9390-52054
GPS Time Code and Frequency Generator

User's Manual

USER'S MANUAL

Model 9390-52054
GPS TIME CODE &
FREQUENCY GENERATOR

OPTIONS INSTALLED:

Standard Internal Time Base
IRIG A/B/ or G AC Code Output
LCD Display
Time Interval Measurement
1MHz Square Wave Output (Buffer Assembly 55106)

Before operating this unit, refer to Section Three (Operation).

REAR PANEL CONNECTOR CONFIGURATION/DESIGNATION:

J3 - IRIG Code Output
J4 - 1PPS Output
J5 - 1MHz Square Wave Output
J6 - Not Used
J7 - 10MHz Sine Wave Output
J8 - 1PPS Input
J9 - Not Used
J10 - Not Used
J11 - RS-232 I/O
J12 - Not Used
J13 - Not Used

ITEMS SUPPLIED WITH UNIT:

Shipping Kit SK9390-52-2 (AC adapter & mating connectors)
Antenna 55086
Antenna Cable 812267
Antenna Installation Kit 55095

NOTE

The 6 Channel TANS Receiver Module has been replaced with an SVee Six Receiver Module. This new module doesn't have the capability of monitoring the antenna current, so the message "ANTENNA FEED FAULT " will not appear. Instead, the program monitors the satellite signal strength and will display the message "SIG. LEVEL LOW" if the antenna or antenna cable is faulty. This message will also appear at initial power on until the unit has started tracking satellites.

TABLE OF CONTENTS

SECTION ONE - GENERAL INFORMATION

PARAGRAPH	TITLE	PAGE
1.1	INTRODUCTION	1-1
1.2	MANUAL SUMMARY	1-1
1.3	NAVSTAR/GPS DESCRIPTION	1-1
1.4	PRODUCT DESCRIPTION	1-2
1.5	SPECIFICATIONS	1-2
1.6	ADDITIONAL SPECIFICATIONS	1-3
1.6.1	ANTENNA/PREAMP	1-3
1.6.2	GPS RECEIVER AND ANTENNA	1-3
1.7	FUNCTIONAL CHARACTERISTICS	1-3
1.7.1	ACQUISITION	1-3
1.7.2	POSITION AND VELOCITY SOLUTION	1-5
1.7.3	DYNAMIC CAPABILITY	1-5
1.7.4	RF JAMMING RESISTANCE AND BURNOUT PROTECTION	1-6
1.7.5	SYSTEM STATUS AND DIAGNOSTICS	1-6
1.7.6	GPS SOLUTION MODES	1-6

SECTION TWO - INSTALLATION

2.1	INTRODUCTION	2-1
2.2	UNPACKING AND INSPECTION	2-1
2.3	RACK MOUNTING PROCEDURE	2-1
2.4	ANTENNA/PREAMP INSTALLATION	2-1
2.5	ANTENNA/PREAMP INTERFACE CONNECTIONS	2-1
2.6	PRIMARY POWER CONNECTIONS	2-5
2.7	GPS TC/FG INTERFACE CONNECTIONS	2-5
2.7.1	RS-232 I/O INTERFACE	2-5
2.7.2	TIMING OUTPUTS	2-5
2.7.3	1PPS INPUT	2-6

SECTION THREE - OPERATION

3.1	INTRODUCTION	3-1
3.2	OPERATIONAL STEPS	3-1

SECTION FOUR - RS-232 I/O PORT DATA INPUT/OUTPUT

PARAGRAPH	TITLE	PAGE
4.1	INTRODUCTION	4-1
4.2	DATUM FIRMWARE VERSION	4-3
4.3	UTC SYNC	4-3
4.4	GPS SYNC	4-3
4.5	PRINT FREQUENCY OFFSET	4-3
4.6	PRINT TIME, STATUS, ERROR CODE, AND SATELLITE VEHICLE NUMBERS	4-6
4.7	PRINT POSITION	4-4
4.8	CLEAR EVENT DATA	4-4
4.9	PRINT EVENT DATA	4-4
4.10	ENABLE EVENT LOG	4-4
4.11	DISABLE EVENT LOG	4-5
4.12	REQUEST EPHEMERIS DATA	4-5
4.13	SELECT MODE	4-5
4.14	ENABLE TIME INTERVAL	4-5
4.15	DISABLE TIME INTERVAL	4-5
4.16	REQUEST TIME INTERVAL	4-5
4.17	REQUEST MASK VALUES	4-5
4.18	ENTER MASK VALUES	4-6
4.19	ENABLE DISCIPLINING	4-6
4.20	DISABLE DISCIPLINING	4-6
4.21	ENTER POSITION	4-6
4.22	ENTER DAC VALUE	4-6
4.23	REQUEST DAC VALUE	4-7
4.24	NUMBER OF POSITION AVERAGES	4-7
4.25	ENTER LOCAL OFFSET	4-7
4.26	SELECT SATELLITE VEHICLE NUMBER	4-7
4.27	ENTER CABLE DELAY	4-7
4.28	REQUEST CABLE DELAY	4-7
4.29	ENTER PDOP LIMIT	4-7
4.30	RESYNCHRONIZE MINOR TIME	4-7
4.31	SELECT CODE OUTPUT	4-8
4.32	SELECT DEFAULT VALUES	4-8

SECTION FIVE - OPTION DESCRIPTIONS 5-1

NOTE

This section contains descriptions of all the available options.
REFER TO THE TITLE/COVER PAGE OF THIS MANUAL FOR THE OPTIONS INSTALLED.

SECTION SIX - MAINTENANCE/TROUBLESHOOTING

6.1	MAINTENANCE	6-1
6.2	TROUBLESHOOTING	6-1

SECTION SEVEN - DRAWINGS/DOCUMENTATION

TOP ASSEMBLY
BLOCK/LOGIC DIAGRAM
SHIPPING KITS

APPENDIX A - ASCII CHARACTER CODES A-1
APPENDIX B - ACRONYMS AND ABBREVIATIONS B-1

SECTION ONE
GENERAL INFORMATION

1.1 INTRODUCTION

This manual describes the installation and operation of the DATUM Model 9390 Global Positioning System Time Code & Frequency Generator (GPS TC/FG) module.

1.2 MANUAL SUMMARY

This manual is divided into the following sections:

SECTION ONE - GENERAL INFORMATION. Includes a general description of the GPS TC/FG and provides technical specifications.

SECTION TWO - INSTALLATION. Describes initial inspection, preparation for use, interconnections to Antenna/Preamp, power connections, and signal interconnections.

SECTION THREE - OPERATION. Describes the local operation of the unit.

SECTION FOUR - I/O PORT DATA INPUT/OUTPUT. Provides information on the protocol and data available through the RS232C I/O port.

SECTION FIVE - OPTION DESCRIPTIONS. Provides specific information on the options available in this unit. For a list of the options installed, refer to the Top Assembly drawing.

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 manual.

1.3 NAVSTAR/GPS DESCRIPTION

The NAVSTAR/GPS satellite-based timing and navigation system consists of a constellation of high altitude satellites orbiting the earth every 12 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 is scheduled for completion in the 1990's and will provide three dimensional positioning, velocity, and time on a continuous, worldwide basis. As of May 1990, a constellation of 14 satellites provides precise time 14 - 23 hours each day and position and velocity for 1 - 6 hours each day dependent on user location. As the constellation of 18 to 21 satellites is completed, the coverage will increase to nearly continuous coverage. The satellites will be located in six different orbital planes inclined approximately 60 degrees to the equator at altitudes of 10,400 miles above the earth.

The GPS TC/FG determines time and frequency by measuring the time of arrival of the precise timing mark and measuring the Doppler effect from one (1) satellite. A previously entered or determined position allows computation of the receiver's time offset. An accurate timing mark (1PPS) can be set, optionally input frequency and time 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. Civilian access to this system is provided through the C/A code. The precision (P) code will be available to authorized users only. The GPS TC/FG 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 50-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 1500 bits long.

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

1.4 PRODUCT DESCRIPTION

The GPS TC/FG operates on the civilian L-band(1575.42MHz) utilizing the 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 UTC (USNO) through the GPS Master Clock system. This link provides traceability to UTC and all international time scales through the use of NIST (National Institute of Standards Technology), USNO (U.S. Naval Observatory and BIPM (Bureau International Des Poids et Measurements) Sevres, France publications.

The unit automatically acquires and tracks satellites based on health status, elevation angle. Time and frequency monitoring data requires only one satellite, once accurate position data has been acquired. In the Auto mode, four satellites are required for the GPS TC/FG to do three dimensional (Latitude, longitude and Altitude) position fixes.

The basic GPS TC/FG includes the Time Code & Frequency Generator Module, an Antenna/Preamp and a coaxial cable for interconnection. A corrected 1PPS output signal and a 10MHz square wave are provided in the basic GPS TC/FG configuration. An RS232 I/O port is also provided in the basic configuration which can be used to control the unit as well as getting data from the unit. The basic unit has the capability of measuring the time interval difference between the GPS 1PPS and an externally input 1PPS. Optional features such as an LCD display or LED Time Display, an RS232 Printer Port, Serial Time Code outputs, external frequency input or time interval measurements, Single or Triple Event Log, low phase noise or standard Frequency Outputs, or an AC power adapter are available to meet specific requirements.

1.5 SPECIFICATIONS

The electrical, physical and environmental specifications for the 9390 are listed in Table 1-1.

TABLE 1-1 SPECIFICATIONS

TIMING OUTPUTS

Pulse Output:	1PPS; 30 to 50 µsec pulse width; 3 volts minimum into 50 Ω. Positive (rising) edge on-time.
Frequency Output:	10MHz sine wave; 3 volts (minimum) into 50 Ω load.
Accuracy:	1 µsec relative to UTC or GPS with current selective availability.
Position Determination:	Better than 25 meters SEP when PDOP is less than 8. Assumes normal satellite upload without SA.

TIMING INPUT

1PPS Pulse Input	TTL/CMOS compatible. The on-time edge is remotely programmable via the RS-232 I/O.

REMOTE CONTROL INTERFACE

(RS-232):	Full remote control of all operating functions in a complete ASCII protocol. Baud rate is adjustable from 50 to 19,200.

INTERNAL TIME BASE Refer to Section Five - Option Descriptions for the time base installed in this instrument.

PRIMARY POWER DC; 10-32 VDC @ less than 20W.

DIMENSIONS

Module:	Height: 1.75 inches Width: 17 inches with 19 inch rack mounting kit. Depth: 12 inches maximum
Antenna/Preamp:	Height: 3.5 inches maximum Width: 5.75 inches maximum Depth: 5.75 inches maximum

WEIGHT

Module:	Approximately 10 lbs.
Antenna/Preamp:	Less than 1.5 lbs.

ENVIRONMENTAL

Operating Temperature:	Monitor	Antenna/Preamp
	0°C to +50°C	-40°C to +85°C

Humidity:

Monitor
95% (noncondensing) up to 40°C

Antenna/Preamp
Unlimited

1.6 ADDITIONAL SPECIFICATIONS

The following is additional information regarding the GPS RPU (Receiver Processing Unit) located within the GPSTC/FG and the Antenna/Preamp.

1.6.1 ANTENNA/PREAMP

The Antenna/Preamp satisfies performance requirements at altitudes of up to 59,000 feet.

1.6.2 GPS RECEIVER AND ANTENNA

The GPS RPU and Antenna/Preamp set has burn-out protection which prevents damage from an RF signal at power densities of up to one (1) watt at the Antenna. The RF signal must be 100 MHz out of band. The C/A band 1575.42 MHz has a bandwidth of 20.48 MHz.

1.7 FUNCTIONAL CHARACTERISTICS

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

1.7.1 ACQUISITION

The GPS RPU Position Fix, Acquisition, and Tracking process features 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 "START-UP", "3-SV", or "4-SV" Mode. See HOW TO SELECT MODE in Section Four of this manual for selection and an explanation of each MODE SELECTION. Mode selection is made via the RS-232 I/O interface. See 4.13 in Section Four of this manual.

The GPS RPU has the ability to track up to six (6) satellites at a time. This ability 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 and going out of view of the Antenna or being declared UNHEALTHY.

The following section describes the Acquisition, Tracking, and GPS solutions performance.

Upon powering up the system, the unit begins a systematic search for satellites that are expected to be above the horizon. In this Start-up mode of operation it uses the last position stored in the battery RAM as a starting point. It will start doing position averaging, and after 200 averages (this number is user selectable), the unit will have acquired its position and will switch to the Single Satellite mode.

SIGNAL INTERRUPTION

During GPS TC/FG operation, should the signal from the satellites be interrupted, the antenna disconnected or blocked, the reacquisition time is dependent on 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 (50) 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 is usually within fifteen (15) seconds.

If the signal is regained within one (1) minute, the expanding frequency search will already have begun cycling. In this case, reacquisition may require a few minutes depending on where the RPU is in the frequency search cycle when the signal is available.

If the signal is regained within one (1) hour, the same search must take place, then 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.

1.7.2 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 TC/FG Processor. The Position data is three (3) dimensional and available in a latitude, longitude, and altitude (WGS-84) coordinate frame. The GPS solutions are computed at typically less than one (1) second intervals.

1.7.3 DYNAMIC CAPABILITY

The following specifications are operational dynamic limits for GPS TC/FG operation.

Velocity:	The velocity of the user is limited to 400 m/sec for proper GPS Receiver operation.
Acceleration:	User acceleration can not exceed four 4g (39.2 m/sec^2).
Jerk:	The rate of change of acceleration is not to exceed 20 m/sec^3.

1.7.4 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 (24) 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 (1) watt (CW) at the Antenna, provided the signal is 100 MHz out of the GPS frequency band.

1.7.5 SYSTEM STATUS AND DIAGNOSTICS

All digital circuitry is tested to the greatest extent possible at power-up. This includes testing the memory systems, processors and monitoring the performance of the channel processors. Should a failure occur in any of these areas, it can be reported 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 status of the Antenna Feedline between the Antenna/Preamp assembly and the Processor. This circuitry will detect both Short and Open conditions in the feedline and report it as an error on the interface and is displayed on the LCD display as an "ANTENNA FEED FAULT" at any time during operation.

1.7.6 GPS SOLUTION MODES

The user may select one of two modes for Position solutions: 3-SV which is two dimensional (Latitude and Longitude), or 4-SV which is three dimensional (Latitude, Longitude and Altitude). The START-UP mode which is used when the unit is initially turned on, uses the three dimensional solution. A third mode is also available for single satellite tracking, which does no Position solutions and is used basically for time keeping and frequency measurements. See SELECT MODE in Section Four of this manual for selection of each mode.

At initial power-up or if remotely selected, the unit will be in the START-UP mode. It will acquire some numbers of positions in the 4-SV mode calculating an average latitude, longitude, and altitude. The factory set default number is 200. These positions will be averaged and loaded into memory. The number of positions used to calculate the average is remotely user selectable. Once the average position has been determined, the unit will go into a single satellite mode tracking the SV with the highest elevation.

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

In the manual 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).

1.7.7 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 ENTER MASK VALUES in Section Four of this manual which gives an explanation of how to select masks via the RS-232 I/O interface.

The system masks are described below.

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 15 to 20 degrees. For Marine or Aircraft applications, it is usually possible to use the satellites very close to the horizon, although pitch/roll should be considered. The system default is that set by the user. Refer to Section Four, paragraph 4.18 for how to select elevation mask.

SIGNAL STRENGTH

This refers to the strength of the signal received from the satellite(not expressed in decibels). Below a value of five (5), the RPU may experience difficulty collecting data and possibly only track satellites intermittently. The System default is that set by the user. Refer to Section Four, paragraph 4.18 for how to select 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 Section Four, paragraph 4.18 for remote selection of PDOP.

SECTION TWO
INSTALLATION

2.1 INTRODUCTION

This section describes the unpacking, inspection, and installation of the GPS TC/FG.

2.2 UNPACKING AND INSPECTION

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

NOTE

When communicating with either DATUM or the responsible carrier regarding shipping damage, refer to the serial number. This number is located on the rear panel of the GPS TC/FG.

2.3 RACK MOUNTING PROCEDURE

The GPS TC/FG module is designed for standard 19 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 TC/FG. To mount it using the optional slide mounting kit, use the eight (8) #6 self tapping screws provided in the kit.

When a large diameter coaxial cable, such as RG213/U, is used to connect the Antenna/Preamp to the GPS TC/FG, it may be desirable to transition to a short length (6 foot) of RG58/U cable using Type N to BNC adapters at each end of the RG58/U cable to connect the Antenna/Preamp to the GPS TC/FG.

The GPS TC/FG 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.

2.4 ANTENNA/PREAMP INSTALLATION

The Antenna/Preamp is housed in a weather-proof 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 and multipath 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 multipath effects. The unit may be mounted on any level surface or on a vertical pipe having 3/4 - 14 NPT threads. See Figure 2-1 Antenna/Preamp Installation, for mounting. This type of Antenna/Preamp requires the coaxial cable having type "N" connectors at both ends.

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 (1575.42 MHz) may jam the GPS RPU.

2.5 ANTENNA/PREAMP INTERFACE CONNECTIONS

A fifty (50) foot long RG-58A/U coaxial cable is provided with type "N" connectors on both ends to connect the Antenna/Preamp to the GPS TC/FG. For cable lengths greater than seventy-five (75) feet, an optional low loss coaxial cable must be used.

The Antenna/Preamp power is provided by the GPS TC/FG 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.

2.6 PRIMARY POWER CONNECTION

The GPS TC/FG is operated from external DC power. The DC power specifications are listed in Specifications Table 1-1 in Section One of this manual.

The three pin DC power input connector J2 is located on the rear panel of the unit. See Figure 2-3 for connector pin assignments. An optional AC Power Adapter (that converts AC to +12VDC) can be supplied to allow operation of the unit from an AC power source of 90-265 VAC at a line frequency of 47-63 Hz.

