number of seconds remaining until the calibration is finished. This number starts at 250 and decrements to zero at a one second rate.

If the MENU key is pressed prior to completing the calibration process, the calibration will be interrupted and the process aborted. However, an additional menu screen (the TWELFTH MENU) will be enabled. The user can access this screen if he cycles through the various menus by pushing the MENU key. This Twelfth screen will enable the nanosecond time interval calibration to be completed at a later date.

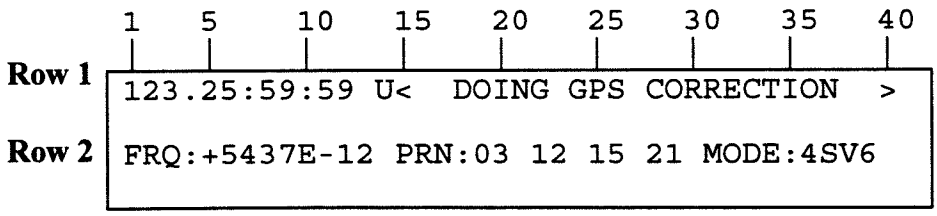
It is important to note that if this automatic time interval calibration is interrupted prior to its completion, it will be necessary to restart and complete it (using the TWELFTH MENU screen) or inaccurate time interval measurements will result.

The following is the normal first MENU that is displayed. It contains the following information:

Datum Firmware Version.
Synchronization.
Time (Seconds through Days).
Status and Error Messages.
Frequency Offset.
Satellite PRN Identification.
Mode.

A sample of the FIRST MENU SCREEN is shown below:

Column:



At power up, the software version appears on the first row of the LCD display. The software version appears as Nxxxx/Sxxxx/DTxxxxx, where Nxxxx is the Navigational Processor Software Version, Sxxxx is the Signal Processor Software Version and DTxxxxx is the Operational Software Version.

The time-of-year is displayed in Row One, starting with Column One and consists of day-of-year, hour, minute, and second. This can be UTC, or GPS time, or display of the local time offset depending on which mode has been selected via the RS-232 I/O port, or via the front panel LCD and keyboard. See paragraph titled "UTC Sync" to select UTC time synchronization, and paragraph titled "GPS Sync" to select GPS synchronization in Chapter Four of this User's Guide, or the paragraph titled "Set Time," under THIRD MENU SCREEN in this section, to select UTC or GPS synchronization using the front panel LCD and keyboard. See paragraph titled "Enter Local Time Offset" in Chapter Four of this User's Guide to enter the desired local time offset via the RS-232 I/O port. The local time offset may also be entered into the unit using the front panel keyboard and LCD. See paragraph titled "Local Time Offset" under the THIRD MENU SCREEN in this chapter.

The letter "U" or "G" which is displayed in Row One, Column Fourteen, denotes whether UTC (U) or GPS (G) synchronization has been selected.

When the GPS TC&FG is synchronized to UTC time, the time-of-year is displayed and the GPS corrected 1pps output is on-time with UTC within ±100 nanoseconds without SA (Selective Availability).

When the GPS TC&FG is synchronized to GPS time, there is a time difference between UTC and GPS time. As of 9 September, 1996, the difference was eleven seconds because of the leap second difference. Leap seconds are added to or subtracted from UTC time, but not GPS time.

Status and error messages are displayed in Row One, starting at Column Fifteen. The status and error messages alternate every ten seconds. At initial power-up, this area will display the Datum firmware version for a few seconds.

The possible status messages displayed are:

Doing GPS Corrections.
GPS Time Not Acquired.
Waiting for Almanac.
PDOP is Too High.
No Usable Satellites.
1 Usable Satellite.
2 Usable Satellites.
3 Usable Satellites.
Selected SV Unusable.
No SV Scheduled.
OSC Stabilizing XX.
Averaging Position XXXX.
Unknown Error.
Flywheel Mode.

The "STATUS CODES" are via the RS-232 I/O when requested, and output by the printer port if the option is implemented. The characters S00 through S15 are printed for the status.

The status message, "DOING GPS CORRECTIONS" is an indication that the GPS Unit is performing the tasks appropriate to the selected mode of operation. The operational modes include AUTO, single satellite, three satellite, and four satellite selections. The various modes will be detailed in subsequent sections of this User's Guide and are listed here to aid in understanding of the "STATUS MESSAGES."

The status message, "WAITING FOR ALMANAC" occurs when the battery-backed RAM containing the almanac data has failed, the unit has been relocated, or the unit has not been powered up for a period of a few weeks. The almanac data defines the clock offset, drift, and orbital parameters needed by the unit to compute the satellite position as a function of time. The Almanac also contains data relative to the "HEALTH" of the GPS System and particular satellite vehicles (SVs).

The status message "PDOP IS TOO HIGH" indicates that the Position Dilution Of Precision (PDOP) exceeds a preset limit. This limit or "MASK" is factory set at twelve meters in the GPS receiver. This mask is consistent with the performance capability established for this instrument. Refer to paragraph titled "Enter Mask Values" in Chapter Four of this User's Guide.

The status message, "NO USABLE SATELLITES" is similar to the "DOING GPS CORRECTIONS" status message, except that the GPS Time has been previously acquired and has been maintained to at least the oscillator reference precision since the last usable satellite was visible. Refer to the paragraph titled "Set Mode (Mode Selection)" in this chapter.

The status message "1 Satellite In View" is displayed if only one usable satellite is in view and a multi-satellite mode has been selected such as the AUTO, 3-SV, or 4-SV. Refer to the paragraph titled "Set Mode (Mode Selection)" in this chapter.

The status message "2 Satellites in View" is displayed if only two usable satellites are in view and the AUTO, 3-SV, or 4-SV has been selected. Refer to the paragraph titled "Set Mode (Mode Selection)" in this chapter.

The status message, "3 Satellites in View" is displayed if only three usable satellites are in view and the AUTO, or 4-SV has been selected. Refer to the paragraph titled "Set Mode (Mode Selection)" in this chapter.

The status messages "No Usable Satellites," "1 Usable Satellite," "2 Usable Satellites" and "3 Usable Satellites" are used to distinguish between satellites which are in view and which are "HEALTHY." For example, if three satellites are in view but only two are usable, for whatever reason, then the status code "2 Usable Satellites" would be displayed if a multi-satellite mode has been selected.

The status message "OSC Stabilizing XX," where the two digit number (ten to 00) following "OSC Stabilizing" represents how far away the oscillator is from stabilization. At power on it will be ten and then down count to 00. The length of time the unit has been OFF and the ambient temperature will affect how long the oscillator takes to stabilize. Refer to paragraph titled "Operational Steps" in this chapter.

The status message "Averaging Position XXXX" where the four digit number after the message "Averaging Position" represents the number of averages remaining before the LOCKED LED will illuminate. The number starts at the maximum number programmed (default is 200) and counts down to 0000. This message is applicable only in the AUTO MODE of operation. Refer to the paragraph titled "Number of Position Averages" for selection of number of averages.

The status message "Unknown Error" is displayed if an unknown fault has been detected in the status reporting hardware or software.

The status message "Flywheel Mode" is displayed if the Flywheel Mode has been selected. (Please note that this mode is optional.) Refer to the paragraph titled "Set Mode (Mode Selection)" in this chapter.

The possible Error Messages displayed are:

Character	Definition
E00	System Check OK.
E01	Battery Failure.
E02	Processor Failure.
E04	Channel 1 Error.
E08	Channel 2 Error.
E16	Signal Level Low.
E32	Offset Too High.

The character error codes are for the RS-232 I/O port and optional printer port outputs.

The "Error Codes" are provided for the same reason as the "Status Codes" in the previous paragraph.

The error message "System Check OK" is displayed when there are no problems with the system and "all is well."

The error message "Processor Error" indicates a signal processor error has been detected. After this error is detected, it will remain until the receiver is reset.

The error message "Channel 1 Error" indicates that an alignment error, or Chip 1 error has been detected. After this error is detected, it will remain until the receiver is reset.

The error message "Channel 2 Error" indicates that an alignment error, or Chip 2 error has been detected. After this error is detected, it will remain until the receiver is reset.

The error message "Signal Level Low" at power up indicates that the unit has not yet acquired any satellites. If this error message persists for a period exceeding one hour after the unit is powered up, or occurs after the time has been set and the unit was actively tracking satellites, the probable cause of this message is a discontinuity in the antenna cable or a failure of the antenna/preamp itself. Check the antenna/preamp cable connections since they are the most likely cause of the discontinuity.

The error message "Offset Too High" is caused by a reference frequency oscillator frequency offset, which is too high to be usable, by the receiver. Errors as low as one part in 10^{-6} could cause this problem. Generally offsets on the order of a few parts in 10^{-5} can be tolerated before a problem exists. All errors except the "Battery Failure" error can be cleared by correction of the causative factor. The "Battery Failure" error can only be reset by cycling the power.

The frequency offset is displayed in Row Two starting with Column One. This offset is the calculated difference between the units local time base and the GPS System frequency. It consists of either a plus (+) or minus (-) followed by a four digit number expressed in parts to 10^{-9} or 10^{-12} (the E-exponent).

The satellite PRN identifications are displayed in Row Two starting with Column Fifteen. These are the SV numbers that the unit is currently tracking. They can consist of up to four two digit numbers.

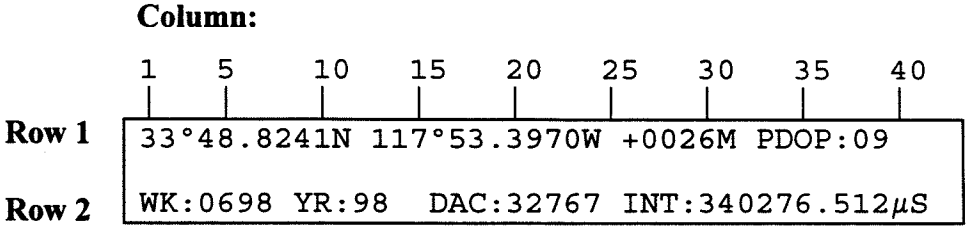
The mode is displayed in Row Two starting at Column Thirty-One. At initial power up, unless otherwise selected, the unit will be in the AUTO mode and 4SV will be displayed, followed by a number, which indicates the number of satellites, which are in view of the antenna. As an example, 4SV6 would indicate that the unit is in the AUTO or 4SV mode, and that there are six satellites in view of the antenna. Once the unit has completed its position averaging, if in the AUTO mode, it will switch to the single satellite (1SV) mode and display 1SV followed by a number indicating the number of satellites in view of the antenna.

3.3.2 SECOND MENU SCREEN

Depressing the MENU keyboard switch once will display this screen. It contains the following information:

Latitude, Longitude, and Altitude.
PDOP Value.
GPS Week Number.
Year.
DAC Value.
Time Interval.

A sample of the Second Menu Screen is shown below:



A sample of the Second Menu Screen is shown below:
Latitude, expressed in Degrees, Minutes, N (North), or S (South) is displayed in Row 1 starting at Column 1. It is followed by Longitude expressed in degrees, minutes, W (West), or E (East). Next is the altitude, starting with a plus (+) or minus (-) followed by four digits expressed in meters.
If the unit is in the 4SV mode and actively tracking four satellites, the PDOP value is shown in Row One starting at Column thirty-three. It is a two digit value which reflects the geometry of the satellites currently being tracked. If the PDOP value exceeds the PDOP mask value, "HI" will appear in place of the two digits.

The four digit GPS week number is displayed at the start of Row Two.

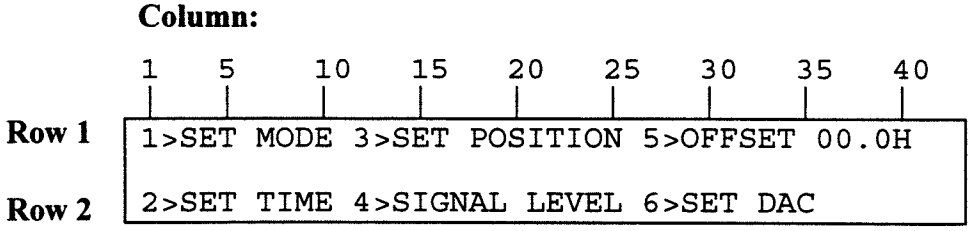
The two digit year (YR) is expressed as a five digit number in Row Two starting at Column Nine

Starting at Column Sixteen of Row Two is the DAC, a 5 digit (00000 to 65535) number which is a digital representation of the analog voltage (0 to +5volts) that controls/disciplines the internal 10MHz oscillator.

The last data displayed in this screen is the Time Interval (INT) which is an example of the time interval measurement between the 1PPS output and an externally supplied 1PPS input.

3.3.3 THIRD MENU SCREEN

Subsequent pushing of the MENU keyboard switch will display the Third Menu Screen which is shown below and contains the following choices:



If the #0 keyboard switch is pressed, the operational software version will appear in the lower right-hand corner (in place of "SET DAC"). /DT/01D

3.3.3.1 1> SET MODE (MODE SELECTION)

To set the mode, press the #1 keyboard switch. The display will change to that as shown below:

0> AUTO 1> 1SV 3> 3SV 4> 4SV 5>FW
OPERATING MODE: AUTO

Choice "0>AUTO"
Depressing the "0" keyboard switch selects the "AUTO" mode. Pressing the MENU keyboard switch will return the display to the THIRD MENU SCREEN. The "AUTO" mode uses four satellites. If more than four satellites are in view and usable, a set of four based on optimal satellite (maximum PDOP) geometry is automatically selected for use.

In this mode, after an initial warm-up delay, and an oscillator stability check/delay, the unit will begin doing position averaging. The number of averages is user selectable but the default number is 200. A position fix takes approximately two seconds, so the position averaging itself could take about ten minutes.

Once the unit has completed its position averaging, the unit will switch to the single satellite (1SV) mode. At this time, the 1pps will be coherent with the internal disciplined 10MHz oscillator and the front panel LOCKED LED will illuminate.

For additional information on the "AUTO" mode, see Chapter Five.

Choice "1>1SV" (Single Satellite Mode)
Depressing the "1" keyboard switch selects the "1SV Mode." Pressing the MENU keyboard switch returns the display to the THIRD MENU SCREEN.

The "1SV" (Single Satellite) mode is the most frequently used mode of operation for timing applications. This mode of operation assumes that the current position (longitude, latitude, and altitude) is accurate. It uses either a single, specific satellite to derive the timing information or an averaged solution of the time information from as many satellites as the receiver is tracking.

When the "1" keyboard switch is depressed, the "Operating Mode" changes to "1SV" and a double "XX" appears after the mode designator "1SV XX." The "X's" prompt the user to input a pair of digits representing the PRN number of the desired satellite vehicle to be used.

If the user enters a pair of zero (00), the receiver will provide an averaged solution of the time information from as many satellites as it is tracking (up to eight). This averaged (over determined) solution will provide a more stable time when operating in the SA environment.

For additional information on the "1SV" mode, Chapter Five.

Choice "3>3SV" (Three Satellite Mode)
Depressing the "3" keyboard switch selects the "3SV" mode and the "Operating Mode" changes to "3SV." Pressing the MENU keyboard switch returns the display to the THIRD MENU SCREEN.

This selection "3SV" forces the GPS Receiver to use the current altitude as an accurate altitude regardless of how many satellites are in view. The unit will not perform either "Timing Corrections" or "Position Fixes" unless a minimum of three usable satellites are in view. This mode is useful in marine applications where the altitude of the receiver remains relatively constant. In this mode, the altitude is not relative to WGS-84. The unit will continue to do two dimensional position fixes until the mode is changed.

For additional information on the "3SV" mode, see Chapter Five.

Choice "4>4SV" (Four Satellite Mode)
Depressing the "4" keyboard switch selects the "4SV" mode and the "Operating Mode" changes to "4SV." Pressing the MENU keyboard switch returns the display to the THIRD MENU SCREEN.
This choice forces the GPS Receiver to remain in the "4SV," four satellite mode at all times. No "position fixes" or "timing corrections" will be performed unless a minimum of four usable satellites is in view.

When four satellites are in view, the unit will perform three-dimensional "position fixes" (latitude, longitude, and altitude) if the PDOP value is below the PDOP mask.
For additional information on the "4SV" mode, see Chapter Five.

Choice "5>FW" (Flywheel Mode)
Depressing the "5" keyboard switch selects the "FW" mode and the "Operating Mode" changes to "FLYWHEEL." Pressing the MENU keyboard switch returns the display to the THIRD MENU SCREEN.

This choice forces the TC&FG into the Flywheel (time code generator) mode. In this mode the unit does *not* get synchronization from the GPS RPU (Receiver Processor Unit). The internal oscillator is not disciplined. The antenna may or may not be connected. No error messages are displayed or generated via the RS-232 I/O. To set generated time, refer to "SET TIME (TIME SELECTION).

3.3.3.2 2> SET TIME (SET TIME SELECTION)

Pressing the #2 keyboard switch selects the "SET TIME." The display will switch to that shown below:

Setting the time is only applicable if the unit is not actively tracking one or more satellites.

ENTER TIME XXX XX:XX:XX

If it is desired to set "TIME" and use the GPS system as a time code generator for any number of reasons such as a faulty antenna, the desired "TIME" may be entered using the numeric keys of the keyboard. Three digits must be entered for the day-of-year, two digits for the hour, two digits for the minute and two digits for the seconds. Leading "zeroes" are required if necessary.

The GPS receiver will use this "TIME" input as its time until the time is acquired from a GPS satellite. The 1pps output of the GPS receiver will not be on time with UTC or GPS, whichever has been selected, until the GPS receiver has acquired time from the satellites.

If the optional "Preset Year" feature is installed, a "Preset Year" message will be displayed when you have finished entering the time of year, or by pressing the MENU keyboard switch. The following message will appear which will enable year preset:

ENTER YEAR XX
ENTER TIME XXX XX:XX:XX

Note: If the user enters a two-digit number between 91 and 99, the year is assumed to be 1991 to 1999. If the user enters a two-digit number between 00 and 90, the year is assumed to be 2000 to 2090.

Pressing the menu key of the keyboard while the "SET TIME" display is selected leads to a sub menu display as follows:

1>SYNC XXX

XXX is UTC or GPS

When this display is shown pressing the "1" key of the keyboard causes "SYNC" to toggle between UTC and GPS.

3.3.3.3 3> SET POSITION (ENTER POSITION SELECTED)

Pressing the "3" keyboard switch selects "3>SET POSITION" which allows the user to enter an accurate position comprised of latitude and longitude in degrees, and minutes to the nearest thousandth of a minute, the Hemisphere (North, South, East, or West) and the altitude in meters referred to WGS-84. This causes the display to change to that shown on the following page:

ENTER LATITUDE: XX XX:XXX

Using the numeric keys of the keyboard enter the latitude in degrees and minutes to the thousandth of a minute and the display will change to that shown below:

ENTER 1 = NORTH, 2 = SOUTH

Using the numeric keys of the keyboard enter either a "1" for the Northern Hemisphere, or a "2" for the Southern Hemisphere and the display will change to that shown below:

ENTER LONGITUDE: XXX.XX.XXX

Using the numeric keys of the keyboard, enter the longitude in degrees and minutes to the thousandth of a minute, and the display will change to that shown below:

ENTER 1 = EAST, 2 = WEST

Using the numeric keys of the keyboard enter either a "1" for the Eastern Hemisphere or a "2" for the Western Hemisphere and the display will change to that shown below:

ENTER ALTITUDE: XXXX METERS

Using the numeric keys of the keyboard, enter a four digit WGS-84 altitude in meters and the display will change to that shown below:

ENTER 1 = POS, 2 = NEG

Using the numeric keys of the keyboard, enter either a "1" for a positive altitude, or a "2" for a negative altitude, for above or below the GPS Reference Sphere (WGS-84).

Note: If a mistake has been made while entering this data, press the MENU keyboard switch to exit, then return to this selection and reenter the data.

3.3.3.4 4> SIGNAL LEVEL (SIGNAL LEVEL SELECTION)

To request the signal strength of the satellites currently being "tracked" by the receiver, press the "4" keyboard switch. The information may take up to ten seconds to be displayed. Each satellite number and its corresponding signal strength will be displayed.

Pressing the MENU key of the keyboard will return the display to the "MAIN MENU SCREEN."

3.3.3.5 5> OFFSET (LOCAL TIME OFFSET SELECTION)

Choice "5>" is the local time offset. This allows the user to input a desired time offset (in ½ hour increments) whereas the LCD, Optional LED display, and/or time output would be offset from the selected UTC or GPS time by the number of hours input. All offset entries are positive (0.00 to 23.5) and are calculated as west of the Greenwich Meridian.

The current offset will be displayed. Pressing the "5" keyboard switch will allow entry of the new offset.

Example:

California is eight hours later than GMT. The local time offset entry would be 08.0.

Japan is nine hours earlier than GMT. The local time offset entry would be 15.0.

The calculation for negative local time offsets (for example, nine hours earlier) is as follows:

(Offset) +24 = entry
(-9) +24 = 15

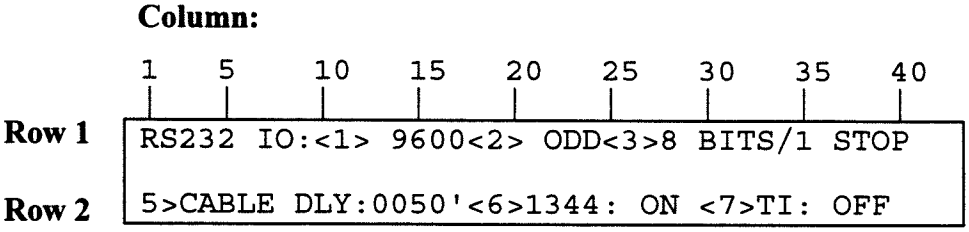
3.3.3.6 6> SET DAC

Choice "6>" allows the user to enter a DAC (Digital to Analog Converter) value from 00000 to 65535. This value is a digital representation of the analog voltage (0 to +5 volts) that is used to control the internal oscillator. This feature is especially useful when attempting to null the oscillator (see Chapter Five).

When keyboard switch 6 is pressed, it allows the user to enter a five digit DAC value, the midrange being 32767.

3.3.4 FOURTH MENU SCREEN – RS232 I/O CONFIGURATION

Subsequent pushing of the MENU keyboard switch will display the Fourth Menu Screen which is shown below and contains the following choices:



This screen allows front panel keyboard selection of the RS-232 I/O parameters and the antenna cable delay.

Use the "1" keyboard switch to select the BAUD RATE. Keep pressing the "1" keyboard switch until the desired baud rate appears. The choices are as follows:

50, 300, 600, 1200, 2400, 4800, 9600, 19200

Use the "2" keyboard switch to select the PARITY. Keep pressing the "2" keyboard switch until the desired parity appears. The choices are as follows:

NONE, ODD, and EVEN

Use the "3" keyboard switch to select the desired number of data bits (word length). Keep pressing the "3" keyboard switch to cycle through the choices which are 7 DATA BITS, and 1 STOP BIT, or 8 DATA BITS and 1 STOP BIT.

The antenna cable length can be entered by pressing the "5" keyboard switch and entering four digits in feet which corresponds to the length of the antenna cable. This will make the 1pps output on time by compensating for the propagation delay of the cable.

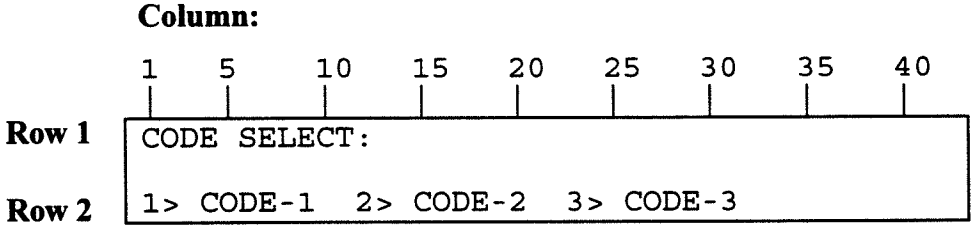
The "6" keyboard switch allows the user to generate either a modified IRIG B per IEEE Std. 1344 (ON) or the standard IRIG B (OFF) with zeros in the control function area. It is an alternate action switch. For the format of IEEE Std. 1344, see Chapter One.

The "7" keyboard switch allows the user to enable or disable time interval measurement, and to select the rising or falling edge of the input pulse as the start (trigger) of this measurement. Sequentially pushing the switch produces the following:

Off
On 1 (selecting the rising edge as the on-time point)
Off
On 0 (selecting the falling edge as the on-time point)

3.3.5 FIFTH MENU SCREEN – MULTIPLE TIME CODE OUTPUTS

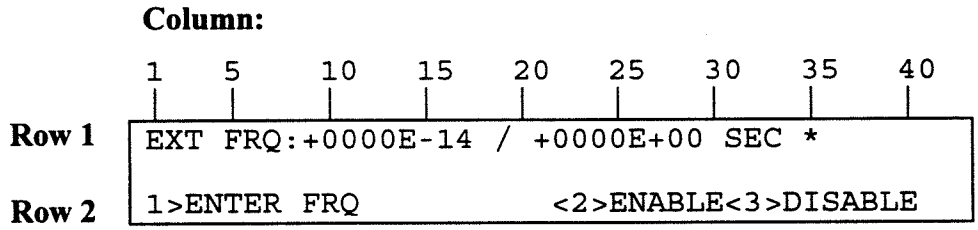
If the keyboard switch is pushed again, the LCD will display the Fifth Menu Screen which is shown on below. Although this screen is displayed, it is only applicable if the TC&FG is configured and furnished with the Multiple Time Code Outputs option, GPS Opt 01 (Assembly 55116).



If this option is provided, its Option Description will be located in the Option Envelope on the inside cover of this manual.

3.3.6 SIXTH MENU SCREEN – EXTERNAL FREQUENCY MEASUREMENT

Subsequent pushing of the MENU keyboard switch will display the Sixth Menu Screen which is shown below and contains the following choices:



3.3.6.1 OPERATION

This feature provides the capability of using the GPS TC/FG to measure the stability/drift of an external signal.

Note: Because J10 is a multipurpose input connector, when the External Frequency measurement option is enabled, the Single Event Log and the 1PPS Input option (Time Interval Measurement) are disabled.

The GPS TC/FG must be actively tracking at least one satellite, and the oscillator should be stabilized/locked (i.e., the front panel TRACKING and LOCKED LEDS should be illuminated).

The external frequency measurement can be set-up/configured from either the front panel keyboard and LCD display or remotely via the RS-232 I/O port.

Pushing keyboard switch "1" followed by a number (00000001 to 10000000) will input the frequency that the user is going to measure.

Pushing keyboard switch "2" will ENABLE the external frequency measurement option. Pushing keyboard switch three will disable it.

Once the correct input frequency has been entered and the option turned on (enabled) if the unit is not locked, "NOTLK" will appear in place of the asterisk (*). If the external frequency measurement option is enabled and the unit is tracking a satellite, an asterisk will appear. If the option is disabled, nothing will appear in this area.

If the unit is locked, the measurement count (once per second) will start to increment. The number is auto scaled, so it will count from 0000E+00 to 9999E+00. The next count will go to 0100+02, etc.

The actual external frequency measurement number itself is also auto scaled. It will display measurements in parts to E-09, E-12, or E-14. If the input offset/measurement is greater than $1x10^{-5}$ or if the input signal contains noise, "TOO HIGH" will be displayed.

The frequency input is divided down to 1pps. It is important to enter the correct frequency number or it will cause a large error in the final result.

3.3.7 SEVENTH MENU SCREEN – SINGLE EVENT LOG

Subsequent pushing of the MENU keyboard switch will display the Seventh Menu Screen which is shown below and contains these choices:

Column:

	1 5 10 15 20 25 30 35 40
Row 1	EVENT LOG<1>STOP<2>CLR<3>EDGE000<4>START
Row 2	S00 E000 ? <5>← <6>→

The event log can also be programmed, read, and/or cleared, using the front panel keyboard.

Pushing keyboard switch "1" stops the event log.

Pushing keyboard switch "2" clears the event log.

Pushing keyboard switch "3" selects which edge of the event input pulse to trigger on. (0 = falling edge, 1 = rising edge). The first digit is for Channel Three and the second digit is for Channel Two (neither of which are active in this option). The third digit is for Channel One. Keep pushing keyboard switch "3" until the correct number (either one or zero) appears in the third digit. The one or zero appearing in the first and second digits is ignored in this option, therefore the contents of these digits will not be important to the unit.

Pushing keyboard switch "4" starts the events log.

Pushing keyboard switch "5" will send you to the previous event.

Pushing keyboard switch "6" will send you to the next event.

The second line of the LCD displays the status, event number, and the time of the event.

EXAMPLE

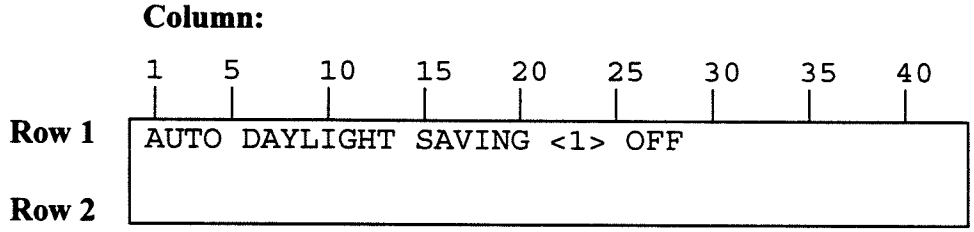
Note: The number enclosed in the arrows indicates the keyboard number.
(<1> = keyboard switch number one.)

EVENT LOG<1>STOP<2>CLR<3>EDGE100<4>START
S00*E010 1 165,21:16:04,3267548<5> <6>

100 =	Rising edge on channel three, falling edge on channels two and one.
S00 =	Event status NORMAL
* =	Event Log ENABLED. A blank means the event log has been DISABLED.
E010 =	Event Number Ten
1 =	Channel Number One
165 =	Day-of-Year
21 =	Hours
16 =	Minutes
04 =	Seconds
3267548 =	Subseconds (tenths of seconds through hundredths-of-nanoseconds).

3.3.8 EIGHTH MENU SCREEN – AUTO DAYLIGHT SAVINGS

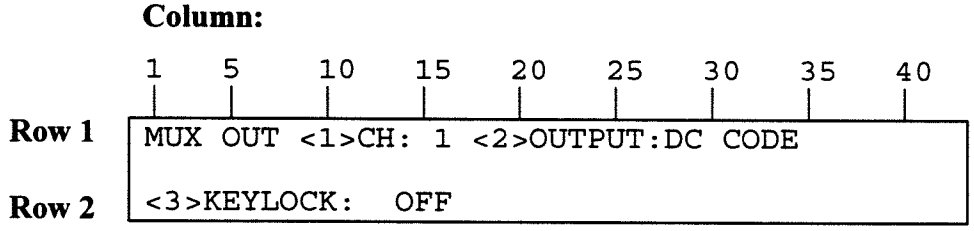
Subsequent pushing of the MENU keyboard switch will display the Eighth Menu Screen which is shown below and contains this choice:



Pushing the "1" keyboard switch will alternately enable or disable the Auto Daylight Savings Time feature. It can also be programmed to automatically turn on/off for up to ten years using the RS-232 I/O port. Refer to Chapter Four of this manual.

3.3.9 NINTH MENU SCREEN – MUX OUTPUT

Subsequent pushing of the MENU keyboard switch will display the Ninth Menu Screen which is shown below and contains these choices:



The rear panel BNC connectors (J4 through J9) can be configured to output various timing signals using the internal jumper pins and the front panel keyboard.

If the MUX input to any output buffer is jumper selected, one of sixteen inputs to that multiplexer can be selected via the front panel keyboard.

This menu screen allows selection of the outputs on the rear panel BNC connectors J4 through J9.

Pushing the "1" front panel keyboard switch cycles through the output channels (1-4).

Channel One controls MUX outputs on J4 and J9.

Channel Two controls MUX outputs on J5 and J8.

Channel Three controls MUX outputs on J6.

Channel Four controls MUX outputs on J7.

Pushing the "2" front panel keyboard switch cycles through the outputs available for the respective channel selected.

The choices are as follows (see the paragraph entitled "Optional Pulse Rate Outputs" in Chapter One):

10MHz	100Hz	LOCKED**
5MHz	10Hz	+5 VOLTS
1MHz	1Hz	1pps
100KHz	.1Hz	DC CODE
10KHz	1PPM	
1KHz	TRACKING*	

* Tracking output is a TTL low when not tracking and a TTL high when tracking.
** Locked output is a TTL low when not locked and a TTL high when locked.

Note: The MUX outputs can also be read and selected via the RS-232 I/O port. See paragraphs titled "Request MUX Output" and "Set MUX Output" in Chapter Four of this User's Guide.

The standard configuration is as follows:

J4 - TRACKING (TTL)
J5 - LOCKED (TTL)
J6 - 1PPS
J7 - 10MHz SINE WAVE
J8 - IRIG B (AC)
J9 - IRIG B (DC)
J10 - 1PPS INPUT (Time Interval Measurement)

Configuration other than the above standard will be found in the Option Description envelope attached to the inside rear cover of this User's Guide.

The internal pins are shown in Figure 2-3 in Chapter Two.

Jumpers J14 and J24 are associated with BNC J4. Jumpers J15 and J25 are associated with BNC J5, etc. The basic circuitry is explained in the following example:

- Jumpering J24 pins 1 and 2 connects the output of a buffer to J4.

- J14 selects the input to that buffer. J14 pins 2, 4, 6, and 8 are connected in common to the buffer input.

- J14 pins 1, 3, 5, and 7 select various inputs to that buffer as shown in Figure 2-3 in Chapter Two.

- The MUX input (jumpering pins J14 1 and 2) selects a 16:1 software controlled multiplexer, the output of which is selectable using the front panel keyboard switches (or via the RS-232 I/O).

- The output buffer can also be used to provide a relay closure on J4. The relay closure will either be an open or closure to ground. To enable this configuration, jumper J24 pins 1 and 3, and J24 pins 2 and 4.

- BNC's J6 and J7 don't have the optional relay configuration.

If the MUX input to any output buffer is jumper selected, one of the sixteen inputs to that multiplexer can be selected by the front panel keyboard.

Pushing the "3" front panel keyboard allows the user to enable or disable operation of the front panel keyboard. The default condition for Keyboard Lock is OFF. This means that the keyboard functions normally. If the user wishes to activate Keyboard Lock, push the "3" keyboard switch.

When Keyboard Lock is ON, only the MENU key will function. Nothing can be entered or changed from the front panel. If the user wishes to turn OFF Keyboard Lock, cycle through the various menus until the Ninth Menu appears. Push the "3" keyboard switch and XXXX will appear on the screen. Enter 9975 and Keyboard Lock will turn to OFF.

3.3.10 TENTH MENU SCREEN – PRINTER PORT CONFIGURATION

Subsequent pushing of the MENU keyboard switch will display the Ninth Menu Screen, which is shown below and contains these choices:

Column:

```
          1    5    10   15   20   25   30   35   40
          |    |    |    |    |    |    |    |    |
Row 1     PRINTER :<1> 9600<2>NONE<3>8BIT<4>1 STP
Row 2               <5> STANDARD MODE
```

This screen allows front panel keyboard selection of the Printer Output port parameters.

Use the "1" keyboard switch to select the BAUD RATE. Keep pressing the "1" keyboard switch until the desired baud rate appears. The choices are as follows:

50, 300, 600, 1200, 2400, 4800, 9600, 19200

Use the "2" keyboard switch to select the PARITY. Keep pressing the "2" keyboard switch until the desired parity appears. The choices are as follows:

NONE, ODD, and EVEN

Use the "3" keyboard switch to select the desired number of data bits (word length). The choices are 7 or 8 data bits.
Use keyboard switch "4" to select the number of stop bits (1 or 2).

Use keyboard switch "5" to select the printer output format, either "Standard" or "One Second Burst".

Standard RS232 Printer Output

This printer port provides the ability to output time, mode, status, frequency, position, and other optional data to an RS-232 compatible serial printer or terminal.

For the J11 connector pin assignments, refer to Chapter One.

The following are examples of output data:

94 027.17:04:38 M0 S00 E00 25 00 00 00 -0019-E12 33 48.8270N 117 53.3864W +0028 T1 705337.5

94 027.17:04:43 M0 S00 E00 25 00 00 00 -0019-E12 33 48.8270N 117 53.3864W +0028 T1 705337.5

94 027.17:04:48 M0 S00 E00 25 00 00 00 -0019-E12 33 48.8270N 117 53.3864W +0028 T1 705337.5

94 = year
027.17:04:38 = time (days, hours, minutes, seconds)
M0 - mode (start-up mode)
* S00 = status code (doing GPS corrections)
* E00 = error code (system check OK)
25 00 00 00 = tracking satellite vehicle 25
-0019E-12- frequency offset measured in parts to 10^{-12}
33 48.8270N = latitude 33 degrees 48.8270 minutes, north
117 53.3864W - longitude 117 degrees 53.3864 minutes, west
+0028 = altitude in meters
T1 705337.5 = time interval in microseconds

* For a listing of status codes and error codes, see the 9390-6000 ExacTime GPS Time and Frequency Generator User's Guide.

External frequency measurement or another option can be substituted for time interval if available and previously enabled.

One Second Burst (RS232 ASCII Time Burst Mode Output)

This interface is configured as Data Terminal Equipment (DTE), synchronous 1PPS "Burst" mode, using 9600 Baud. No control/handshake lines are utilized. The time word output is shown below in Table 1. Each byte consists of one start bit, eight data bits, one parity bit (odd) and one stop bit. However, this configuration can be changed using the front panel keyboard switches or remotely using the RS-232 I/O.

The data transmission is serial asynchronous by character, and the ASCII character code is used. The time information is interpreted as being UTC time.

(SOH) DDD:HH:MM:SSQ (CR) (LF)

See Table 1 for the definition of each field contained in this time information string.

Table 1
Protocol 1
Time Information

Field	Definition
(SOH)	Start of Header (ASCII control character).
DDD	Day of Year.
HH	Hours (24-hour clock).
MM	Minutes.
SS	Seconds.
Q	Quality indicator (see description below).
(CR)	Carriage Return (ASCII control character).
(LF)	Line Feed (ASCII control character).

The on-time point is at the beginning of the Carriage Return character.

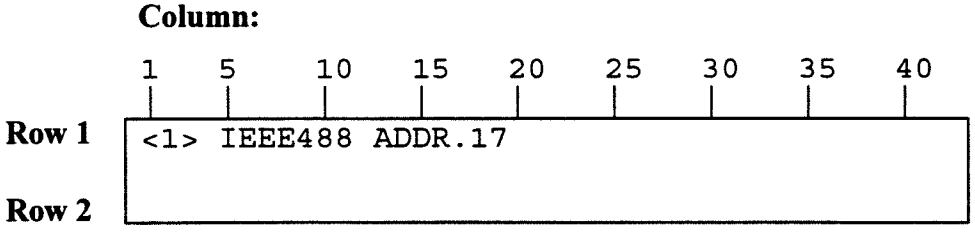
Quality Indicator:

This indicator is an estimation of the accuracy of the unit's 1PPS compared to the GPS system 1PPS.

ASCII Character	HEX Equivalent	Definition
(space)	20	< 1 microsecond
.	2E	< 10 microseconds
*	2A	< 100 microseconds
#	23	< 1 millisecond
?	3F	> 1 millisecond (unknown)

3.3.11 ELEVENTH MENU SCREEN – IEEE-488 I/O INTERFACE

If the keyboard switch is pushed again, the LCD will display the Eleventh Menu Screen, which is shown below. Although this screen is displayed, it is only applicable if the TC&FG is configured and furnished with the IEEE-488 I/O Interface option, GPS Opt 14 (Assembly 55115).



If this option is provided, its Option Description will be located in the Option Envelope on the inside cover of this manual.

3.4 CONFIGURATION OF REAR PANEL BNC CONNECTORS J4-J9

The rear panel BNC connectors (J4 through J9) can be configured to output various timing signals using the internal jumper pins and the front panel keyboard.

Per Figure 2-3 in Chapter Two, the following table details the various outputs available at J4:

JUMPER BLOCK J24	JUMPER BLOCK J14	OUTPUT AT J4
pins 1 and 2 shorted	pins 1 and 2 shorted	1 of 16 selectable Channel 1 Mux outputs
pins 1 and 2 shorted	pins 3 and 4 shorted	IRIG B AC code out
pins 1 and 2 shorted	pins 5 and 6 shorted	10MHz sine wave output
pins 1 and 2 shorted	pins 7 and 8 shorted	Tracking TTL output
pins 1 and 3 shorted	pins 2 and 4 shorted	Tracking (relay closure to ground)

Per Figure 2-3 in Chapter Two, the following table details the various outputs available at J5:

JUMPER BLOCK J25	JUMPER BLOCK J15	OUTPUT AT J5
pins 1 and 2 shorted	pins 1 and 2 shorted	1 of 16 selectable Channel 2 Mux outputs
pins 1 and 2 shorted	pins 3 and 4 shorted	IRIG B AC code out
pins 1 and 2 shorted	pins 5 and 6 shorted	10MHz sine wave output
pins 1 and 2 shorted	pins 7 and 8 shorted	Locked TTL output
pins 1 and 3 shorted	pins 2 and 4 shorted	Locked (relay closure to ground)

Per Figure 2-3 in Chapter Two, the following table details the various outputs available at J6:

JUMPER BLOCK J16	OUTPUT AT J6
pins 1 and 2 shorted	1 of 16 selectable Channel 3 Mux outputs
pins 3 and 4 shorted	IRIG B AC code out
pins 5 and 6 shorted	10MHz sine wave output
pins 7 and 8 shorted	unused

Per Figure 2-3 in Chapter Two, the following table details the various outputs available at J7:

JUMPER BLOCK J17	OUTPUT AT J7
pins 1 and 2 shorted	1 of 16 selectable Channel 4 Mux outputs
pins 3 and 4 shorted	IRIG B AC code out
pins 5 and 6 shorted	10MHz sine wave output
pins 7 and 8 shorted	unused

Per Figure 2-3 in Chapter Two, the following table details the various outputs available at J8:

JUMPER BLOCK J28	JUMPER BLOCK J18	OUTPUT AT J8
pins 1 and 2 shorted	pins 1 and 2 shorted	1 of 16 selectable Channel 2 Mux outputs
pins 1 and 2 shorted	pins 3 and 4 shorted	IRIG B AC code out
pins 1 and 2 shorted	pins 5 and 6 shorted	10MHz sine wave output
pins 1 and 2 shorted	pins 7 and 8 shorted	unused
pins 3 and 4 shorted	N/A	Event 3 input

Per Figure 2-3 in Chapter Two, the following table details the various outputs available at J9:

JUMPER BLOCK J29	JUMPER BLOCK J19	OUTPUT AT J9
pins 1 and 2 shorted	pins 1 and 2 shorted	1 of 16 selectable Channel 1 Mux outputs
pins 1 and 2 shorted	pins 3 and 4 shorted	IRIG B AC code out
pins 1 and 2 shorted	pins 5 and 6 shorted	10MHz sine wave output
pins 1 and 2 shorted	pins 7 and 8 shorted	unused
pins 3 and 4 shorted	N/A	Event 2 input

CHAPTER FOUR
I/O PORT DATA INPUT/OUTPUT

4.0 INTRODUCTION

The GPS timing unit has been equipped with an RS-232 interface using a nine pin connector designated as RS-232 I/O J12. It can be used to communicate to and from the GPS ExacTime unit. All communication is in the ASCII format. The standard character protocol is one start bit, eight data bits, an odd parity bit, and one stop bit. However, the baud rate, number of data bits, parity, and number of stop bits are selectable using the front panel keyboard switches. See Chapter Three, "Additional Menu Screens."

The interface cable pin assignments and designations are shown in Chapter Two.

All communication to the GPS ExacTime Unit consists of two or three categories of characters. The first category is a single character, which is always an ASCII $ (Hex 24). This is the attention/log-on character. The second category is an ID ASCII character, which is a command to the GPS ExacTime Unit. The third category (which may or may not be applicable) is a series of ASCII data bits to input data into the GPS ExacTime Unit. Leading zeros must be used where necessary. For example, if the number is fifty-two, and if the data to be entered is a four digit number, then it must be entered as 0052.

Note: If a mistake is made while inputting new characters (prior to the last character), issuing the "$" character, this will cause a reset, and the new (correct) characters can be input.

When entering data via the RS-232 I/O port, if there is a pause longer than three seconds between input values, communication with the GPS timing unit will terminate.

Table 4-1 shows the command options available. The ASCII character is shown following its HEX equivalent. Following the table, each command is described with the necessary steps for execution.

Table 4-1 is located on the following page.

Table 4-1
RS-232 ASCII I/O Command Table

ASCII ID Character	HEX Character	Description
`	60	Datum firmware version.
c	63	UTC sync.
d	64	GPS sync.
e	65	Print frequency offset.
f	66	Print time, status, error code, and SV number.
=	3D	Print year (4 digits), time, status, error code and SV number.
i	69	Print position.
j	6A	Clear event data.
k	6B	Print event data.
l	6C	Enable event log.
m	6D	Disable event log.
r	72	Select mode.
s	73	Enable time interval.
t	74	Disable time interval.
u	75	Request time interval.
x	78	Request mask values.
y	79	Enter mask values.
z	7A	Enable discipline.
{	7B	Disable discipline.
}	7D	Enter position.
~	7E	Enter DAC value.
DEL	7F	Request DAC value.
P	50	*Select output code.
Q	51	Enter number of position averages.
|	7C	Enter local time offset.
S	53	Select satellite vehicle number (for single satellite mode).
T	54	Enter cable delay.
U	55	Request cable delay.
V	56	Enter PDOP limit.
W	57	Re-synchronize minor time.
X	58	Select default values.
Y	59	External Frequency Measurement – Select Input Frequency
Z	5A	External Frequency Measurement – Enable/Disable
[	5B	External Frequency Measurement – Request Data
]	5D	Request satellite signal strength.
^	5E	Request unit operating parameters.

The remainder of Table 4-1 is continued on the following page.

Table 4-1
RS-232 ASCII I/O Command Table, Continued...

ASCII ID Character	HEX Character	Description
A	41	*Request external 60 Hz measurement data.
B	42	*Set-up external 60 Hz measurement.
C	43	*Enter IEEE-488 address.
H	48	Printer – Set-Up Configuration
I	49	Printer – Request Configuration
>	3E	Printer Port Mode Selection
g	67	Printer – Select Output Rate
h	68	Printer – Request Output Rate
n	6E	Printer – Enable/Disable & Data Select
JR	4A, 52	Request MUX output.
JS	4A, 53	Set MUX output.
K	4B	Set Major Time.
<	3C	Set Year.
O	4F	Automatic Daylight Savings Time
@	40	Request Unit Serial Number

* = Optional. Refer to the Option Description in the envelope attached to the cover of this manual.

4.1 DATUM FIRMWARE VERSION

This command outputs the Datum firmware version installed in the unit.

- The user inputs $`(HEX 24/HEX 60).
- The unit will respond with eight characters followed by CR/LF.

4.2 UTC SYNC

This command will synchronize the unit to the Universal Time Coordinated time standard.

- The user inputs $c (HEX 24/HEX 63).
- The unit will respond with OK, followed by CR/LF.

4.3 GPS SYNC

This command will synchronize the unit to the Global Positioning System time standard.

- The user inputs $d (HEX 24/HEX 64).
- The unit will respond with OK, followed by CR/LF.

4.4 PRINT FREQUENCY OFFSET

This command will output the calculated difference between the units' local time base and the GPS system frequency.

- The user inputs $e (HEX 24/HEX 65).
- The unit will respond with a plus or minus sign, four digits, and an exponent having the weight of parts in 10^{-9} or 10^{-12}.

Example: +0579E-09

4.5 PRINT TIME, STATUS, ERROR CODE, AND SATELLITE VEHICLE NUMBERS

This command allows the user to print the year, day-of-year, hour, minute, second, millisecond, status code, error code, and the vehicle numbers of the satellites being tracked. The Status Codes are shown in Table 4-2 and the Error Codes are shown in Table 4-3.

Table 4-2
Status Codes

Characters	Definition
S00	Doing GPS Correction.
S01	GPS time not acquired.
S02	Waiting for almanac.
S03	PDOP is too high.
S08	No useable satellites.
S09	One usable satellite.
S10	Two useable satellites.
S11	Three useable satellites.
S12	Selected SV not useable.
S13	No SV scheduled.
S14	Oscillator stabilizing.
S15	Averaging position.
S16	Flywheel Mode

***Note*:** If a Status Code is produced other than those listed above, the error is undefined.

Table 4-3
Error Codes

Characters	Definition
E00	System check OK.
E01	Battery failure.
E02	Processor error.
E04	Channel One error.
E08	Channel Two error.
E16	Signal level low.
E32	Offset too high.

- If the user inputs $f (HEX 24/HEX 66).

- The unit will respond with the following:

  3 digits of day of year.
  2 digits of hour.
  2 digits of minute.
  2 digits of second.
  3 digits of milliseconds (space).
  3 character status code (space).
  3 character error code (space).
  Up to 4 satellite vehicle numbers CR/LF.

Each satellite vehicle is identified by its PRN I.D.

Example: 056.12:13:45.768 S00 E00 03 13 20 26

It is the 56th day of the year (February 25th).
The time is 12 hours, 13 minutes, 45 seconds and 768 milliseconds.
The unit is doing GPS corrections.
The system check is OK.
The unit is tracking satellites 3, 13, 20, and 26.

- If the user inputs $ = (HEX 24/HEX 3D).

- The unit will respond with the following:

  4 digits of year.
  3 digits of day of year.
  2 digits of hour.
  2 digits of minute.
  2 digits of second.
  3 digits of milliseconds (space).
  3 character status code (space).
  3 character error code (space).
  Up to 4 satellite vehicle numbers CR/LF.

Each satellite vehicle is identified by its PRN I.D.

Example: 1999 056.12:13:45.768 S00 E00 03 13 20 26

Year = 1999
It is the 56th day of the year (February 25th).
The time is 12 hours, 13 minutes, 45 seconds and 768 milliseconds.
The unit is doing GPS corrections.
The system check is OK.
The unit is tracking satellites 3, 13, 20, and 26.

4.6 PRINT POSITION

This command allows the user to read the accurate position known to the GPS ExacTime unit. The latitude will be expressed in units of degrees and minutes labeled North or South, relative to the equatorial plane which is defined as zero latitude. The longitude will be expressed in units of degrees and minutes labeled East or West relative to the Greenwich Meridian. The altitude will be expressed in meters either above (+) or below (-) the GPS Reference Sphere (WGS-84). Altitude can be negative, and a sea level altitude may be above or below the GPS Reference Sphere.

- The user inputs $i (HEX 24/HEX 69).

- The unit will respond with the following:

  2 digits of degrees latitude (space).
  2 digits of minutes latitude.
  4 digits of ten thousandths of minutes latitude.
  N or S (space).
  3 digits of degrees longitude (space).
  2 digits of minutes longitude.
  4 digits of ten thousandths of minutes longitude.
  E or W (space).
  + or -.
  4 digits of altitude in meters CR/LF.

Example: (Datum's position.)
33 48.8241N 117 53.3970W +0026

4.7 CLEAR EVENT DATA

This command clears any previously stored events from memory, if the event option has been installed in the unit.

- The user inputs $j (HEX 24/HEX 6A).

- The unit will respond with OK, followed by CR/LF.

4.8 PRINT EVENT DATA

The GPS Timing Unit has the optional capability of storing up to 256 events from up to three inputs (channels). When the command is sent to print the event data, the first response is three characters representing event status. The user responds with a % character. This is followed by the unit outputting the event number, the channel number, and the time the event occurred. When this first event has been output, the user must respond with a % character signifying the event information has been taken. The unit will then output the second event.

This process of outputting the data followed by the user's response (%) continues until all events have been output. If the user does not take the data and respond with a % within three seconds, communication with the GPS timing unit will terminate. If no data is available, the unit will respond with a question mark. If more than 256 events occur, subsequent events will be lost or overwritten. If two events occur very close together, it is possible that one of the events could be missed. If that happens, the fact that an event has been missed will be reported in the event status. Table 4-4 shows the possible event status codes.

Table 4-4
Event Status Codes

Code	Definition
S00	Normal.
S02	Missed event Channel One.

In the following example are the steps for printing (outputting) the single event log:

- The user inputs $k (HEX 24/HEX 6B).
- The unit responds with S00 CR/LF.
- The user responds with %.
- The unit will then output the first event. E000 1 056.12:13:45.1437952 CR/LF.
- When this data has been taken, the user responds with %.

- The unit will output the second event. E001 1 056.12:13:46.5327642 CR/LF.
- When this data has been taken, the user responds with %.
- The unit will then output E002 ? CR/LF.

The question mark signifies that there is no data available. Event E001 was the last event.

In the above example, S00 indicates no missing events. The first event (E000) occurred on Channel One at the specified time. The second event (E001) occurred on Channel One at the specified time.

4.9 ENABLE SINGLE EVENT LOG

This command enables the event log option. It consists of the log-on command followed by three digits. Entering "111" signifies that the positive/rising edge of the input pulse is the on-time edge of the event. Entering "000" signifies that the negative/falling edge of the input pulse is the on-time edge of the event.

When sent, this command automatically disables the 1pps time interval function.

- The user inputs $1 (HEX 24/HEX 6C) and 3 digits.
- The unit will respond with OK, followed by CR/LF.

Example: 000

The above example will enable the single event log. The on-time edge of the input pulses will be the negative/falling edge.

4.10 DISABLE EVENT LOG

This command disables the event data log.

- User inputs $m (HEX 24/HEX 6D).
- The unit responds with OK CR/LF.

4.11 SELECT MODE

This command allows the user to select the mode of operation. This one digit command indicates the following modes:

0 = AUTO Mode.
1 = Single Satellite Mode (Highest Available Satellite).
3 = Three Satellite Mode.
4 = Four Satellite Mode.
5 = Flywheel Mode (Optional).

Note: If the single satellite mode is selected, it can be accompanied by the "Select Satellite Vehicle Number" command (see Chapter Four). This will dictate which satellite the unit will track.

- The user inputs $r (HEX 24/HEX 72).
- The unit responds with OK CR/LF.

The example above selects the three satellite mode of operation.

4.12 ENABLE TIME INTERVAL

This command enables the time interval measurement using the external 1pps input. The command must also indicate which edge of the 1pps input is going to be used.

0 = Negative/falling edge.
1 = Positive/rising edge.

This command automatically disables the event log feature.

- The user inputs $s (HEX 24/HEX 73) 1.
- The unit responds with OK CR/LF.

The example above enables the time interval measurement feature and selects the positive edge of the 1pps input as the on-time edge.

4.13 DISABLE TIME INTERVAL

This command disables the time interval measurement.

- The user inputs $t (HEX 24/HEX 74).
- The unit responds with OK CR/LF.

4.14 REQUEST TIME INTERVAL

This command allows the user to request the time interval measurement between the internal GPS corrected 1pps pulse and an external 1pps input pulse. The response consists of three digits of milliseconds, three digits of microseconds, and a decimal point followed by one digit of hundreds of nanoseconds.

- The user inputs $u (HEX 24/HEX 75).
- The unit responds with 134276.512 CR/LF.

The example above indicates that the difference between the internal GPS corrected 1pps pulse and the external 1pps pulse is 134276.512 microseconds.

Every time a measurement needs to be taken, a request has to be issued.

4.15 REQUEST MASK VALUES

This command allows the user to view the currently selected mask values. They consist of one digit of dynamics code, two digits of elevation angle, two digits of signal level, and two digits of PDOP. See Table 4-5 below for dynamic code values.

Table 4-5
Dynamic Code Values

Value	Meaning	Assumed Velocity
0	Current value is left unchanged.	
1	Land.	< 120 knots.
2	Sea.	< 50 knots.
3	Air.	< 800 knots.
4 (Default)	Static.	Stationary.

Note: Unless changed, four (static) is the default/normal mode. The user won't receive the zero value when requesting the Dynamics Code value. It is useful only when entering the mask values and the user doesn't want to change the current Dynamics Code value.

The elevation mask is the minimum angle (in degrees) for tracking satellites. The signal level mask defines the minimum signal strength of a satellite to be used in a solution. The PDOP mask is the maximum PDOP that will be used by the RPU for satellite tracking in any two or three dimensional solution (when tracking three of four satellites).

- The user inputs $x (HEX24/HEX78).
- The unit responds with 4 05 06 10 CR/LF.

The example above indicates a dynamics code of four (static/stationary), and elevation angle mask of five degrees, a signal level mask of six, and a PDOP mask of ten.

4.16 ENTER MASK VALUES

This command allows the user to input/change the mask values. The first digit (after the log-on I.D. characters) is the dynamics code. This is followed by two digits of elevation angle mask, two digits of signal level mask, and two digits of PDOP mask. When doing position averaging, the PDOP mask must be ≥PDOP Limit.

- The user inputs $y (HEX 24/HEX 79) 4050610.
- The unit responds with OK CR/LF.

The above example indicates that the user inputs a dynamics code of four (static/stationary), an elevation angle mask of five degrees, a signal level mask of six, and a PDOP mask of ten.

4.17 ENABLE DISCIPLINING

This command allows the user to enable the discipline feature. The internal time base is periodically disciplined/corrected to the GPS time base.

- The user inputs $z (HEX 24/HEX 7A).
- The unit responds with OK CR/LF.

4.18 DISABLE DISCIPLINING

This command allows the user to disable the discipline feature.

- The user inputs $ { (HEX 24/HEX 7B).
- The unit responds with OK CR/LF.

4.19 ENTER POSITION

This command allows the user to manually enter the position of the antenna/preamp.

The command consists of :

Two digits of degrees latitude.
Two digits of minutes latitude.
Three digits of sub-minutes latitude.
N (North) or S (South).
Three digits of degrees longitude.
Two digits of minutes longitude.
Three digits of sub-minutes longitude.
E (East) or W (West).
+ (plus) or - (minus).
Four digits of altitude in meters.