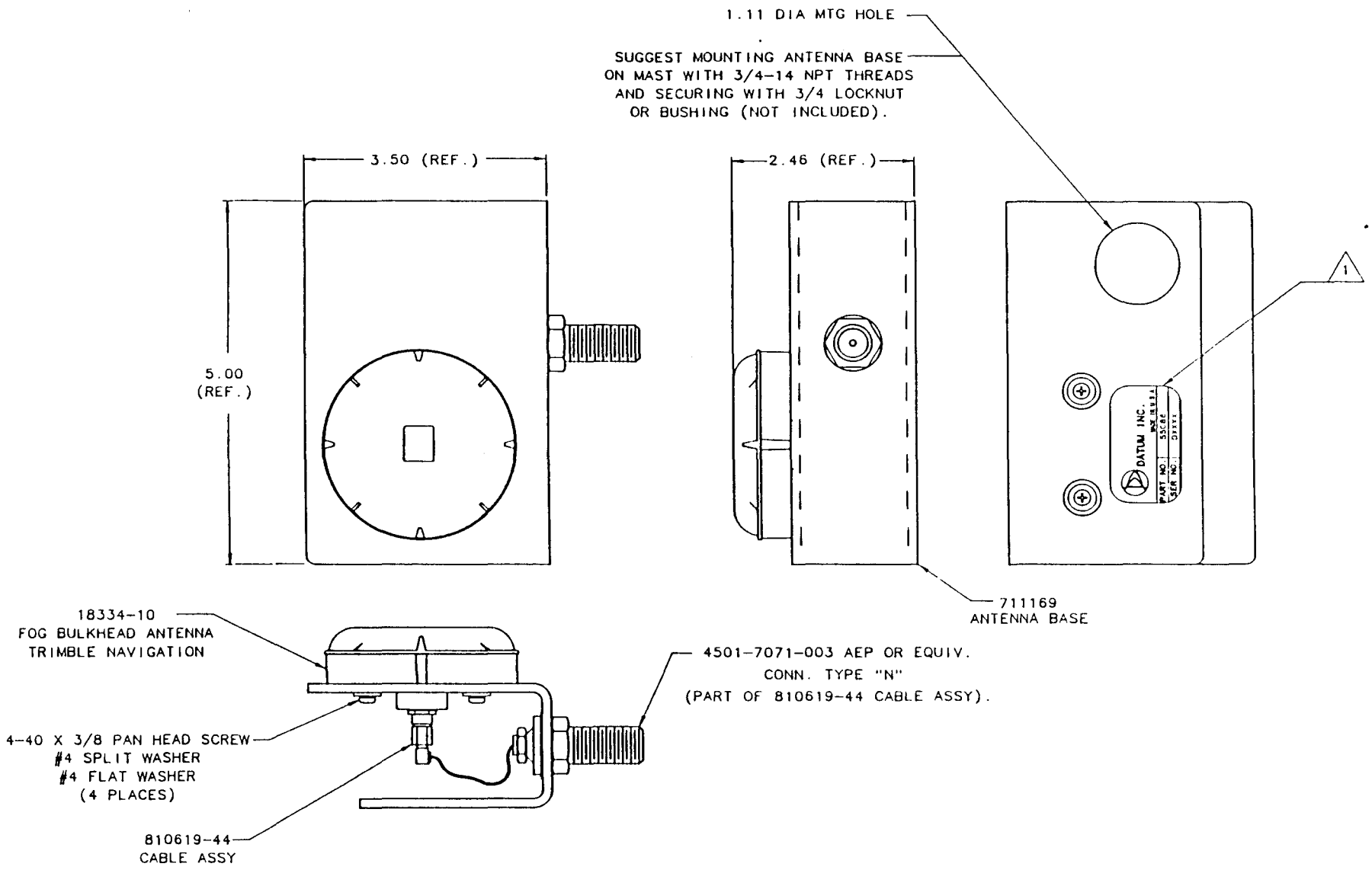
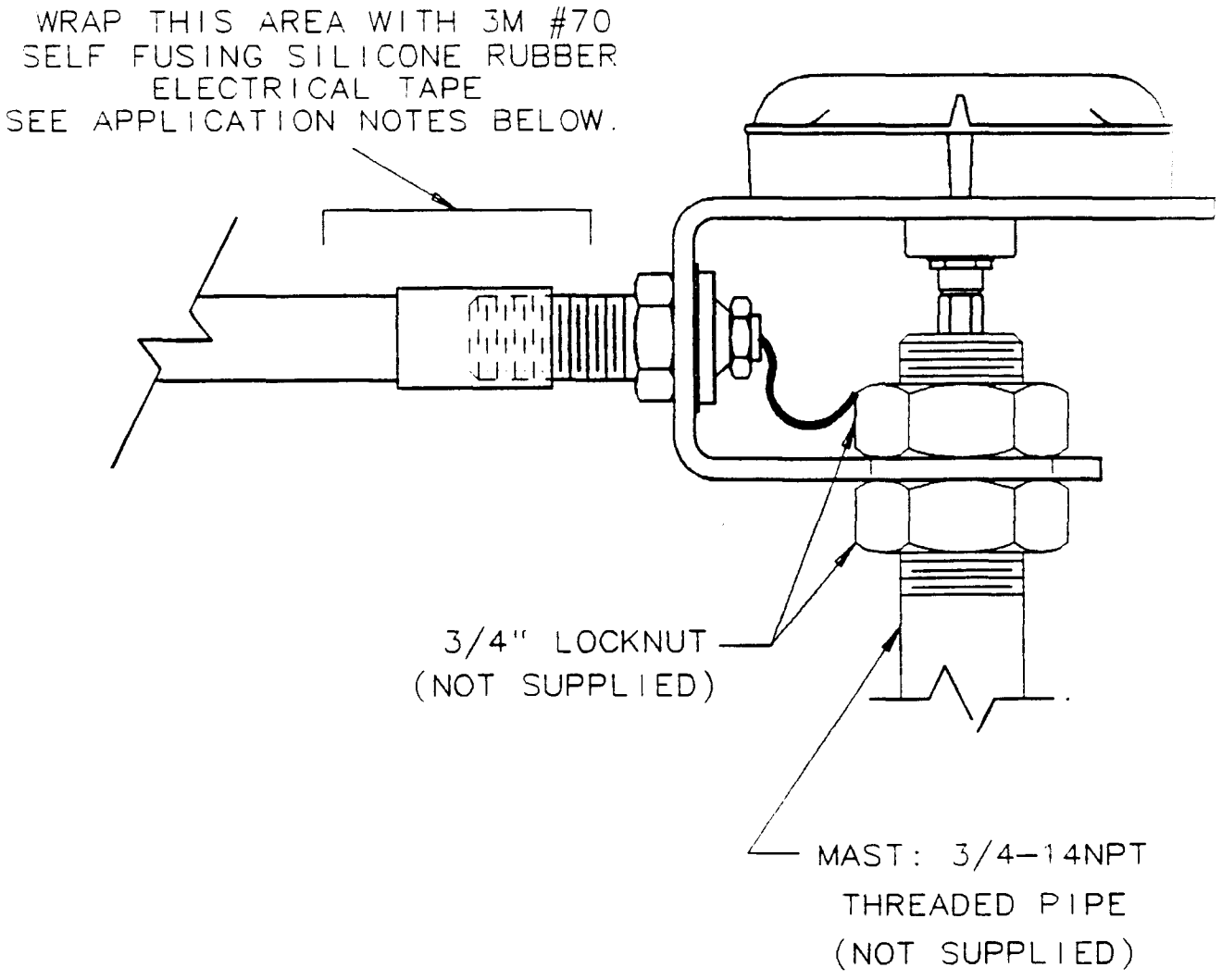


Figure 2-1. Antenna/Preamp Installation

5. OPERATING AND STORAGE TEMPERATURES -40° C TO +85° C.
4. ANTENNA CURRENT 30 MILLIAMPS MAX.
2. ANTENNA INPUT VOLTAGE 5±.5V.

1. DATUM LABEL, SHOWING ANTENNA PART NO. AND SERIAL NO, TO BE ATTACHED APPROXIMATELY WHERE SHOWN.

TYPICAL MOUNTING



APPLICATION NOTES:

TIGHTEN ANTENNA CABLE CONNECTOR SECURELY TO ANTENNA. OVERWRAP END SEAL WITH SEVERAL HALF-LAPPED LAYERS. OVERWRAP ENTIRE TERMINATION WITH ONE ADDITIONAL HALF-LAPPED LAYER FROM ONE INCH ON CABLE JACKET TO METALLIC LUG. WRAP WITH MODERATE TENSION (10 TO 100% ELONGATION). APPLY LAST LAP WITH ZERO STRETCH. PRESS DOWN TO AVOID END LIFTING BEFORE FUSION TAKES PLACE.

2.7 GPS TC/FG UNIT INTERFACE CONNECTIONS

The GPS TC/FG interface connections consist of cabling for the Antenna/Preamp assembly J1, the RS232 I/O port J11 and the time and frequency input/outputs and/or other optional inputs or outputs.

2.7.1 RS-232 I/O INTERFACE J11

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 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 RS232 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 Section Four - Introduction.

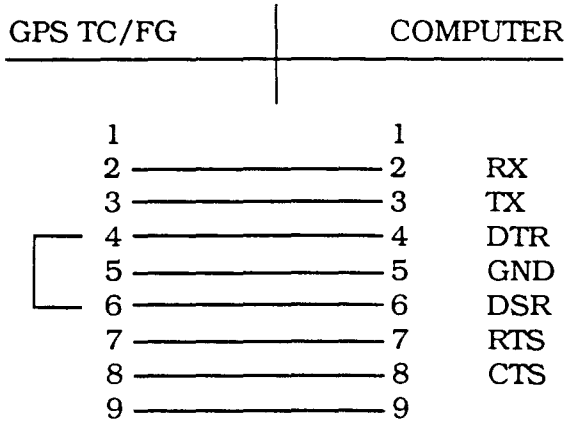
2.7.2 TIMING OUTPUTS

A corrected 1PPS output and a 10MPPS output are provided on rear panel BNCs. The 10MPPS will remain in a fixed phase relationship with the 1PPS as long as the front panel "LOCKED" LED is illuminated.

2.7.3 1PPS INPUT

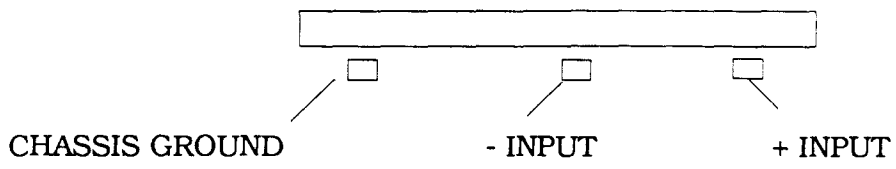
A 1PPS input is provided on a rear panel BNC labeled J8. This input can be utilized when making time interval measurements between the internal corrected GPS 1PPS and the external 1PPS pulse. This is a multipurpose input that can also be optionally utilized to record an external event or accept a external 1, 5, or 10MHz signal.

FIGURE 2-2
RS-232 I/O CABLE
PIN ASSIGNMENTS



NOTE: Pin 4 is connected to pin 6 inside the GPS TC/FG.

FIGURE 2-3
J2 DC POWER CONNECTOR
PIN ASSIGNMENTS



REAR VIEW OF CHASSIS

SECTION THREE
OPERATION

3.1 INTRODUCTION

This section describes the operation of the basic GPS TC/FG. Operating instructions for optional features is contained in Section Five.

3.2 OPERATIONAL STEPS

Assuming the appropriate input/output cables have been installed (see Section Two), the operation is as follows:

3.2.1 Perform a COLD RESET as follows:

a. Close (push down) rear panel DIP switch SW2, position S2.
b. Apply power to the unit using the rear panel push-button switch. On units having the optional LCD display, the following message will appear. "Disable cold reset switch, recycle power". On units without the LCD display, wait approximately 5 seconds.
c. Turn off power. Open (push up) rear panel DIP switch SW2, position S2. Reapply power.
d. This COLD RESET procedure cleared the battery backed RAM and loaded in specific default conditions including the following position:

LAT	37°23.5680N
LON	122°2.2862 W
ALT	-0003M

NOTE: This COLD RESET procedure only has to be performed upon initially receiving the unit (because the unit's position has been changed), if new firmware has been installed, or if the unit has a problem tracking multiple satellites. It does not have to be performed every time the unit is truned on.

3.2.2 Within ten (10) minutes, assuming four (4) satellite availability, the TRACKING LED will illuminate indicating that the unit is tracking and has set time.

3.2.3 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 2 seconds, so the position averaging itself could take about 10 minutes.

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

If the LOCKED front panel LED does not illuminate within one hour, check the DAC value and/or the Status via the RS232 port (See Section 4.23 and 4.6 respectively). If the DAC value number has approached one of its extremes (00000 or 65535), or if the Status is S14 (osc. stabilizing), the oscillator needs to be nulled/calibrated. Refer to the option description, Internal Time Base, in Section Five.

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

3.3 OPERATIONAL CHARACTERISTICS

The standard internal time base is a 10MHz crystal controlled oven 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 TC/FG 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.

SECTION FOUR
I/O PORT
DATA INPUT/OUTPUT

4.1 INTRODUCTION

The GPS TC/FG is equipped with an RS-232 interface using a 9 pin D connector designated as RS232 I/O J11. It can be used to communicate to and from the GPS TC/FG. All communication is in the ASCII format with the character protocol of one (1) start bit, eight (8) data bits, an odd parity bit, and one (1) stop bit.

The BAUD rate is selected using rear panel DIP switches designated S6, S7, and S8. Available BAUD rates and the appropriate Switch selections are shown below in Table 4-1. Closing a switch (ON) equates to 0.

TABLE 4-1

BAUD RATE	SWITCH POSITION		
	S6	S7	S8
50	0	0	0
300	0	0	1
600	0	1	0
1200	0	1	1
2400	1	0	0
4800	1	0	1
9600	1	1	0
19200	1	1	1

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

All communication to the GPS TC/FG 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 TC/FG. The third category (which may or may not be applicable) is a series of ASCII data bits to input data into the GPS TC/FG. Leading zeros must be used where necessary. For example, if the data to be entered is a four (4) digit number, and the number is 52, it must be entered as 0052.

NOTE

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

When entering data via the RS232 I/O port, if there is a pause longer than three seconds between input values, communication with the GPS TC/FG will terminate.

Table 4-2 shows the command options available. The ASCII character is shown followed its HEX equivalent. Following the Table, each command is described with the necessary steps for execution.

TABLE 4-2
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 satellite vehicle numbers.
i	69	print position.
j	6A	clear event data. *
k	6B	print event data. *
l	6C	enable event log. *
m	6D	disable event log. *
q	71	request ephemeris data.
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.
R	52	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	resynchronize minor time
X	58	select default values
Y	59	enter external frequency to be measured *
Z	5A	enable/disable external freq. measurement *
[	5B	request external freq. measurement data *
\	5C	enable/disable ext. osc operation *
]	5D	request satellite signal strength
^	5E	request unit operating parameters
A	41	request external 60 Hz measurement data *
B	42	set-up external 60 Hz measurement *
C	43	enter IEEE-488 address. *
g	67	enter printer print rate *
h	68	request printer print rate *
n	6E	enable/disable & set-up printer function *
a	61	request Rubidium lock status.*
D	44	enter 60Hz offset data.*

* Optional

4.2 DATUM FIRMWARE VERSION

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

(1) The user inputs $` (HEX 24/HEX 60)
(2) The unit will respond with eight (8) characters followed by CR/LF.

4.3 UTC SYNC

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

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

4.4 GPS SYNC

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

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

4.5 PRINT FREQUENCY OFFSET

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

(1) The user inputs $e (HEX 24/HEX 65)
(2) The unit will respond with a plus or minus sign, four (4) digits, and an exponent having the weight of parts in 10^{-9} or 10^{-12}.

example: +0579E-09

4.6 PRINT TIME, STATUS, ERROR CODE, & SATELLITE VEHICLE NUMBERS

This command allows the user to print the day of the 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 4-3 and the Error Codes in Table 4-4.

TABLE 4-3
STATUS CODES

CHARACTERS	DEFINITION
S00	Doing GPS Correcti
S01	GPS Time Not Acqui
S02	Waiting for Almana
S03	PDOP Is Too High
S08	No Useable Satellites
S09	1 Usable Satellite
S10	2 Useable Satellites
S11	3 Useable Satellites
S12	Selected SV Unusable
S13	No SV Scheduled
S14	Osc Stabilizing
S15	Averaging Position

NOTE:

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

TABLE 4-4
ERROR CODES

CHARACTERS	DEFINITION
E00	System Check OK
E01	Battery Failure
E02	Processor Error
E04	Alignment error, chip 1
E08	Alignment error, chip 2
E16	Antenna Feed Fault
E32	Offset Too High

(1) The user inputs $f (HEX 24/HEX 66)
(2) 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 (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.

4.7 PRINT POSITION

This command allows the user to read the accurate position known to the GPS TC/FG. 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 labelled 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.

(1) The user inputs $l (HEX 24/HEX 69)
(2) 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

4.8 CLEAR EVENT DATA (optional)

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

(1) The user inputs $j (HEX 24/HEX 6A).
(2) The unit will respond with OK followed by CR/LF.

4.9 PRINT EVENT DATA (optional)

The GPS TC/FG 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 3 characters representing event status, followed by 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 3 seconds, communication with the GPS TC/FG will terminate. If no data is available, the unit will respond with a ?. 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 4-5 shows the possible event status codes.

TABLE 4-5
EVENT STATUS CODES

CODE	DEFINITION
S00	Normal
S02	missed event channel 1
S08	missed event channel 2
S0a	missed event channels 1 and 2
S20	missed event channel 3
S22	missed event channels 1 and 3
S28	missed event channels 2 and 3
S2a	missed event channels 1, 2, and 3.

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

(1) The user inputs $k (hex 24/hex 6B)
(2) The unit responds with S00 CR/LF
(3) The user responds with % CR/LF
(4) The unit will then output the 1st event.
E000 1 056.12:13:45.1437952 CR/LF
(5) When this data has been taken, the user responds with % CR/LF.
(6) The unit will output the 2nd event.
E001 3 056.12:13:46.5327642 CR/LF.
(7) When this data has been taken, the user responds with % CR/LF
(8) The unit will then output E002 ? CR/LF.

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

In the above example S00 indicates no missing events. The 1st event (E000) occurred on channel 1 at the specified time. The 2nd event (E001) occurred on channel 3 at the specified time.

4.10 ENABLE EVENT LOG (optional)

This command enables the event log option. It consists of the log-on command followed by three digits, each digit corresponding to a channel. The first digit signifies which edge of the input pulse is the on-time edge of the event on channel 1. "0" equals the negative/falling edge and "1" equals the positive/rising edge of the pulse. The same is true for channels 2 and 3.

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

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

The above example will enable the event log. The on-time edge of the input pulses on channels 1 and 3 will be the negative/falling edge. The on-time edge of the input pulse on channel 2 will be the positive/rising edge.

4.11 DISABLE EVENT LOG (optional)

This command disables the event data log.

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

4.12 REQUEST EPHEMERIS DATA

This command allows the user to request the ephemeris data of a specific satellite at a specific date and at a specific position. The input to the GPS TC/FG consists of the log-on command, 4 digits of GPS week, 2 digits of latitude, an S or N, 3 digits of longitude, an E or W, 2 digits of the satellite PRN identification, and CR/LF.

The unit will respond with a ? if no data is available. If data is available, the response will consist of 24 digits indicating when that satellite is visible. The response will take about ten (10) seconds. A dash indicates no visibility.

(1) The user inputs $q (HEX 24/HEX 71)
053733N117W12
(2) GPS TC/FG responds with:

- 1 2 3 4 5 6 - - - - 1 2 3 4 - - - - - - - - - UTC
CR/LF

The above example indicates ephemeris data request for satellite vehicle 12 for week 0537 at a latitude of 33°N and a longitude of 117°W.

The response indicates that satellite vehicle 12 will be visible from 01:00 to 06:00 and from 11:00 to 14:00.

4.13 SELECT MODE

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

0	=	Start-up mode
1	=	single satellite mode (highest available satellite).
3	=	three satellite mode
4	=	four satellite mode

NOTE:

If the single satellite mode is selected, it can be accompanied by the Select Satellite Vehicle Number command (see Section 4-26). This will dictate which satellite the unit will track.

(1) The user inputs $r (HEX 24/HEX 72) 3
(2) The unit responds with OK CR/LF.

The example above selects the three satellite mode of operation.

4.14 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.

(1) The user inputs $s (HEX 24/ HEX 73) 1
(2) 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.

4.15 DISABLE TIME INTERVAL

This command disables the time interval measurement.

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

4.16 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, a decimal point followed by one digit of hundreds of nanoseconds.

(1) The user inputs $u (HEX 24/ HEX 75)
(2) The unit responds with 134276.5 CR/LF.

The example above indicates that the difference between the internal GPS corrected 1PPS pulse and the external 1PPS pulse is 134276.5 microseconds.

Everytime a measurement needs to be taken, a request has to be issued.

4.17 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 4-6 for Dynamics Code values.

TABLE 4-6
DYNAMICS 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	static	stationary

NOTE:

Unless changed, 4 (static) is the default/normal mode. The user won't receive the 0 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 of 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 2 or 3 dimensional solution (when tracking 3 or 4 satellites).

(1) The user inputs $x (HEX 24/HEX 78).
(2) The unit responds with: 4 05 06 10 CR/LF

The example above indicates a Dynamics Code of 4 (static/stationary), an Elevation Angle mask of 5 degrees, a Signal level mask of 6, and a PDOP mask of 10.

4.18 ENTER MASK VALUES

This command allows the user to input/change the mask values. The first digit (after the log-on and I.D. characters) is the Dynamics Code. This is followed by two (2) digits of Elevation Angle mask, two (2) digits of Signal Level mask, and two (2) digits of PDOP mask. When doing position averaging, the PDOP mask must be $\geq$ PDOP Limit. (see Section 4.29). Refer to Section 4.32 for selecting default values.

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

The above example indicates the user inputs a Dynamics Code of 4 (static/stationary), an Elevation Angle mask of 5 degrees, a Signal Level mask of 6, and a PDOP mask of 10.

4.19 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.

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

4.20 DISABLE DISCIPLINING

This command allows the user to disable the discipline feature.