- The user inputs $ } (HEX 24/HEX 7D) 3348824N11753397W+0026
- The unit responds with OK CR/LF.

The above example is entering Datum's position of:

Latitude 33° 48.824 N.
Longitude 117° 53.397 W.
Altitude + 0026 meters.

4.20 ENTER DAC VALUE

This command allows the user to manually enter a DAC (Digital to Analog Converter) value that is used to adjust the internal time base. This would typically be done prior to the front panel LOCKED LED turning on, if disciplining was turned off, or to null/calibrate the internal oscillator.

The DAC value consists of five digits from 00000 to 65535. If a number is entered that is greater than 65535, it will automatically be converted to 65535.

- The user inputs $ ~ (HEX 24/HEX 7E) 32767.
- The unit responds with OK CR/LF.

The above example sets the DAC value at approximately the middle of its range.

4.21 REQUEST DAC VALUE

This command allows the user to request the current DAC value.

- The user inputs $ (del) (HEX 24/HEX 7F).
- The unit responds with a five digit value followed by CR/LF.

Note: (del) is the delete key.

4.22 SELECT CODE OUTPUT (OPTIONAL)

This command allows the user to select which code is output if the code output option is installed in the unit. When entering this command, the time interval and/or event log functions will be momentarily interrupted. It consists of two digits. IRIG B122 is the default. The optional output codes are defined as follows:

Number	Code Output
00	IRIG B
01	IRIG A
02	IRIG G

- The user inputs $P (HEX 24/HEX 50) followed by two digits (see above table).
- The unit responds with OK CR/LF.

4.23 NUMBER OF POSITION AVERAGES

This command allows the user to select the number of position averages that will be used to calculate position in the start-up mode of operation. The command is comprised of four digits representing a number from 0010 to 9999. Ten (0010) is the smallest number of position averages that can be entered. The default is 200.

- The user inputs $Q (HEX 24/HEX 51) followed by four digits.
- The unit responds with OK CR/LF.

Note: The timing accuracy of this unit is directly related to the position accuracy. The more accurate the position, the more accurate the time. It is recommended that for timing accuracy of ≤ 300 nanoseconds, 2,000 to 5,000 position averages be performed to insure an accurate position or input an accurate, surveyed position into the unit.

4.24 ENTER LOCAL OFFSET

This command allows the user to input a desired time offset (in ½ hour increments) whereas the LCD or optional LED display and/or time outputs would be offset from the selected UTC or GPS time by the number of hours input. All offsets entered (00.0 to 23.5) are positive and calculated as west of the Greenwich Meridian (or input an accurate, surveyed position into the unit).

- The user inputs $| (HEX 24/HEX 7C) 07.0.
- The unit responds with OK CR/LF.

The above example (07.0) inputs a local time offset to correspond to daylight savings time in the Pacific Time Zone.

4.25 SELECT SATELLITE VEHICLE NUMBER

This command allows the user to select which satellite the GPS ExacTime Unit will track. Prior to using this command, the unit must be put into the single satellite mode.

- The user inputs $S (HEX 24/HEX 53) followed by the two digit satellite PRN identification. (Leading zero is required.)
- The unit responds with OK CR/LF.

4.26 ENTER CABLE DELAY

This command allows the user to enter a cable delay that compensates for the propagation delay between the antenna/preamp and the RPU caused by the cable. The delay is approximately 1.5 nanoseconds per foot of antenna cable. The user simply enters the total length of antenna cable as a four digit number expressed in feet.

- The user inputs $T (HEX 24/HEX 54) 0100.
- The unit responds with OK CR/LF.

In the above example, the user has input cable delay to compensate for one-hundred feet of antenna cable.

4.27 REQUEST CABLE DELAY

This command allows the user to interrogate the GPS ExacTime unit and find out what cable delay the unit is currently using.

- The user inputs $U (HEX 24/HEX 55).
- The unit responds with a four digit number that equates to the length of antenna cable (in feet) that is stored in memory, followed by CR/LF.

Note: This command would only be applicable if the user has changed antenna cable length and is unsure what delay has been programmed into the GPS ExacTime unit.

4.28 ENTER PDOP LIMIT

This command allows the user to enter the maximum PDOP that will be used in doing position averaging. It consists of a two digit number. It must always be ≤ the PDOP mask.

- The user inputs $V (HEX 24/HEX 56) 08.
- The unit responds with OK CR/LF.

The above example illustrates entering a PDOP limit of eight.

4.29 RESYNCHRONIZE MINOR TIME

This command allows the user to manually re-synchronize the minor time (subseconds) to the GPS on-time 1pps pulse. This command must be issued if the antenna cable length is changed and subsequently a new cable delay is entered.

- The user inputs $W (HEX 24/HEX 57).
- The unit responds with OK CR/LF.

4.30 SELECT DEFAULT VALUES

This command allows the user to input/reset a series of default parameters into the GPS ExacTime Unit, which are:

Dynamics Code	4
Elevation Angle	10°
Signal Mask	3
PDOP Mask	12
PDOP Limit	12
Mode	Start-up (AUTO).
Position Average Number	200
Time Interval	Disabled, falling edge.
Event Log	Disabled, falling edge (all three events).
Exact Frequency Measurement	Disabled.
Local Offset	00.0
Cable Delay	50
Position	Trimble Navigation's
MUX Outputs	CH1 IRIG B DC CH2 10MHz CH3 1pps CH4 10HMz

- The user inputs $X (HEX 24/HEX 58).
- The unit responds with OK CR/LF.

4.31 EXTERNAL FREQUENCY MEASUREMENT – SELECT INPUT FREQUENCY

This command allows the user to specify the input frequency.

- User inputs $Y (HEX 24/HEX 59) followed by eight digits and CR/LF. The eight (8) digits correspond to the input frequency. Leading zeros are required to be entered.
- The unit responds with OK CR/LF.

Example: $Y01000000 CR/LF

The above example illustrates selecting an input frequency of 1MHz.

4.32 EXTERNAL FREQUENCY MEASUREMENT – ENABLE/DISABLE

This command allows the user to enable the external frequency measurement option.

- The user inputs $Z (HEX 24/HEX 5A) followed by a 1.
- The unit responds with OK CR/LF.

This command allows the user to disable the external frequency measurement option.

- The user inputs $Z (HEX 24/HEX 5A) followed by a 0.
- The unit responds with OK CR/LF.

4.33 EXTERNAL FREQUENCY MEASUREMENT – REQUEST DATA

This command allows the user to request the external frequency measurement data. The measurement and subsequent calculation is done at least once every five seconds and is averaged over the time period beginning when the external frequency measurement option was enabled.

- The user inputs $[(HEX 24/HEX 5B).
- The unit responds with a + or -, four digits representing the magnitude of drift/stability, E-, two digits (exponent - power of ten), space, four digits representing the time period in seconds, E+, two digits (exponent - power of ten).

4.34 REQUEST SATELLITE SIGNAL STRENGTH

This command allows the user to obtain the signal strength of each satellite in view. The larger the number, the greater the signal strength.

- The user inputs $] (HEX 24/HEX 5D).
- The unit responds with #, two digits of the satellite PRN number, + or -, and two or three digits of signal strength. This format will be printed for each satellite in view.

If the signal strength is 0.00, the satellite has not been acquired.

If the signal strength is a negative number, the satellite is not currently in lock.

The last satellite's information will be followed by CR/LF.

Example: #12+13.2 # 24 + 10.6 CR/LF

The above example illustrates the unit responding with a signal strength of +13.2 for satellite vehicle twelve and +10.6 for satellite vehicle twenty-four. The actual message will contain more satellites than this example.

4.35 REQUEST UNIT OPERATING PARAMETERS

This command allows the user to request a number of operating parameters that aren't available with other specific commands.

- The user inputs $^ (HEX 24/HEX 5E).
- The unit will respond with the following example:

U M0 D1 L00 PL12 PA0200 PR0 OS0 GPIB17 LK1

Table 4-6
Operating Parameters

U	UTC sync.
G	GPS sync.
M0	Mode 0 (start up mode).
D1	Discipline. 1 = on, 0 = off.
L00	Local time offset.
PL12	PDOP limit used for positioning averaging.
PA0200	Number of position averages.
PR0	Printer option. 0 = off, 1 = on.
OS0	External Oscillator. 0 = internal. 1 = external.
GPIB17	The address (17) of the IEEE-488 interface. This number will be meaningful only if the option is installed.
LK1	1 = Unit Locked 0 = Unit Unlocked

The last response is CR/LF.

4.36 PRINTER – SET-UP CONFIGURATION

This command allows the user to set-up the printer configuration. It is applicable to both the Standard RS232 Printer Output and the One Second Burst RS232 ASCII Time Output.

- The user enters $H (HEX 24/HEX 48) followed by abcd where:

  a = baud rate (0-7)
  - 0 = 50
  - 1 = 300
  - 2 = 600
  - 3 = 1200
  - 4 = 2400
  - 5 = 4800
  - 6 = 9600
  - 7 = 19200

  b = number of data bits
  - 0 = 7
  - 1 = 8

  c = parity
  - 0 = none
  - 1 = odd
  - 2 = even

  d = number of stop bits
  - 0 = 1
  - 1 = 2

4.37 PRINTER – REQUEST CONFIGURATION

This command allows the user to request the current printer set-up. It is applicable to both the Standard RS232 Printer Output and the One Second Burst RS232 ASCII Time Output.

- The user enters $I (HEX 24/HEX 49).

- The unit responds with: 09600 8/7 N/O/E 1/2<CR><LF>.
  (Baud Rate) (8 or 7 data bits) (none, odd, or even parity) (1 or 2 stop bits)
  (carriage return) (line feed).

4.38 PRINTER PORT MODE SELECTION

This command allows the user to specify the printer mode or output format . The selection is either "Standard" or "One Second Burst". For a detailed description of these two formats, refer to Chapter Three – Operation.

- The user inputs $> (HEX 24/HEX 3E) followed by either a 0 or a 1.

  The "0" is for the standard format.
  The "1" is for the one second burst format.

- The unit responds with OK CR/LF.

4.39 PRINTER – SELECT OUTPUT RATE

This command allows the user to specify the interval rate at which the data is output. It can be any time from three (3) seconds to 9999 seconds. (Leading zeros are required). It is applicable only to the Standard RS232 Printer Output.

- User inputs $g (HEX 24/HEX 67) followed by four (4) digits corresponding to the number of seconds.

  Example: $g0005

- The unit responds with OK CR/LF (carriage return/line feed).

  Example: $g0005

The above example illustrates selecting an output interval rate of five seconds.

4.40 PRINTER – REQUEST OUTPUT RATE

This command allows the user to determine what is the current output rate. It is applicable only to the Standard RS232 Printer Output.

- User inputs $h(HEX 24/HEX 68).

- The unit responds with four (4) digits followed by CR/LF. These four digits correspond to the output interval rate in seconds.

4.41 PRINTER – ENABLE/DISABLE & DATA SELECT

This command is applicable only to the Standard RS232 Printer Output.

- User inputs $n (HEX 24/HEX 6E) followed by three (3) digits.

- The first digit enables or disables the printer port.

  0 = printer port disabled
  1 = printer port enabled

- The second digit enables or disables position information output.

  0 = position information disabled
  1 = position information enabled

- The third digit enables or disables the output of option data (if available).

  0 = option data disabled
  1 = option data enabled (if the option itself is available and has been previously turned on)

  Example: $n101

The unit responds with OK CR/LF.

The above example illustrates the user turning on the printer port, not outputting any position information, but outputting option data (such as external frequency measurement). Refer to the following examples of output data:

94 027.17:04:38 M0 S00 E00 25 00 00 00 -0019-E12 33 48.8270N 117 53.3864W +0028 T1 705337.512

94 027.17:04:43 M0 S00 E00 25 00 00 00 -0019-E12 33 48.8270N 117 53.3864W +0028 T1 705337.512

94 027.17:04:48 M0 S00 E00 25 00 00 00 -0019-E12 33 48.8270N 117 53.3864W +0028 T1 705337.512

94 = year
027.17:04:38 = time (days, hours, minutes, seconds)
M0 - mode (start-up mode)
* S00 = status code (doing GPS corrections)
* E00 = error code (system check OK)
25 00 00 00 = tracking satellite vehicle 25
-0019E-12- frequency offset measured in parts to 10^{-12}
33 48.8270N = latitude 33 degrees 48.8270 minutes, north
117 53.3864W - longitude 117 degrees 53.3864 minutes, west
+0028 = altitude in meters
T1 705337.512 = time interval in microseconds

* For a listing of status codes and error codes, refer to Chapter Three.

External frequency measurement or another option can be substituted for time interval if available and previously enabled.

4.42 REQUEST MUX OUTPUT

This command allows the user to find out which output is selected on the four multiplexed channels. The command consists of the log-in character ($-HEX 24), the primary character (J-HEX 4A), and the secondary character (R-HEX 52).

- The user inputs $JR (HEX 24/HEX 4A/HEX 52).

- The unit responds with :

    1 aa 2 aa 3 aa 4 aa CR/LF.

The digits 1-4 correspond to the MUX channels. "aa" (two digits) corresponds to Table 4-7.

Table 4-7
Request MUX Output

00	10MHz
01	5MHz
02	1MHz
03	100KHz
04	10KHz
05	1KHz
06	100Hz
07	10Hz
08	1Hz
09	.1Hz
10	1PPM
11	TRACKING
12	LOCKED
13	+5 Volts
14	1pps
15	DC Code

See Chapter One of this User's Guide for specifications.

4.43 SET MUX OUTPUT

This command allows the user to select the signal output on the four multiplexed channels. The command consists of the log-on character ($-HEX 24), the primary character (J-HEX 4A) and the secondary character (S-HEX 53).

- The user enters $JS (HEX 24/HEX 4A/HEX 53) followed by:
  aabbccdd

  Where:
  aa corresponds to 2 digits = Channel 1.
  bb corresponds to 2 digits = Channel 2.
  cc corresponds to 2 digits = Channel 3.
  dd corresponds to 2 digits = Channel 4.

Note: The digits (00-15) are the same as in Table 4-7.

4.44 SET MAJOR TIME – TOD (TIME OF DAY)

This command allows the user to input and change the TOD. This command is only useful when the unit is in the "Flywheel" mode (See Chapter Three) It consists of the attention/log-on character, the command character, and nine characters representing days (day-of-year), hours, minutes, and seconds.

- The user enter $K (HEX 24/HEX 4B) followed by:

  DDDHHMMSS

- The unit responds with OK CR/LF.

4.45 SET YEAR

This command allows the user to enter two (2) digits of year into the GPS time. It consists of the attention/log-on character, the command character, and 2 characters representing year.

- The user enters $< (HEX 24/HEX 3C) followed by two digits.

- The unit responds with OK CR/LF.

4.46 AUTOMATIC DAYLIGHT SAVINGS TIME

This feature provides the capability of offsetting the time by one hour to compensate for daylight savings time. It can be turned on and off using the front panel keyboard. It can also be programmed to automatically turn on /off for up to ten years using the RS-232 I/O port.

Primary Command
- The user inputs $O (HEX 24/HEX 4F).

Secondary Command
One of five secondary commands can be issued (in conjunction with the primary command) to perform the following functions:

Daylight Savings Disable
This command disables the daylight savings time feature.

- The user inputs D (HEX 44).

- The unit responds with OK followed by CR/LF (carriage return/line feed).

Daylight Savings Enable
This command enables the daylight savings time feature.

- The user inputs E (HEX 45).

- The unit responds with OK followed by CR/LF.

Loading the Default of 10 Intervals – See Table 4-8.
This command allows the following daylight savings time intervals to be loaded into memory.

If you want the unit to automatically increment/decrement, the following command must be proceeded by the ENABLE command.

- The user inputs F (HEX 46).

- The unit responds with OK followed by CR/LF.

Request a Daylight Savings Time Interval
This command returns a start and stop time for a specific interval.

- The user inputs R (HEX 52) followed by an interval number of 0-9 (HEX 30 - HEX 39).

- The unit responds with:
  #c Yaa Dbbb Hmm Dbbb Hmm CR/LF
  where:
  c = interval number (0-9)
  aa = year
  bbb = Julian day
  mm = hour

- The first group Dbbb Hmm indicates the start time of daylight savings.

- The second group Dbbb Hmm indicates the stop time of daylight savings.

Set a Daylight Savings Time Interval
This command allows the user to program a daylight savings time interval.

- The user inputs S (HEX 53) followed by:
  caabbbmmbbbmm
  where c, aa, bbb, and mm have the same weight/value as explained in the REQUEST command.

General Specifications

If the stop time is greater than the start time, then the interval is assumed to be in the same year. If the stop time is less than the start time, then the stop time is assumed to be in the next year.

Performing a "Cold Reset" will disable the Daylight Savings time feature and load in the ten default time intervals.

Each time interval must be at least two hours in duration.

Any changes must be made at least one hour prior to the next time interval.

The time intervals do not have to be programmed in sequence.

All set-ups are stored in battery backed RAM so they are retained if the unit is turned off and back on again.

Table 4-8
Automatic Daylight Savings Time – Default Values

	First Sunday of April			Last Sunday of October		
(Default) Interval	Year	Julian Day	Hour	Year	Julian Day	Hour
0	98	095	01	98	298	02
1	99	094	01	99	304	02
2	00	093	01	00	303	02
3	01	091	01	01	301	02
4	02	097	01	02	300	02
5	03	096	01	03	299	02
6	04	095	01	04	305	02
7	05	093	01	05	303	02
8	06	092	01	06	302	02
9	07	090	01	07	301	02

4.47 REQUEST UNIT SERIAL NUMBER

This command allows the user to request the unit's serial number (the same serial number that is on the rear panel).

- The user inputs $@ (HEX 24/HEX 40).
- The unit will respond with four characters followed by CR/LF.

CHAPTER FIVE
MAINTENANCE/TROUBLESHOOTING

5.0 MAINTENANCE

This unit utilizes solid-state components. There are no moving parts (except switches etc.) or parts with limited life.

5.1 ADJUSTMENTS

Periodically the internal time base may have to be nulled/calibrated due to aging and drift of the oscillator.

5.1.1 INTERNAL OSCILLATOR CALIBRATION

It is recommended that the oscillator be nulled when the DAC value starts to approach 5,000 or 60,000.

The GPS TC&FG will have one of three oscillators installed in it:

- A voltage controlled temperature compensated crystal oscillator located on the GPS Main Assembly 35002 in location Y2.
- A low noise oven oscillator located on the GPS Main Assembly 35002 in location Y1.
- A low profile rubidium oscillator attached to the bottom plate of the chassis assembly.

There are two methods to null/calibrate the internal oscillator. Use whichever method is suitable to your means and capabilities.

First Method
The oscillator can be nulled against a known frequency standard with an oscilloscope or other suitable means by using the following steps:

1. Turn on the unit and wait approximately one hour for the oscillator to warm up and stabilize.
2. Sync one trace of an oscilloscope on the known frequency standard. Using the other trace, monitor the 10MHz output of the unit. Remove the top cover of the unit.

3. The input of the DAC must be held static prior to the nulling oscillator. This can be accomplished one of three ways:

    - Disconnect the antenna from the rear of the unit.

    - Select the single satellite mode (1SV), and select a satellite that is not in view (or Pick SV33 which doesn't exist).

    - Disable disciplining. Refer to Chapter Four, "Disable Disciplining" in the User's Guide.

4. Set the DAC value to it's midpoint 32767. Refer to Chapter Four ,"Enter DAC Value" in the User's Guide.

The oscillator is adjusted using a plastic adjustment tool. Depending on which oscillator is installed, the adjustment screw (inside the oscillator) is in one of three locations:

- The voltage controlled temperature compensated crystal oscillator located on the GPS Main Assembly 35002 in location Y2 has its adjustment access hole on the top of the oscillator.

- The low noise oven oscillator located on the GPS Main Assembly 35002 in location Y1 has its access hole on the side of the oscillator. There is an access screw used to seal the oscillator that has to be removed first. Remember after the adjustment is complete to replace the access screw.

- The low profile rubidium oscillator attached to the bottom plate of the chassis assembly has its adjustment hole on the top of the oscillator.

5. Adjust the oscillator until the 10MHz output is stable with respect to the frequency standard.

6. Enable disciplining. Refer to Chapter Four, "Enable Disciplining" in the User's Guide. Replace the top cover.

7. After approximately one hour, check the DAC value number again. If it has changed by more than ±5000 from 32767, repeat steps two through six.

Second Method

If a known frequency standard is not available, the oscillator may be nulled as follows:

1. Set the unit to operate in the single satellite (1SV) mode. Make sure the unit is tracking a satellite.

2. Read the DAC value either from the RS-232 I/O port, or from the LCD display.

3. Remove the top cover. Locate the oscillator and its adjustment access hole.

4. SLOWLY (no more than 45° each time) adjust the oscillator and watch the DAC value change. If the DAC value is 65535, turn the oscillator adjustment counterclockwise, which will decrease the frequency and the DAC value. If the DAC value is 00000, turn the oscillator adjustment clockwise, which will increase the frequency and the DAC value.

5. Wait approximately one minute between each adjustment to allow the oscillator to stabilize.

6. Keep adjusting the oscillator in the appropriate direction until the DAC value is approximately at its midpoint (32767). Replace the top cover.

7. If after approximately one hour, the DAC value has changed by more than ±5,000 from 32767, repeat steps one through six.

5.1.2 LCD ADJUSTMENT

The contrast of the LCD display may be adjusted using potentiometer R8.

5.1.3 AC CODE ADJUSTMENTS

The modulation ratio of the AC code output can be adjusted from a typical range of 2:1 to 6:1. It has been factory adjusted for a ratio of 3:1. The modulation ratio adjustment is potentiometer R3.

The code output amplitude is adjusted using potentiometer R4. It can be adjusted to approximately eight volts peak-to-peak, terminated into 50Ω.

5.1.4 10MHz SINE WAVE

The amplitude of the 10MHz sine wave output can be adjusted using potentiometer R60. The nominal amplitude is approximately three volts peak-to-peak terminated into 50Ω.

5.2 TROUBLESHOOTING

5.2.1 GENERAL

If at any time the unit fails to operate or operates intermittently, it is a good idea to remove the top cover and look for any visible problems or damage. Make sure all cables are securely connected. Insure all integrated circuits are mounted into their sockets where applicable. Look for damaged components.

Because the design of the unit utilizes LSI (Large Scale Integrated) circuits, and is microprocessor based, much of the operation is controlled by firmware/software. There are few user serviceable components. If severe problems are encountered, consult the factory.

Note: When servicing the power supply, disconnect the AC power from the unit.

5.2.2 POWER LED WILL NOT ILLUMINATE WHEN ON/OFF SWITCH IS ACTIVATED

DC voltage is not present on J21 input connector pins on Assembly 35002.

Table 5-1
J21 Input Connector Pins

J21 pin 1	Ground.
J21 pin 2	-12 volts.
J21 pin 3	+12 volts.
J21 pin 4	+5 volts.

- Check the fuses in the power entry module.
- Check power wiring connections.

5.2.3 TRACKING LED DOES NOT ILLUMINATE

- Antenna/preamp is defective.
- Cable or connections between the antenna/preamp and the unit are open or intermittent.
- SV6 CM3 Timing Module (55146) is defective.
- If the operational mode is 1SV, the satellite vehicle selected may not be visible or even exist at all. Check that the SV PRN selected is valid and visible.

If this occurs, the message "SELECTED SV UNUSABLE" will appear on the LCD display and four usable satellite vehicle PRN numbers will be displayed. The user may go to the SECOND MENU SCREEN and use the SELECT MODE to enter 1SV and 00 which allows the unit to utilize the highest healthy satellite. This information can also be accessed via the RS-232 port by requesting "Print Time, Status, Error Code, And Satellite Vehicle Numbers" which is found in Chapter Four of this User's Guide. The SV PRN number desired may also be entered via the RS-232 port, using the paragraph titled "Select Satellite Vehicle" in Chapter Four of this User's Guide.

5.2.4 LOCKED LED DOES NOT ILLUMINATE

- Internal oscillator may have to be nulled/calibrated.
- Mask values may be set too high.

5.2.5 UNIT DOES NOT TRACK STATELLITES, ERROR MESSAGE/CODE - SIGNAL LEVEL LOW

- Antenna/preamp failure.
- Antenna cable open or shorted (center conductor to shield).

5.2.6 COLD RESET

A "COLD RESET" needs to be performed upon the following conditions:

- The unit fails to operate or operates intermittently and it is not a power, tracking, or locked problem.

Cold Reset Procedure

- Turn off or disconnect AC power.
- While holding down the MENU key of the keyboard, reapply power and observe the LCD display to read:

  COLD RESET DONE, UNIT SET TO DEFAULT
  PLEASE RELEASE COLD RESET SWITCH

- Release the MENU key of the keyboard.
- The default values have now been loaded into the unit.

- Each of the above default values needs to be examined and changed/reentered as necessary. (See Section 4.31). If the unit is left in the default "AUTO" mode, it will find its own position.

Note: If new software has been installed in the unit, a cold reset will automatically be performed the first time power is applied. The following message will appear on the LCD for approximately four seconds:

COLD RESET DONE, UNIT SET TO DEFAULT

5.3 THEORY OF OPERATION

5.3.1 GPS SYSTEM OPERATION

Before going into the Theory of Operation of the ExacTime 9390-6000 or 6010 GPS Time and Frequency Generator we must first understand the operation of the GPS system and what the Satellites are providing. The GPS system is a ranging system, in which satellites inform the ground user equipment where they are located and give the time information. The function of the user equipment is to determine its position (X, Y, and Z) as well as the time (T). This is accomplished through the use of simultaneous equations. Since there are four unknowns it requires at least four satellites to solve the equations. At power-on the user equipment has no idea where it is located or what time it is. Once it has acquired (TRACKED) four satellites, it can begin the process of solving the equations. Once a position has been determined, it can be loaded into memory and used to solve for the time only. Another aspect of the GPS system that is in need of some explanation is a deterrent function known as Selective Availability (SA). This is a purposeful degradation of the GPS system's performance so that an enemy of the United States can not use the system accurately against us in time of a war. The degradation that takes place is from twenty-five meters to one-hundred meters Spherical Error of Probability (SEP) for position information and one-hundred nanoseconds to 300 nanoseconds 95% of the time for Time information.

5.3.2 MODES OF OPERATION

Now that we understand that a GPS is a ranging system and the user equipment must calculate its position as well as time, we will now take a look at the different MODES of operation of the equipment and understand how it affects the operation of the equipment. There are several modes of operation for the ExacTime (Auto, 1SV, 3SV, 4SV, and Flywheel). We will start off with the Flywheel mode and work our way back to the normal Auto mode.

5.3.2.1 FLYWHEEL MODE (OPTIONAL)

Flywheel mode is a new, optional mode in which the unit is powered-on and does not operate from GPS information. The operator can set the time and the unit will function as a stand-alone clock and frequency source. No correction to the time or frequency are done by the unit, it simply continues from the last information in terms of the DAC value, position data, output selection, etc.

5.3.2.2 4SV MODE

The 4SV (Satellite Vehicle) mode of operation is a dynamic mode in that it is solving for all four variables (X, Y, Z, and T) at the same time. This mode is used either by the system to determine its location or used in a three-dimensional moving platform (i.e. aircraft). The GPS receiver used in the ExacTime is a Core 3 Module. This receiver has six channels in which to decode satellite information (what is referred to as *tracking* a satellite). Four of the channels will be collecting data from four satellites while the remaining two channels will be collecting data from as many as four more satellites in a multiplex scheme. In this way the receivers processor can be solving for the four unknowns from as many as four sets of equations at the same time. This is referred to as an "over-determined solution." Some of the effects of SA can be smoothed out using this process. However, in this mode the time information is moving as well as a function of newly calculated positions each second. This is not the most stable timing mode to operate in, but for moving platforms it is the best mode of operation.

5.3.2.3 3SV MODE

The 3SV mode, like the 4SV mode, is used in dynamic (moving) systems. However, the 3SV mode only solves for the X, Y, and T values. The altitude (Z) data is fixed at some entered value or previously calculated value. This would be the case on a ship or land vehicle where the altitude remains fixed. Like the 4SV mode, the 3SV mode is not a very stable timing mode.

5.3.2.4 1SV MODE

Older equipment of just a few years ago, the 1SV mode was indeed a single satellite solution solving for the time information from only one satellite at a time. The new core module 3T provides another added capability. It is better to refer the 1SV mode to a one-dimensional mode. The receiver will use the stored position in memory and solve for the time information from as many as eight satellite at the same time. The receiver will then provide an average solution of the time information to the ExacTime, thus providing a more stable time in which to operate under the effects of SA. This is the best timing mode of operation as long as the equipment is in a static environment and a good position has been entered into memory.

5.3.2.5 AUTO MODE

The Auto mode is a preprogrammed mode in the ExacTime and is the default mode that the unit is shipped to the customer in. At power-on the unit does not know where it is nor what time it is, thus it must determine all of this. At power-on the Auto mode commands the receiver into the 4SV mode of operation so that it can determine the location as well as time. The ExacTime will first set an approximate time and position as soon as it tracks four satellites. It will then begin stabilizing the internal oscillator in order to get it close to the correct frequency. After completion of the oscillator stabilization the unit will begin collecting position information. It will average the default selection of 200 positions, the unit can be set to collect as many as 9999 positions. After the 200 positions have been collected it will command the receiver into a 1SV mode, load the average position into the receiver, set time and begin normal 1SV mode of operation. We will discuss this normal mode of operation in more detail later.

5.3.3 EXACTIME INTERNAL CONFIGURATION

The ExacTime unit is comprised of several sub-assemblies, power supplies, main clock assembly, GPS receiver, front panel LCD display, front panel keypad, optional rubidium oscillator, option motherboard, plug-in option assemblies. For the purpose of this discussion a configuration including a rubidium oscillator, 1MHz and 5MHz sine wave output options will be used in the understanding of the ExacTime's operation (please see Figure 5-1).

5.3.3.1 POWER SUPPLIES (P/N 8010-7608-1 & 8010-7624)

The basic power supply in this configuration is 8010-7608-1. This supply is used to power the ExacTime and all of the electronic assemblies (i.e. main assembly, front panel assemblies, GPS receiver, and option motherboard). It provides the system with a regulated +5 volts, +12 Volts and -12 Volts. All of the electronics use these voltages to operate within the ExacTime. An optional second power supply (8010-7624) is required if the optional internal rubidium oscillator is provided. The rubidium oscillator requires a regulated +24 Volts at up to two amps during warm-up so there is a dedicated supply for this purpose. Without some or all of the voltages the unit will not operate correctly. When checking for any problem within the ExacTime it would be good to verify all of the power supply voltages to be assured they are correct. This can be done at the connectors located at each supply or at the end of the power cables.

5.3.3.2 MAIN ASSEMBLY (P/N 35002)

The main assembly is the center of the unit. It includes a microcomputer, memory, I/O interface, buffers, and all of the additional circuits to support the ExacTime's functions. The computer provides information to the front panel LCD for display of information to the operators as to the status, error, and many other operational information and selections. It interfaces to the front panel keypad and scans for operator key depressions and displays the selected information. All inputs and outputs at the rear panel with the exceptions of the ones provided by the option motherboard come from the main assembly. All outputs are buffered so as to prevent any damage to the unit should any output be shorted for any reason. Located on the main assembly is the Core 3 Receiver Module as a plug-in assembly. It is held in place by four small screws and connects via an OSX connector and a multi-pin DIP connector. We will discuss the operation of the Main Assembly later in this section in more detail.

5.3.3.3 FRONT PANEL KEYPAD & LCD ASSEMBLY (P/N 55158)

The front panel keypad is a board that has small buttons and rubber fingers that go through the front panel to provide the operator with a colored push button and tactile feedback of a button push. The push buttons are scanned by the main assembly computer for operator entry of information or commands. This board provides the mounting for the LCD display as well. The LCD provides all of the operator information, menu selections, and operator feedback of entries. The interface is through two multi-pin ribbon cables to the Main Assembly.

5.3.3.4 OPTION MOTHERBOARD (P/N 35007)

The option motherboard is used in order to expand the capabilities of the ExacTime. It provides a computer buss command interface to option assemblies, if required, as well as basic 1pps, 10MHz, 5MHz, 1MHz, IRIG B and other signals that may be required for option expansion. The option slots (1-4) provide this information to optional plug-in assemblies (see the ExacTime Configuration Guide for a list of the option assemblies available). For this example the only option assemblies plugged in are the 1MHz and 5MHz sine wave shapers. The sine wave shapers simply take the 1MHz or 5MHz TTL square wave signals provided on the buss interface and provide a sine wave output to the rear panel BNC connectors on the option motherboard. The option motherboard provides buffers before the signals go the BNC connector so as to prevent and damage should the output be shorted for any reason. Additional options could be added to this configuration as there are two additional slots available for customer expansion. Should any of the option outputs fail it is a simple matter to determine if the buffer has failed or the module assembly has failed by swapping the modules. The sine wave shapers are interchangeable and can be plugged in to any slot or from another unit. Power is provided to the assembly through a parallel cable from the power supply.

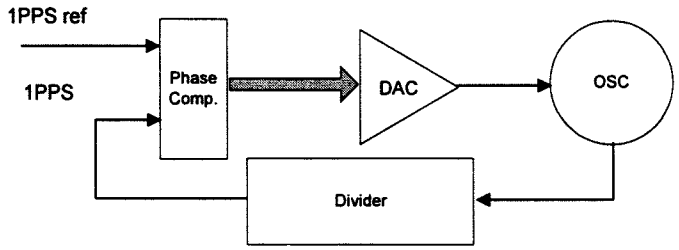
5.3.3.5 RUBIDIUM OSCILLATOR (LPRO) (OPTIONAL)

The internal rubidium oscillator is an LPRO (Low Profile Rubidium Oscillator) from the Efratom Division of Datum Inc. It is powered from a separate +24 volt power supply due to the power consumption as well as the higher voltage requirements. The interface to the main assembly is through several connections. The 10MHz frequency output is provided to the main assembly via an OSX coax cable connection. A second OSX coax cable connection provides the control voltage to adjust the output frequency of the oscillator. This signal is provided by a digital-to-analog converter on the main assembly. It is used to "discipline" control the frequency output to the GPS reference. Occasionally it may be necessary to make a coarse adjustment on the Rubidium should the electrical control reach the limit. The coarse control is a screw adjustment on the bottom of the rubidium oscillator and is not a major function. The only purpose is to bring the electrical adjustment back into the operating range. It *is not a calibration* requirement just a range control function. It is accomplished through the use of a screwdriver and simply monitoring the front panel DAC information. The maintenance section of this User's Guide describes the process, but a simple turn of the screw SLOWLY will put the DAC back in the working range. If the DAC value is going to the HIGH end simply turn the screw until the DAC value is say down around 10,000, if the DAC value is at the LOW end turn the screw until the DAC reads around 50,000. In this way the range of operation will be extended until the next adjustment is needed. Typically once the rubidium begins aging it will age in the same direction for the life of the oscillator.

5.3.4 MICROCOMPUTER PROGRAMMED THEORY OF OPERATION

The microprocessor clock provides a system where by the time as well as the frequencies generated are "disciplined" phase locked to the GPS reference information. Looking at Figure 5-1 there are three things that form the interface between the receiver and the clock. First is an RS-422 I/O - this provides all of the operating commands, status, and GPS data to the clock. Second is a 1pps reference pulse - this pulse is positioned early by 1 +/- .5 milliseconds from the UTC/GPS true 1pps time. Third is the 16 F/O (16.368MHz) frequency used by the receiver to track and decode the GPS signal within each of the six channels. The course acquisition (C/A) code has a chip rate of 1.023Mbps. The 16.368 is an even multiple of this chip rate. Through the use of this frequency input the receiver can provide some interesting information as well as the receiver providing the 1pps reference output that is locked, divided down from the 16 F/O. If the 16 F/O frequency is increased it will move the 1pps reference early, and if decreased it will move later. Once the receiver has positioned the 1pps reference, after it begins tracking satellites, it will report over the RS-422 I/O the difference between the 1pps reference and the real "on-time" 1pps that is calculated from the GPS message. This information is called the BIAS data. The receiver will also provide what is called the BIAS-RATE information or frequency error. This is able to be done because the 16 F/O is used to track the C/A code it then knows the frequency offset used to keep up with the satellite code rate as well as the rate correction data from each satellite. It will then provide this rate error over the RS-422 I/O to the clock.

During the "Oscillator Stabilize" phase the clock will take the BIAS-RATE information and control the internal oscillator's frequency to correct for any frequency offset. When the unit turns on the LOCK LED the current BIAS information is loaded into the clock to position the output 1pps to the correct time as reported by the receiver. The clock will read the BIAS information and subtract it from the LOCK BIAS value, and the difference (after much filtering) is used to control the frequency of the internal oscillator.



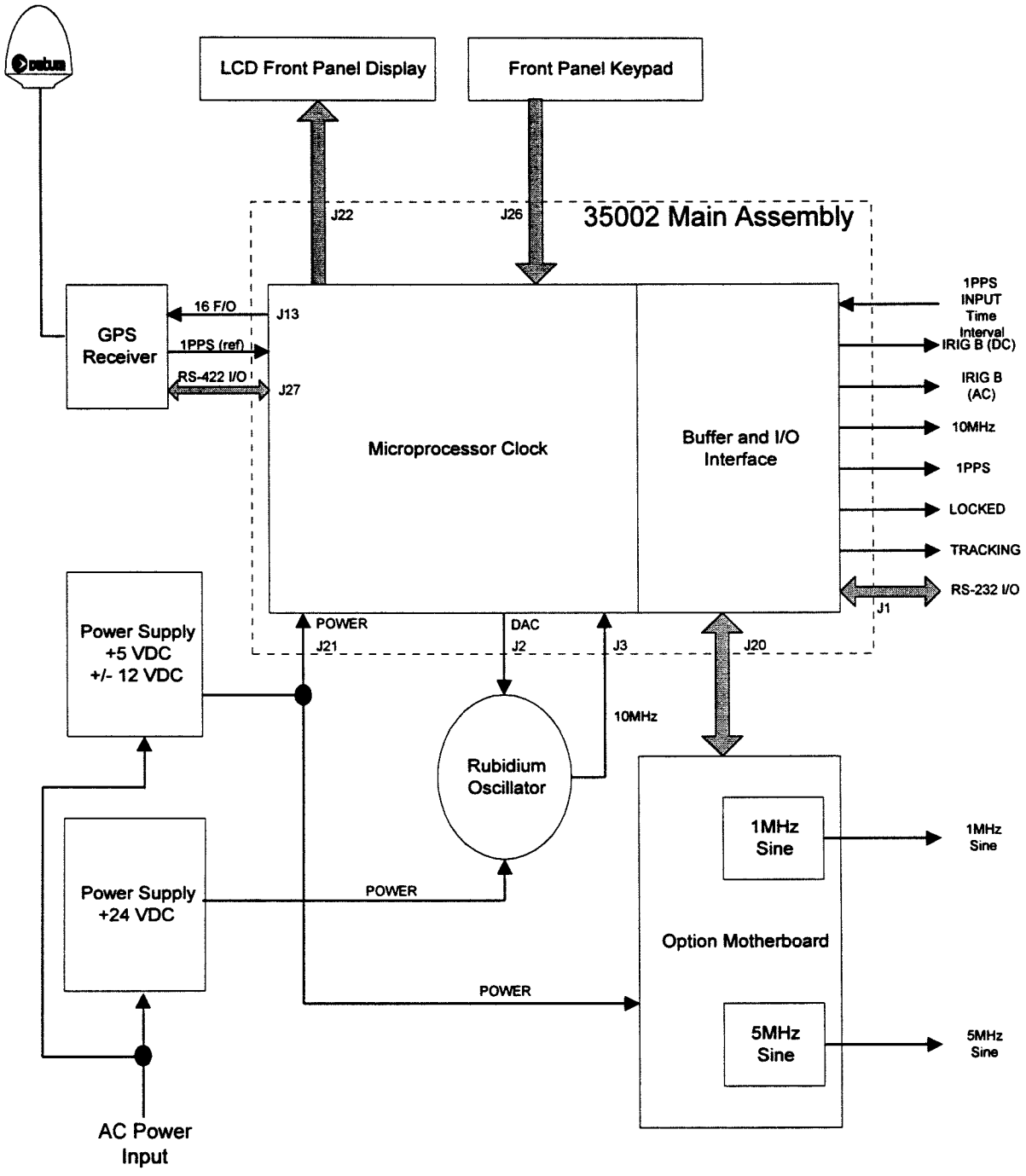
Phase Lock Loop Clock

For a very simple way to look at this process we can use the above diagram of a phase lock loop to describe the function that is taking place. As you can see the 1pps that is derived from the oscillator can be controlled by the DAC so that the phase relationship is that of the reported BIAS information along with the 1pps reference. In this way all of the frequencies as well as the time information provided by the clock is "disciplined" to the GPS reference information. Both the integration (filtering) of the information in the computer as well as the oscillator stability form a very stable system especially when the oscillator is a rubidium oscillator.

Symptom		Possible Cause	Solution
No Lights and No Display	1	No Input Power	Check AC power cord...is it correctly and firmly installed?
	2	Blown Fuse	Check AC line fuses for opens.
	3	No DC Power to (35002) Main Board	Check J21 for proper cable connection. Check J21 for correct voltages: Pin 1 - Ground Pin 2 - -12 Volts Pin 3 - +12 Volts Pin 4 - +5 Volts
No Information on LCD	1	Ribbon Cable Not Connected	Check Cable for proper seating.
	2	Contrast Not Adjusted	Check pot.R5 for proper adjustment.
	3	Bad LCD	Change LCD with known good.
	4	LCD Drivers Bad	Change 35002 main board with known good.
Time Does Not Count	1	Bad 16FO	Check Output of 16.368 MHz crystal.
	2	Bad Core 3	Swap CORE 3 with known good.
Will Not Acquire SV's	1	No GPS Signal from Antenna	Check all antenna cable connections. Swap antenna with known good.
	2	No Power to Antenna (S/B + 5 udc on J2)	Check continuity of cable 812502-14. Swap CORE 3 with known good.
	3	DAC Level at Extremes (S/B 20000 - 40000)	Do cold reset - See "Cold Reset" in this chapter of the User's Guide.
	4	No 10 MHz	Check 10MHz output from LPRO. Check LPRO power supply for 24 vdc.
	5	Bad CORE 3	Swap CORE 3 with known good.
	6	Bad 35002 Main Board	Swap 35002 with known good.
Will Not Lock	1	10MHz not stable	Check stability of 10MHz from LPRO against known standard.
	2	Bad Main Board	Swap 35002 with known good.
No Output from 1 or 5MHz Option	1	Amplitude too Low	Check amplitude adjustment pot on sine wave shaper board.
	2	Bad Sine wave Shaper Board	Swap shaper with known good
	3	Bad Motherboard	Swap option motherboard with known good
	4	Bad Main Board	Swap main board with known good.

Symptom		Possible Cause	Solution
Cannot Communicate Via RS-232	1	RS-232 Cable Not Connected	Check RS-232 cable connection at J12 on rear panel.
	2	Wrong Parameters	Check RS-232 I/O parameters for compatibility with system.
	3	I/O Glitch	Try cold reset - See "Cold Reset" in this chapter of the User's Guide.
	4	Bad Main Board	Swap 35002 with known good
No / Wrong Output J4-J9	1	Wrong or Missing Jumper	Check Jumper Configuration on 35002.
	2	Bad Main Board	Swap 35002 with known good.
Push Button Doesn't Work	1	Interface Cable Not Connected	Check cable 812515-3 for proper seating.
	2	Bad Switch	Swap front panel assembly with known good

Figure 5-1
ExacTime Block Diagram



6.0 PARTS LIST

The parts lists listed below can be found on the pages following page 6-2.

Title	Number	Revision
ExacTime - 1.75 Inches Full Rack Mount	9390-6000	N
ExacTime – 3.50 Inches Full Rack Mount	9390-6010	F
ExacTime GPS TC & FG (1U)	KT9390-6000-1	D
ExacTime GPS TC & FG (2U)	KT9390-6010-1	D
GPS Main	KT35002-145	P
Assembly, Front Display	55173	C
Assembly, Front Display	55175	A
Cable Assembly	812362-39	N/C
Cable Assembly	812502-14	N/C
Cable Assembly	812515-1	H
Cable Assembly	812515-2	A
Cable Assembly	812515-3	N/C

Note: The "KT" prefix in front of a parts list number only signifies that it is a kit for an outside process, and the parts listed are identical to the number without the prefix.

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Item: 9390-6000 Description: EXACTIME GPS TC & FREQ. GENERATOR Revision: N

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	4000-8112 POWER CORD: NEMA 5-15P TO IEC320		1.00000	EA	U	I			?
M	912000 GPS ANTENNA MOUNTING KIT	A	1.00000	EA	U	J			?
M	9390-6000-1 9390-6000 (BASIC UNIT)	D	1.00000	EA	U	I			?
M	0702-0010-1 FUSE: 1A, 250V, S/B, 5X20MM		2.00000	EA	U	I			?
M	0702-5000-1 FUSE: 1/2A, 250V, S/B, 5X20MM		2.00000	EA	U	I			?

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Rev N - T8120

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

NOTES
THE 1 AMP FUSES (0702-0010) ARE SPARE
FUSES FOR 2 120 VAC OPERATION.

THE .5 AMP FUSES (0702-5000) ARE SPARE
FUSES FOR 4 230 VAC OPERATION.

1 EACH EXACTIME USER'S MANUALS
(8500-0082) NEED TO BE SUPPLIED WITH
EACH UNIT.

Item: 9390-6010 Description: EXACTIME GPS TIME & FREQUENCY GENERATOR Revision: F

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	4000-8112 POWER CORD: NEMA 5-15P TO IEC320		1.00000	EA	U	I			?
M	912000 GPS ANTENNA MOUNTING KIT	A	1.00000	EA	U	J			?
M	9390-6010-1 9390-6010 (BASIC UNIT)	D	1.00000	EA	U	I			?
M	0702-0010-1 FUSE: 1A, 250V, S/B, 5X20MM		2.00000	EA	U	I			?
M	0702-5000-1 FUSE: 1/2A, 250V, S/B, 5X20MM		2.00000	EA	U	I			?

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Rev F - T8120

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

NOTES: THE 1 AMP FUSES (0702-0010) ARE SPARE FUSES FOR 120 VAC OPERATION. THE .5 AMP FUSES (0702-5000) ARE SPARE FUSES FOR 230 VAC OPERATION.

1 EACH EXACTIME USER'S MANUALS (8500-0082) NEEDS TO BE SUPPLIED WITH EACH UNIT.

END OF PARTS LIST FOR 9390-6010

DATUM, INC
Item Current Routing

Item: KT9390-6000-1 Description: 9390-6000 (BASIC UNIT) Revision: D

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	200	OUTSIDE KITTING	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

NOTES:
PLEASE COPY AND PASTE THE NOTES.

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	0303-2810 IC: 28F010-150 PLCC32		1.00000	EA	U	I			?
M	1790-2418-2 SCREW LOCK KIT: D-SUB CONN FEMALE		2.00000	EA	U	I			?
M	35002-145 GPS MAIN - STD OSC, MEM BAMK	P	1.00000	EA	U	J			?
M	55173 FRONT DISPLAY ASSY 1U	C	1.00000	EA	U	I			?
M	711737 P/S INSULATOR (3x5)	N/C	1.00000	EA	U	P			?
M	711581-1 RACK EAR/HANDLE 1U WIDE	C	2.00000	EA	U	I			?
M	711633-2 FRONT PANEL ASS'Y 1U	A	1.00000	EA	U	I			?
M	8010-LPT4-2 POWER SUPPLY: AC/DC +5/+12/-12V 40W		1.00000	EA	U	I			?
M	812362-39 CABLE ASSY, LCD (LCD)	N/C	1.00000	EA	U	I			?
M	812502-14 CABLE ASSEMBLY (ANTENNA)	N/C	1.00000	EA	U	I			?
M	812515-2 CABLE ASSEMBLY (DC)	A	1.00000	EA	U	I			?
M	812515-1 CABLE ASSY, AC POWER (AC)	H	1.00000	EA	U	I			?
M	812515-3 CABLE ASSY, FRONT DISPLAY (KEYBOARD)	N/C	1.00000	EA	U	I			?

Item: KT9390-6000-1 Description: 9390-6000 (BASIC UNIT) Revision: D

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq		
	M	925105 LABEL, NAMEPLATE	C	1.00000	EA	U	I			?		
	M	925106 LABEL: EXACTIME	N/C	1.00000	EA	U	I			?		
	M	951066 BUTTON, MOLDED SILICON (2 X 7 ARRAY)	B	1.00000	EA	U	I			?		
	M	925116 LABEL-CHASSIS GROUND	N/C	1.00000	EA	U	P			?		
	M	711635 CHASSIS ASSEMBLY (EXACTIME 1U)	A	1.00000	SET	U	P			?		
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Rev D - T8120

Item: KT9390-6010-1 Description: 9390-6010 (BASIC UNIT) Revision: D

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	200	OUTSIDE KITTING	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

NOTES:
SEE TOP ASSY#A-9390-6010-1 FOR
INFORMATION
PROM 0303-2810 IS PROGRAMMED PER TDT
NUMBER SHOWN ON THE SALES ORDER AND
INSTALLED IN SOCKET U7 ON 35002.
PLEASE COY AND PASTE THE NOTES.

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	0303-2810 IC: 28F010-150 PLCC32		1.00000	EA	U	I			?
M	1790-2418-2 SCREW LOCK KIT: D-SUB CONN FEMALE		2.00000	EA	U	I			?
M	35002-145 GPS MAIN - STD OSC, MEM BAMK	P	1.00000	EA	U	J			?
M	711737 P/S INSULATOR (3x5)	N/C	1.00000	EA	U	P			?
M	711549 BUTTON SPACER, PLASTIC		1.00000	EA	U	I			?
M	8010-LPT4-2 POWER SUPPLY: AC/DC +5/+12/-12V 40W		1.00000	EA	U	I			?
M	812362-39 CABLE ASSY, LCD (LCD)	N/C	1.00000	EA	U	I			?
M	812502-14 CABLE ASSEMBLY (ANTENNA)	N/C	1.00000	EA	U	I			?
M	812515-1 CABLE ASSY, AC POWER (AC)	H	1.00000	EA	U	I			?
M	812515-2 CABLE ASSEMBLY (DC)	A	1.00000	EA	U	I			?
M	812515-3 CABLE ASSY, FRONT DISPLAY (KEYBOARD)	N/C	1.00000	EA	U	I			?

Item: KT9390-6010-1 Description: 9390-6010 (BASIC UNIT) Revision: D

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq		
	M	925105 LABEL, NAMEPLATE	C	1.00000	EA	U	I			?		
	M	925106 LABEL: EXACTIME	N/C	1.00000	EA	U	I			?		
	M	951066 BUTTON, MOLDED SILICON (2 X 7 ARRAY)	B	1.00000	EA	U	I			?		
	M	55175 FRONT DISPLAY ASSY 2U	A	1.00000	EA	U	I			?		
	M	711582-1 RACK EAR/HANDLE 2U WIDE	C	2.00000	EA	U	I			?		
	M	711638-2 FRONT PANEL ASS'Y 2U	A	1.00000	EA	U	I			?		
	M	711640 CHASSIS ASSEMBLY 2U	A	1.00000	EA	U	I			?		
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Rev D - T8120

DATUM, INC
Item Current Routing

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	200	OUTSIDE KITTING	0.00	0.00	0.00	0.000	0.000	?	?	1.00	Yes	

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	0103-0000 RES: JUMPER, 0 OHM, 0W, SM0805 R1 R26 R41 R68 R89 R90 R91 R93		8.00000	EA	U	I			?
M	0103-1000 RES: 100 OHM, 1/10W, 1%, SM0805 R103		1.00000	ea	U	I			?
M	0103-1001 RES: 1K, 1/10W, 1%, SM0805 R21 R78 R79 R82		4.00000	EA	U	I			?
M	0103-1002 RES: 10K, 1/10W, 1%, SM0805 R10 R16 R18 R19 R22 R23 R24 R27 R28 R29 R30 R37 R43 R50 R51 R52 R55 R62 R70 R71 R72 R83 R84 R85 R86 R87 R88 R92		28.00000	EA	U	I			?
M	0103-1003 RES: 100K, 1/10W, 1%, SM0805 R31 R38 R44 R74		4.00000	EA	U	I			?
M	0103-1004 RES: 1M, 1/10W, 1%, SM0805 R35 R49 R94		3.00000	EA	U	I			?
M	0103-2001 RES: 2K, 1/10W, 1%, SM0805 R12 R14 R63 R73 R75 R76 R77 R95		8.00000	EA	U	I			?
M	0103-2002 RES: 20K, 1/10W, 1%, SM0805		5.00000	EA	U	I			?

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision			Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
		R42 R54 R56 R57 R58										
	M	0103-2211 RES: 2.21K, 1/10W, 1%, SM0805				3.00000	EA	U	I			?
		R53 R66 R67										
	M	0103-2212 RES: 22.1K, 1/10W, 1%, SM0805				1.00000	EA	U	I			?
		R59										
	M	0103-2431 RES: 2.43K, 1/10W, 1%, SM0805				1.00000	EA	U	I			?
		R5										
	M	0103-3011 RES: 3.01K, 1/10W, 1%, SM0805				1.00000	EA	U	I			?
		R7										
	M	0103-3920 RES: 392 OHM, 1/10W, 1%, SM0805				10.00000	EA	U	I			?
		R6 R17 R20 R64 R97 R98 R99 R100 R101 R102										
	M	0103-3921 RES: 3.92K, 1/10W, 1%, SM0805				1.00000	EA	U	I			?
		R9										
	M	0103-3922 RES: 39.2K, 1/10W, 1%, SM0805				2.00000	EA	U	I			?
		R39 R45										
	M	0103-4751 RES: 4.75K, 1/10W, 1%, SM0805				3.00000	EA	U	I			?
		R11 R13 R32										
	M	0103-5110 RES: 511 OHM, 1/10W, 1%, SM0805				3.00000	EA	U	I			?

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq		
		R40 R61 R65										
	M	0103-5111 RES: 5.11K, 1/10W, 1%, SM0805		1.00000	EA	U	I			?		
		R48										
	M	0103-5621 RES: 5.62K, 1/10W, 1%, SM0805		4.00000	EA	U	I			?		
		R15 R47 R80 R81										
	M	0113-08R2 RES: 8.2 OHM, 1/4W, 5%, SM1210		2.00000	EA	U	I			?		
		R33 R36										
	M	0163-0103 RES: POT, 10K, 1T, 3MM, SM		1.00000	EA	U	I			?		
		R4										
	M	0163-0502 RES: POT, 5K, 1T, 3MM, SM		3.00000	EA	U	I			?		
		R3 R8 R60										
	M	0203-0101 CAP: 100PF, 50V, 5%, COG, SM0805		16.00000	EA	U	I			?		
		C6 C52 C61 C68 C75 C76 C78 C79 C80 C88 C92 C93 C94 C96 C97 C98										
	M	0203-0104 CAP: 0.1UF, 50V, 10%, X7R, SM0805		1.00000	EA	U	I			?		
		C64										
	M	0203-0220 CAP: 22PF, 50V, 5%, COG, SM0805		3.00000	EA	U	I			?		
		C27 C46 C47										

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision			Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
	M	0203-0331 CAP: 330PF, 50V, 5%, COG, SM0805 C24				1.00000	EA	U	I			?
	M	0203-0391 CAP: 390PF, 50V, 5%, COG, SM0805 C48				1.00000	EA	U	I			?
	M	0203-0561 CAP: 560PF, 50V, 5%, COG, SM0805 C4				1.00000	EA	U	I			?
	M	0213-0102 CAP: 1000PF, 50V, 20%, X7R, SM0805 C3 C7 C8 C9 C10 C12 C13 C19 C30 C32 C49 C54 C55 C60 C113 C116				16.00000	EA	U	I			?
	M	0213-0103 CAP: 0.01UF, 50V, 20%, X7R, SM0805 C63				1.00000	EA	U	I			?
	M	0213-0333 CAP: 0.033UF, 50V, 20%, X7R, SM0805 C1 C2 C5 C11 C14 C15 C16 C18 C20 C21 C22 C23 C25 C26 C28 C29 C31 C33 C36 C37 C38 C39 C40 C41 C42 C43 C44 C45 C50 C51 C53 C56 C57 C58 C62 C65 C66 C67 C69 C70 C71 C72 C73 C77 C81 C84 C85 C86 C87 C89 C90 C91 C95 C99 C100 C101 C102 C103 C104 C105 C106 C107 C108 C109 C110 C111 C112 C114				68.00000	EA	U	I			?

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision			Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
	M	0223-0105 CAP: 1UF, 20V, 20%, A CASE C115				1.00000	EA	U	I			?
	M	0223-0476 CAP: 47UF, 16V, 20%, D CASE C17 C34 C35 C74 C82 C83				6.00000	EA	U	I			?
	M	0301-0180 IC: Z80180 PLCC68 U12				1.00000	EA	U	I			?
	M	0301-1230 IC: DS1230 DIP28 U13				1.00000	EA	U	I			?
	M	0301-3064 IC: XC3064-70 PLCC84 U2 U11				2.00000	EA	U	I			?
	M	0303-0586 IC: AD586L SO8 U10				1.00000	EA	U	I			?
	M	0303-0634 IC: BUF634 SO8 U32 U33 U34 U35 U36 U37				6.00000	EA	U	I			?
	M	0303-0809 IC: MAX809 SOT23 U7				1.00000	EA	U	I			?
	M	0303-0811-1 IC: AD811 SO8 U18				1.00000	EA	U	I			?