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

4.21 ENTER POSITION

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

The command consists of:

two (2) digits of degrees latitude
two (2) digits of minutes latitude
three (3) digits of subminutes latitude
N (north) or S (south)
three (3) digits of degrees longitude
two (2) digits of minutes longitude
three (3) digits of subminutes longitude
E (east) or W (west)
+ (plus) or - (minus)
four (4) digits of altitude in meters

(1) The user inputs
$} (HEX 24/HEX 70) 3348824N11753397W+0026
(2) 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

4.22 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 5 digits from 00000 to 65535. If a number is entered that is greater than 65535, it will automatically be converted to 65535.

(1) The user enters $ ~ (HEX 24/HEX 7E) 32767
(2) The unit responds with OK CR/LF.

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

4.23 REQUEST DAC VALUE

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

(1) The user enters $ (del) (HEX 24/HEX 7F)

NOTE
(del) is the delete key.

(2) The unit responds with a five (5) digit value followed by CR/LF.

4.24 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 (4) 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.

(1) The user inputs $Q (HEX 24/HEX 51) followed by 4 digits.
(2) 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, 2000 to 5000 position averages be performed to insure an accurate position.

4.25 ENTER LOCAL OFFSET

This command allows the user to input a desired time offset (in hours) whereas the optional LCD or 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 to 23) are positive and calculated as west of the Greenwich Meridian.

(1) The user inputs $R (HEX 24/HEX 52) 07.
(2) The unit responds with OK CR/LF.

The above example (07) inputs a local time offset to correspond to day light savings in the Pacific Time Zone.

4.26 SELECT SATELLITE VEHICLE NUMBER

This command allows the user to select which satellite the GPS TC/FG will track. Prior to using this command, the unit must be put into the Single Satellite Mode. (See Section 4.13)

(1) The user inputs $S (HEX 24/HEX 53) followed by the two (2) digit satellite PRN identification.

NOTE
Leading zero required.

(2) The unit responds with OK CR/LF.

4.27 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 (4) digit number expressed in feet. Also refer to Section 4.30 - Resynchronize Minor Time.

(1) The user enters $T (HEX 24/HEX 54) 0100.
(2) The unit responds with OK CR/LF.

In the above example, the user has input cable delay to compensate for 100 feet of antenna cable.

4.28 REQUEST CABLE DELAY

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

(1) The user inputs $U (HEX 24/HEX 55).
(2) The unit will respond with a four digit number that should equate 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 TC/FG.

4.29 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 (2) digit number. It must always be ≤ the PDOP mask (See Section 4.18).

(1) The user enter $V (HEX 24/HEX 56) 08.
(2) The unit responds with OK CR/LF.

The above example illustrates entering a PDOP limit of eight (8).

4.30 RESYNCHRONIZE MINOR TIME

This command allows the user to manually resynchronize 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 (See section 4.27).

(1) The user enters $W (HEX 24/HEX 57),
(2) The unit responds with OK CR/LF.

4.31 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 (2) 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

(1) The user enters $P (HEX 24/HEX 50) followed by two (2) digits (See above table).
(2) The unit responds with OK CR/LF.

4.32 SELECT DEFAULT VALUES

This command allows the user to input/reset a series of default parameters which are:

Dynamics Code	4
Elevation Angle	10°
Signal Mask	3
PDOP Mask	12
PDOP Limit	12
Mode	start-up
Position Average Number	200
Time Interval	disabled, falling edge
Event Log	disabled, falling edge (all three events)
Ext Frq Measurement	disabled
Local Offset	0
Cable Delay	50

(1) The user enters $X (HEX 24/HEX 58)
(2) The unit responds with OK CR/LF.

4.33 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.

(1) The user inputs $] (HEX 24/HEX 5D)
(2) 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 00.0 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 response:

#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 12 and +10.6 for satellite vehicle 24. The actual message will contain more satellites than this example.

4.34 REQUEST UNIT OPERATING PARAMETERS

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

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

U M0 D1 L00 PL12 PA0200 PR0 OS0 GPIB17

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 position 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.

The last response is CR/LF.

SECTION FIVE
OPTION DESCRIPTIONS

5.1 INTRODUCTION

This section contains the description, specifications, and operation of all the optional features available in this instrument. Refer to the title/cover page of this manual for the options installed.

OPTION DESCRIPTION
INTERNAL ANTENNA BIAS-TEE
927004

INTRODUCTION

This option provides the ability to have two GPS units operate/share the same antenna.

FUNCTIONAL EXPLANATION

The GPS antenna is an active device that derives its power through the antenna cable from the GPS TC/FG. When operating two GPS TC/FG from the same antenna, a splitter is required, but only one unit can power the antenna.

This Bias-Tee installed inside the GPS TC/FG allows this unit to receive the RF signal from the antenna, but blocks the DC voltage from powering the antenna. The antenna is powered from the other GPS TC/FG.

If it is required to operate this unit in the normal mode (without the Bias-Tee), proceed as follows:

1. Remove the top cover of the GPS TC/FG.
2. Disconnect the antenna cable going from the rear panel to the RF & DC input of the Bias-Tee.
3. Disconnect the cable going from the RF output of the Bias-Tee to J1 of the SVee Six Module (55082).
4. Reconnect the antenna cable to J1 of the SVee Six Module.
5. Reinstall the top cover of the GPS TC/FG.

OPTION DESCRIPTION
STANDARD INTERNAL TIME BASE
10MHz OVEN OSCILLATOR

INTRODUCTION

This option provides an internal, disciplined, 10MHz oven oscillator as the unit's time base. This 10MHz time base is frequency corrected using a DAC (digital to analog converter) and locked to the GPS corrected 1PPS.

SPECIFICATIONS

Output Frequency/ Waveform:	10MHz sine wave
Output Amplitude:	0.5VRMS into 50Ω
Aging Rate:	$\leq 3 \times 10^{-9}$ per day $\leq 1.5 \times 10^{-6}$ per year
Temperature Stability:	$\leq 3 \times 10^{-8}$ over a temperature range of -20°C to +-70°C.
Operating Temperature:	-20°C to +-70°C.
Altitude:	Sea level to 50,000 Ft.
Electrical Tuning:	2.5×10^{-7} for 0 to +5VDC
Mechanical Frequency Adjust:	Nominal 1×10^{-6} Range for 10 years of aging.

It is recommended that the oscillator be nulled when the DAC value starts to approach 5000 or 60,000. There is a hole labeled CALIB in the rear panel for the oscillator adjustment. The screw must be removed to provide access to this adjustment.

There are two methods to null/calibrate the internal oscilaltor.

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

1) Turn on the unit and wait approximately 1 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.
3) The input to the DAC must be held static prior to nulling the oscillator. This can be accomplished one of three ways:
   a. Disconnect the antenna input from the rear of the unit.
   b. Select the single satellite mode, and select a satellite that is not in view. (or pick SV33 which doesn't exist).
   c. Turn off disciplining. Refer to Section Four, paragraph 4.20.
4) Set the DAC to its midpoint of 32767. Refer to Section Four, paragraph 4.22.
5) Remove the oscillator adjustment access screw. Adjust the oscillator until the 10MHz output is stable with respect to the frequency standard.
6) Reinstall the screw. Turn on disciplining.
7) After approximately one hour, check the DAC value number again. If it has changed by more than ±5000 from 32767, repeat Steps 2 thru 6.

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

1) Put the unit into the single satellite (1SV) mode tracking one satellite. If possible, track a Block 1 satellite (PRN 3, 12, or 13).
2) Read the DAC value either from the RS232 port or from the optional LCD display.
3) Remove the oscillator adjustment access screw to provide access to the oscillator adjustment.
4) SLOWLY (no more than 10° each time) adjust the oscillator and watch the DAC value change. If the DAC value is 65535, turn the oscillator adjustment counter clockwise which will decrease the frequency and decrease the DAC value. If the DAC value is 00000, turn the oscillator adjustment clockwise which will increase the frequency and increase the DAC value.
   NOTE: If the above procedure doesn't work, reverse the direction of the oscillator adjustment.
5) Keep adjusting the oscillator in the appropriate direction until the DAC value is approximately in its midpoint.
6) Install the screw in the oscillator adjustment access hole.
7) If after approximately one hour, the DAC value has changed by more than ±5000 from 32767, repeat Steps 1 thru 4.

OPTION DESCRIPTION
LIQUID CRYSTAL DISPLAY

INTRODUCTION

This option provides a front panel LCD display, two (2) rows of forty (40) characters per row. It displays two (2) separate menu screens that are changed by pushing the front panel DISPLAY push button.

The unit has a provision for adjusting the LCD contrast. Remove the top cover. Refer to the Top Assembly drawing for the location of potentiometer R1 labeled LCD. Adjust this pot for the desired contrast.

FIRST MENU SCREEN

This is the menu that is displayed when power is first applied to the unit. It contains the following information:

Datum Firmware version
time (seconds thru days)
status and error messages
frequency offset
satellite PRN identification
mode

A sample of the first menu screen is shown below:

Time of Year is displayed in row 1 starting at column 1 and consisting of day of year, hour, minute, and second. This can be UTC or GPS time, or display the local time offset depending on which mode has been remotely selected.

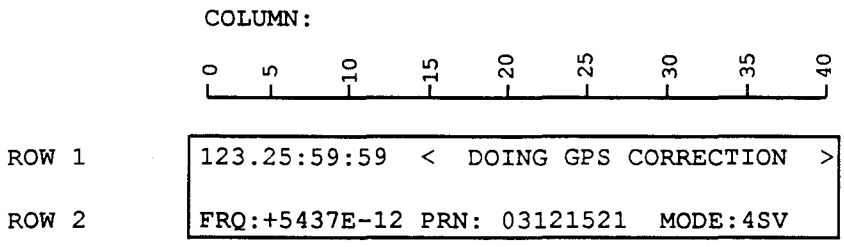
Status and Error messges are displayed in ROW 1 starting at column 15. The Status and Error messages alternate every ten (10) seconds. At initial power-up, this area will display the Datum firmware version for a few seconds.

The possible Status messages displayed are:

DOING GPS CORRECTION
GPS TIME NOT ACQUIRED
WAITING FOR ALMANIC
PDOP IS TOO HIGH
NO USEABLE SATELLILTES
1 USEABLE SATELLITE
2 USEABLE SATELLITES
3 USEABLE SATELLITES
SELECTED SV UNUSEABLE
NO SV SCHEDULED
OSC STABILIZING XX
AVERAGING POSITION XXXX
UNKOWN ERROR

The two (2) digit number (10 to 00) after the message OSC STABILIZING represents how far away the oscillator is from stabilization. At power on, it will be 10, 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 Section Three - Operation.

The four (4) digit number after the message AVERAGING POSITION represents how many averages remain before the LOCKED LED will illuminate. The number starts at the maximum number programmed (default is 200) and down counts to 0000. This message is applicable only in the Start-up mode of operation.



Revised 7-26-94

The possible Error messages displayed are:

SYSTEM CHECK OK
BATTERY FAILURE
PROCESSOR ERROR
ALIGNMENT ERROR, CHIP 1
ALIGHMENT ERROR, CHIP 2
ANTENNA FEED FAULT
OFFSET TOO HIGH

The Frequency Offset is diplayed in row 2 starting at column 1. This offset is the calculated difference between the unit's local time base and the GPS system frequency. It consists of a + or - folowed by a four (4) digit number expressed in parts to 10^{-9} or 10^{-12} (the E-exponent).

The Satellite PRN identifications are displayed in row 2 starting at column 15. These are the SV numbers that the unit is currently tracking. They can consist of up to four (4) two digit numbers, depending on which operational mode has been selected.

The Mode is diplayed in row 2 starting at line 31. At initial power-up, unless otherwise selected, the unit will be in the Start-up Mode and 4SV will be displayed. Once the unit has done its position averaging, it will switch to the single satellite mode and display 1SV. The unit will display 3SV when in the three satellite mode, and 4SV when in the four satellite mode.

SECOND MENU SCREEN

This screen will alternate with the first screen every time the DISPLAY push button is activated. It contains the following information:

LATITUDE, LONGITUDE, AND ALTITUDE
PDOP VALUE
GPS WEEK NUMBER
DAC VALUE
TIME INTERVAL

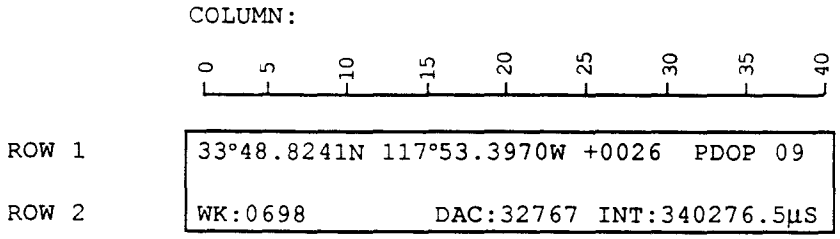
A sample of the second menu screen is shown below:

Latitude expressed in degrees, minutes, and N (north) or S (south) is displayed in row 1 starting at column 1. It is followed by Longitude expressed in degrees, minutes, and W (west) or E (east). Next is Altitude starting with a + or - followed by four (4) digits expressed in meters.

If the unit is in the 4SV mode and actively tracking four satellites, the PDOP value is shown in row 1 starting at column 32. It is a two (2) digit value that 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 (4) digit GPS WEEK NUMBER will be displayed at the start of row 2. The DAC VALUE will be expressed as a five (5) digit number in row 2 starting at column 16.

The TIME INTERVAL measurement between the external 1PPS input and the internal corrected GPS 1PPS will be displayed (if enaabled) in row 2 starting at column 26. It is expressed as a six (6) digit number of microseconds and one (1) digit of tenths of microseconds (hundreds of nanoseconds).



OPTION DESCRIPTION
IRIG A132 GENERATION

This option will generate an IRIG A132 modulated serial time code. The rear panel BNC labeled OUTPUT-CODE is capable of providing a 3 volt peak-to-peak signal terminated into 50 ohms. If more than one (1) code output option has been provided, selection of which code is output is made remotely via the RS-232 I/O. Refer to Section 4.31 of this manual.

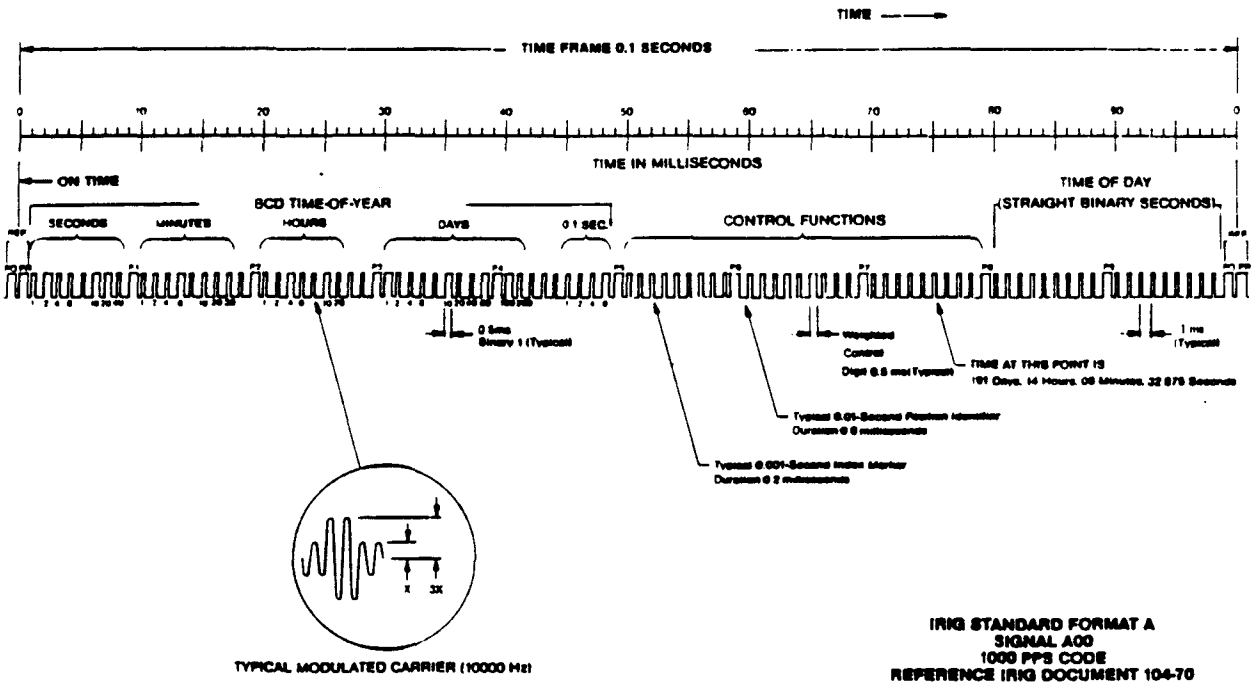
The output amplitude and modulation ratio are adjustable using potentiometers R17 and R18 respectively. Refer to the Top Assembly Drawing for the location of these adjustments. The top cover must be removed to provide access to these pots.

Amplitude Adjustment (R17) from .5 to 6 volts peak to peak.

Modulation Ratio Adjustment (R18) from 0 to 100%. Nominal ratio range from 2:1 to 6:1.

Refer to the following page for the IRIG A Time Code Format.

IRIG FORMAT 'A' – GENERAL



TYPICAL MODULATED CARRIER (10000 Hz)

IRIG STANDARD FORMAT A
SIGNAL A00
1000 PPS CODE
REFERENCE IRIG DOCUMENT 104-70

1. **TIME FRAME:** 0.1 second
2. **CODE DIGIT WEIGHTING OPTIONS:** BCD, SB or both
   a. Binary Coded Decimal Time-of-Year CODE WORD – 34 binary digits.
      (1) Seconds, minutes, hours, days and 0.1 seconds. Recycles yearly.
   b. Straight Binary Time-of-Day CODE WORD – 17 binary digits.
      (1) Seconds only.
      Recycles each 24 hours. (86399)
3. **CODE WORD STRUCTURE:**
   a. **BCD.** Word begins at INDEX COUNT 1. Binary-coded elements occur between POSITION IDENTIFIER ELEMENTS (seven for seconds; seven for minutes; six for hours; ten for days; four for 0.1 seconds) until the CODE WORD is complete. A POSITION IDENTIFIER occurs between decimal digits in each group to provide separation for visual resolution.
   b. **SB.** Word begins at INDEX COUNT 80. Seventeen binary-coded elements occur, with a POSITION IDENTIFIER between the 9th and 10th binary-coded elements.
4. **LEAST SIGNIFICANT DIGIT:** Occurs first, except for fractional seconds information, which occurs following the day-of-year information.
5. **ELEMENT RATES AVAILABLE:**
   a. 1000 per second (basic Element rate)
   b. 100 per second (POSITION IDENTIFIER rate)
   c. 10 per second (Frame rate)
6. **ELEMENT IDENTIFICATION:**
   a. "On-Time" reference point for each Element is its leading edge.
   b. INDEX MARKER duration: 0.2 milliseconds (Binary Zero or uncoded Element)
   c. CODE DIGIT duration: 0.5 milliseconds (Binary one)
   d. POSITION IDENTIFIER: 0.8 milliseconds
   e. REFERENCE MARKER: Two consecutive POSITION IDENTIFIERS.
   (The "on-time" point, to which the CODE WORD refers, is the leading edge of the second POSITION IDENTIFIER.)
7. **RESOLUTION:** 1 millisecond (unmodulated); 0.1 millisecond (modulated).
8. **CARRIER FREQUENCY:** 10 kHz when modulated.

OPTION DESCRIPTION
IRIG B122 GENERATION

This option will generate an IRIG B122 modulated serial time code. The rear panel BNC labeled OUTPUT-CODE is capable of providing a 3 volt peak-to-peak signal terminated into 50 ohms. IRIG B122 is the default code output. However, if more than one (1) code output option has been provided, selection of which code is output is made remotely via the RS-232 I/O. Refer to Section 4.31 of this manual.