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision			Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
	M	0303-0822 IC: AD822A SO8 U3 U4 U20 U24				4.00000	EA	U	I			?
	M	0303-1488 IC: 14C88 SO14 (MOTOROLA ONLY) U23 U29				2.00000	EA	U	I			?
	M	0303-1489 IC: 14C89A SO14 (MOTOROLA ONLY) U28 U30				2.00000	EA	U	I			?
	M	0303-16C5-52 IC: TL16C552 PLCC68 U9				1.00000	EA	U	I			?
	M	0303-7626 IC: MP7626K PLCC28 U5				1.00000	EA	U	I			?
	M	0303-7828 IC: AD7828 PLCC28 U22				1.00000	EA	U	I			?
	M	0303-78L0-9 IC: 78L09 SO8 U38				1.00000	EA	U	I			?
	M	0303-8561 IC: AD8561 SO8 U17 U19 U31				3.00000	EA	U	I			?
	M	0303-9501 IC: AD9501J PLCC20 U21				1.00000	EA	U	I			?

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision			Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
	M	0303-DAC0 IC: DAC08 SO16 U1				1.00000	EA	U	I			?
	M	0303-HC02 IC: 74HC02 SO14 U14				1.00000	EA	U	I			?
	M	0303-HC08 IC: 74HC08 SO14 U6				1.00000	EA	U	I			?
	M	0303-HC14 IC: 74HC14 SO14 U25				1.00000	EA	U	I			?
	M	0303-HC45-38 IC: 74HC4538 SO16 U15				1.00000	ea	U	I			?
	M	0503-0914 DIODE: 1N914 SOT-23 CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8				8.00000	EA	U	I			?
	M	1301-4080 OSCILLATOR: 10 MHZ SINEWAVE Y2				1.00000	EA	U	I			?
	M	1313-0000 CRYSTAL: 12.288 MHZ SM Y3				1.00000	EA	U	I			?
	M	1503-0051 RELAY: SM SPDT 5VDC U26 U27				2.00000	EA	U	I			?

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision			Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
	M	1702-5863 CONN: OSX JACK ST PC				1.00000	EA	U	I			?
		J13										
	M	1702-B4PV CONN: 4P 1X4 HEADER ST				1.00000	EA	U	I			?
		J21										
	M	1703-0002 CONN: 4P 2X2 HEADER ST SM				4.00000	EA	U	I			?
		J24 J25 J28 J29										
	M	1703-0003 CONN: 3P 1X3 HEADER ST SM				1.00000	EA	U	I			?
		J30										
	M	1703-0004 CONN: 8P 2X4 HEADER ST SM				6.00000	EA	U	I			?
		J14 J15 J16 J17 J18 J19										
	M	1703-0007 CONN: 14P 2X7 HEADER ST SM				1.00000	EA	U	I			?
		J22										
	M	1703-0010-1 CONN: 10P 1X10 HEADER ST				1.00000	EA	U	I			?
		J23										
	M	1703-0012 CONN: 12P 1X12 HEADER ST SM				1.00000	EA	U	I			?
		J26										
	M	1703-0050-1 CONN: 50P 2X25 HEADER R/A SM				1.00000	EA	U	I			?
		J20										

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	1704-0009-D CONN: 2X9 D-SUB RECP/RECP J1		1.00000	EA	U	I			?
M	1704-7677 CONN: BNC BULKHEAD JACK R/A J4 J5 J6 J7 J8 J9 J10		7.00000	EA	U	I			?
M	1704-DF11 CONN: 8P 2X4 SOC STRIP ST 2MM J27		1.00000	EA	U	I			?
M	1706-2010 TERM: TURRET .063D PC TP1		1.00000	EA	U	I			?
M	1706-5474-02 CONN: 2P SHUNT .1C BLUE INSTALL JUMPERS ON OR BETWEEN THE FOLLOWING POINTS: J14 7&8 J15 7&8 J16 1&2 J17 5&6 J18 3&4 J19 1&2 J24 1&2 J24 4 J25 1&2 J25 4 J28 1&2 J29 1&2		12.00000	EA	U	I			?
M	1708-0010-1 CONN: 10P 2X5 HEADER ST J31		1.00000	EA	U	I			?
M	1713-0032 SOCKET: IC 32P PLCC SM U8		1.00000	EA	U	I			?
M	172435J P. C. BOARD	J	1.00000	EA	U	I			?
M	2310-0256 STANDOFF: FF, 2-56X5/16, 3/16RND, BR		4.00000	EA	U	I			?

Item: KT35002-145 Description: GPS MAIN BOARD KIT Revision: P

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
	Type	Item	Revision			Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
		CORE MODULE SUPPORT										
	M	55146				1.00000	EA	U	I			?
		TIMING MODULE: SV6 CM3XT										
	M	1301-4080-1				1.00000	EA	U	I			?
		OSCILLATOR: 16.368 MHZ										
		Y4										
20	250	OUTSIDE ASSEMBLY	0.00	0.00	0.00	0.000		0.000		?	?	1.00 Yes
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000		0.000		?	?	1.00 No
40	400	TEST	0.00	0.00	0.00	0.000		0.000		?	?	1.00 No

SEE ASSEMBLY AID # A-35002 "B-SIZE"

J32 IS 3 PIN MADE FROM P/N CA-S36-23B-43
HEADER 9MFG. STOCK) MFR: 22526

J32 MOUNT SHORT LEADS THROUGH P.C.
BOARD.

PLACE MYLAR TAPE *7141 (2 INCH) UNDER Y2
AND Y4.

Item: 55173 Description: FRONT DISPLAY ASSY 1U Revision: C

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	1204-1002 SW: PUSHBUTTON SPST 6MM 0 1 2 3 4 5 6 7 8 9 MENU		11.00000	EA	U	I			?
M	1708-0012-3 CONN: 12P 1X12 HEADER ST		1.00000	EA	U	I			?
M	172490D P. C. BOARD	D	1.00000	EA	U	I			?
M	2204-3680 LED: GREEN T-1 3/4 DIFFUSED LOCKED TRACKING POWER		3.00000	EA	U	I			?
M	2206-4002 DISPLAY: LCD 40X2 (33.5MM MAX. WIDTH)		1.00000	EA	U	I			?

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.500	0.000	?	?	1.00	No	

NOTES:
THIS ASSEMBLY REQUIRES THE FOLLOWING
HARDWARE:

*4014	SCREW: 4-40X3/8 P.H.	4 EACH
*4048	WASHER: #4 SPLIT	4 EACH
*4049	WASHER: #4 FLAT	4 EACH
*4054	HEX NUT: 4-40, RADIO	4 EACH
*7083B	WASHER: #4 X .070 FIBER	4 EACH

SEE DRAWING 55173 "C-SIZE" FOR SCH. AND
ASSY AID.

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Item: 55175 Description: FRONT DISPLAY ASSY 2U Revision: A

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	1204-1002 SW: PUSHBUTTON SPST 6MM 0 1 2 3 4 5 6 7 8 9 MENU		11.00000	EA	U	I			?
M	1708-0012-3 CONN: 12P 1X12 HEADER ST		1.00000	EA	U	I			?
M	172495B P. C. BOARD	B	1.00000	EA	U	I			?
M	2204-3680 LED: GREEN T-1 3/4 DIFFUSED LOCKED TRACKING POWER		3.00000	EA	U	I			?
M	2206-4002 DISPLAY: LCD 40X2 (33.5MM MAX. WIDTH)		1.00000	EA	U	I			?

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

NOTES:
THIS ASSEMBLY REQUIRES THE FOLLOWING
HARDWARE:

*4014	SCREW: 4-40X3/8 P.H.	4 EACH
*4048	WASHER: #4 SPLIT	4 EACH
*4049	WASHER: #4 FLAT	4 EACH
*4054	HEX NUT: 4-40, RADIO	4 EACH
*7083B	WASHER: #4 X .070 FIBER	4 EACH

SEE DRAWING 55175 "C-SIZE" FOR SCH. AND
ASSY AID.

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Item: 812362-39 Description: CABLE ASSY, LCD Revision: N/C

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	1704-6014 CONN: 14P FLAT CABLE SOC		2.00000	EA	U	I			?
M	4004-0014 CABLE: FLAT 14C RAINBOW 28 AWG CABLE LENGTH IS 11 INCHES.		1.00000	FT	U	I			?

20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.250	0.000	?	?	1.00	No
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No

DATUM, INC
Item Current Routing

Item: 812502-14 Description: CABLE ASSEMBLY Revision: N/C

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

SEE ASSEMBLY DRAWING 812502.
USE MFG STOCK 4004-0188 A/U CABLE.

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	1704-7071 CONN: TYPE N BULKHEAD JACK		1.00000	EA	U	I			?
M	1704-8299 CONN: OSX COAX R/A CABLE		1.00000	EA	U	I			?

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.500	0.000	?	?	1.00	No	
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

SEE ASSEMBLY DRAWING 812502.
USE MFG STOCK 4004-0188 A/U CABLE.

Item: 812515-1 Description: CABLE ASSY, AC POWER Revision: H

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	1704-8031 CONN: 3P 1X3 HOUSING .156C		1.00000	EA	U	I			?
M	1704-KD14 CONN: 3P PWR ENTRY MODULE IEC320		1.00000	EA	U	I			?
M	1792-0111 CONTACT: CRIMP 18-24 AWG GOLD		2.00000	EA	U	I			?
M	4005-1015-1 WIRE: UL1015 20AWG BROWN		1.00000	FT	U	I			?
M	4005-1015-54 WIRE: UL1015 20AWG GREEN/YELLOW		1.00000	FT	U	I			?
M	4005-1015-6 WIRE: UL1015 20AWG LT. BLUE		1.00000	FT	U	I			?
M	0702-0010-1 FUSE: 1A, 250V, S/B, 5X20MM		2.00000	EA	U	I			?
M	0750-4303-1 FUSE DRAWER: 2 POLE 5X20MM		1.00000	EA	U	P			?

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.500	0.000	?	?	1.00	No	
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

SEE CABLE DRAWING 812515-1

ADD'L HARWARE REQ'D:
*7070: PANDUIT DNF18-205F1B-M FEMALE QUICK-DISCONNECT TERMINALS. 3EA
18RA-2577 FEMALE DISCONNECT, T&B. 2EA
5442-22 #8 INT TH SLDR LUG, SEASTROM. 2EA.

Item: 812515-2 Description: CABLE ASSEMBLY Revision: A

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

SEE CABLE DRAWING 812515-2

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	1704-8061		1.00000	EA	U	I			?
	CONN: 6P 1X6 HOUSING .156C								
M	1704-VHR4		2.00000	EA	U	I			?
	CONN: 4P 1X4 HOUSING .156C								
M	1792-0111		4.00000	EA	U	I			?
	CONTACT: CRIMP 18-24 AWG GOLD								
M	1792-SVH2		8.00000	EA	U	I			?
	CONTACT: SOCKET								

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.500	0.000	?	?	1.00	No	
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

SEE CABLE DRAWING 812515-2

Item: 812515-3 Description: CABLE ASSY, FRONT DISPLAY Revision: N/C

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
10	225	INHOUSE KITTING-OP10	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

SEE CABLE DRAWING 812515-3

Type	Item	Revision	Quantity	U/M	Per	Ref	Eff Date	Obs Date	BOM Seq
M	1704-0012 CONN: 12P 1X12 IDC 24AWG		2.00000	EA	U	I			?
M	4004-0012 CABLE: FLAT 12C NOTCHED 24 AWG		2.00000	FT	U	I			?

Oper	WC	Description	Move Hrs	Queue Hrs	Setup Hrs	LbrHrs/Pc	MchHrs/Pc	FixSchHrs	OffsetHrs	Crew Size	Ctl Pnt	Cell
20	327	OPER.-ELEC/MECH ASSY	0.00	0.00	0.00	0.250	0.000	?	?	1.00	No	
30	452	PROD. TEST INSP	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	
40	400	TEST	0.00	0.00	0.00	0.000	0.000	?	?	1.00	No	

SEE CABLE DRAWING 812515-3

CHAPTER SEVEN
DRAWINGS LIST

7.0 DRAWINGS

The drawings listed below can be found on the pages following page 7-2.

Title	Number	Revision
ExacTime – TC & FG	A-9390-6000	M
ExacTime – TC & FG	A-9390-6010	E
GPS Main	35002	P
Assembly, Front Display	55173	C
Assembly, Front Display	55175	A
Cable Assembly	812362-39	N/C
Cable Assembly	812502	N/C
Cable Assembly	812515-1	H
Cable Assembly	812515-2	A
Cable Assembly	812515-3	N/C

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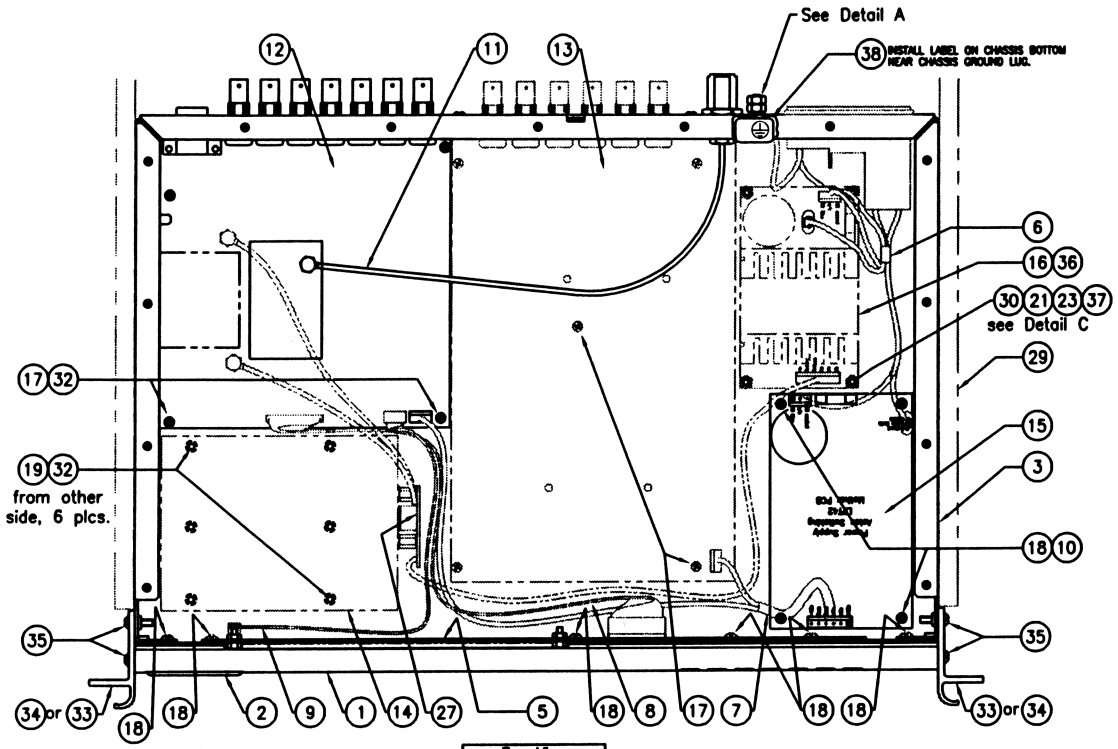
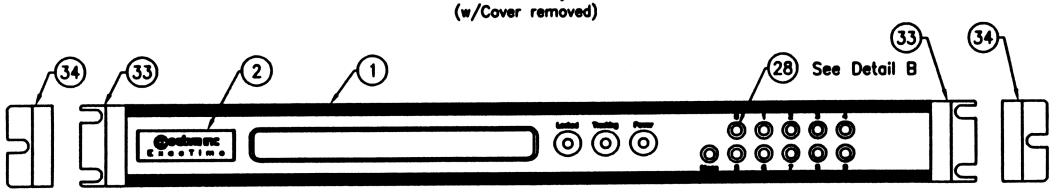


Top View
Assembly
(w/Cover removed)



Front View
Assembly

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	Initial production release.	6/17/96	RdM
B	Removed the 'E' option	6/20/96	DSK/Omnica
C	[illegible]	6/25/96	RdM/Omnica
D	[illegible]	7/16/96	DSK/Omnica
E	[illegible]	8/20/96	RdM/Omnica
F	[illegible]	8/28/96	RdM/Omnica
G	[illegible]	9/30/96	RdM/Omnica
H	Changes per ECO #17383	12/10/96	CFC
J	Changes per ECO #17438	8/29/97	RdM/Omnica
K	Changes per ECO #17486	2/20/98	CFC
L	Changes per ECO'S T7770 AND T7782	10/2/98	E.H.
M	Changes per ECO T8110	03/28/00	CH/JL

ITEM	PART NUMBER	DESCRIPTION	<A>	<B>	<C>	<D>
38	925116	Label, Ground Symbol	1	1	1	1
37	2310-4000	Spacer, #4 x 1/8	–	4	–	4
36	711537-1	Power Supply Insulator	–	1	–	1
35	*6018b	Screw, #6-32 x 1/2 Phil.pan hd, Black oxide	8	8	8	8
34	711571-1	Extruded Rack Ear/Handle, 1U Full rack (painted)	<4>	<4>	<4>	<4>
33	711581-1	Extruded Rack Ear/Handle, Wide, 1U Full rack (painted)	<4>	<4>	<4>	<4>
32	ANL-22	Thread Locking Compound	A/R	A/R	A/R	A/R
31	812515-6	Cable, AC Dual Power Supplies	–	1	–	1
30	*4017b	Screw, #4-40 x 3/8 Phil 100deg flat hd., Black oxide	–	4	–	4
29	708882	Slide, Rack mount kit w/ screws	<J>	<J>	<J>	<J>
28	951066	Buttons, Molded silicon, 2x7 array	1	1	1	1
27	35012	LPRO Connector	–	1	–	1
26	925105	Label, Rear w/Serial number	1	1	1	1
25	*8023	Washer, #8 internal star	4	4	4	4
24	*6034	Washer, #6 internal star	8	8	8	8
23	*4052	Washer, #4 internal star	8	12	13	17
22	*8019	Nut, #8-32 Hex, Steel	4	4	4	4
21	*4053	Nut, #4-40 Hex, Steel	–	4	–	4
20	*8013	Screw, #8-32 x 3/4 Phil pan hd., Zinc plated steel	1	1	1	1
19	*4008b	Screw, #4-40 x 1/4 Phil 100deg flat hd., Black oxide	–	6	–	6
18	*6002	Screw, #6-32 x 1/4 Phil pan hd.	8	8	8	8
17	*4006	Screw, #4-40 x 1/4 Phil pan hd.	4	4	9	9
16	8010-7624	Power supply, 24 volt (B)	–	1	–	1
15	8010-LPT4-2	Power supply, 5volt (A)	1	1	1	1
14	1301-LPRO	LPRO Rubidium	–	1	–	1
13	35007	Assemby, Mother board PCB	–	–	1	1
12	35002-14	Assembly, Main PCB	1	1	1	1
11	812502-14	Cable, Antenna	1	1	1	1
10	711537-2	Power Supply Insulator	1	1	1	1
9	812362-39	Cable, LCD Data to Main PCB	1	1	1	1
8	812515-3	Cable, Front Display PCB to Main PCB, 12 in.	1	1	1	1
7	812515-2	Cable, Main Power Supply to Main & Mother PCBs	1	1	1	1
6	812515-1	Cable, AC Inlet to Power supplies.	1	–	1	–
5	55173	Assembly, Front Display PCB, Sngl.Ht Full Rack	1	1	1	1
4	711488	Option plate, 6BNC	–	–	1	1
3	711635	Chassis Assembly, Sngl.Ht Full Rack	1	1	1	1
2	925106	Label, Front panel, 'Datum'	1	1	1	1
1	711633-2	Front Panel wo/'ExacTime' Printing, Sngl.Ht Full Rack	1	1	1	1

PARTS LIST

<4> Optional Rack Ears available for all models:

Part No.	Description	Std.	Opt.
711581-1	Extruded Rack Ears, Wide, 1U Full rack (painted)	2	–
711571-1	Extruded Rack Ears, 1U Full rack (painted)	–	2

<J> Optional kit available for all models.

2. Reference design layout DATUM\LAYSHF.dwg (Autocad R13).
1. Dimensions shown are in inches. Dimensions within () are for reference only, not to be applied to critical features.

NOTES: UNLESS OTHERWISE SPECIFIED

Option Key	
OPTION	DESCRIPTION
<A>	'Datum' base assembly
<B>	'Datum' w/Time cell
<C>	'Datum' w/Mother board
<D>	'Datum' w/Time cell & Mother board

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL. .XX ±.03 .XXX ±.010 ANGLE ±1°

TITLE: ExacTime – TC&FG, 1U Full rack

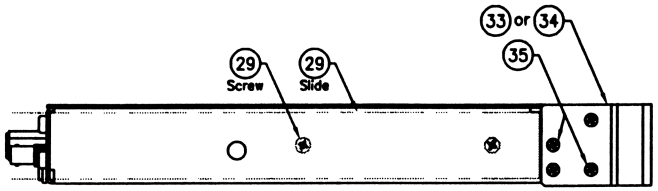
datum inc

DWN	RdM/Omnica	6/12/96	DES		
CHK	CFC	11/7/97	ENGR	CFC	11/7/97
SCALE	1/2 size		PRC	OJPN2	

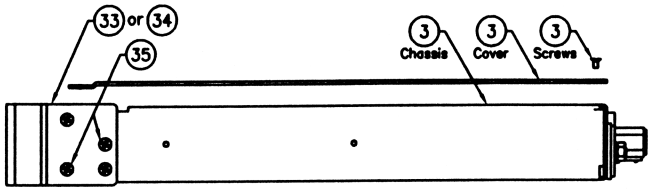
C A-9390-6000 M

SIZE | SHT 1 OF 2 | REV

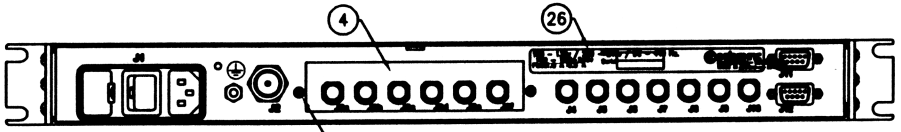
CAD FILE NAME: A9390-6000M-1.dwg DISK NO. 105 ACAD 2000



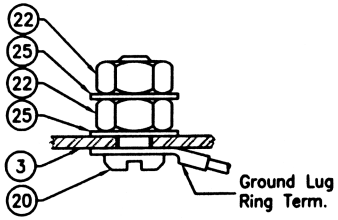
Left View
Assembly
(shown upright)
(w/Opt. Rack Slide)



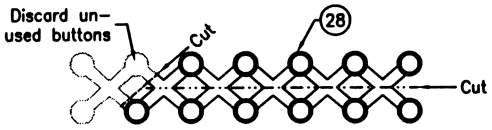
Right View
Assembly
(shown upright)
(w/Cover removed)



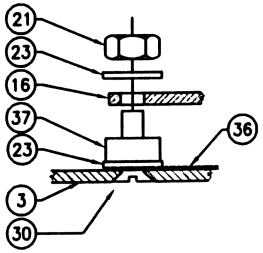
Rear View
Assembly
(shown upright)



Detail A
Ground Stud Mounting
Scale: 2x size



Detail B
Button Array modification
Scale: 2x size



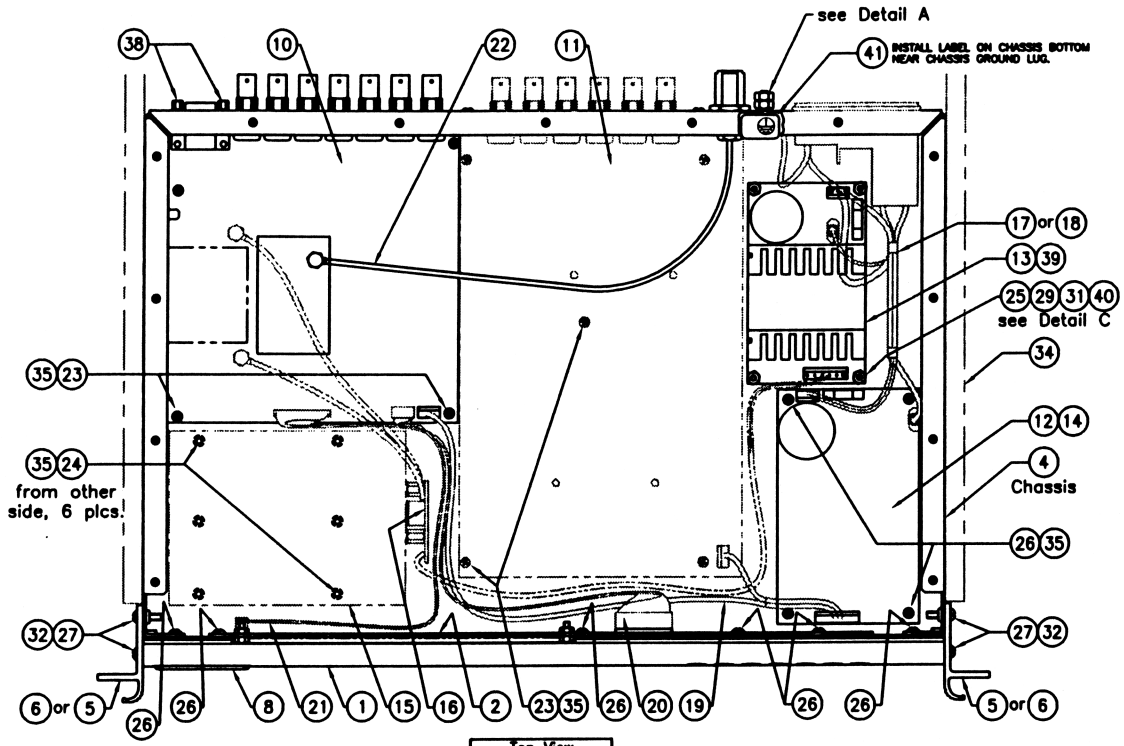
Detail C
Aux. Power Supply Mounting
Scale: 2x size

NOTES: UNLESS OTHERWISE SPECIFIED

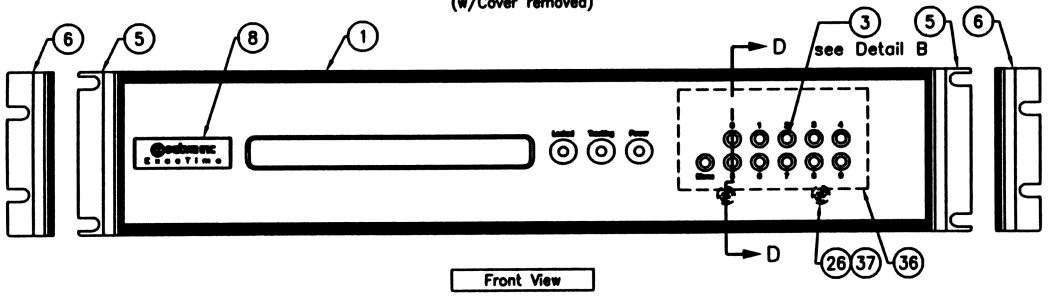
SIZE		SHT		OF		REV
C	A-9390-6000	2		2		M

CAD FILE NAME: A9390-6000M-2.dwg DISK NO. 105
ACAD 2000

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	Initial production release.	10/25/96	RdM/Omnica
B	Changes per ECO no. T7439.	10/29/97	RdM/Omnica
C	Changes per ECO no. T7486.	2/20/98	CFC
D	Changes per ECO'S T7770 and T7792.	10/2/98	E.H.
E	Changes per ECO T8110	03/28/00	GH/JL



Top View
Assembly
(w/Cover removed)



Front View
Assembly

ITEM	PART NUMBER	DESCRIPTION	<A>	<B>	<C>	<D>
41	925116	Label, Ground Symbol	1	1	1	1
40	2310-4000	Spacer, #4 x 1/8	–	4	–	4
39	711537-1	Power Supply Insulator	–	1	–	1
38	1790-2418-2	Standoff Kit, #4-40 x 3/16 (pair w/nuts & washers)	2	2	2	2
37	*6033	Washer, #6 x 3/8 od x 1/32 thk, Flat	2	2	2	2
36	711549	Machined Plastic Button Spacer	1	1	1	1
35	ANL-22	Thread Locking Compound	A/R	A/R	A/R	A/R
34	708882	Slide, Rack mount kit w/ screws	<J>	<J>	<J>	<J>
33	*8023	Washer, #8 internal star	4	4	4	4
32	*6034	Washer, #6 internal star	8	8	8	8
31	*4052	Washer, #4 internal star	8	12	13	17
30	*8019	Nut, #8-32 Hex, Steel	4	4	4	4
29	*4053	Nut, #4-40 Hex, Steel	–	4	–	4
28	*8013	Screw, #8-32 x 3/4 Phil pan hd., Zinc plated steel	1	1	1	1
27	*6018b	Screw, #6-32 x 1/2 Phil.pan hd, Black oxide	8	8	8	8
26	*6002	Screw, #6-32 x 1/4 Phil pan hd.	10	10	10	10
25	*4017b	Screw, #4-40 x 3/8 Phil 100deg flat hd., Black oxide	–	4	–	4
24	*4008b	Screw, #4-40 x 1/4 Phil 100deg flat hd., Black oxide	–	6	–	6
23	*4006	Screw, #4-40 x 1/4 Phil pan hd.	4	4	9	9
22	812502-14	Cable, Antenna	1	1	1	1
21	812362-39	Cable, LCD Data to Main PCB	1	1	1	1
20	812515-3	Cable, Front Display PCB to Main PCB, 12 in.	1	1	1	1
19	812515-2	Cable, Main Power Supply to Main & Mother PCBs	1	1	1	1
18	812515-6	Cable, AC Dual Power Supplies	–	1	–	1
17	812515-1	Cable, AC Inlet to Power supplies.	1	–	1	–
16	35012	LPRO Connector	–	1	–	1
15	1301-LPRO	LPRO Rubidium	–	1	–	1
14	711537-2	Power Supply Insulator	1	1	1	1
13	8010-7624	Power supply, 24 volt (B)	–	1	–	1
12	8010-LPT4-2	Power supply, 5volt (A)	1	1	1	1
11	35007	Assemby, Mother board PCB	–	–	1	1
10	35002-14	Assembly, Main PCB	1	1	1	1
9	925105	Label, Rear w/Serial number	1	1	1	1
8	925106	Label, Front panel, 'ExacTime'	1	1	1	1
7	711488	Option plate, 6BNC	–	–	1	1
6	711572-1	Extruded Rack Ears, 2U Full rack (painted)	<4>	<4>	<4>	<4>
5	711582-1	Extruded Rack Ears, Wide, 2U Full rack (painted)	<4>	<4>	<4>	<4>
4	711640	Chassis Assembly, 2U Full rack, 'ExacTime'	1	1	1	1
3	951066	Buttons, Molded silicon, 2x7 array	1	1	1	1
2	55175	Assembly, Front Display PCB, 2U Full rack	1	1	1	1
1	711638-2	Front Panel, 2U Full rack, wo/'ExacTime' Printing	1	1	1	1

PARTS LIST

<4> Optional Rack Ears available for all models:

Part No.	Description	Std.	Opt.
711582-1	Extruded Rack Ears, Wide, 2U Full rack (painted)	2	–
711572-1	Extruded Rack Ears, 2U Full rack (painted)	–	2

Option Key	
OPTION	DESCRIPTION
<A>	'Datum' base assembly
<B>	'Datum' w/Time cell
<C>	'Datum' w/Mother board
<D>	'Datum' w/Time cell & Mother board

<J> Optional kit available for all models.