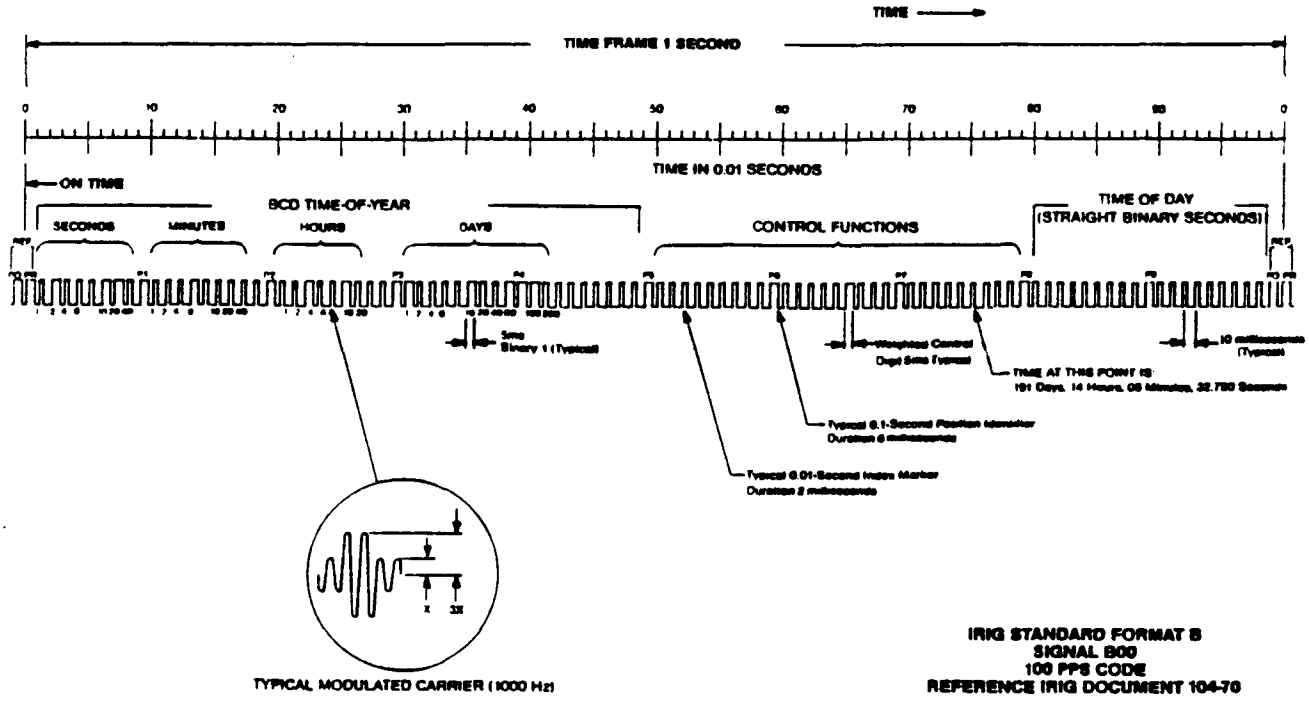
The output amplitude and modulation ratio are adjustable using potentiometers R17 and R18 respectively. Refer to the Top Assembly Drawing for the location of these adjustments. The top cover must be removed to provide access to these pots.

Amplitude Adjustment (R17) from .5 to 6 volts peak to peak.

Modulation Ratio Adjustment (R18) from 0 to 100%. Nominal ratio range from 2:1 to 6:1.

Refer to the following page for the IRIG B Time Code Format.

IRIG FORMAT 'B'—GENERAL



TYPICAL MODULATED CARRIER (1000 Hz)

IRIG STANDARD FORMAT B
SIGNAL B00
100 PPS CODE
REFERENCE IRIG DOCUMENT 104-70

1. **TIME FRAME:** 1.0 second.
2. **CODE DIGIT WEIGHTING OPTIONS:** BCD, SB or both:
   a. Binary Coded Decimal Time-of-Year CODE WORD — 30 binary digits.
      (1) Seconds, minutes, hours and days. Recycles yearly.
   b. Straight Binary Time-of-Day CODE WORD — 17 binary digits.
      (1) Seconds only. Recycles each 24 hours. (86399)
3. **CODE WORD STRUCTURE:**
   a. **BCD:** Word begins at INDEX COUNT 1. Binary-coded elements occur between POSITION IDENTIFIER ELEMENTS (seven for seconds, seven for minutes; six for hours; ten for days) until the CODE WORD is complete. A POSITION IDENTIFIER occurs between decimal digits in each group to provide separation for visual resolution.
   b. **SB:** Word begins at INDEX COUNT 80. Seventeen binary-coded elements occur with a POSITION IDENTIFIER between the 9th and 10th binary-coded elements.
4. **LEAST SIGNIFICANT DIGIT:** occurs first.
5. **ELEMENT RATES AVAILABLE:**
   a. 100 per second (basic Element rate)
   b. 10 per second (POSITIVE IDENTIFIER Rate)
   c. 1 per second (Frame Rate)
6. **ELEMENT IDENTIFICATION:**
   a. "On-Time" reference point for each Element is its leading edge.
   b. INDEX MARKER duration: 2 milliseconds (Binary zero or uncoded Element)
   c. CODE DIGIT duration: 5 milliseconds (Binary one)
   d. POSITION IDENTIFIER duration: 8 milliseconds
   e. REFERENCE MARKER — one per second: Two consecutive POSITION IDENTIFIERS.
   (The "On-Time" point, to which the CODE WORD refers, is the leading edge of the second POSITION IDENTIFIER.)
7. **RESOLUTION:** 10 milliseconds (unmodulated); 1 millisecond (modulated).
8. **CARRIER FREQUENCY:** 1 kHz when modulated.

OPTION DESCRIPTION
IRIG G142 GENERATION

This option will generate an IRIG G142 modulated serial time code. The rear panel BNC labeled OUTPUT-CODE is capable of providing a 3 volt peak-to-peak signal terminated into 50 ohms. If more than one (1) code output option has been provided, selection of which code is output is made remotely via the RS-232 I/O. Refer to Section 4.31 of this manual.

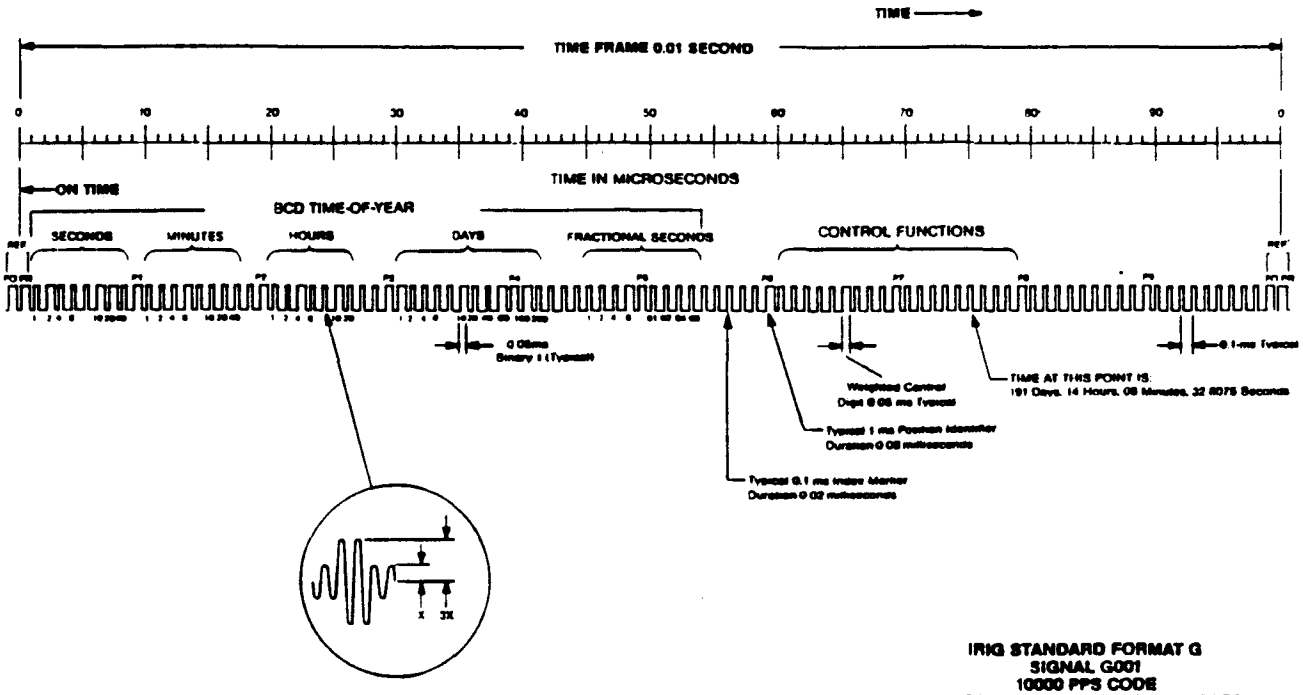
The output amplitude and modulation ratio are adjustable using potentiometers R17 and R18 respectively. Refer to the Top Assembly Drawing for the location of these adjustments. The top cover must be removed to provide access to these pots.

Amplitude Adjustment (R17) from .5 to 6 volts peak to peak.

Modulation Ratio Adjustment (R18) from 0 to 100%. Nominal ratio range from 2:1 to 6:1.

Refer to the following page for the IRIG G Time Code Format.

IRIG FORMAT 'G' – GENERAL



TYPICAL MODULATED CARRIER (100,000 Hz)

IRIG STANDARD FORMAT G
SIGNAL G001
10000 PPS CODE
REFERENCE IRIG DOCUMENT 104-70

1. **TIME FRAME:** 0.01 second.
2. **CODE DIGIT WEIGHTING:** BCD Time-of-Year CODE WORD – 38 binary digits.
   a. Seconds, minutes, hours, days, 0.1 seconds and 0.01 seconds; recycles yearly.
3. **CODE WORD STRUCTURE:** BCD Word begins at INDEX COUNT 1. Binary Coded Elements occur between POSITION IDENTIFIER ELEMENTS (seven for seconds; seven for minutes; six for hours; ten for days; four for 0.1 seconds; four for 0.01 seconds) until the CODE WORD is complete. A POSITION IDENTIFIER occurs between decimal digits in each group to provide separation for visual resolution.
4. **LEAST SIGNIFICANT DIGIT:** Occurs first, except for fractional seconds information, which occurs following the Day-of-Year information.
5. **ELEMENT RATES AVAILABLE:**
   a. 10000 per second (basic Element Rate)
   b. 1000 per second (POSITION IDENTIFIER Rate)
   c. 100 per second (Frame Rate)
6. **ELEMENT IDENTIFICATION:**
   a. 'On-Time' reference point for each element is its leading edge.
   b. INDEX MARKER duration: 0.02 milliseconds (Binary zero or uncoded Element)
   c. CODE DIGIT duration: 0.05 milliseconds (Binary one)
   d. POSITION IDENTIFIER duration: 0.08 milliseconds
   e. REFERENCE MARKER: Two consecutive POSITION IDENTIFIERS.
   (The 'On-Time' point, to which the CODE WORD refers, is the leading edge of the second POSITION IDENTIFIER.)
7. **RESOLUTION:** 0.10 milliseconds (unmodulated); 0.01 milliseconds (modulated).
8. **CARRIER FREQUENCY:** 100 kHz when modulated.

OPTION DESCRIPTION
NASA 36 GENERATION

This option will generate a NASA 36 modulated serial time code. The rear panel BNC labeled OUTPUT-CODE is capable of providing a 3 volt peak-to-peak signal terminated into 50 ohms. IRIG B122 is the default code output. However, if more than one (1) code output option has been provided, selection of which code is output is made remotely via the RS-232 I/O.

The following select code function changes that which is described in the basic manual.

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 (2) digits. IRIG B122 is the default. The optional output codes are defined as follows:

Number	Code Output
00	IRIG B
01	NASA 36

(1) The user enters $P (HEX 24/HEX 50)followed by two (2) digits (See above table).
(2) The unit responds with OK CR/LF.

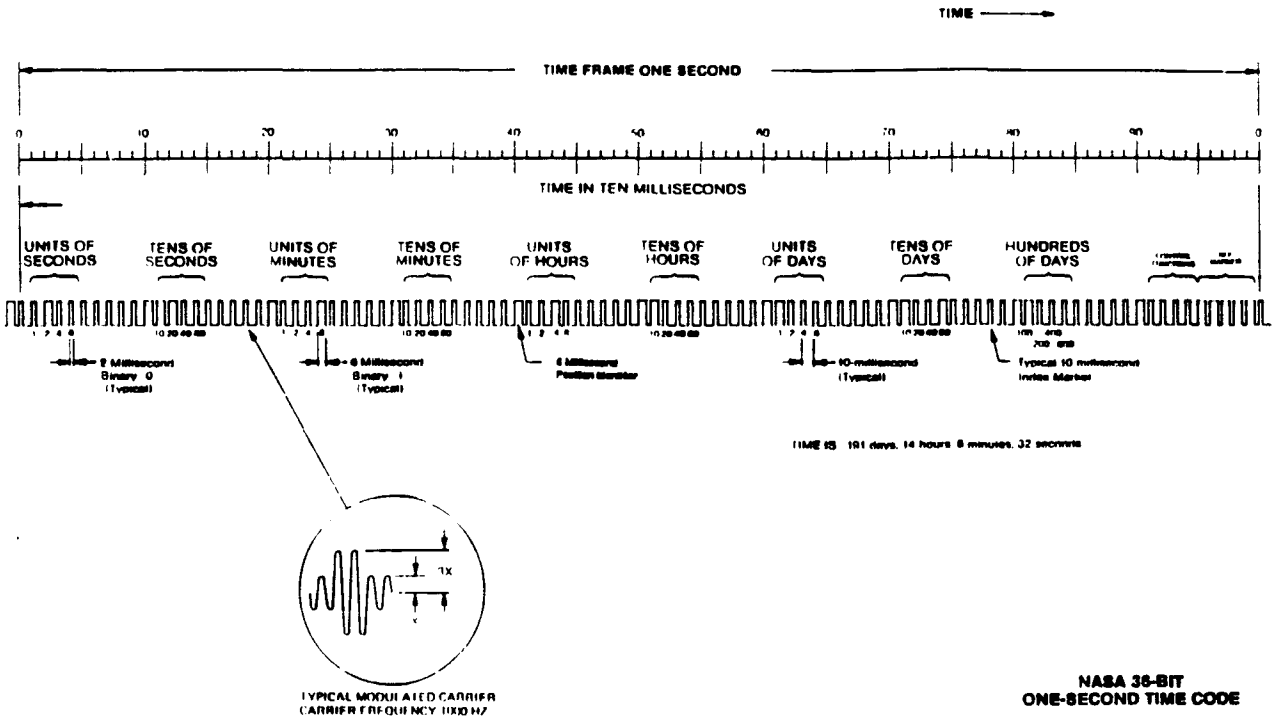
The output amplitude and modulation ratio are adjustable using potentiometers R17 and R18 respectively. Refer to the Top Assembly Drawing for the location of these adjustments. The top cover must be removed to provide access to these pots.

Amplitude Adjustment (R17) from .5 to 6 volts peak to peak.

Modulation Ratio Adjustment (R18) from 0 to 100%. Nominal ratio range from 2:1 to 6:1.

Refer to the following page for the NASA 36 Time Code Format.

NASA 36-BIT TIME CODE (GENERAL)
(NASA 1 SECOND BCD TIME CODE)



NASA 36-BIT ONE-SECOND TIME CODE

1. **TIME FRAME:** 1 second
2. **CODE DIGIT WEIGHTING:** Binary Coded Decimal Time-of-Year CODE WORD — 30 binary digits. Seconds, minutes, hours and days; recycles yearly.
3. **CODE WORD STRUCTURE:** BCD: Word begins at INDEX COUNT 1. Binary-Coded Elements occur between POSITION IDENTIFIER ELEMENTS in 4-digit groups until the CODE WORD is complete. A CODE DIGIT occurs between decimal digits in each group to provide separation for visual resolution.
4. **LEAST SIGNIFICANT DIGIT:** Occurs first.
5. **ELEMENT RATES AVAILABLE:**
   a. 100 per second (basic Element Rate)
   b. 1 per second (Frame Rate)
6. **ELEMENT IDENTIFICATION:**
   a. "On-Time" reference point for each element is its leading edge.
   b. INDEX MARKER duration: 2 milliseconds (Binary zero or uncoded Element)
   c. CODE DIGIT duration: 6 milliseconds (Binary one)
   d. POSITION IDENTIFIER duration: 6 milliseconds
   e. REFERENCE MARKER: Five consecutive POSITION IDENTIFIERS followed by an INDEX MARKER.

   (The "On-Time" point, to which the CODE WORD refers, is the leading edge of the INDEX MARKER following the four POSITION IDENTIFIERS.)
7. **RESOLUTION:** 10 milliseconds (unmodulated); 1 millisecond (modulated).
8. **CARRIER FREQUENCY:** 1 kHz when modulated.

OPTION DESCRIPTION
EXTERNAL FREQUENCY MEASUREMENT

INTRODUCTION

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

SPECIFICATIONS

Input Connector:	J8
Frequency Range:	1Hz to 10MHz (descrete, whole numbers - not fractional parts).
Input Wave form From 1Hz to 10MHz:	Retangular or square wave (minimum pulse width 50 nanoseconds) Amplitude range: Logic "0" +0.2V ±0.2VDC Logic "1" +2.4V to +15 VDC
From 100 KHz to 10MHz:	Sinusoidal Amplitude range: 1 - 5 volts peak to peak

OPERATION

NOTE: Beacuse J8 is a multipurpose input connector, when the External Frequency Measurement option is enabled, the Event 1, 1PPS, and 1/5/10MHz options are disabled.

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

The following features are input/selected via the RS-232 I/O port. (Refer to Section 4.1 - Introduction). They should be selected in the following order:

1.1 SELECT INPUT FREQUENCY

This command allows the user to specify the input frequency.

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

example: $Y01000000 CR/LF

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

NOTE: The input frequency selected must agree with the actual frequency input. Otherwise, the internal divider will calculate the wrong value, the measurement will be incorrect, and erratic operation of the unit could result.

1.2 Connect the input frequency to be measured to rear panel BNC J8. This input frequency must be present prior to enabling the external frequency measurement option.

1.3 ENABLE EXTERNAL FREQUENCY MEASUREMENT

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

1) User inputs $Z1 CR/LF
2) Unit responds with OK CR/LF.

1.4 REQUEST MEASURMENT

This command allows the user to request a measurement of the external frequency input. The measurement and subsequent calculation is done at least once every 5 seconds and is averaged over the time period beginning when the external frequency measurement option was enabled.

1) User Input $[CR/LF.
   [is left bracket or ASCII character hex 5B.
2) The unit responds with + or -, 4 digits representing the magnitude of drift/stability, E-, 2 digits (exponent - power of 10), space, 4 digits representing the time period in seconds, E+, 2 digits (exponent - power of 10).

   example: +0735E-12 8640E+01

The above example indicates the input frequency has drifted an average of 735 parts in 10^{-12} (or 7×10^{-10}) over a period of one day (86,400 seconds).

The drift exponent will be displayed in parts to 10^{-9}, 10^{-12}, or 10^{-14}.

1.5 DISABLE EXTERNAL FREQUENCY MEASUREMENT

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

1) User inputs $Z0 CR/LF

2) The unit responds with OK CR/LF.

If the unit is equiped with the optional LCD display, the following operational characteristics apply:

1) After the input frequency has been selected and the external frequency measurment feature has been enabled, select the third menu screen by activating the front panel DISPLAY push button. It will sequentially select either the first, second, or third menu screen each time it is pressed.
2) Starting at Row 1, column 1 the following will be displayed:

EXT FRQ: ± (4 digits) E- (2 digits) / (4 digits) E- (2 digits) SEC*

The first 4 digits represent the magnitude of the drift followed by 2 digits of the power of 10. The next 4 digits represent the time period in seconds followed by 2 digits of the power of 10. The asterisk will appear if the External Frequency Measurment option is enabled.

If the external frequency measurement is subsequently disabled, and the third menu screen is selected, the last measurement made will be displayed, but the asterisk won't appear.

OPTION DESCRIPTION
CODE/PULSE RATE OUTPUTS
ASSEMBLY 55090

INTRODUCTION

This option provides AC and DC code outputs, pulse rate outputs, and status/alarm outputs. The pulse rate outputs are internally selectable. The AC/DC code outputs and status/alarm outputs are optionally available depending on specific requirements.

SPECIFICATIONS

AC Code Outputs:	Capable of providing a 3 volt peak-to-peak signal terminated into 50 ohms.
DC Code Outputs:	TTL compatible. Logic "0" +.02V ± 0.2 VDC Logic "1" +3.7V ± 1.3 VDC
Pulse Rate Outputs:	TTL compatible. Positive edge on-time. Duty Cycle 80/20% or 50/50%
1 Pulse Per Minute:	TTL compatible Positive edge on time. Duration: 1 second
Status/Alarm Outputs:	Open collector outputs. Maximum voltage +30 VDC. Capable of sinking 300 milliampheres.

CONFIGURATION

The following signals are provided on J13, an optional, rear panel, DB-25P connector:

Pin	Signal	Pin	Signal
1	Ground	14	1PPM (Neg)
2	DC #1 (Pos)	15	AC #1
3	DC #2 (Pos)	16	AC #2
4	DC #3 (Pos)	17	AC #3
5	DC #4 (Pos)	18	AC #4
6	Ground	19	Ground
7	Ground	20	Ground
8	Ground	21	Loss of Track (O.C.)
9	DC #1 (Neg)	22	Loss of Power (O.C.)
10	DC #2 (Neg)	23	N/C
11	DC #3 (Neg)	24	Ground
12	DC #4 (Neg)	25	Ground
13	1PPM (Pos)		

The AC and DC outputs are the same format/type as that on J3.

The DC codes are output from differential line drivers that can be used single ended (TTL compatible) or differential.

The 1PPM output can be internally selectable for the following rates:

1MPPS
500 KPPS
100 KPPS
50 KPPS
10 KPPS
5 KPPS
1 KPPS
500 PPS
100 PPS
50 PPS
10 PPS
5 PPS
1 PPS
1 PPM (One pulse per minute)

The above pulse rates (2 each) can be internally jumper selectable and appear on rear panel BNC's J5 and J6.

The status/alarm outputs (open collector) are normally on (low). If the unit loses lock or tracking, the Loss of Track output will turn off. The Loss of Power output is on when power is applied to the unit.

OPTION DESCRIPTION
TRIPLE EVENT LOG

This option provides the capability of logging the time occurrence of up to 256 events from three (3) separate inputs. A pulse on the event input will cause that time to be logged/stored on either the rising (positive-going) or falling (negative-going) edge of the input pulse. Which edge is designated as on-time is remotely programmable via the RS-232 I/O. Each event will have a defining number (from 000 to 255) and a channel identifier (1, 2, or 3).

The event memory can be read and/or cleared via the RS-232 I/O. Refer to Sections 4.9 and 4.8 of this manual. If the inputs exceed 256 events (occurrences), the new data will be lost. If two events occur less than ten (10) 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 Sections 4.10 and 4.11 of this manual.

OPTION DESCRIPTION
STANDARD RS-232 PRINTER PORT

INTRODUCTION

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

CONNECTOR CONFIGURATION (J12)

GPS TC/FG
PRINTER PORT

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

The RTS (Request to Send) and CTS (Clear To Send) handshaking signals are not utilized.

DESCRIPTION

This interface is configured as DTE (Data Terminal Equipment). Each byte of output data consists of one start bit, eight data bits, one parity bit (odd) and one stop bit. The BAUD rate is selectable using the rear panel DIP switch SW2. It is the same rate as the RS-232 I/O port, connector J11. (Refer to Section 4.1 of this manual.)

OPERATION

The following commands and controls are selected via the RS-232 I/O port:

1.1 SELECT PRINTER 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).

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

2) 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.

1.2 REQUEST PRINTER OUTPUT RATE

This command allows the user to determine what is the current output rate.

1) User inputs $h(HEX 24/HEX 68)
2) The unit responds with four (4) digits followed by CR/LF. These four digits correspond to the output interval rate in seconds.

1.3 PRINTER CONTROL

This command allows the user to control the printer port output and to select the format of the output data.

1) 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.)

2) The unit responds with OK CR/LF

example: $n101

The example above 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 TI 705337.5

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

94 027.17:04:48 M0 S00 E00 25 00 00 00 -0019-E12 33 48.8270N 117 53.3864W +0028 TI 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
TI 705337.5 = time interval in microseconds

External Frequency Measurement or another option can be substituted for Time Interval if available and previously enabled.

OPTION DESCRIPTION
RS-232 BURST MODE TIME OUTPUT

INTRODUCTION

This option provides the capability of using the printer port of the GPS TC/FG to burst out a packed BCD time word output once a second.

CONNECTOR CONGIGURATION

GPS TC/FG
PRINTER PORT

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

DESCRIPTION

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 consists of five bytes of 12 bits per byte. Refer to the Serial Output Format. Each byte consists of one start bit, eight data bits, one parity bit (odd) and two stop bits.

The start bit of the first byte is within ±2 milliseconds of on-time.

BYTE NUMBER	BIT 1	BIT 2	BIT 3	BIT 4	BIT 5	BIT 6	BIT 7	BIT 8	BIT 9	BIT 10	BIT 11	BIT 12
1	START	SEC 1	SEC 2	SEC 4	SEC 8	SEC 10	SEC 20	SEC 40	0	PARITY	STOP	STOP
2	START	MIN 1	MIN 2	MIN 4	MIN 8	MIN 10	MIN 20	MIN 40	0	PARITY	STOP	STOP
3	START	HR 1	HR 2	HR 4	HR 8	HR 10	HR 20	0	0	PARITY	STOP	STOP
4	START	DAY 1	DAY 2	DAY 4	DAY 8	DAY 10	DAY 20	DAY 40	DAY 80	PARITY	STOP	STOP
5	START	DAY 100	DAY 200	0	0	0	0	0	0	PARITY	STOP	STOP

OPTION DESCRIPTION
1 MHz SINE WAVE SHAPER
20457-1

INTRODUCTION

This option description provides an explanation of the Sine Wave Shaper logic used to develop the Sine Wave output and adjustment of the output amplitude.

This Shaper Assembly can be plugged into either P19/J23 or P18/J22 of the option area. The 1MHz sine wave output will be present on rear panel BNC J6 or J5 respectively.

FUNCTIONAL EXPLANATION

A 1MHz square wave derived from the 10MHz internal oscillator is input to J1 pin 4 of the Sine Wave Shaper Assembly. The signal is filtered and shaped to generate the 1MHz Sine Wave output at P1 pin 2 of the same assembly.

This signal is then routed to a rear panel BNC. Refer to the Title page of this manual for connector designation. Refer to the Top Assembly Drawing for connector location. This signal is adjustable from 0 to 6 volts peak-to-peak and has been factory adjusted to 3 volts peak-to-peak into a 50 ohm load.

OUTPUT AMPLITUDE ADJUSTMENT

The output amplitude of this signal can be adjusted to the desired amplitude using LEVEL potentiometer R13, on the Sine Wave Shaper assembly.

OPTION DESCRIPTION
5 MHz SINE WAVE SHAPER
20457-2

INTRODUCTION

This option description provides an explanation of the Sine Wave Shaper logic used to develop the Sine Wave output and adjustment of the output amplitude.

This Shaper Assembly can be plugged into either P19/J23 or P18/J22 of the option area. The 5MHz sine wave output will be present on rear panel BNC J6 or J5 respectively.

FUNCTIONAL EXPLANATION

A 5MHz square wave derived from the 10MHz internal oscillator is input to J1 pin 7 of the Sine Wave Shaper Assembly. The signal is filtered and shaped to generate the 5MHz Sine Wave output at P1 pin 2 of the same assembly.

This signal is then routed to a rear panel BNC. Refer to the Title page of this manual for connector designation. Refer to the Top Assembly Drawing for connector location. This signal is adjustable from 0 to 6 volts peak-to-peak and has been factory adjusted to 3 volts peak-to-peak into a 50 ohm load.

OUTPUT AMPLITUDE ADJUSTMENT

The output amplitude of this signal can be adjusted to the desired amplitude using LEVEL potentiometer R13, on the Sine Wave Shaper assembly.

OPTION DESCRIPTION
DAYLIGHT SAVINGS TIME SWITCH

INTRODUCTION

This option provides the capability of offsetting the time by one hour to compensate for daylight savings time.

OPERATION

Rear panel DIP switch SW2, position 3 (S3), when ON (closed/down) will add one hour to the displayed time.

OPTION DESCRIPTION
EXTERNAL FREQUENCY OPERATION

INTRODUCTION

This option provides the ability of using an external time base to operate the TC & FG. This external frequency can be 1,5, or 10 MHz, selectable via the I/O port.

SPECIFICATIONS

Input Connector:	J8
Frequency:	1,5, or 10 MHz
Input Wave Form:	Rectangular or Square Wave. Amplitude range: Logic "0" +0.2V ± 0.2VDC. Logic "1" +2.4V to +15VDC. Sinesoidal. Amplitude range: 1-5 volts peak to peak.
Frequency Stability	Better than or equal to 3×10^{-9}.

OPERATION

NOTE: Because J8 is a multipurpose input connector, when the External Frequency Operate option is enabled, the Event 1, 1PPS, and External Frequency Measurement options are disabled.

When External Frequency Operate option is enabled, the internal oscillator will lock to this external frequency.

This option can be selected via the RS232 I/O port in the following manner:

1) User inputs $\(hex5C) followed by two digits. The first digit is 0 for internal oscillator or 1 for external oscillator.
The second digit selects the frequency of the external input. 0 is for 1MHz, 1 is for 5MHz, 2 is for 10MHz, and any digit for internal oscillator.

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

Example: $\11

The above example illustrates selecting the External Frequency Operation option at 5MHz. If after having selected the external frequency operate option, the user wishes to return to internal operation, $\0X has to be input. The "X" stands for any digit. The program always requires two digits after the backslash character. If the first digit is zero (selecting internal time base/oscillator) the program requires a second digit, but it will be ignored.

OPERATIONAL CHARACTERISTICS

At power up, the previous mode int/ext is retained in battery backed memory. At initial power up the Mode is internal.

When external frequency is selected, the front panel LOCKED LED will turn off. The 1PPS output will track the systems GPS 1PPS. The 1PPS output will not be coherent with the internal oscillator.

When external frequency is selected, oscillator stabilization will start at 02 and go to 00. It may initially vacilate back and forth depending on the stability of the external source.

If internal oscillator/time base is selected, the oscillator stabilization process will start at 10 and count down to 00.

Make sure the correct frequency is specified when external is selected.

OPTION DESCRIPTION
CODE/PULSE RATE OUTPUTS
ASSEMBLY 55094

INTRODUCTION

This option provides a 10KHz square wave output, and other optional AC, DC, and pulse rate outputs. The optional outputs are available depending on specific requirements.

SPECIFICATIONS

10KHz Square Wave:	Output on rear panel BNC J5. TTL compatible Logic "0" +0.2V ±0.2VDC Logic "1" +3.7V ± 1.3 VDC Positive/rising edge on-time.

OPTION DESCTRIPTION
REMOTE/LOCAL CODE SELECT

INTRODUCTION

This option provides the ability to remotely or locally select the type of IRIG code generated by the GPS TC & FG.

OPERATION

Rear panel DIP switch S2 positions 4 and 5 are used for IRIG code selection. Refer to Table 1 below:

TABLE 1

FUNCTION	SWITCH 4	SWITCH 5
RS-232 I/O Control	Open (up)	Open (up)
IRIG A	Closed (down)	Open (up)
IRIG B	Open (up)	Closed (down)
IRIG G	Closed (down)	Closed (down)

OPTION DESCRIPTION
PARALLEL OUTPUTS

INTRODUCTION

This option description provides a functional explanation of the Parallel Output option which has been added to this unit.

FUNCTIONAL EXPLANATION

This option provides forty-two (42) parallel output lines representing time of year in BCD milliseconds, seconds, minutes, hours and days. The appropriate outputs from the Minor and Major Time Counters are routed to a set of non-inverting isolation buffers. Outputs are at standard TTL levels ("0" = +0.2 V plus/minus 0.2 VDC/"1" = +3.7 V plus/minus 1.3 VDC) and each output is capable of supplying up to ten (10) standard TTL loads.

A Sample Time Pulse is provided to indicate when data is stable. A true going pulse which is approx. .5 microseconds wide on this pin indicates the data has not stabilized. When this pulse goes away, the data is stable.

PARALLEL OUTPUT PIN CONNECTIONS

Pin	Term	Pin	Term	Pin	Term
1	ms1	21	M2	41	D100
2	ms2	22	M4	42	D200
3	ms4	23	M8	43	
4	ms8	24	M10	44	
5	ms10	25	M20	45	N/U
6	ms20	26	M40	46	N/U
7	ms40	27	H1	47	N/U
8	ms80	28	H2	48	SAMPLE TIME
9	ms100	29	H4	49	SIG GND
10	ms200	30	H8	50	SIG GND
11	ms400	31	H10	51	N/U
12	ms800	32	H20	52	N/U
13	S1	33	D1		
14	S2	34	D2		
15	S4	35	D4		
16	S8	36	D8		
17	S10	37	D10		
18	S20	38	D20		
19	S40	39	D40		
20	M1	40	D80		

OPTION DESCRIPTION
BUFFER ASSEMBLY
55106

INTRODUCTION

This option provides a buffered 1MHz square wave or a buffered DC level shift code output for the -1 assembly.

The Buffer Assembly can be plugged into either P19/J23 or P18/J22 of the option area. The buffered output will be present on rear panel BNC J6 or J5 respectively.

SPECIFICATIONS

Output Amplitude:	TTL levels terminated into 50 ohms.
Output Connector:	Rear panel BNC J5 or J6 depending on where Buffer Assembly is installed.

OPTION DESCRIPTION
10PPS

INTRODUCTION

This option description provides a functional explanation for the 10PPS output which has been added to this unit.

FUNCTIONAL EXPLANATION

The 10PPS signal is generated on the 55087 assembly and then routed to the 55090 code/pulse rate assembly. On the 55090 assembly, the 10PPS signal is buffered using a 26C31. The signal is then routed to the J5 BNC connector located in the rear panel.

SPECIFICATIONS

10PPS: Output on rear panel BNC J5.
TTL compatible
Logic "0" + 0.2V ±0.2 vDC
Logic "1" + 3.7V ±1.3VDC
Negative edge on-time Duty cycle 80/20%
Capable of sinking and sourcing 20 ma.

OPTION DESCRIPTION
IEEE-488 I/O INTERFACE
ASSEMBLY 55089

INTRODUCTION

This assembly is designed in accordance with the IEEE-488/1978 specification and is used to provide the electrical interface between the GPS Time Code and Frequency Generator (TC & FG) and the IEEE-488 bus.

When programmed as a listener, this assembly provides the capability to remotely control the TC & FG. When programmed as a talker, this assembly provides the capability to output time, status, location, etc. Five of the eight bus control lines: DAV, NRFD, NDAC, ATN and IFC are used in this option. EOI, SRQ, and REN have no assigned function. The controller can not perform a serial poll of this assembly.

INSTALLATION

This assembly is plugged into the option area of the Synchronized Time Code/Frequency Module, Assembly 55091. Interconnection to the IEEE-488 bus is provided through rear panel connector J13. Connect the IEEE-488 cable to J13.

OPERATION

The first step in using the IEEE-488 I/O is to program/select the Device Address. By pressing the front panel Display push button, the third menu will display the IEEE-488 address. If a cold reset was performed at power up, the default address will be 17. The address can be changed by closing (pushing down) rear panel DIP switch SW2 position 3. Watch the display, and the address will increment at one second intervals. When the desired address is reached, open (push up) DIP switch SW2 position 3. The Device Address can also be selected via the RS-232 I/O port. (Refer to Section 4.1 of this manual). The user inputs $CXX. (The XX corresponds to a two digit device address number). The unit will respond with OK CR/LF (carriage return/line feed.)

All communication to or from the IEEE-488 port is in the ASCII format. At power up, the interface is in the wait/idle state. To talk to our interface, send the following commands/mnemonics:

UNL (unlisten)
MTA (my talk address containing the address of the controller)
LAG (listen address group containing the address of our interface)
The attention/log-on character (see Section 4.1)
The command/ID character
The specific data (if applicable)

NOTE: With the exception of UNL, MTA, and LAG, the protocol is identical to that of the RS-232 I/O . (See Section 3-23). When communicating to the 488 interface, if more than 30 seconds elapses between commands, the I/O will time out and the communication will have to be repeated.

If after talking to our interface, it is necessary to receive some data, send the following commands/mnemonics:

UNL (unlisten)
MLA (my listen address containing the address of the controller).
TAG (talker address group containing the address of our interface).

Our interface will always respond with specific data followed by CR/LF.

IEEE-488 BUS INTERFACE CONNECTOR PIN ASSIGNMENT

J13 pin	Signal
1	DI01
2	DI02
3	DI03
4	DI04
5	EOI
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	GND
13	DI05
14	DI06
15	DI07
16	DI08
17	REN
18	GND
19	GND
20	GND
21	GND
22	GND
23	GND
24	GND

MAINTENANCE

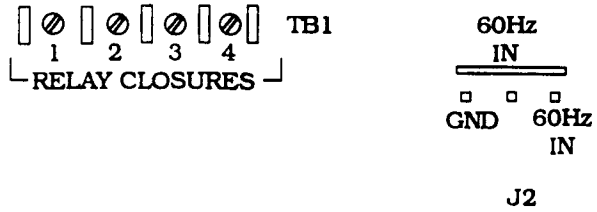
No routine maintenance is required.

OPTION DESCRIPTION
60Hz MEASUREMENT/
FAULT RELAYS

INTRODUCTION

This option provides the capability of measuring the frequency, phase angle, and elapsed time offset of an externally supplied 60Hz AC sine wave. It also supplies two fault relay closures.

REAR PANEL CONFIGURATION



SPECIFICATIONS

60Hz Input	
Input Connector:	J2
Signal Characteristics:	60Hz, approximately 30 volt peak-to-peak signal from AC adapter.
Relay Closure Outputs Configuration:	TB1 pins 1 and 2 - fault closure. TB1 pins 3 and 4 - not locked closure.

OPERATION

With the unit operating, connect the AC adapter to J2. Make sure when plugging in the AC adapter to the AC power source that it is correctly polarized, i.e. the pin labeled AC Hi is plugged into the AC HOT receptacle. If this connection is reversed, the phase angle measurements will be off by 180°.

The frequency measurement is made by counting how many 60Hz sine waves occur between successive corrected 1PPS pulses from the GPS Receiver.

The phase angle measurement is made by calculating where the 1PPS pulse occurs in relationship to the 60Hz sine wave.

The error calculation is the accumulated time error based on whether the sine wave is fast or slow. A time error offset can be entered when the 60Hz measurement is off, which is used as a starting point for the time error calculation.

The following features are input/selected via the RS-232 I/O port. (Refer to Section 4-1 Introduction):

1.1 ENABLE/DISABLE 60Hz MEASUREMENT

This command allows the user to enable or disable the 60Hz measurement feature.

1) The user inputs $B (HEX 24 HEX 42) followed by either a 0 or a 1. 0 turns off the option, 1 turns on the option.
2) The unit responds with OK CR/LF.

   example: $B1

   The above example illustrates enabling the 60Hz measurement option.

   If the option is turned on (enabled) and it isn't available, the message OPT? will be sent.

1.2 ENTER 60Hz OFFSET DATA

This command allows the user to enter a starting point for the time error calculation.

1) The user inputs $D (HEX 24 HEX 44) followed by 1 digit (sign), 1 digit, decimal point, followed by 4 digits.

   The sign digit's definition is : 1 = +.
   0 = -.

2) The unit responds with OK CR/LF.

   example: $D - 2.3406

   The above example illustrates entering a time error offset of -2.3406 seconds. NOTE: The time error offset can only be entered if the 60Hz measurement option is off.

   If a time offset is entered while the 60Hz option is enabled, the message OPT ON will be sent, and the time offset data ignored.

1.3 REQUEST 60Hz MEASUREMENT DATA

This command allows the user to obtain the 60Hz measurement data.

1) The user enters $A (HEX 24 HEX 41)
2) The unit responds with XX.XXX, space, Hz (representing frequency measurement), ±X.XXXX, space, SEC (representing accumu-

lated time error), space, XXX.X, space, DEC, (representing phase angle measurement), space, ±X.XXXX, space, OFFSET (representing time offset), CR/LF.

example: 60.132 Hz + 1.357 SEC 180.2 DEG +1.206 OFFSET CR/LF

The above response states that the frequency measurement is 60.132Hz, the accumulated time error is +1.357 seconds, the phase angle is 180.2 degrees, and the time offset is +1.206 seconds.