2. Reference design layout DATUM\LAYDHF.dwg (Autocad R13).
1. Dimensions shown are in inches. Dimensions within () are for reference only, not to be applied to critical features.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: X ±0.03 X.XX ±0.010 ANGLES ±1°/2

TITLE: ExacTime – TC&FG, 2U Full rack

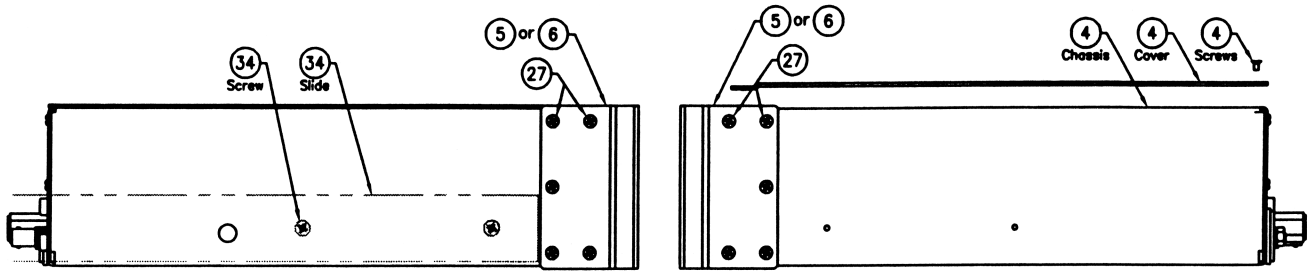
datum inc

DWN	RdM/Omnica	10/24/96	DES		
CHK	CFC	11/7/97	ENGR	CFC	11/7/97
SCALE	1/2 size		PRC	CJPN2	

C A-9390-6010 E

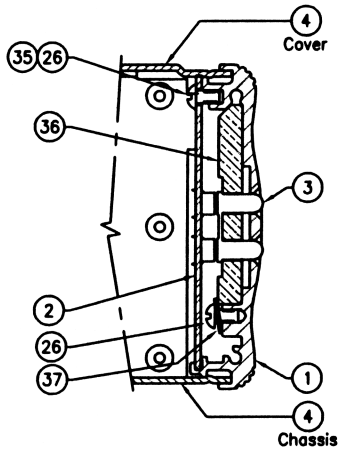
SIZE | SHT 1 OF 2 | REV

CAD FILE NAME: A9390-6010E-1.dwg DSK NO. 105 ACAD 2000

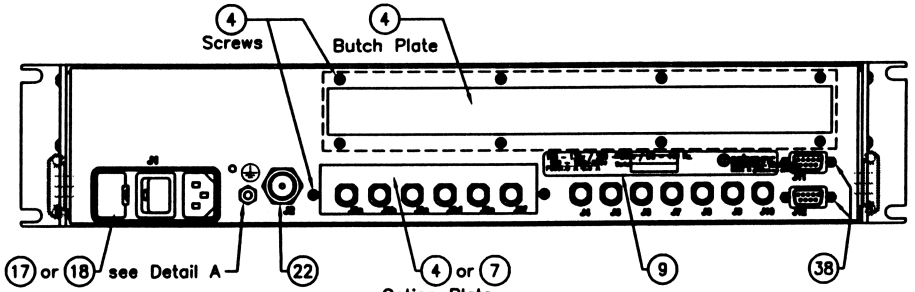


Left View
Assembly
(shown upright)
(w/Opt. Rack Slide)

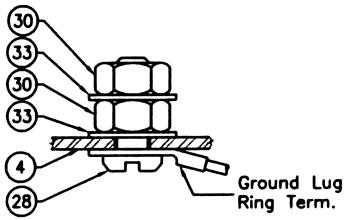
Right View
Assembly
(shown upright)
(w/Cover removed)



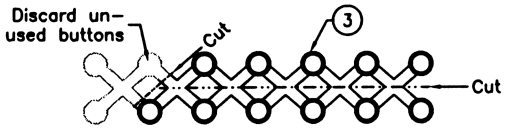
Section D–D
Thru Front Panel
Scale: Full size



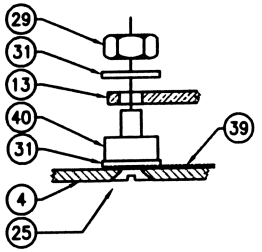
Rear View
Assembly
(shown upright)



Detail A
Ground Stud Mounting
Scale: 2x size



Detail B
Button Array modification
Scale: 2x size



Detail C
Aux. Power Supply Mounting
Scale: 2x size

NOTES: UNLESS OTHERWISE SPECIFIED

C	A-9390-6010	E
SIZE	SHT 2 OF 2	REV

DWG FILE NAME:A9390-6010E-2.dwg DISK NO. 105
ACAD 2000

LTR	DESCRIPTION	DATE	APPROVED
C	REVISED PER ECO T7317	6/26/96	F A
D	REVISED PER ECO T7336	8/1/96	F A
F	REVISED PER ECO T7392	3/19/97	F A
G	REVISED PER ECO T7401	8/1/97	F A
H	REVISED PER ECO T7749	5/2/98	G H
J	REVISED PER ECO T7746	5/27/98	G H
K	REVISED PER ECO T7809	8/18/98	G H
L	REVISED PER ECO T7828	9/21/98	G H
M	REVISED PER ECO T7828-2	12/3/98	B H
N	REVISED PER ECO T7987	6/24/99	G H
P	REVISED PER ECO T8044	1/11/00	G H

RESISTORS 0805 1%, 1210 5%
CAPACITORS <1000 PF 5%, ALL OTHERS 20%
DRAWINGS ASSEMBLY A35002
FABRICATION 172435J

△7 NOT USED ON -6 ASSY

△E Y2, J33 AND 55162 (ONCORE BOARD) ARE USED ON -6 ASSY
J13, J27 AND 55146 ARE NOT USED ON -6 ASSY

△5 U21, U22 AND U24 ARE USED ON -5 ASSY

△4 R1 AND R26 ARE USED ON -4 ASSY
R2 AND R25 ARE NOT USED ON -4 ASSY

△3 Y1 IS USED ON -3 ASSY P/N 1301-3083-2

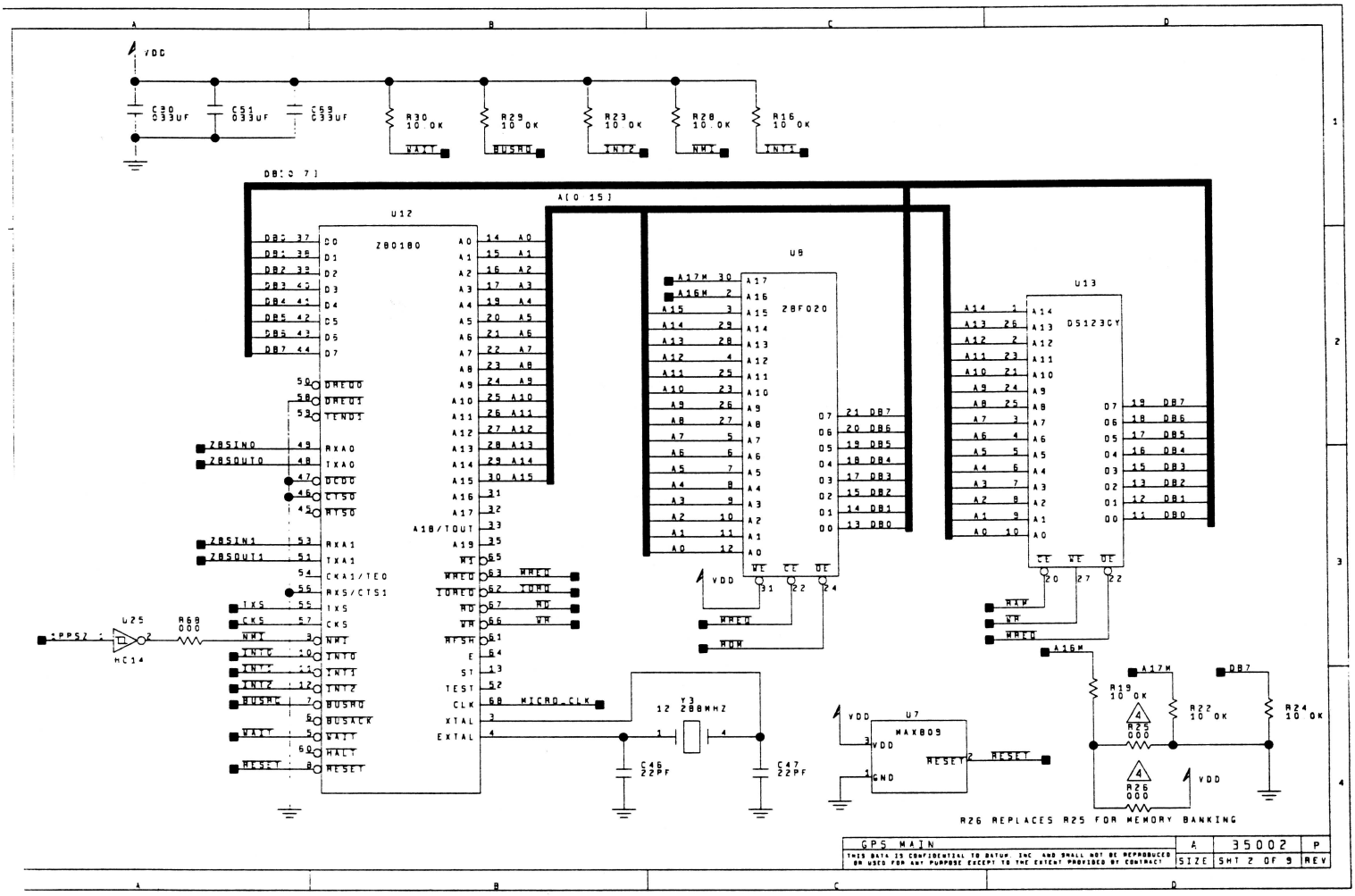
△2 Y1 IS USED ON -2 ASSY P/N 1301-3083-1

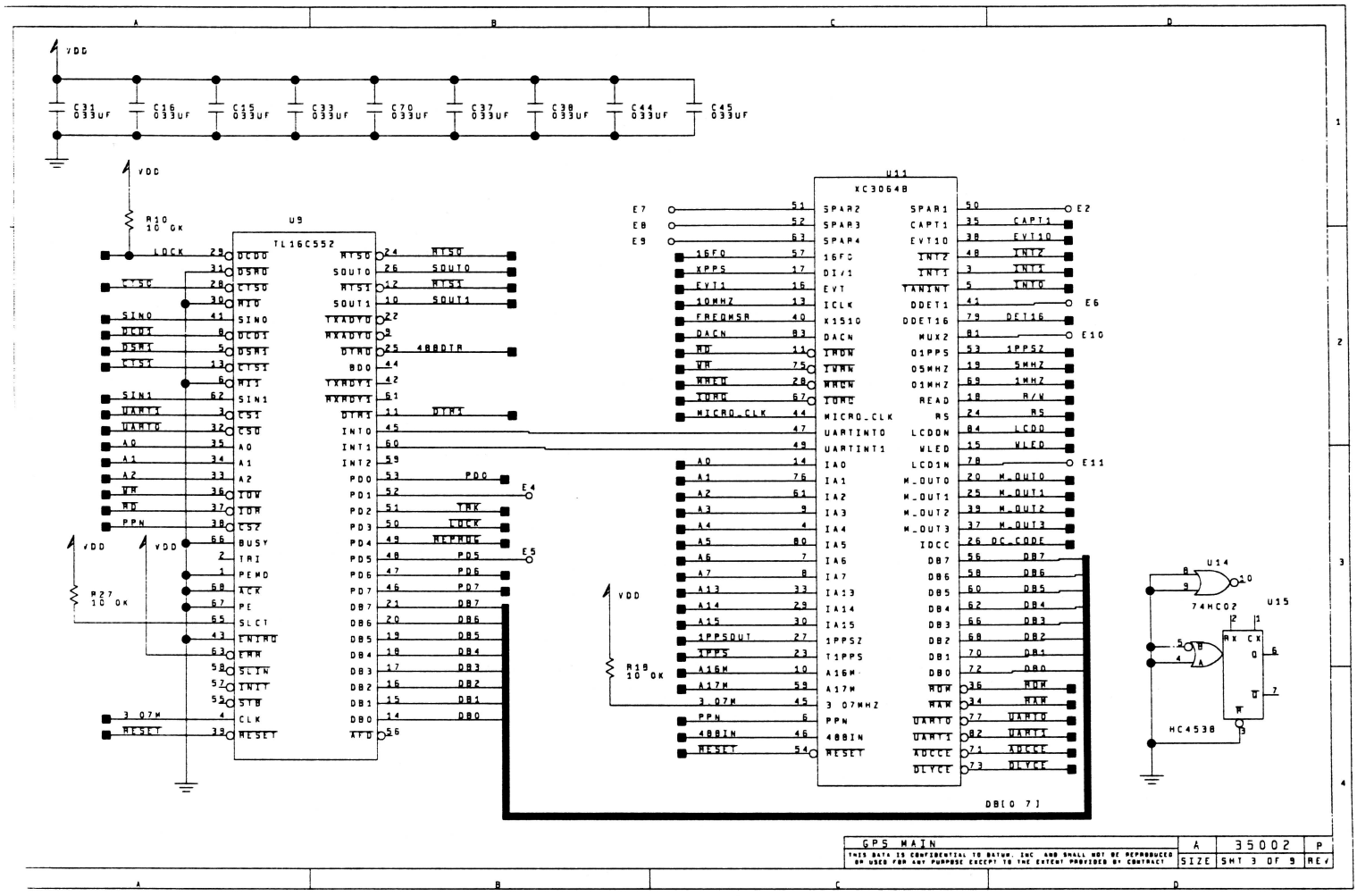
△1 Y2, J27 AND 55146 (S\S CM3 BOARD) ARE USED ON -1 ASSY
R96 IS NOT USED ON -1 ASSY

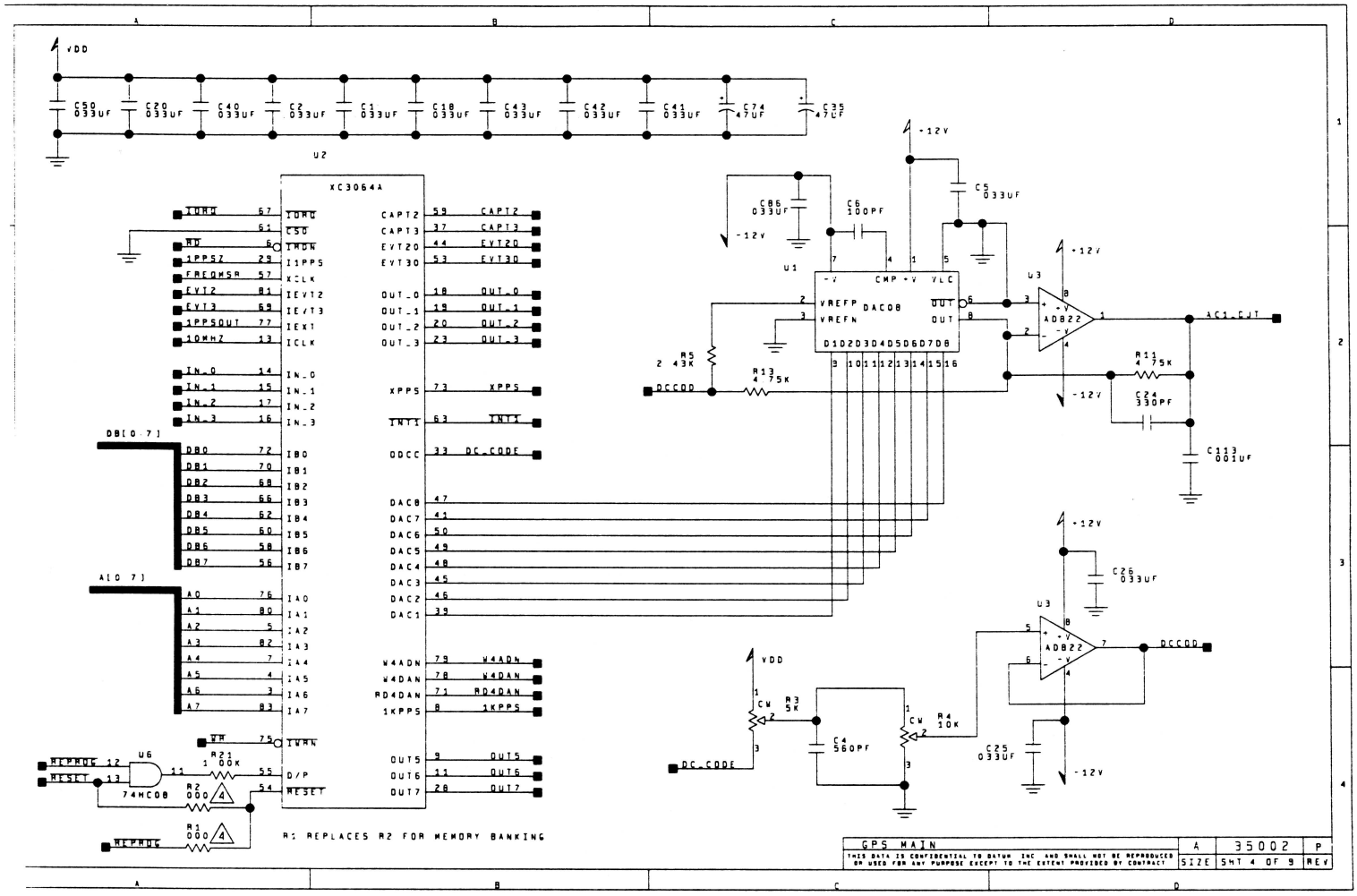
TITLE
GPS
MAIN

DWN		datum inc		
DES				
CHK				
ENGR F AMSBAUGH	10/23/95	A	35002	P
SCALE NONE	FSC 0JPN2	SIZE	SHT 1 OF 9	REV

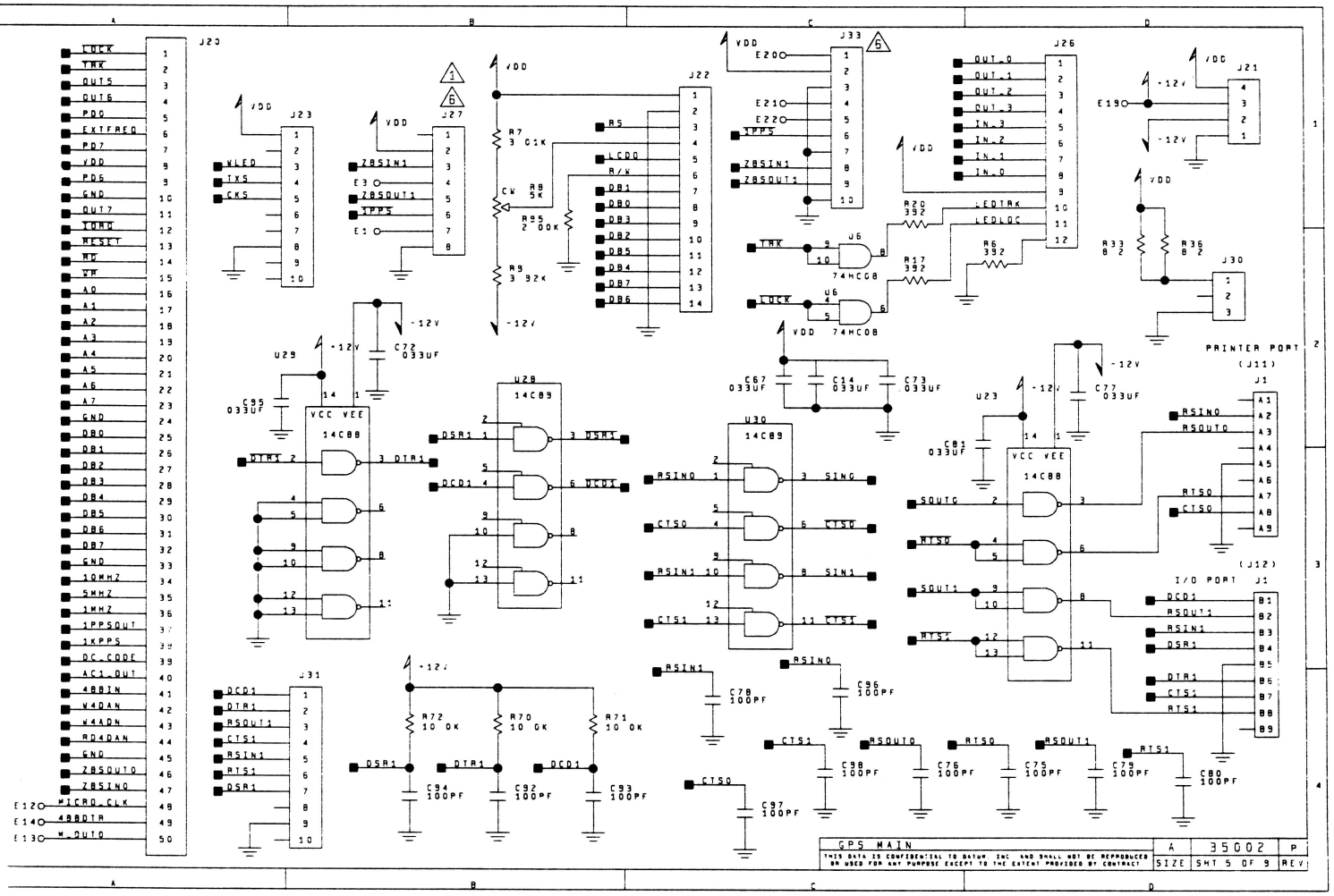
DISK NO 348P VIEWLOGIC

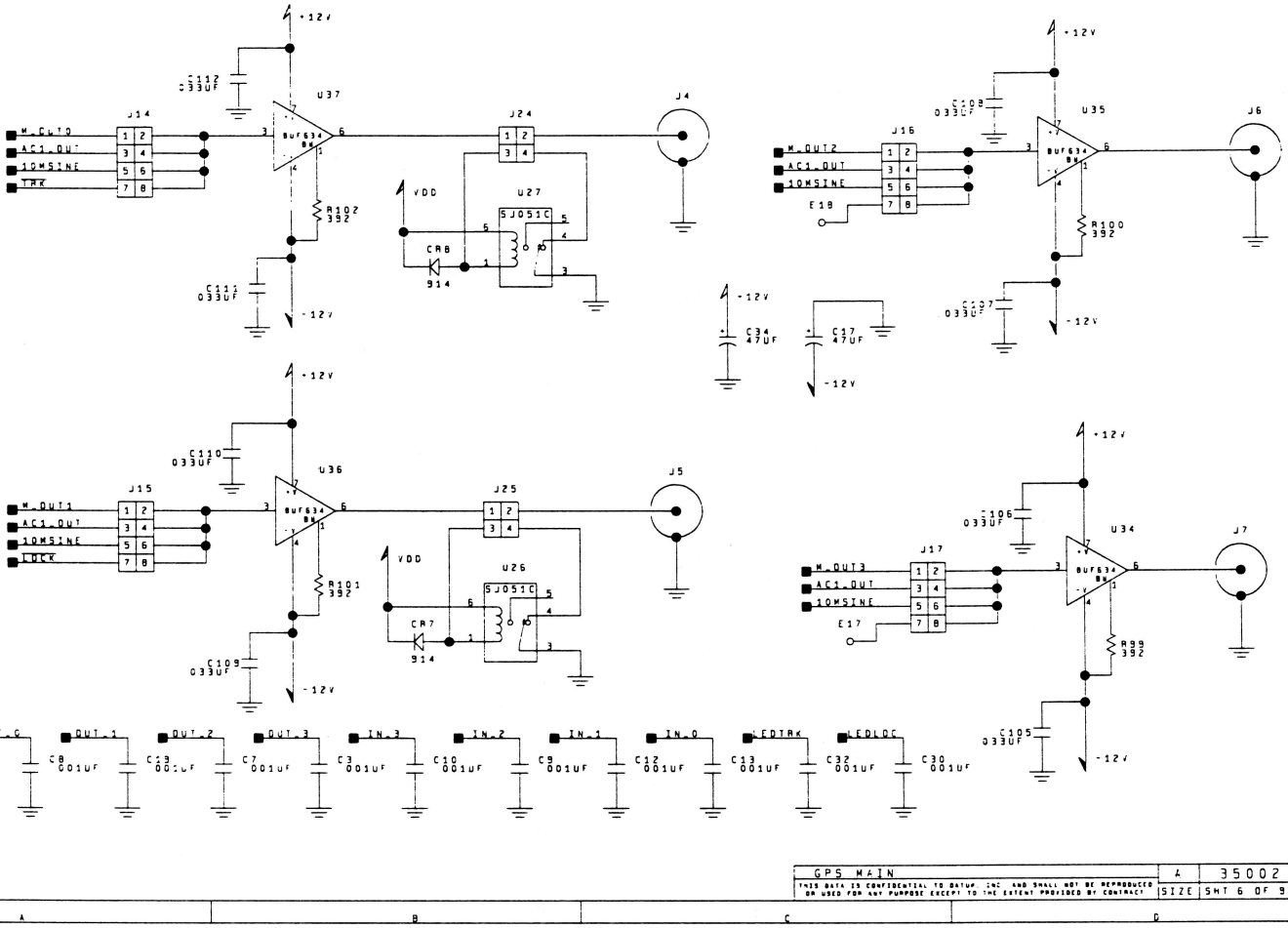

VDD
C30 .033UF
C51 .033UF
C53 .033UF
R30 10.0K
R29 10.0K
R23 10.0K
R28 10.0K
R16 10.0K
WAIT
BUSRQ
INT2
NMI
INT1
DB[0:7]
A[0:15]
U12
Z80180
U8
28F020
U13
DS1230Y
Z85IN0
Z85OUT0
Z85IN1
Z85OUT1
1PPS2
U25
HC14
R68 000
MICRO_CLK
Y3
12.288MHZ
C46 22PF
C47 22PF
U7
MAX809
RESET
R19 10.0K
R22 10.0K
R24 10.0K
R25 000
R26 000
R26 REPLACES R25 FOR MEMORY BANKING
GPS MAIN
THIS DATA IS CONFIDENTIAL TO DATUM, INC. AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT
A
35002
SIZE
SHT 2 OF 9
REV


VDD
C31 .033UF
C16 .033UF
C15 .033UF
C33 .033UF
C70 .033UF
C37 .033UF
C38 .033UF
C44 .033UF
C45 .033UF
R10 10.0K
U9
TL16C552
U11
XC3064B
R27 10.0K
R19 10.0K
U14
74HC02
U15
HC4538
DB[0 7]
GPS MAIN
THIS DATA IS CONFIDENTIAL TO DATUM, INC AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT
A
35002
SIZE
SHT 3 OF 9
REV