The 60Hz measurement data is also available on the third menu of the front panel LCD display. The format is as follows:

FRQ: 60.132Hz PHASE: 180.2 DEG ON
ERROR: +1.357 Sec OFFSET: +1.206 Sec

If the 60Hz option is not enabled, ON will be replaced with OFF. When the unit is first turned on, it will come up in the OFF (default) mode. If the 60Hz option is turned on prior to the unit achieving LOCK, ON will be replaced with NOT LK and measurement data will not be available.

When measuring the 60Hz with a time period of 16.66 milliseconds, if a measurement occurs outside a 1 millisecond window of that time period (such as a noise spike), the measurement is ignored, and an error is counted. If 1000 successive errors are read, the message ERR appears, and the 60Hz measurement option is turned off.

This option also has two relay closures to indicate timing/fault of the unit. The fault relay (output on rear panel terminal strip TB1-1 and 2) will provide contact closure upon the following conditions:

a) A processor error, channel 1 error, or channel 2 error from the GPS Receiver (SVee Six Module).
b) Loss of +5VDC.
c) If the DAC value goes below 300 or above 65000.

The timing relay (output on rear panel terminal strip TB1-1 and 4) will provide contact closure until the unit has achieved oscillator lock, i.e. until the front panel LOCKED LED illuminates.

SECTION SIX
MAINTENANCE/TROUBLESHOOTING

6.1 MAINTENANCE

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

Periodically the internal time base may have to be calibrated/nulled. Refer to the calibration description of the Internal Time Base in Section Five.

6.2 TROUBLESHOOTING

6.2.1 GENERAL

If at any time the unit fails to operate or operates intermittently, it is always 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 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.

The following are some common problems and their causes:

6.2.2 POWER LED DOESN'T ILLUMINATE WHEN ON/OFF SWITCH IS ACTIVATED.

a. DC voltage is not present on input connector J2.
b. Fuse F1 is blown.
c. Microprocessor U1 is not operational.

6.2.3 TRACKING LED DOES NOT ILLUMINATE.

a. Antenna/preamp is defective.
b. Cable or connections between antenna/preamp and unit are open or intermittent.
c. 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 optional LCD display and four (4) satellite vehicle PRN numbers will be displayed that are useable. This data can also be accessed via the RS232 I/O port by requesting "Print Time, Status, Error Code, and Satellite Vehicle Numbers.

6.2.4 LOCKED LED DOES NOT ILLUMINATE.

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

6.2.5 ERROR MESSAGE/CODE - ANTENNA FEED FAULT

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

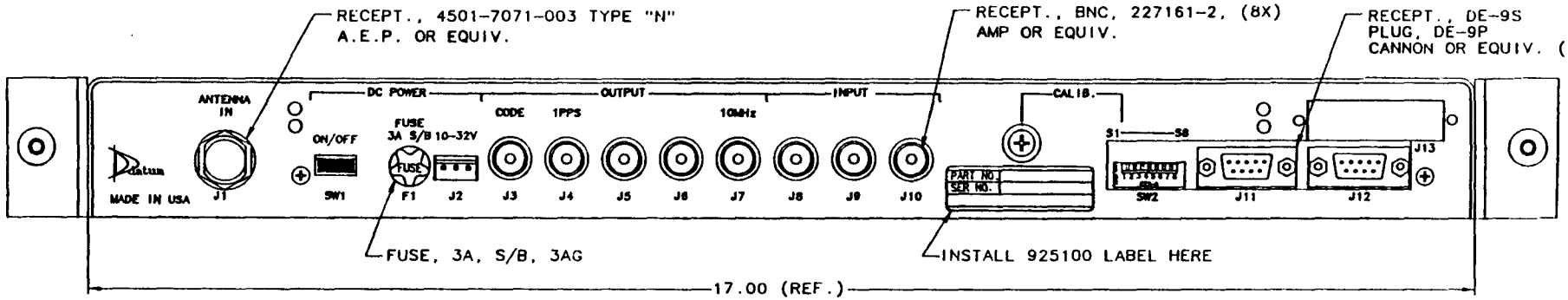
SECTION SEVEN
DRAWINGS/DOCUMENTAITON

1.	GPS Time Code & Frequency Generator (Top Assembly)	9390-52XXX
2.	Logic/Block Diagram	9390-9644
3.	Shipping Kit	SK9390-52-1
4.	Shipping Kit	SK9390-52-2

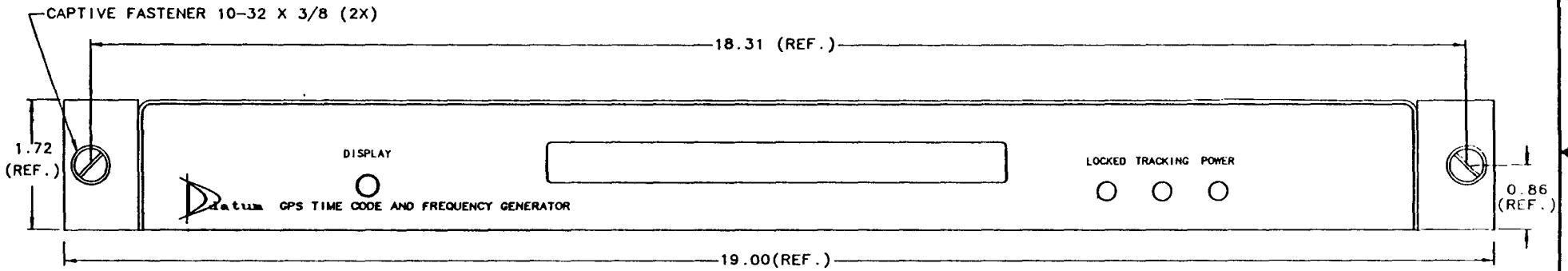
Note:
Only one shipping kit will be provided. Refer to the title page of this manual for the specific shipping kit supplied.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

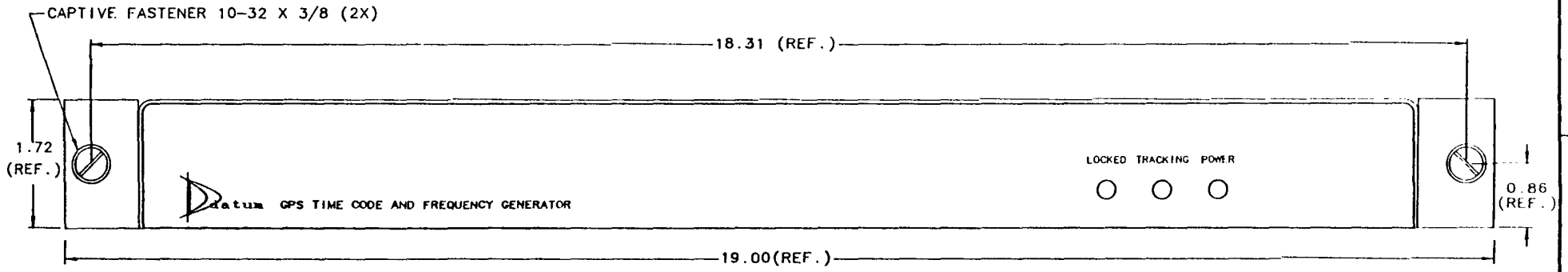
REAR PANEL ROTATED 180°



FRONT PANEL WITH OPTIONAL LCD DISPLAY



FRONT PANEL WITHOUT OPTIONAL LCD DISPLAY



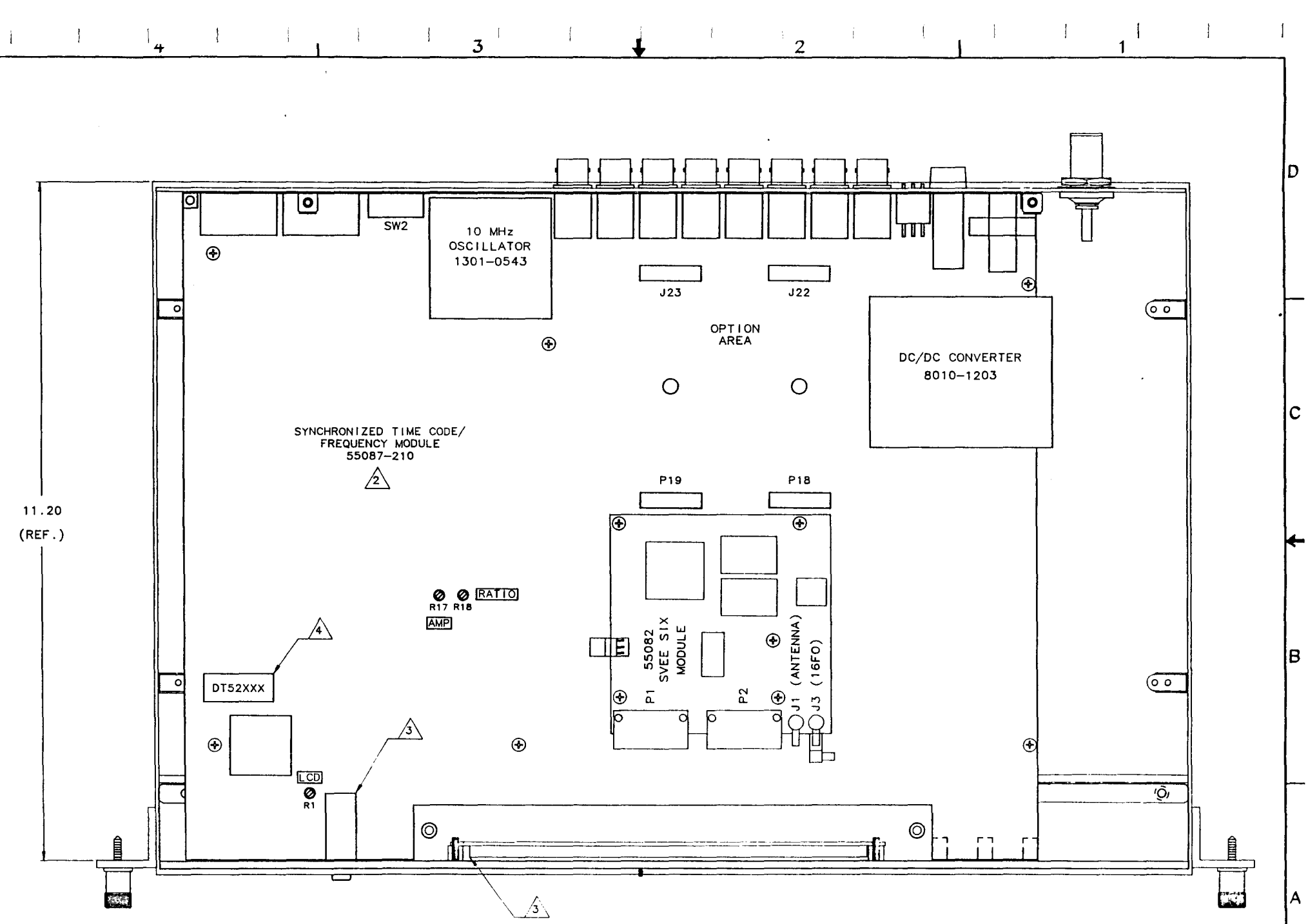
4. FOR THE SPECIFIC FIRMWARE VERSION SUPPLIED, REFER TO THE COVER PAGE OF THE USER'S MANUAL.
3. USED WITH THE OPTIONAL LCD DISPLAY.
2. THE DASH NUMBER WILL BE -10 WITH THE LCD DISPLAY.
1. FOR THE REAR PANEL CONNECTOR CONFIGURATION/DESIGNATION, REFER TO THE COVER PAGE OF THE USER'S MANUAL.

NOTES: UNLESS OTHERWISE SPECIFIED

TITLE: GPS TIME CODE AND FREQUENCY GENERATOR

Datum inc.
1363 S. STATE COLLEGE BLVD
ANAHEIM, CALIFORNIA 92806

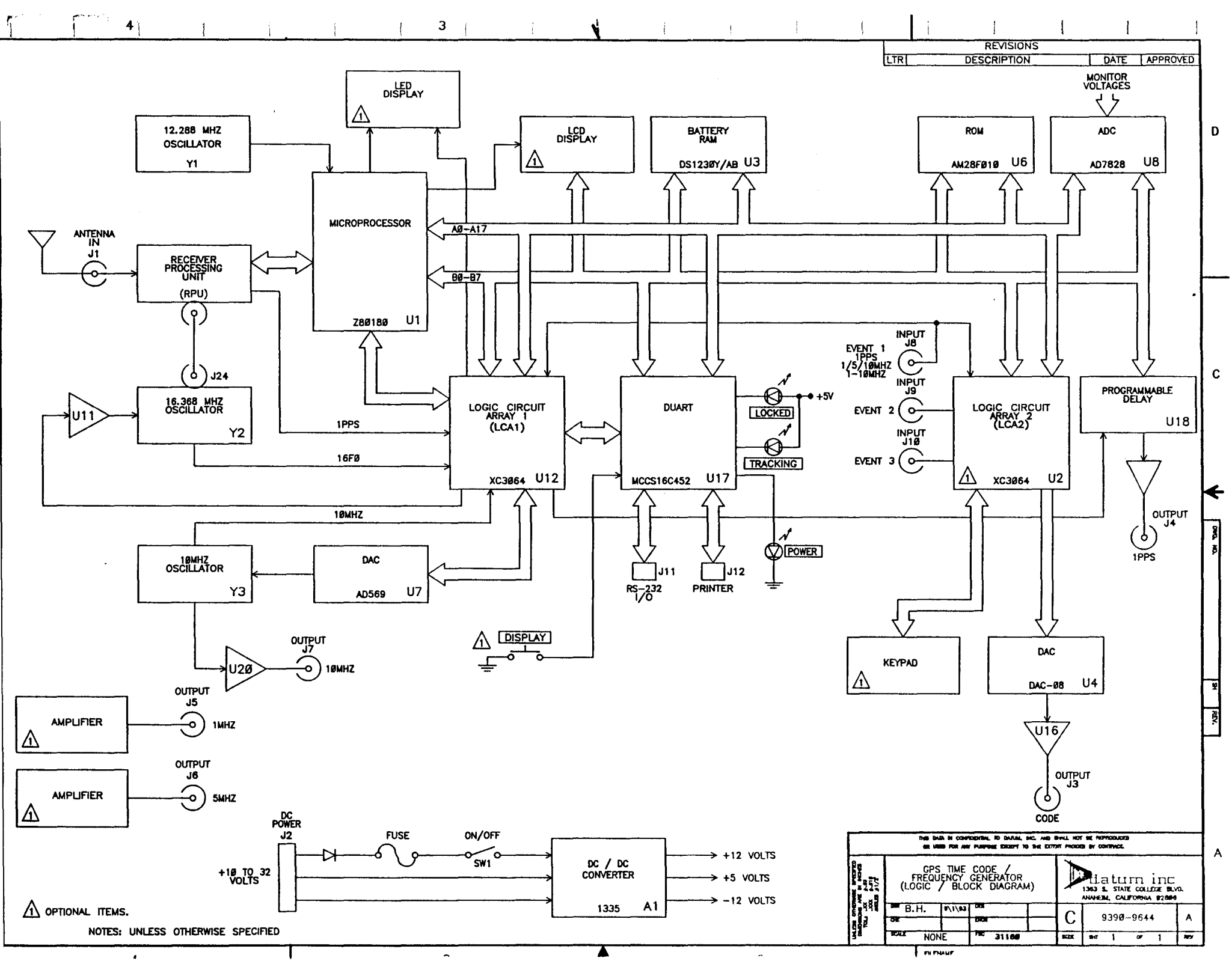
SCALE 1:1 | FSC 31160 | C | 9390-52XXX | SIZE | SHT 1 OF 2 | REV



NOTES: UNLESS OTHERWISE SPECIFIED

C | 9390-52XXX | SIZE | SHT 2 OF 2 | REV

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



1 OPTIONAL ITEMS.

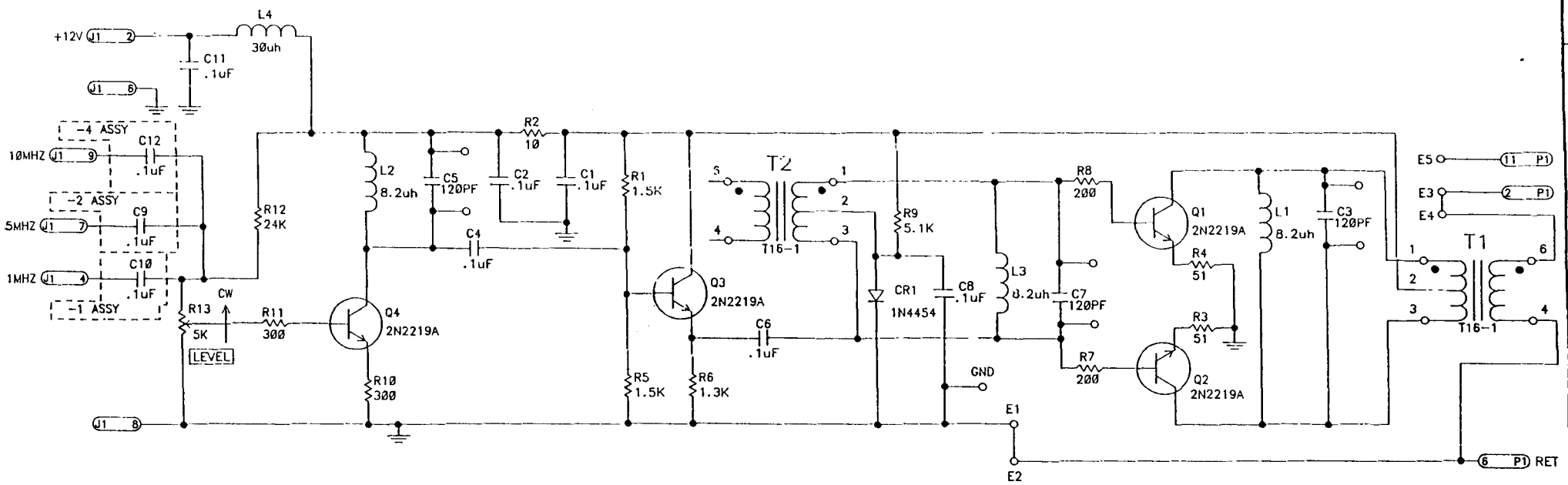
NOTES: UNLESS OTHERWISE SPECIFIED

GPS TIME CODE / FREQUENCY GENERATOR (LOGIC / BLOCK DIAGRAM)

datum inc
1363 S. STATE COLLEGE BLVD.
ANAHEIM, CALIFORNIA 92806

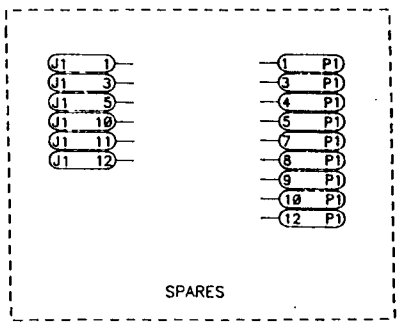
DRN B.H.	9\1\93	DES		C	9390-9644	A
CHK		ENGR			
SCALE NONE		PRC 31160		SIZE	SHT 1 OF 1	REV

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO T6911	5/4/94	G.H.
B	REVISED PER ECO T7141	6/22/95	G.H.
C	REVISED PER ECO T7313	6/29/96	GH



-4 ASSY (10MHZ) PARTS TABLE
C9 AND C10 P/N 0240-0104 (NOT USED)
C3 C5 C7 P/N 0227-0680 (68PF)
L1 L2 L3 P/N 0601-0332 (3.3UH)
INSTALL C12 (0240-0104)

-1 ASSY (1MHZ) PARTS TABLE
C9 AND C12 P/N 0240-0104 (NOT USED)
C3 C5 C7 P/N 0201-0821 (820PF)
L1 L2 L3 P/N 0601-0303 (30UH)



2. -3 ASSEMBLY CONNECTORS J1 AND P1 NOT USED.
1. -2 ASSEMBLY SHOWN (5MHZ).

NOTES: UNLESS OTHERWISE SPECIFIED

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

SINEWAVE SHAPER

Datum inc

DWN B.H.	4/22/93	DES	
DR		ENGR G.H.	6/95
SCALE NONE		PSC 31160	

C | 20457 | C

SIZE | SHT 1 OF 1 | REV

DWG NO	SH
A-20457	1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO T6911	05/04/94	GH
B	REVISED PER ECO T7141	06/22/95	GH
C	REVISED PER ECO T7313	96/06/26	GH
D	REVISED PER ECO 6723	01/11/12	EH
E	REVISED PER ECO 7054	02/08/21	

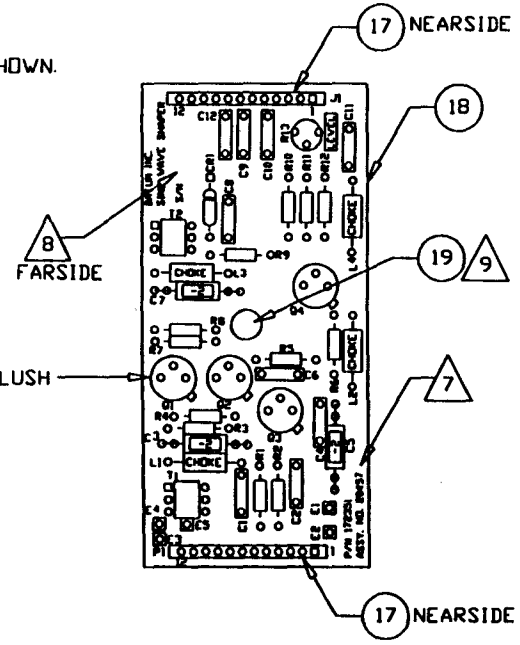
NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER MIL-STD-100.
2. SEE PARTS LIST FOR ALL REFERENCE DOCUMENTS PERTINENT TO THE PRODUCTION OF THIS ASSEMBLY.
3. PC BOARD NO. 172351 CURRENT REVISION.
4. C9 AND C12 NOT USE ON -15 ASSEMBLY.
5. C10 AND C12 NOT USED ON -25 ASSEMBLY.
6. C8 AND C10 NOT USED ON -45 ASSEMBLY.

⚠7 IDENTIFY ASSEMBLY NO., (AND -NO.) WHERE SHOWN.

⚠8 IDENTIFY S/N ON FARSIDE OF BOARD.

⚠9 ITEM NOT AFFIXED TO BOARD. SHIP WITH UNIT IN MARKED BAG.



NEARSIDE OF PC BOARD SHOWN

SEE SEPARATE PARTS LIST
PART NO. 20457-TAB

A-20457	NONE	9390-6XXX ET6XXX
PART NUMBER	NEXT ASSY	USED ON
APPLICATION		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DIMENSIONS APPLY BEFORE FINISHING PROCESS
ANGLE TOLERANCE ± 0° 30'
DIAMETERS CONCENTRIC TO WITHIN ±.005
DECIMAL TOLERANCES X=±.1 XX=±.01 .XXX=±.005
DRAWINGS PREPARED IN ACCORDANCE WITH ASME Y14.5-1994
SURFACE TEXTURE 125 ✓

DO NOT SCALE DRAWING

MATERIAL	FINISH

FILENAME A-20457e.DWG
CONTRACT NO ACAD2000

APPROVALS

QUALITY	MATL CONT	DWN BY B HOLLINGSWORTH	DATE (YR-MO-DA) 93/04/22
PROD ENGR	MFG	CHKR E.HERAS	ENGR G.HAMMOND
		DSGN ENGR	DOC CONT C.HAMBLY
		CUST	DATE

Datum inc
IRVINE
TIME & FREQUENCY PRODUCTS, INC.
3 PARKER, IRVINE, CA 92618-1605

SINE WAVE SHAPER

SIZE	CAGE CODE	DWG NO	REV
B	55761	A-20457	E

SCALE 1:1 WEIGHT SHEET 1 OF 1

LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO T6796	6-10-93	
B	REVISED PER ECO T6805	7-7-93	
C	REVISED PER ECO T6821	8-17-93	
D	REVISED PER ECO T6831	9-3-93	
E	REVISED PER ECO T6857	10-21-93	
F	ADDED CR30 PER ECO T6869	11-3-93	
G	REVISED PER ECO T6885	12-10-93	
J	REVISED PER ECO T6936	5-17-94	
K	REVISED PER ECO T7023	10-10-94	

18MSINE

U7 AD569 DAC

U23 74HC4053

Y2 CO-481V 16.368MHz

Y3 8367-543 18MHz

U22 74HC04

U3 DS1230Y/AB

U14 MAX698ACPA

Y1 12.288MC

U1 Z8018B

U6 27C818Q15B DT52XXX

U12 XC3064

⚠7 R28 AND R33 ARE USED ONLY WITH OSC 1301-0542 AND 1301-0543.

⚠6 -11 ASSY. USES TANS MODULE.

⚠5 USED ON -18 ASSY.

⚠4 USED ON -9 ASSY.

⚠3 Y3 IS 1301-3083-2 ON -3 ASSY. R74 AND R76 ARE USED ON -3 ASSY.

⚠2 Y3 IS 1301-3083-1 ON -2 ASSY. R74 AND R76 ARE USED ON -2 ASSY.

⚠1 Y3 IS 1301-0542 ON -1 ASSY. ALL RESISTORS ARE IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED

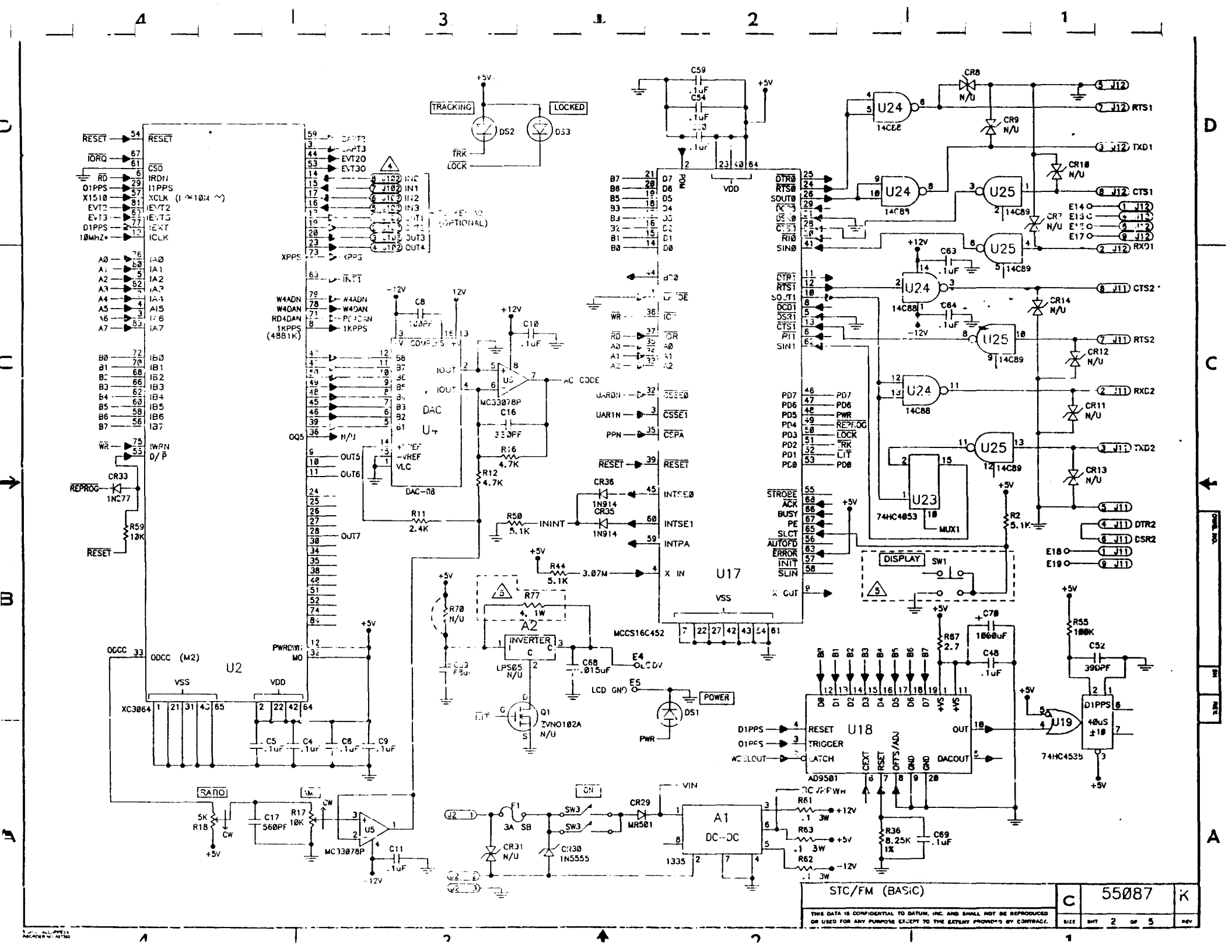
TITLE: SYNCHRONIZED TIME CODE/ FREQUENCY MODULE (BASIC)

Datum Inc. 1363 S. STATE COLLEGE BLVD. ANAHEIM, CALIFORNIA 92806

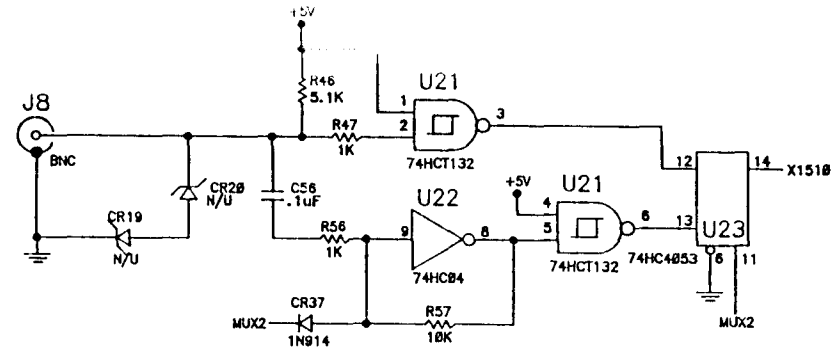
DWN ESTHER 2/8/93 | CHK | ENGR | SCALE NONE | FSC 31160

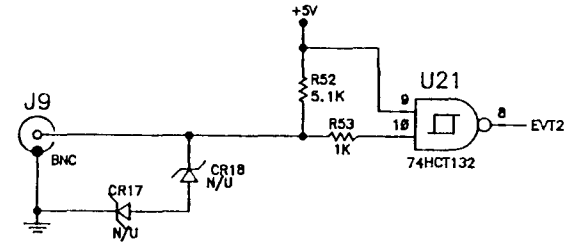
C | 55087 | K

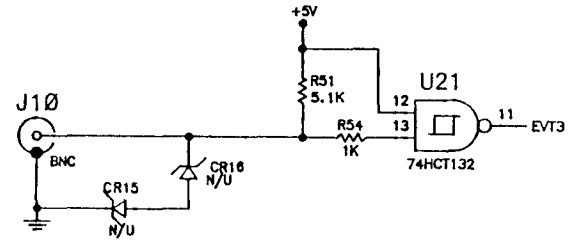
SIZE | SHT 1 OF 5 | REV

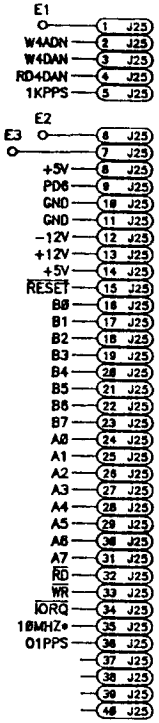

TRACKING
LOCKED
DS2
DS3
TRK
LOCK
U2
XC3064
ODCC (M2)
VSS
VDD
U17
MCCS16C452
X IN
X OUT
U18
AD9501
RESET
TRIGGER
LATCH
DACOUT
A1
DC-DC
1335
U23
74HC4053
MUX1
U19
74HC4535
DISPLAY
SW1
POWER
DS1
DAC
U4
DAC-08
MC33078P
INVERTER
A2
Q1
ZVNO102A
N/U
CR33
1N277
CR35
1N914
CR36
1N914
CR29
MR501
CR31
N/U
CR30
1N5555
F1
3A SB
RATIO
STC/FM (BASIC)
55087
C
K
SHT 2 OF 5
THIS DATA IS CONFIDENTIAL TO DATUM, INC. AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT.