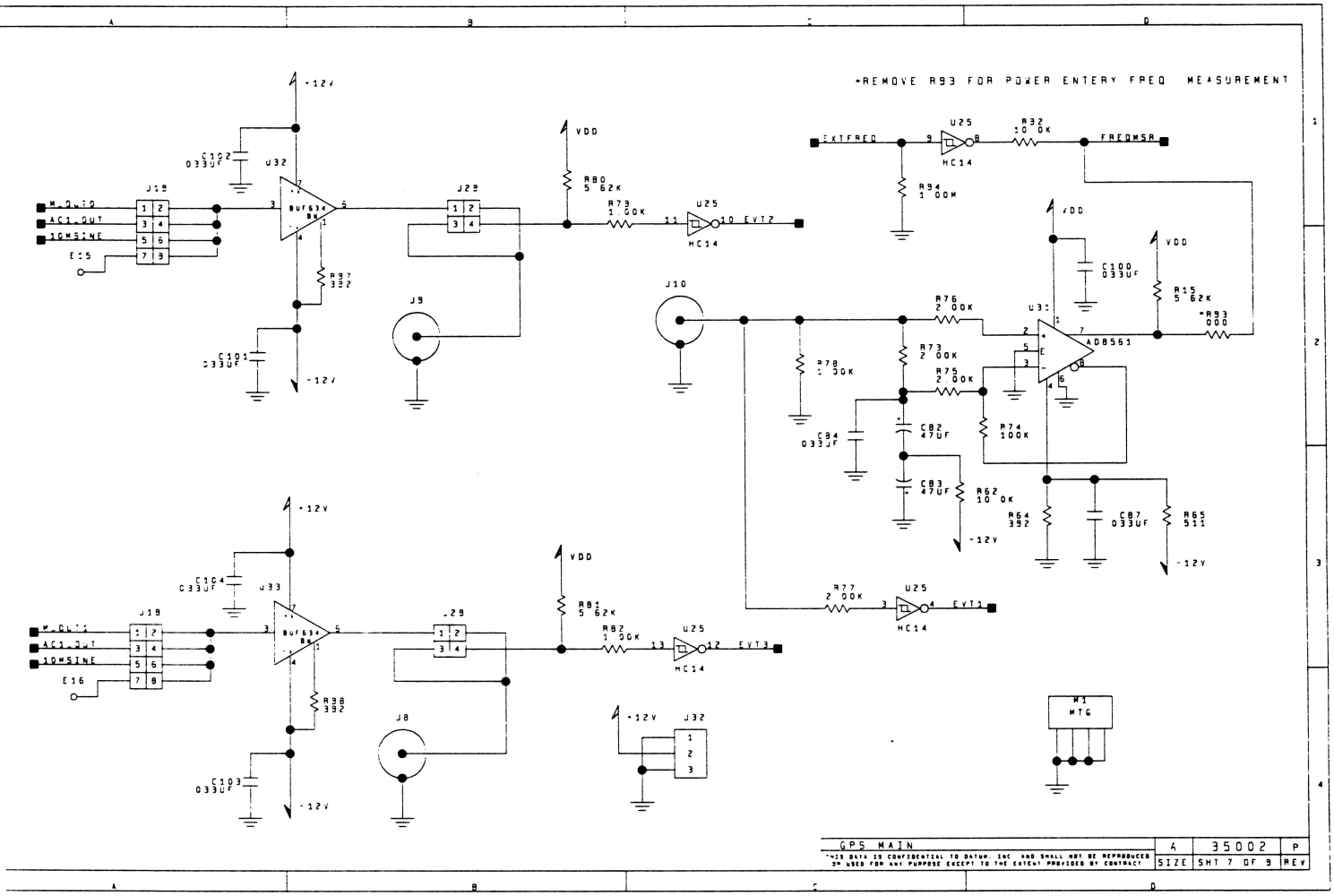


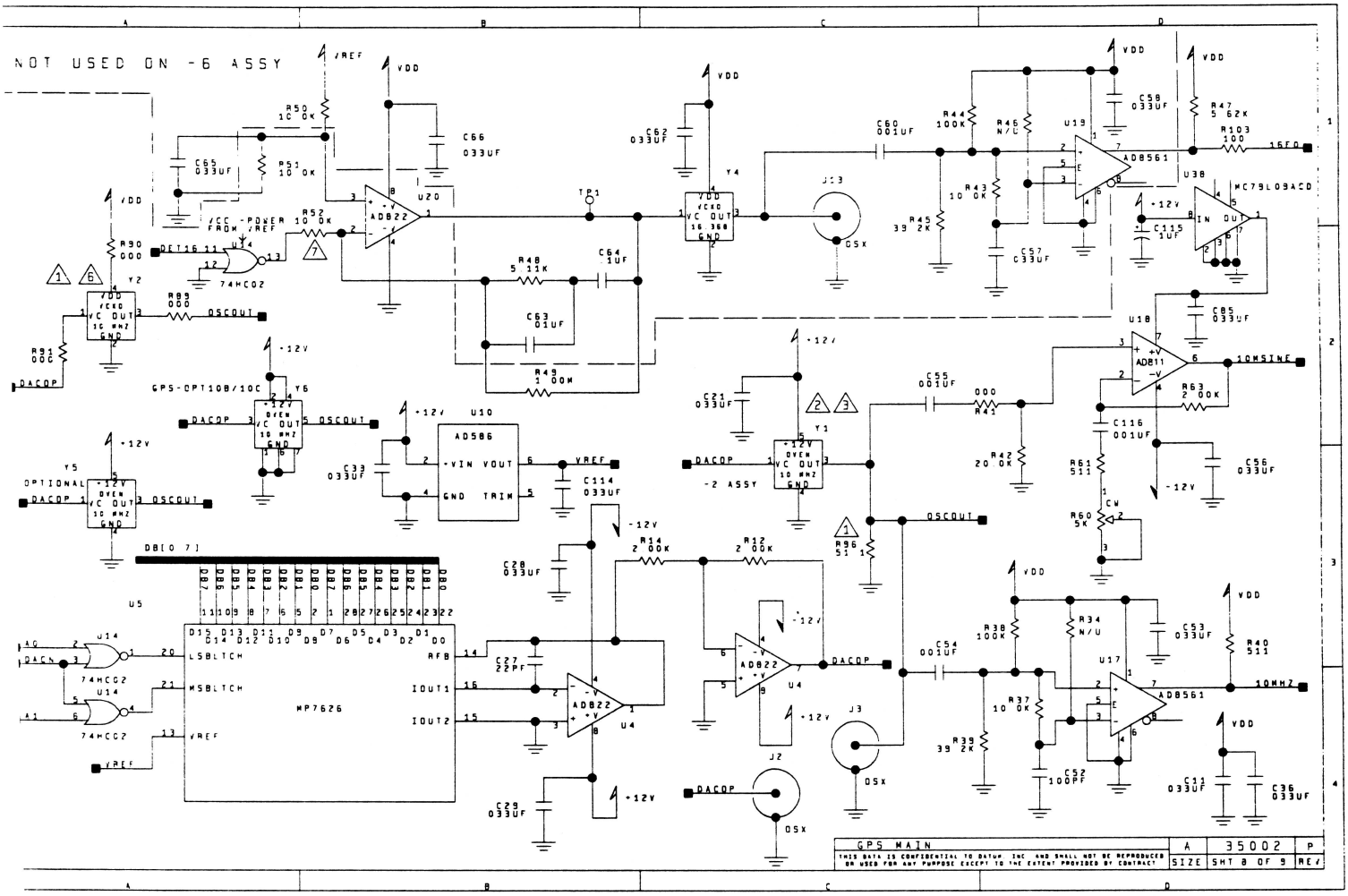
GPS MAIN	A	35002	P
THIS DATA IS CONFIDENTIAL TO DATUM INC AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT	SIZE	SHT 4 OF 9	REV

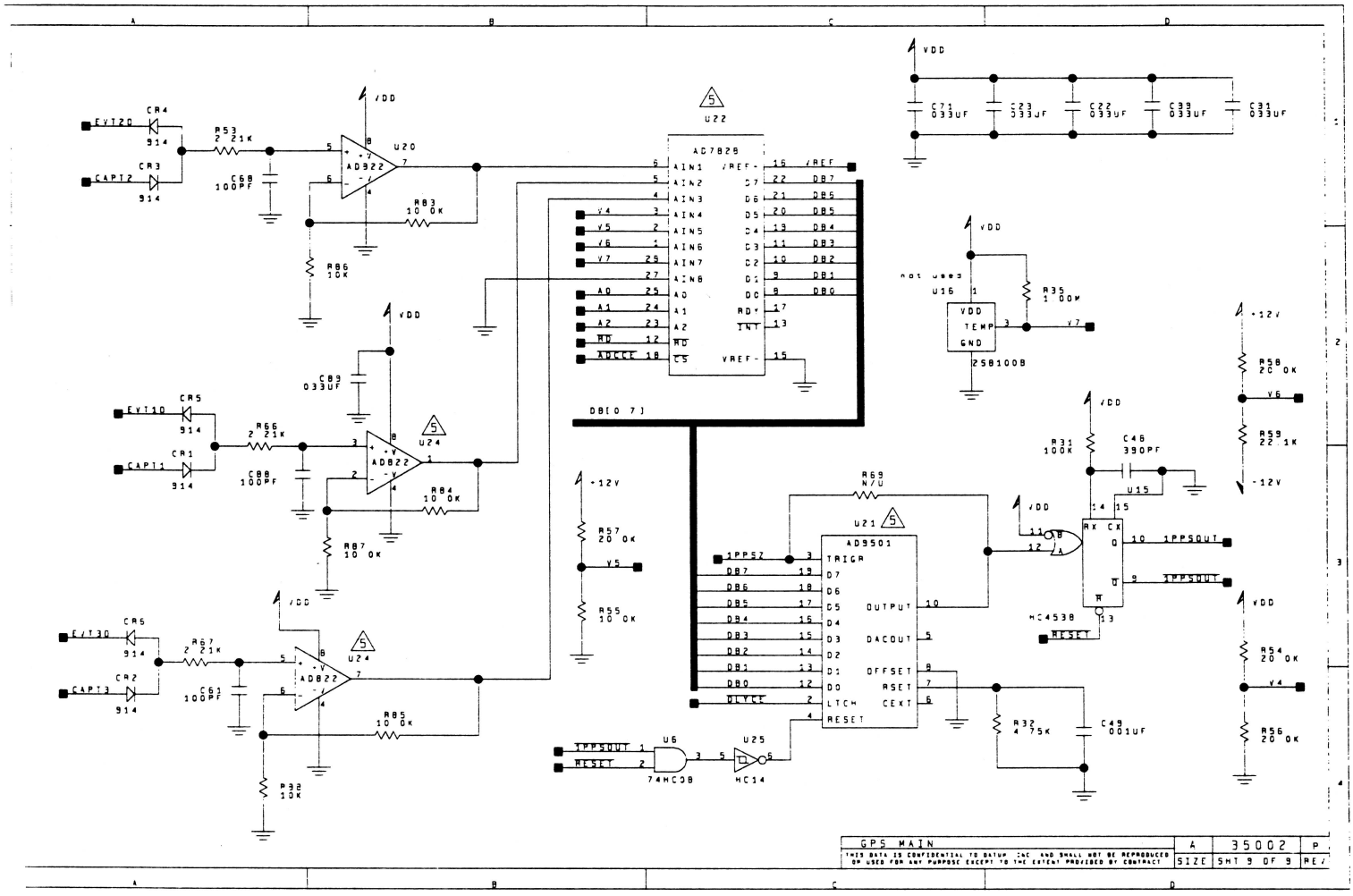

J20
LOCK
TMK
OUT5
OUT6
PD0
EXTFREQ
PD7
VDD
PD5
GND
OUT7
TONE
RESET
MD
WR
A0
A1
A2
A3
A4
A5
A6
A7
GND
DB0
DB1
DB2
DB3
DB4
DB5
DB6
DB7
GND
10MHZ
5MHZ
1MHZ
1PPSOUT
1KPPS
DC_CODE
AC1_OUT
488IN
W4DAN
W4DN
RD4DAN
GND
ZBSOUT0
ZBSIN0
MICRO_CLK
488DTR
W_OUT0
J23
VLED
TXS
CKS
J27
ZBSIN1
E3
ZBSOUT1
1PPS
E1
J22
R5
LCDO
R/W
DB1
DB0
DB3
DB2
DB5
DB4
DB7
DB6
R7 3 01K
CW
R8 5K
R95 2 00K
R9 3 92K
J33
E20
E21
E22
1PPS
ZBSIN1
ZBSOUT1
J26
OUT_0
OUT_1
OUT_2
OUT_3
IN_3
IN_2
IN_1
IN_0
J21
E19
R30 392
R6 392
R17 392
LEDTRK
LEDLOC
R33 8 2
R36 8 2
J30
U6
74HC08
U29
VCC VEE
14C88
U28
14C89
U30
U23
C72 033UF
C67 033UF
C14 033UF
C73 033UF
C77 033UF
C85 033UF
C81 033UF
C78 100PF
C96 100PF
C98 100PF
C76 100PF
C75 100PF
C79 100PF
C80 100PF
C97 100PF
C94 100PF
C92 100PF
C93 100PF
R72 10 0K
R70 10 0K
R71 10 0K
J31
DCD1
DTR1
RSOUT1
CTS1
RSIN1
RTS1
DSR1
PRINTER PORT
(J11)
J1
I/O PORT
(J12)
RSIN0
RSOUT0
RTS0
CTS0
SOUT0
SOUT1
SIN0
SIN1
GPS MAIN
THIS DATA IS CONFIDENTIAL TO DATUM INC AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT
A
35002
SIZE
SHT 5 OF 9
REV



GPS MAIN	A	35002	P
THIS DATA IS CONFIDENTIAL TO DATUM INC AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT	SIZE	SHT 6 OF 9	REV

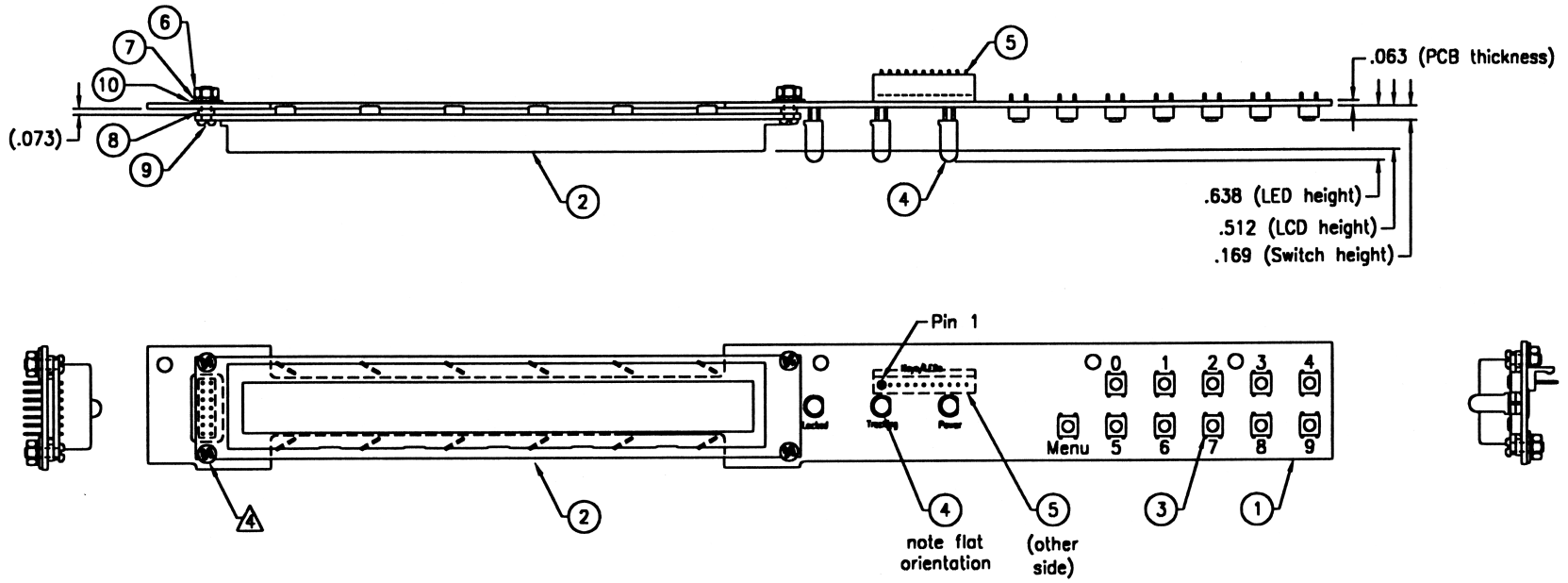

*REMOVE R93 FOR POWER ENTERY FREQ MEASUREMENT
+12V
C102 .033UF
U32
J18
M_CLK
AC1.OUT
10MSINE
E15
Buf634
J29
R80 5.62K
VDD
R78 1.00K
U25
HC14
EVT2
R97 332
C101 .033UF
-12V
J9
J10
EXTFREQ
R94 1.00M
R32 10.0K
FREQMSR
C100 .033UF
R15 5.62K
*R93 000
U31
AD8561
R76 2.00K
R73 2.00K
R75 2.00K
R78 1.00K
C84 .033UF
C82 47UF
R74 100K
C83 47UF
R62 10.0K
R64 392
C87 .033UF
R65 511
R77 2.00K
EVT1
C104 .033UF
U33
R81 5.62K
R82 1.00K
R38 392
C103 .033UF
J8
J32
M1 MTG
GPS MAIN
A
35002
P
SIZE
SHT 7 OF 9
REV

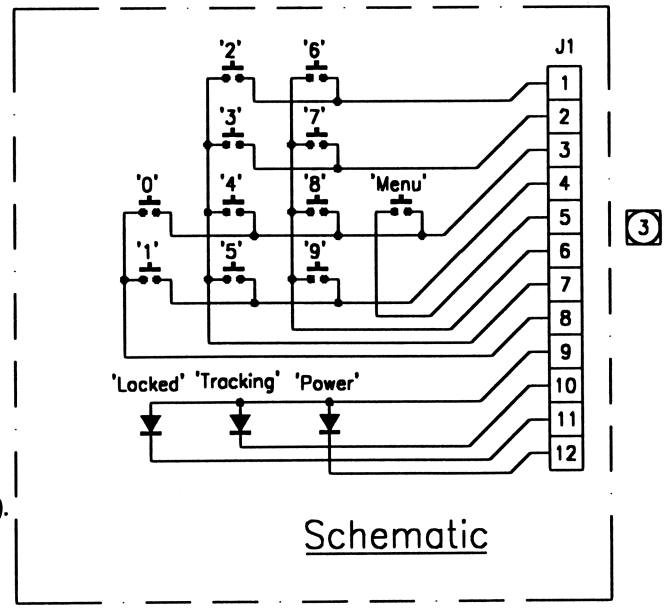

NOT USED ON -6 ASSY
GPS-OPT10B/10C
OPTIONAL
-2 ASSY
MP7626
AD822
AD586
AD8561
AD811
MC79L09ACD
74HC02
74HC32
74HC00
GPS MAIN
35002
SHT 8 OF 9



GPS MAIN	A	35002	P
THIS DATA IS CONFIDENTIAL TO DATUM, INC. AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT	SIZE	SHT 9 OF 9	REV

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO T7586	3/5/98	G.H.
B	REVISED PER ECO T7988	7/9/99	G.H.
C	REVISED PER ECO T7988-1	7/15/99	G.H.





Schematic

ITEM	PART NUMBER	DESCRIPTION	QUAN
10	*4049	Washer, #4 Flat	4
9	*4014	Screw, 4-40x.375 phillips pan head	4
8	*70838	Spacer, #4 x .070	4
7	*4048	Washer, #4 Split	4
6	*4054	Nut, 4-40 hex, radio	4
5	1708-0012-3	Connector, Header, .025"sq. vertical single .100"row x12pin	1
4	2204-3680	Lamp, LED, T-1 3/4	3
3	1204-1002	Switch, SPST momentary pushbutton	11
2	2206-4002	Display module, LCD	1
1	1724900	PCB, Front Display, Full rack (single ht.)	1

PARTS LIST

4 Do not install items 6 thru 10 on this hole when LCD P/N 2206-5002 is used.

3 Spacer lenght may be varied to maintain proper LCD height.

2. Reference SCHEMATIC AND ASSY. AID 55173.dwg (Autocad R13).

1. Dimensions shown are in inches. Dimensions within () are for reference only, not to be applied to critical features.

NOTES: UNLESS OTHERWISE SPECIFIED

TITLE: FRONT DISPLAY (1U, FULL RACK)

datum inc

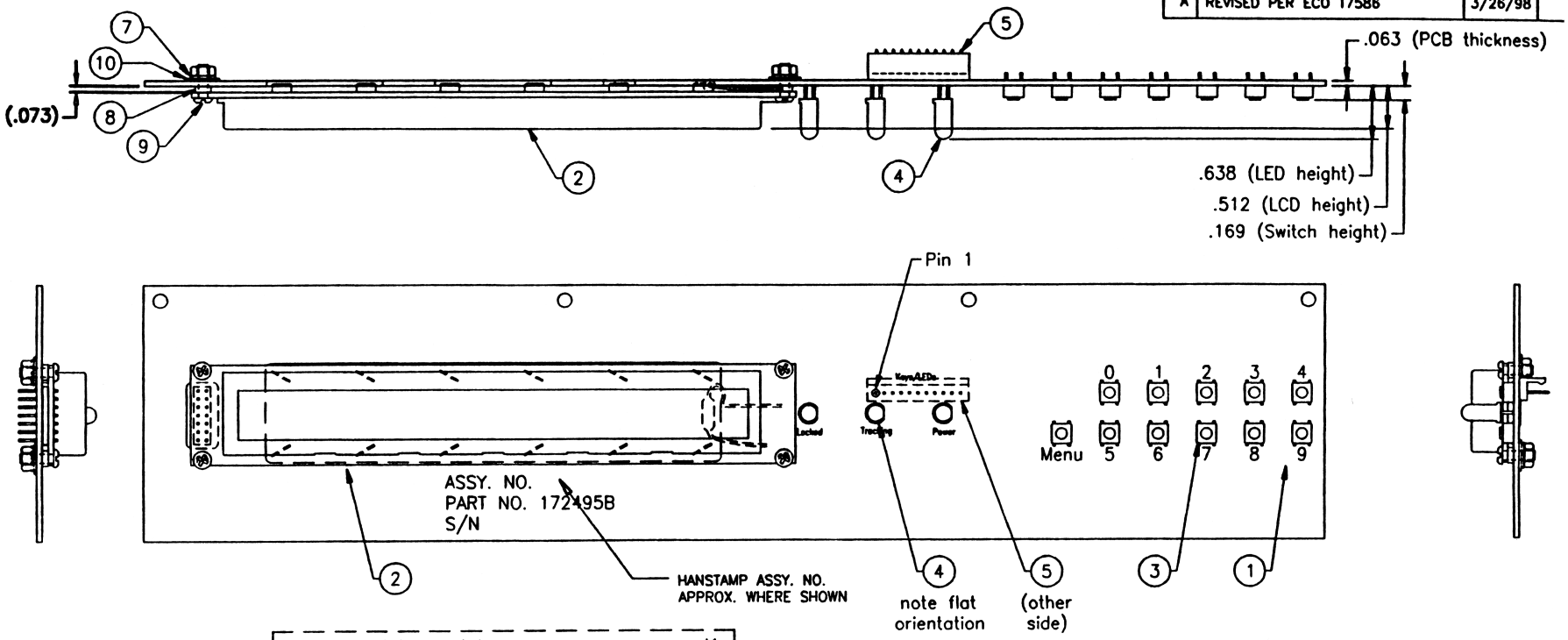
DRN G. BAUER 7/9/99 | DES | CHK C. HAMMOND 7/9/99 | APP | DATE | SCALE 1/1 | FSC

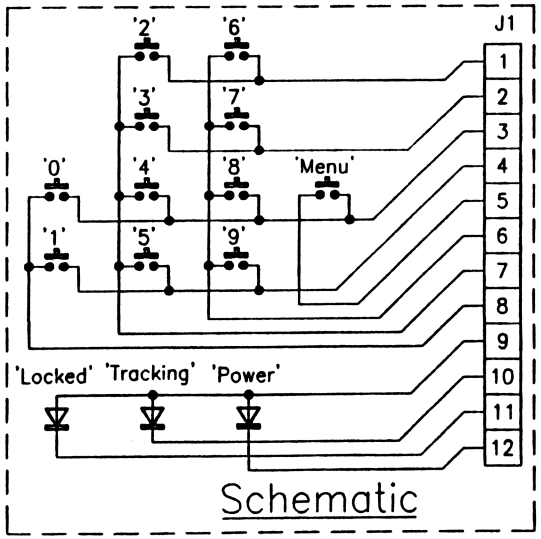
C | 55173 | C

SIZE | SHT 1 OF 1 | REV

FILE NAME: 55173C.DWG
DISK NO. 4110-1 ACAD R14

REVISIONS			
LTR	DESCRIPTION	DATE	APP
A	REVISED PER ECO T7586	3/26/98	





ITEM	PART NUMBER	DESCRIPTION	QU
10	*4049	Washer, #4 Flat	
9	*4014	Screw, #4-40 x .38 Phillips pan head	
(3) 8	**7083B**	**Spacer, #4 x .070**	
7	*4048	Washer, #4 Split	
6	*4054	Nut, #4-40 Hex, radio	
5	1708-0012-3	Connector, Header, .025"sq. vertical single .100"row x12pin	
4	2204-3680	Lamp, LED, T-1 3/4	
3	1204-1002	Switch, SPST momentary pushbutton	
2	**2206-4002**	Display module, LCD	
1	**172495B**	PCB, Front Display, 2U Full rack	

PARTS LIST

(3) Spacer length may be varied to maintain proper LCD height.

2. Reference SCHEMATIC AND ASSY. AID 55175.dwg (Autocad R13).

1. Dimensions shown are in inches. Dimensions within () are for reference only, not to be applied to critical features.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL: .XX ±.03 .XXX ±.010 ANGLES ±1/2°

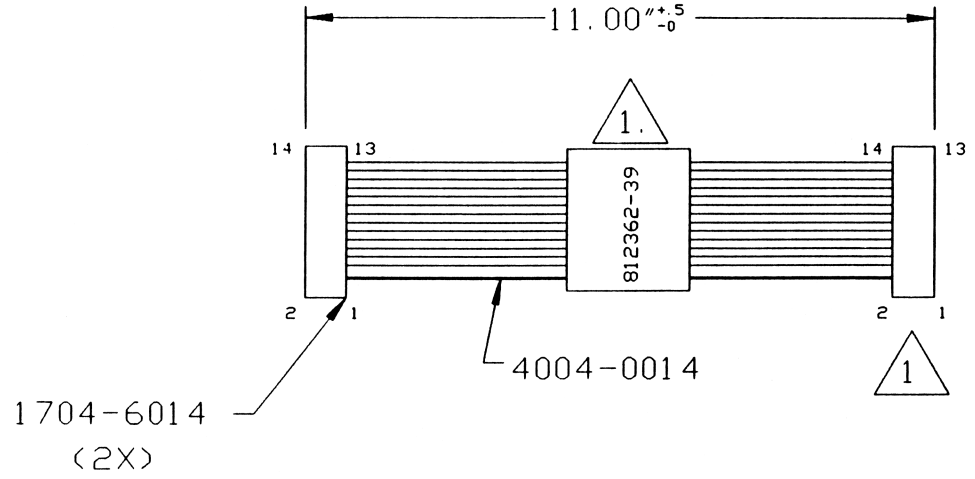
TITLE: FRONT DISPLAY 2U FULL RACK

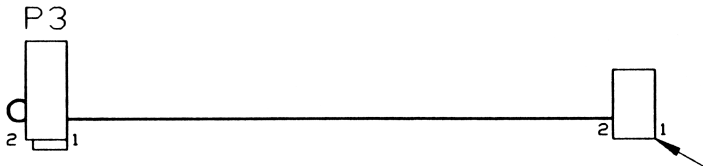
datum inc

DWN	G BAUER	11-5-97	
CHK			
ENGR	G HAMMOND	3/26/98	
SCALE	1/1	FSC 31180	

C 55175

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED





USED ON 9390-6000 ASSY

1. HANDSTAMP "P" NO. AND IDENTIFY WITH PART NO. IN CENTER OF CABLE WITH PLASTIC TAPE AND HANDSTAMP.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL: .XX ±.03 .XXX ±.010 ANGLES ±1/2°

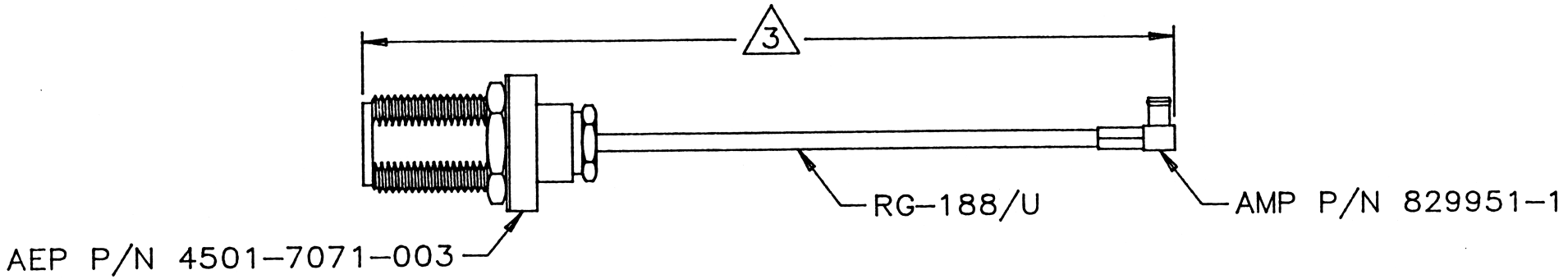
TITLE: CABLE ASSY

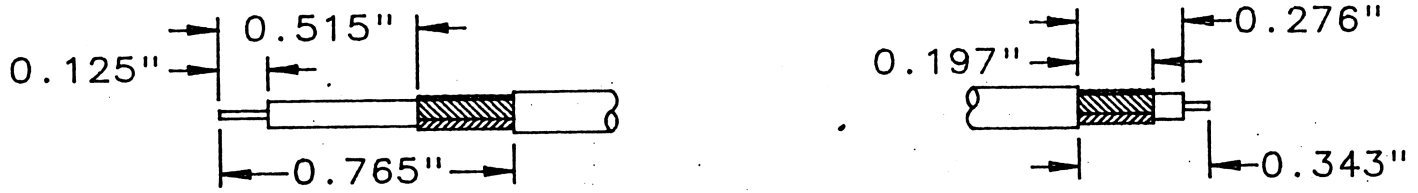
datum, inc

DWN ESTHER HERAS	7/5/96	DES		A	812362-39	
CHK		ENGR	8/96			
SCALE NONE		FSC 31160		SIZE	SHT 1 OF 1	REV

CAD FILE NAME: 81236239 DWG DISK NO 01
AUTOCAD R13

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVE





RECOMMENDED STRIPPING DIMENSIONS
SCALE 2/1

3. DASH NUMBER EQUALS LENGTH IN INCHES ±0.5".
2. TOLERANCE FOR STRIPPING DIMENSIONS IS ±0.016".
1. IDENTIFY CABLE AS 812502 AT MIDPOINT OF CABLE.

NOTES: UNLESS OTHERWISE SPECIFIED

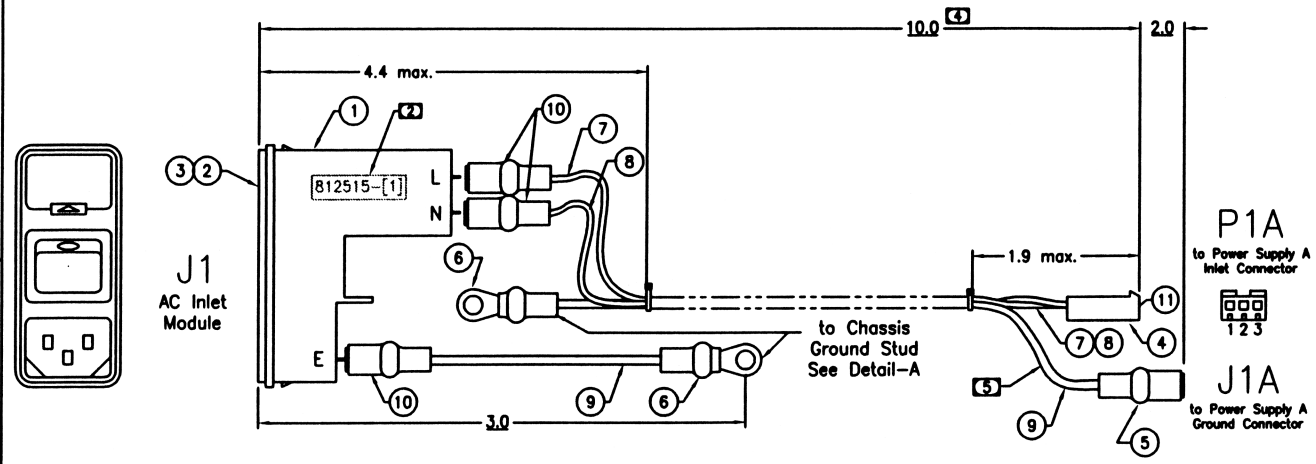
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL: .XX ±.03 .XXX ±.010 ANGLES ±1/2°

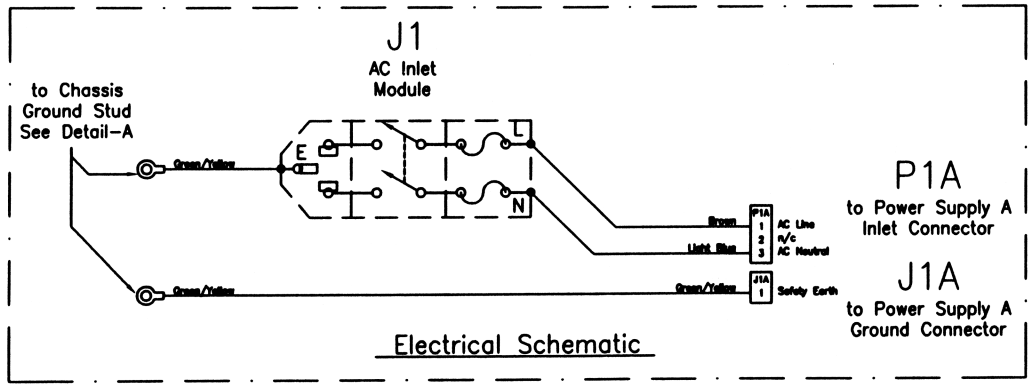
TITLE: CABLE ASSEMBLY

DWN CARY	11-30-95	DES	
CHK		ENGR Galt	1/96
SCALE 1/1		FSC 31160	

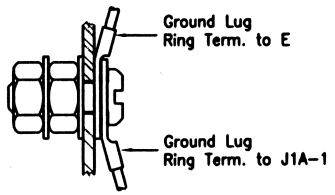
datum inc.
1363 S.STATE COLLEGE BLVD.
ANAHEIM, CALIFORNIA 92806

SIZE		REV
A	812502	
	SHT 1 OF 1	





Electrical Schematic



Detail A
Ground Stud Mounting

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	Initial Production Release	6/12/96	DSK/Omnica
B	Swapped Black & White Lines	6/17/96	DSK/Omnica
C	P/N was 812515-X, file was 812515.dwg.	6/18/96	RdM/Omnica
D	Added: Item 4 p/n. Changed: Drawing name was '...to Pwr.Supplies' GA1, Item 12 was 'Tie wrap'; Item 7 & 8 quan was 6" GA1; Item 9 quan was 11" GA1; 'J1' was 'P1' GC3 & C4; 'P1A' was 'P3' GC1 & B2; 'J1A' was 'P6' GC1 & B2; 'Chassis Stud' was 'P2' GB4. Removed: Option table GA3; Options '-2' & '-3' (see dwg.812515-6); connectors 'P5' & 'P4' GC2 & B2.	6/26/96	RdM/Omnica
E	Removed: Item 13, 'Label, Part Number'; Note 2, variables for part number, Datum assigned vendor code, and current revision, year, and month.	7/16/98	DSK/Omnica
F	ECO#17779-1: ; Item 6 chg. Qty fr 1 to 2; Item7 added P/N & Chg. wire color; Item 8 added P/N & Chg wire color; Item 9 added P/N; Item 10 del. desc. (Solder & Qty o/r) & added P/N & Desc. (Term. Red); Item 11 del. desc. (Nshrink & Qty 1.5"); Item 12 moved to 11 & Del. Item 12;	10/13/98	G.H.
G	ECO#17941: Item #4, Replaced PN#1704-3031 with PN#1704-8031, Item #11, Replaced PN#1782-0852 Replaced with PN#1792-0111.	4/01/99	G.H.
H	Revised per ECO# T8110	3/28/00	GH/JL

ITEM	PART NUMBER	DESCRIPTION	QUAN
11	1792-0111	Contact, Terminals. Molex PN# 08-58-0111	2
10	*7070	Terminal, quick-disconnects (Red)	3
9	4005-1015-54	Wire, UL1015 #20AWG, Green w/Yellow stripe	15"
8	4005-1015-6	Wire, UL1015 #20AWG, Lt. Blue	10"
7	4005-1015-1	Wire, UL1015 #20AWG, Brown	10"
6	5442-22	Terminal, Ring, #8,	2
5	18RA-2577	Terminal, Slide-on, 1/4" fem.	1
4	1704-8031	Connector, .156" Header, 1x3 pin Fem. Molex PN# 09-50-8031	1
3	0702-0010-1	Fuse, 1A, 250V, SB, 5X20MM	2
2	0750-4303-1	Power Entry Fuse Drawer: 2 Pole 5X20MM	1
1	1704-KD14	Power Entry Module	1

PARTS LIST

[4] Measured along wire.

3. Reference design layout DATUM\LAYSHF.dwg (Autocad R13).

[2] Mark as shown, using 3.0[.12] high characters.

1. Dimensions shown are in inches. Dimensions within () are for reference only, not to be applied to critical features.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES FRACT ±1/32 .XX ±0.02 .XXX ±0.010 ANGLES ±1/2°

TITLE: Cable assembly, AC Inlet to Pwr.Supply

datum inc

DRN RdM/Omnica 6/26/96 DES

CHK DSK/Omnica 6/12/96 ENGR

SCALE Full PSC OJPN2

SIZE C 812515-1 REV H

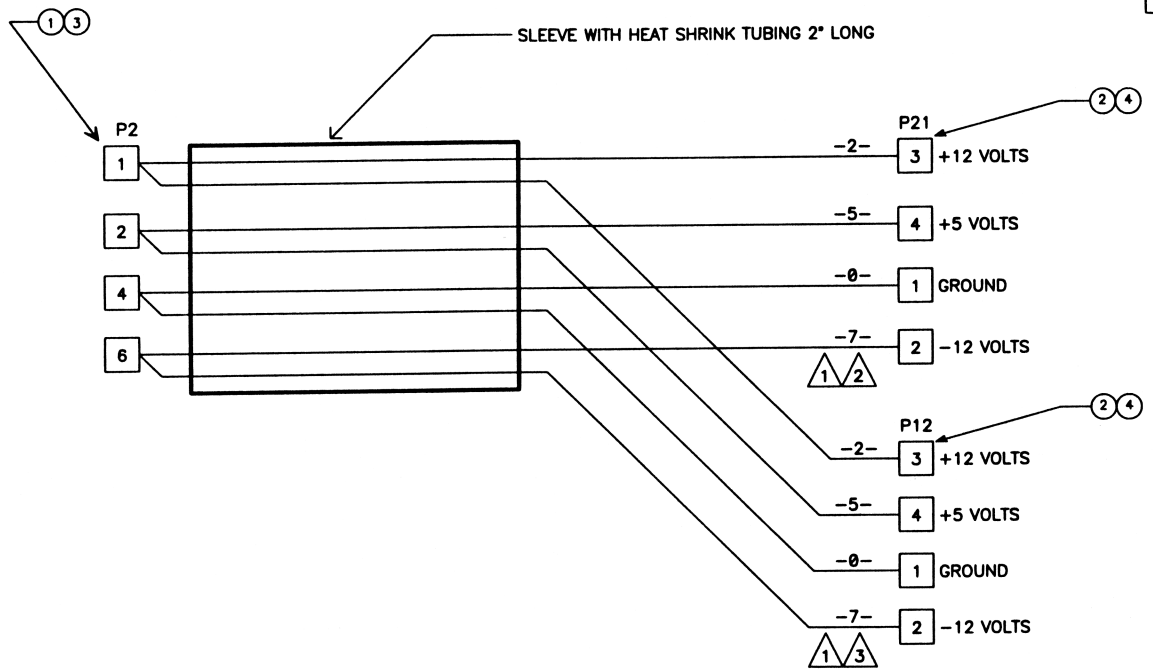
SHT 1 OF 1

ACAD 2000 CAD FILE NAME: 812515-1H.dwg DISK NO.

DWG. NO.	SH	REV.

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
—	Production Release	7/26/96	CFC
A	Chg Per ECO T7941: Item 1: Chg P/ N fr. 1704-3031 to 1704-8031. Item 3: Chg P/N fr. 1792-0852 to 1792-0111. Note 3: Extented cable length 2".	4/02/99	G.H.



ITEM	PART NUMBER	DESCRIPTION	QUAN
4	1792-SVH2	Connector: Socket	8
3	1792-0111	Contact, Terminal Molex PN# 08-58-0111	4
2	1704-VHR4	Connector .156" Header, 1x4 pin Fem.	2
1	1704-8031	Connector .156" Header, 1x6 pin Fem. Molex PN# 09-05-8031	1

PARTS LIST

△3 CABLE LENGTH IS 7 INCHES.

△2 CABLE LENGTH IS 15 INCHES.

△1 ALL WIRING IS 20 AWG.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL: .XX ±.03 .XXX ±.010 ANGLES ±1/2°

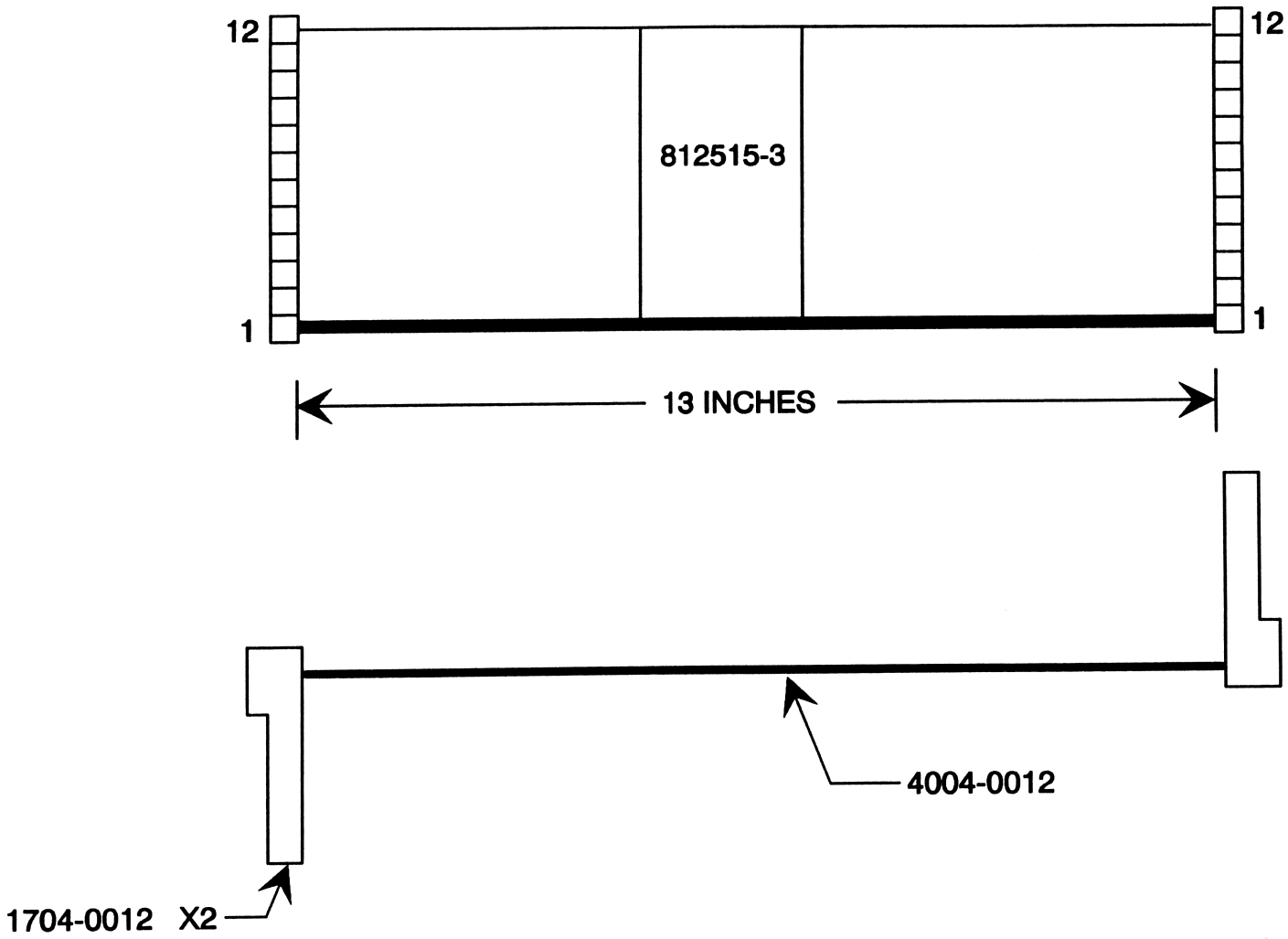
CABLE ASSEMBLY

Datum inc

DWN ESTHER	7/26/96	DES		B	812515-2	A
CHK		ENGR G.H.	7/96			
SCALE NONE		FSC 0JPN2		SIZE	SHT 1 OF 1	REV

FILENAME 812515-2a.SCH
DISK NO. 381

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



AT MIDPOINT OF CABLE,
IDENTIFY WITH CABLE PART NUMBER.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOL: XX ±.03 XXX ±.010 ANGLES ±1/2°

CABLE ASSEMBLY

datum inc

DWN	GH	DATE	DES		A	812515-3	
CHK			ENGR GH	8/96			
SCALE	NONE		FSC 31160		SIZE	SHT 1 OF 1	REV

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APPENDIX A
ASCII CHARACTER CODE TABLE

ASCII Character Code Table
Part One

DEC	OCT	HEX	CHAR
0	000	00	NUL (^)
1	001	01	SOH (^A)
2	002	02	STX (^B)
3	003	03	ETX (^C)
4	004	04	EOT (^D)
5	005	05	ENQ (^E)
6	006	06	ACK (^F)
7	007	07	BEL (^G)
8	010	08	BS (^H)
9	011	09	HT (^I)
10	012	0A	LF (^J)
11	013	0B	VT (^K)
12	014	0C	FF (^L)
13	015	0D	CR (^M)
14	016	0E	SO (^N)
15	017	0F	SI (^O)
16	020	10	DLE (^P)
17	021	11	DC1 (^Q)
18	022	12	DC2 (^R)
19	023	13	DC3 (^S)
20	024	14	DC4 (^T)
21	025	15	NAK (^U)
22	026	16	SYN (^V)
23	027	17	ETB (^W)
24	030	18	CAN (^X)
25	031	19	EM (^Y)
26	032	1A	SUB (^Z)
27	033	1B	ESC (^[ )
28	034	1C	FS (^ \ )
29	035	1D	GS (^])
30	036	1E	RS (^^)
31	037	1F	US (^_)

Note: First ^ denotes the Control Key.

ASCII Character Code Table
Part Two

DEC	OCT	HEX	CHAR
32	040	20	SP
33	041	21	!
34	042	22	"
35	043	23	#
36	044	24	$
37	045	25	%
38	046	26	&
39	047	27	'
40	050	28	(
41	051	29	)
42	052	2A	*
43	053	2B	+
44	054	2C	,
45	055	2D	-
46	056	2E	.
47	057	2F	/
48	060	30	0
49	061	31	1
50	062	32	2
51	063	33	3
52	064	34	4
53	065	35	5
54	066	36	6
55	067	37	7
56	070	38	8
57	071	39	9
58	072	3A	:
59	073	3B	;
60	074	3C	<
61	075	3D	=
62	076	3E	>
63	077	3F	?

ASCII Character Code Table
Part Three

DEC	OCT	HEX	CHAR
64	100	40	@
65	101	41	A
66	102	42	B
67	103	43	C
68	104	44	D
69	105	45	E
70	106	46	F
71	107	47	G
72	110	48	H
73	111	49	I
74	112	4A	J
75	113	4B	K
76	114	4C	L
77	115	4D	M
78	116	4E	N
79	117	4F	O
80	120	50	P
81	121	51	Q
82	122	52	R
83	123	53	S
84	124	54	T
85	125	55	U
86	126	56	V
87	127	57	W
88	130	58	X
89	131	59	Y
90	132	5A	Z
91	133	5B	[
92	134	5C	\
93	135	5D	]
94	136	5E	^
95	137	5F	_

ASCII Character Code Table
Part Four

DEC	OCT	HEX	CHAR
96	140	60	`
97	141	61	a
98	142	62	b
99	143	63	c
100	144	64	d
101	145	65	e
102	146	66	f
103	147	67	g
104	150	68	h
105	151	69	i
106	152	6A	j
107	153	6B	k
108	154	6C	l
109	155	6D	m
110	156	6E	n
111	157	6F	o
112	160	70	p
113	161	71	q
114	162	72	r
115	163	73	s
116	164	74	t
117	165	75	u
118	166	76	v
119	167	77	w
120	170	77	x
121	171	79	y
122	172	7A	z
123	173	7B	{
124	174	7C	|
125	175	7D	}
126	176	7E	~
127	177	7F	DEL

APPENDIX B
GLOSSARY OF TERMS

2-D, 3-D

Refers to two-dimensional and three-dimensional positions. A 2-D position provides latitude and longitude only. In a 2-D position fix, the altitude is assumed to be fixed. Only three satellites are required to do a 2-D position. A 3-D position fix provides the altitude in addition to the latitude and longitude and requires four satellites.

- A -

ACPOS

Accurate Position.

Almanac

A reduced precision subset of the ephemeris parameters. The almanac data is used by the GPS satellite receiver to compute the elevation and azimuth angle of the satellite. Each satellite broadcasts the almanacs for all satellites.

ALT

Altitude.

Anywhere Fix

The ability of a receiver to start position calculations without being given an approximate location and appropriate time.

APPOS

Approximate Position.

ASCII

American Standard Code for Information Interchange.

Azimuth

The angle for true North of the horizontal projection of the line of sight vector measured clockwise.

AZM

Azimuth.

- B -

Bandwidth
The range of frequencies in a signal.

BIPM
Bureau International des Poids et Measurements, located in Sevres, France.

BPS
Bits per second (data transmission rate from the satellites).

- C -

Carrier
A signal that can be varied from a known reference by modulation.

Carrier Frequency
The frequency of the un-modulated fundamental output of a radio transmitter.

C/A
Coarse/Acquisition code. This is the civilian code made available by the DoD. It is also known as SPS (Standard Positioning Service).

Channel
Refers to the GPS receiver hardware that is required to lock to a satellite, make the range measurements, and collect data from the satellite.

Clock Bias
The difference between the clock's indicated time and true universal time.

Control Segment
A world-wide network of GPS monitoring and control stations that ensure the accuracy of satellite positions and their clocks.

- D -

Data Message
A 1500 bit message included in the GPS signal which reports the satellite's location, clock corrections, and health. Rough information on the other satellites in the constellation is also included.

DCE
Data Communications Equipment (See RS-232-C).

DoD
Department of Defense.

DOP
Dilution of Precision.

Doppler Shift
The apparent change in the frequency of a signal caused by the relative motion of the transmitter and receiver.

DoT
Department of Transportation.

DTE
Data Terminal Equipment (See RS-232-C).

- E -

ECEF
Earth Centered - Earth Fixed.

EIA
Electronic Industries Association.

Elevation Angle
The angle between the line of sight vector and the horizontal plane.

Elevation Mask

Refers to the angle below which a satellite is considered unusable. It is used to prevent the receiver from searching for satellites which are obscured by buildings or mountains.

Ephemeris

A set of parameters that describe the satellite orbit very accurately. It is used by the receiver to compute the position of the satellite. This information is broadcast by the satellites.

- F -

FRQ

Frequency.

- G -

GDOP

GDOP refers to the Geometric Dilution of Precision. It describes how much of an uncertainty in range affects the uncertainty in position. The GDOP depends on where the satellites are relative to the user.

A large GDOP means that a small error in range will translate into a large error in position. GDOP has two components:

PDOP (Position Dilution of Precision).
TDOP (Time Dilution of Precision).

Geoid

Refers to the actual physical shape of the earth which is hard to describe mathematically due to the irregularities of the local surface and the land-sea variations.

GMT

Greenwich Mean Time.

GMT Offset/Local Time Offset

An example of the difference between local time and GMT time is:

EST (Eastern Standard Time) minus GMT time is five hours.

GPIB

General Purpose Interface Bus (IEEE-488 Interface).

GPS

Global Positioning System. Consists of twenty-four NAVSTAR satellites in six different orbits, the ground control and monitor stations, and the user community.

- H -

Handover Word

The word in the GPS message that contains synchronization information for the transfer of tracking from the C/A to P code.

HDOP, VDOP

HDOP and VDOP are the horizontal and vertical components of the PDOP. They describe how an uncertainty in range effects the horizontal position (latitude and longitude) and the vertical position (altitude). For 2-D position fixes HDOP is all that counts.

- I -

ICD

Interface Control Document.

ID

Identification.

I/F

Interface.

I/O

Input/Output.

ION

Ionosphere/Ionospheric.

Ionosphere
The band of charged particles eighty to 120 miles above the earth's surface.

Ionospheric Refraction
The change in the propagation speed of a signal as it passes through the ionosphere.

- J -

No glossary terms have been defined for "J."

- K-

No glossary terms have been defined for "K."

- L -

L1
The primary L-Band signal radiated by each NAVSTAR satellite at 1575.42 MHz. The L1 beacon is modulated with the C/A and P codes with the NAV message. L2 is centered at 1227.60.

LAT
Latitude.

LON
Longitude.

LSB
Least Significant Bit.

- M -

MSB

Most Significant Bit.

Monitor Station

One of five world-wide stations maintained by DoD and used in the GPS control segment to monitor and control the satellite clock and orbital parameters. Corrections are calculated and uploaded to each satellite once each day.

Multipath Errors

Errors caused by the interference of a signal that has reached the GPS receiver by two or more different paths. Usually caused by one path being bounced or reflected.

- N -

NAV

Navigation.

NAV DATA

The 1500 bit navigation message broadcast by each satellite at fifty BPS (Bits Per Second) on both the L1 and L2 beacons. This message contains system time, clock correction parameters, ionospheric delay model parameters, the satellite Ephermeris and health status. This information is used to process GPS signals to obtain the users position and velocity.

NAVSTAR

The name given to GPS satellites.

NIST

National Institute of Standards Technology.

ns/nsec

Nanosecond.

- O -

No glossary terms have been defined for "O."

- P -

P Code

The protected or military code used on both L1 and L2 GPS beacons. This code is available only to authorized users.

PDOP

PDOP refers to the Position Dilution of Precision. PDOP is composed of HDOP and VDOP. It has typically good values between two and seven. See HDOP and VDOP.

PPS

Precision Positioning Service. The most accurate dynamic positioning possible with GPS, based on dual frequency P code.

PRN

Pseudo Random Number

p/s

Picoseconds per second.

Pseudo Random Code

A signal with random noise-like proportions. It is a very complicated but repeated pattern of ones and zeros.

Pseudo-Range

A measure of the range from the GPS receiver (antenna) to the satellite. Pseudo-range is obtained by multiplying the speed of light by the apparent transit time of the signal from the satellite. Pseudo-range differs from actual range because the satellite and user clocks are offset from GPS system time by propagation delays and other errors.

- Q -

No glossary terms have been defined for "Q."

- R -

Rise/Set Time

Refers to the period during which a satellite is visible. For example, when it has an elevation angle that is above the elevation mask. A satellite is said to rise when the elevation angle exceeds the elevation mask, and set when the elevation drops below the mask.

RS-232-C

An EIA specification.

- S -

S/A

Selective Availability. Selective availability is essentially a method for artificially creating a significant clock error in the satellites. When implemented, it is the largest source of error in the GPS system.

SCH

Schedule.

SEP

Spherical Error Probable.

SPS

Standard Positioning Service. The normal civilian positioning accuracy obtained by using the single frequency C/A code.

SS

Space Segment.

SV

Space Vehicle (GPS satellite).

- T -

TDOP

TDOP refers to the Time Dilution of Precision. It depends on the uncertainty in the clock bias.

TI

Time Interval.

- U -

µs

Microsecond.

USNO

United States Naval Observatory.

UTC

Universal Time Coordinated. The time standard maintained by the U.S. Naval Observatory. GPS Time is directly related to UTC time.

- V -

No glossary terms have been defined for "V."

- W -

WK

Week Number.

WGS-72

Word Geodetic System (1972). A mathematical reference ellipsoid used by GPS, having a semi-major axis of 6378.137 kilometers and a flattening of 1/298.26.

WGS-84

Word Geodetic System (1984). A mathematical reference ellipsoid used by GPS, having a semi-major axis of 6378.137 kilometers and a flattening of 1/298.257223563.

- X -

No glossary terms have been defined for "X."

- Y -

No glossary terms have been defined for "Y."

- Z -

No glossary terms have been defined for "Z."

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THE MASTERS OF TIME