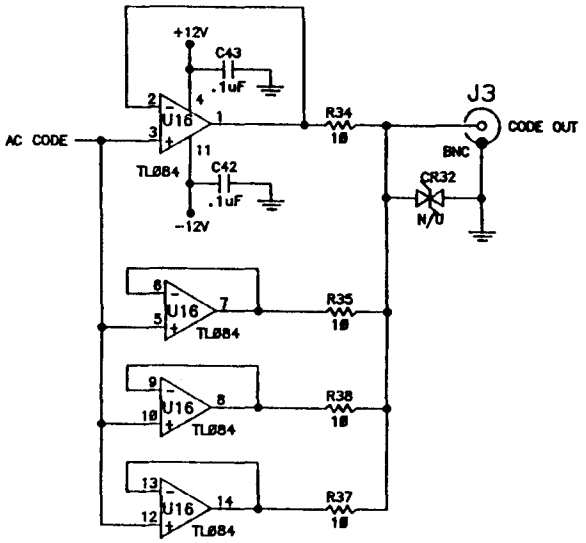
INPUTS

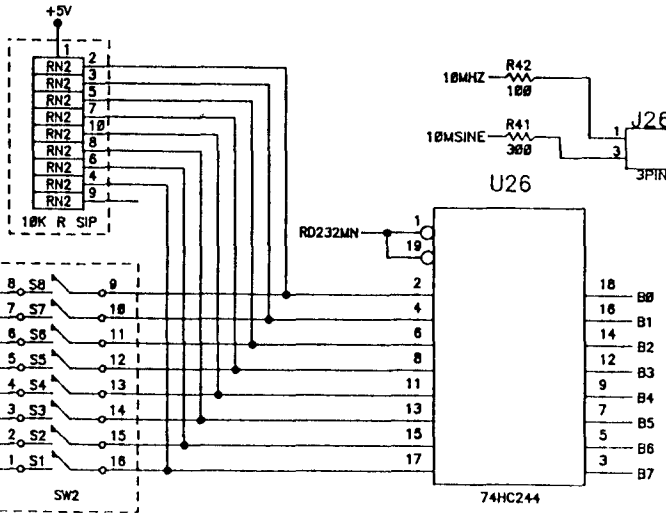


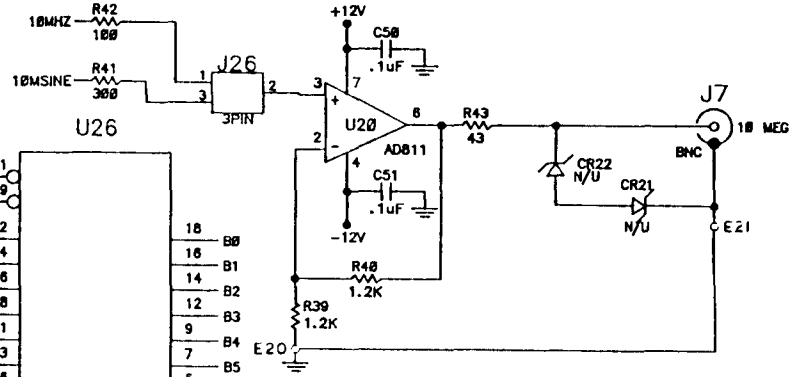


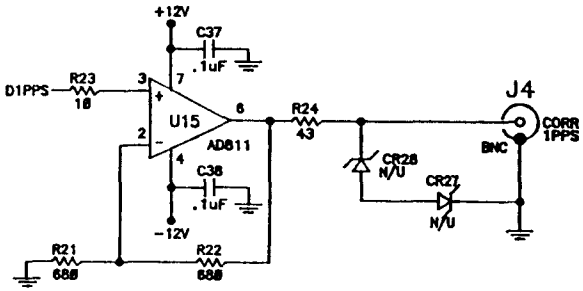




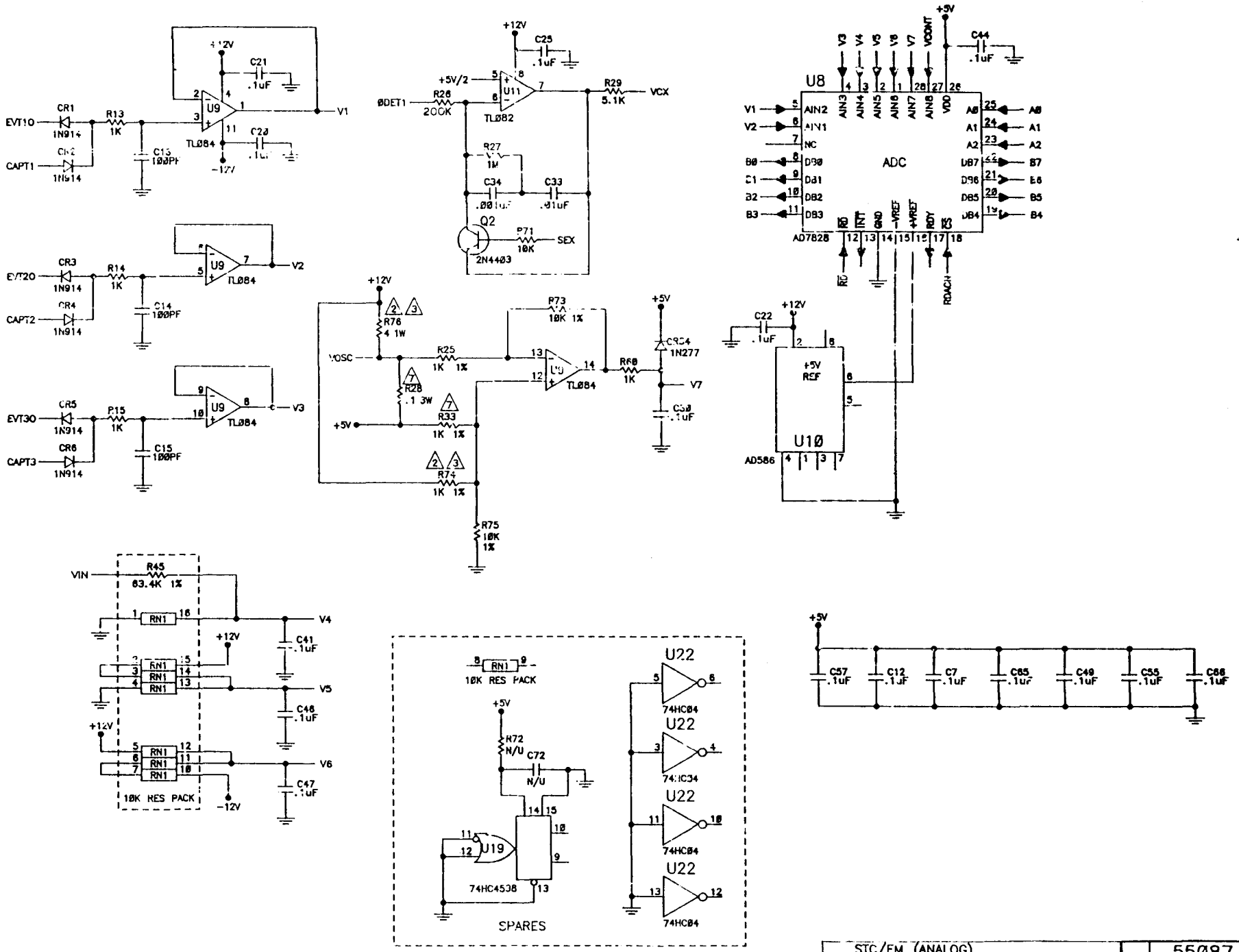




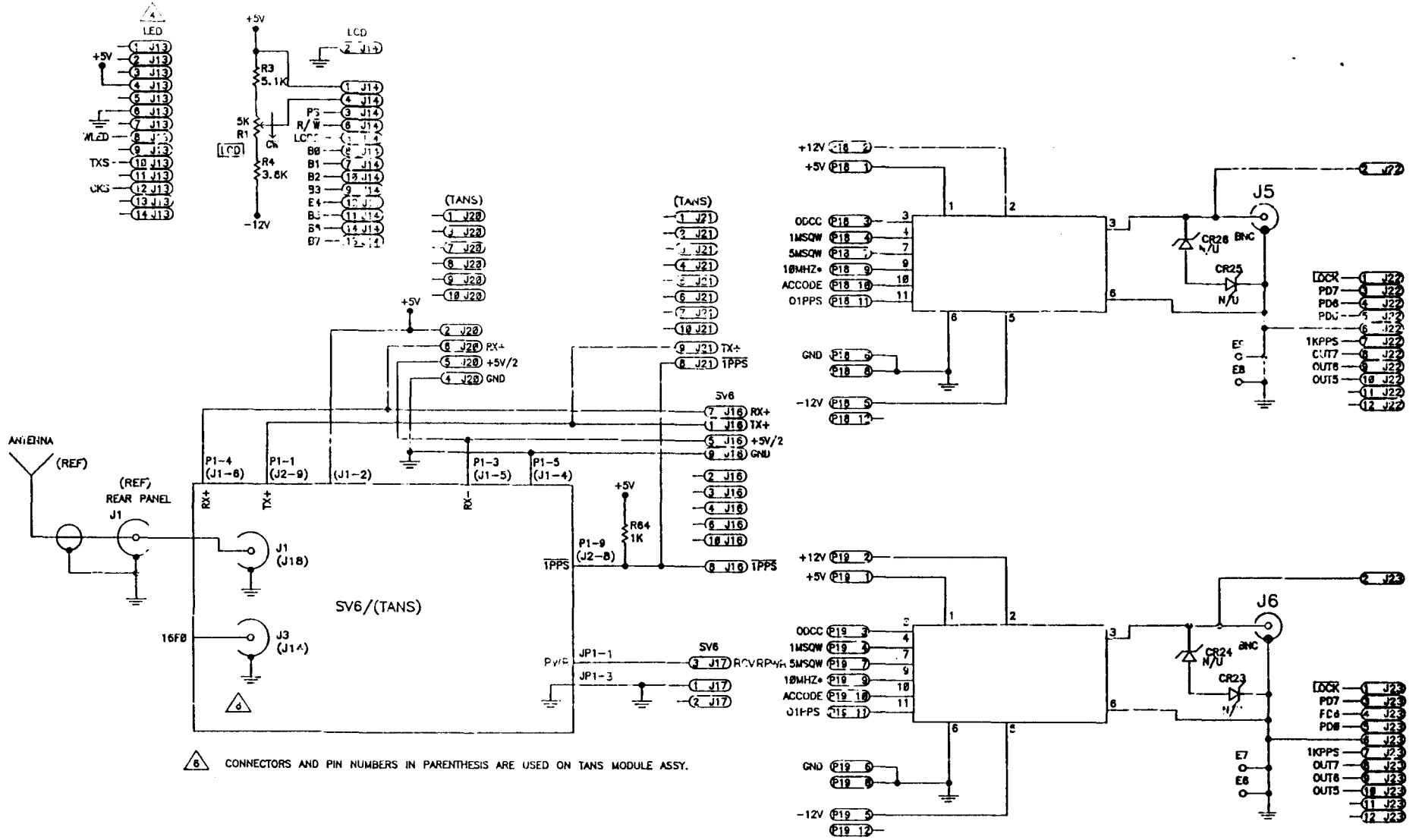




STC/FM (I/O)	C	55087	K
THIS DATA IS CONFIDENTIAL TO DATUM, INC. AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT.	SIZE	SHT 3 OF 5	REV

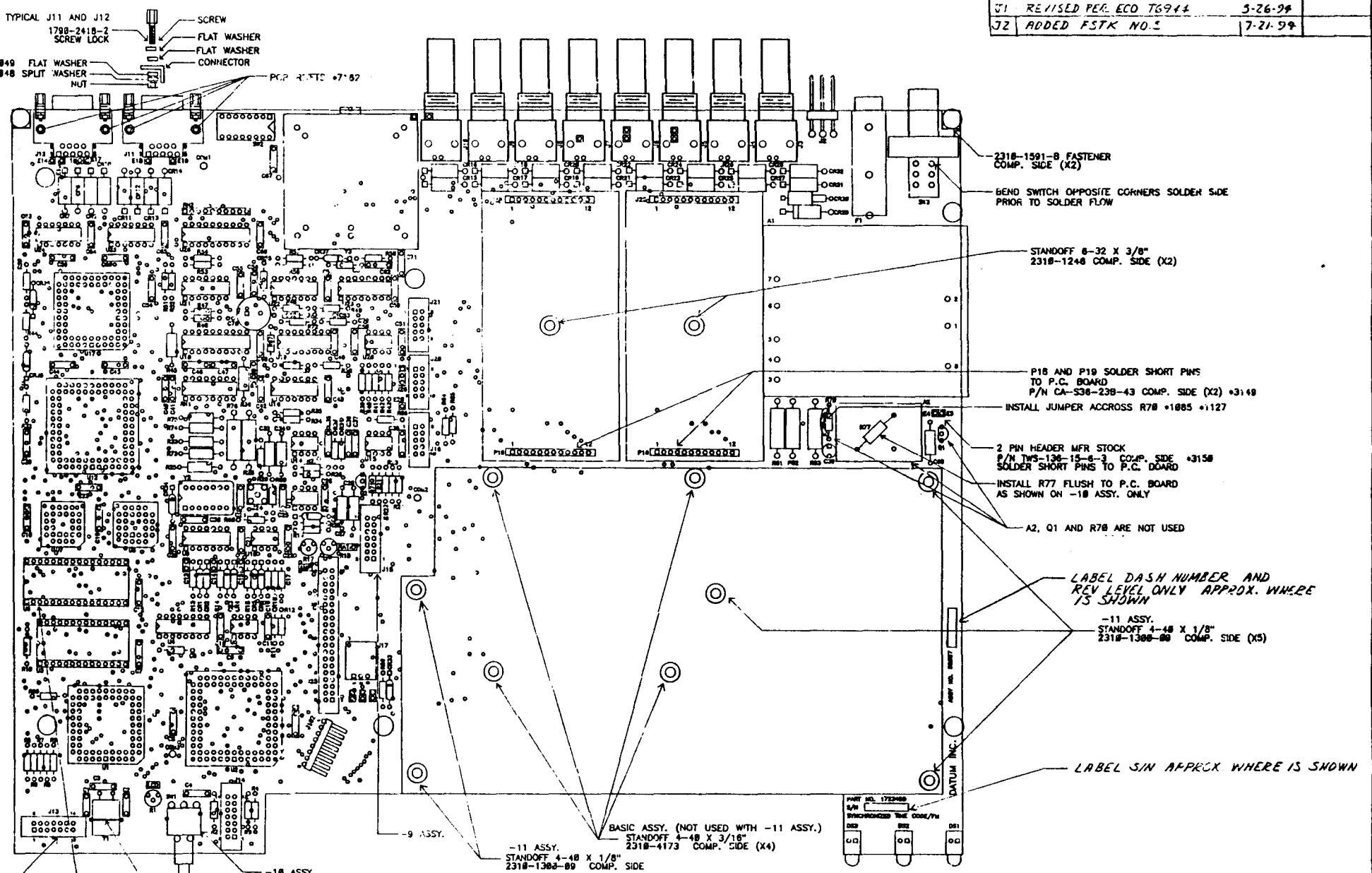


STC/FM (ANALOG)	C	55087	K
THIS DATA IS CONFIDENTIAL TO DATUM, INC. AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT.	SIZE	SHT 4 OF 5	REV



STC/FM (BASIC)	C	55087	K
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 5 OF 5	REV

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
J1	REVISED PER ECO T6944	3-26-94	
J2	ADDED FSTK NO.S	7-21-94	



7. R28 AND R33 ARE NOT USED ON -2 OR -3 ASSY.
6. CR7-CR28, CR31,-CR32 ARE NOT USED.
5. Y3 IS 1301-3683-2 ON -3 ASSY. R74 AND R76 ARE USED ON -3 ASSY.
4. Y3 IS 1301-3683-1 ON -2 ASSY. R74 AND R76 ARE USED ON -2 ASSY.
3. Y3 IS 1301-0542 ON -1 ASSY.
2. INSTALL OSCILLATOR Y2 AND Y3 .05" OFF OF P.C. BOARD.
1. PC BOARD 172345 D

NOTES: UNLESS OTHERWISE SPECIFIED

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

TITLE: SYNCHRONIZED TIME CODE/F.M.

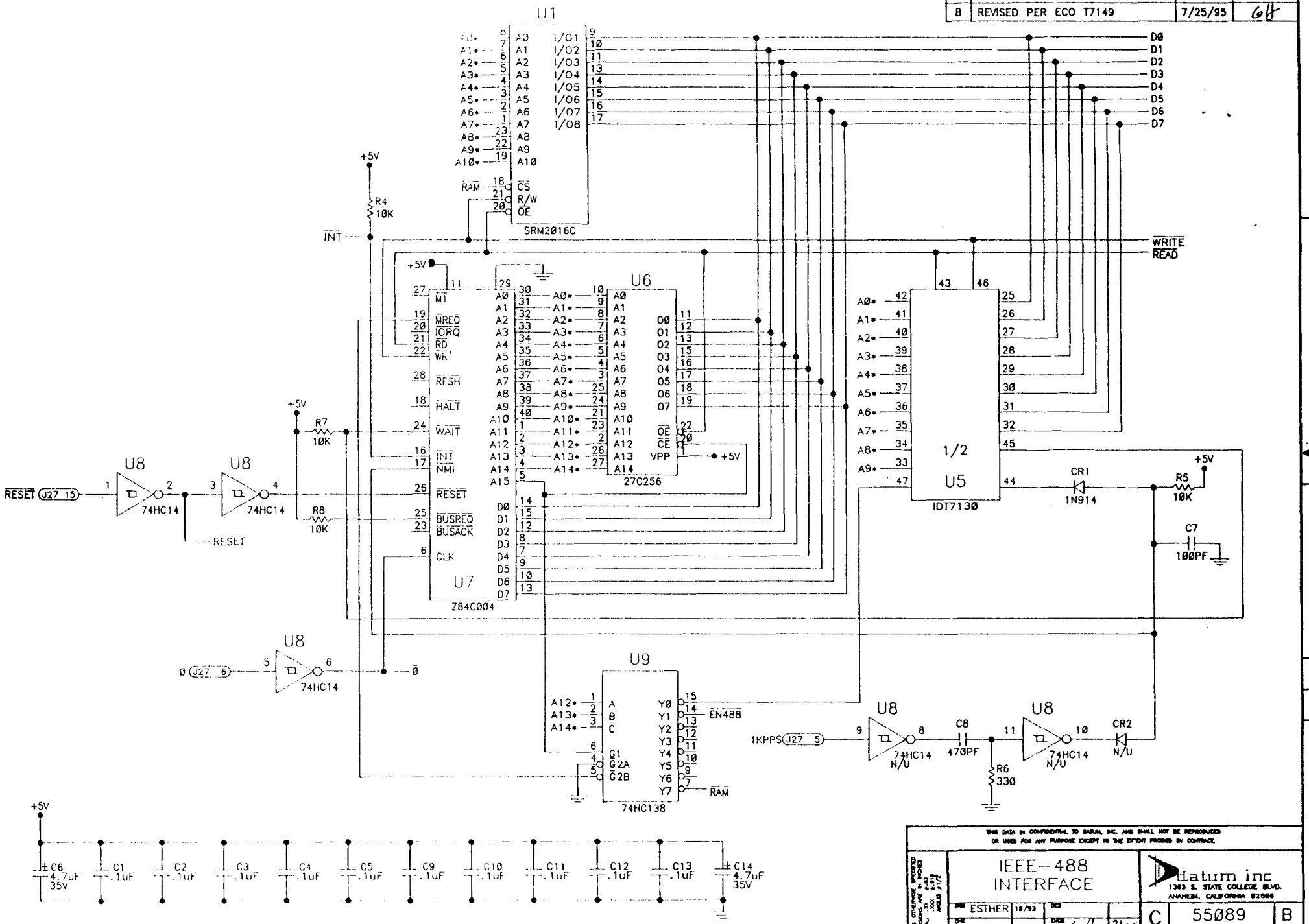
Datum inc. 1363 S. STATE COLLEGE BLVD. ANAHEIM, CALIFORNIA 92806

DWN	STEVE	4/12/93	DES		
CHK			ENGR		
SCALE	1:1		PRD	31160	

SIZE C | A-55087 | K

SHT 1 OF 1 REV

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO T6900	1/22/94	G.H.
B	REVISED PER ECO T7149	7/25/95	GH



NOTES: UNLESS OTHERWISE SPECIFIED

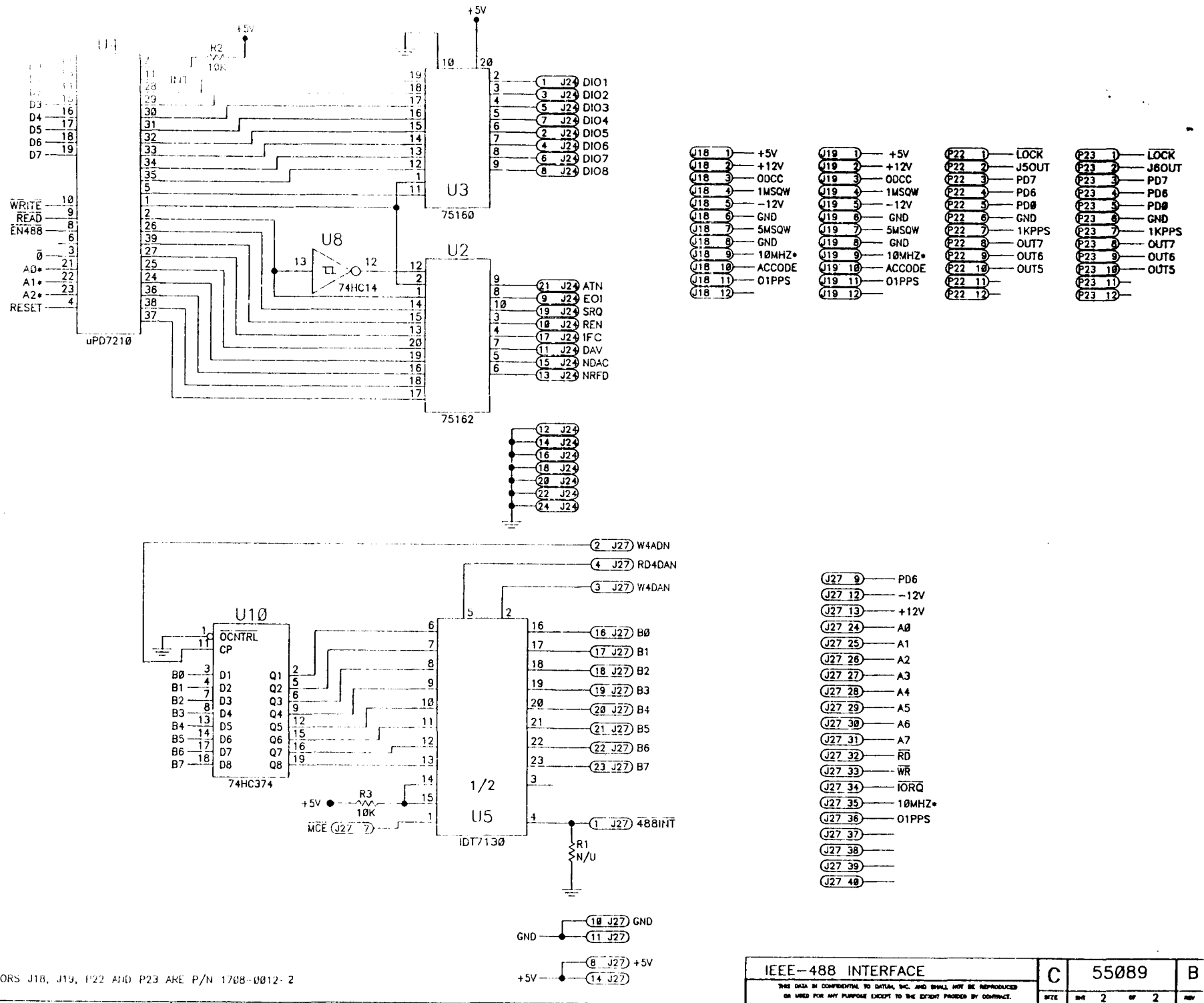
IEEE-488 INTERFACE

datum inc
1363 S. STATE COLLEGE BLVD.
ANAHEIM, CALIFORNIA 92806

DRN	ESTHER 10/93	DES	
CHK		ENGR	GH 7/95
SCALE	NONE	PSC	31160

C | 55089 | B

SHT 1 OF 2



1. -1 ASSY. CONNECTORS J18, J19, P22 AND P23 ARE P/N 1708-0012-2

IEEE-488 INTERFACE	C	55089 B
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 2 OF 2 REV

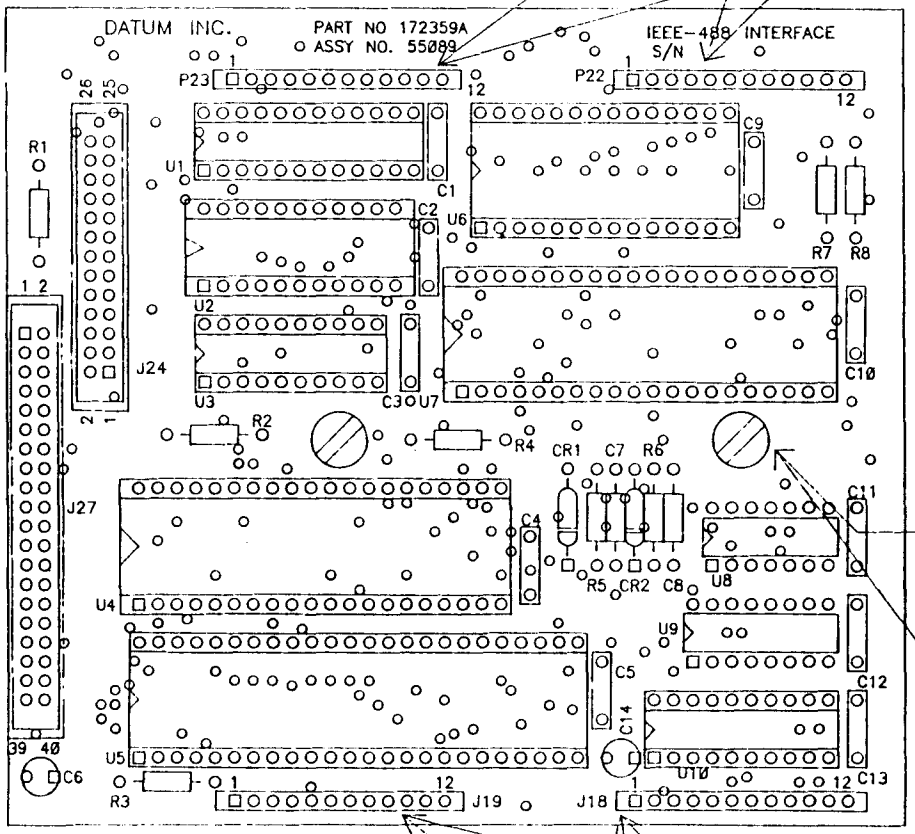
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

ON −1 ASSY.

INSTALL CONN P/N 1708−0012−2
ON COMP. SIDE OF PC BOARD

ON BASIC ASSY.

INSTALL CONN P/N CA−S36−23B−43
ON SOLDER SIDE OF PC BOARD



ON BASIC ASSY.

SWAGE ON FASTENER P/N 2325−2007
ON COMP. SIDE OF PC BOARD

ON −1 ASSY.

USES STANDOFF P/N 2310−6981
INSTALLED AT NEXT LEVEL

ON BASIC ASSY.

INSTALL CONN P/N 1708−0012
ON SOLDER SIDE OF PC BOARD

ON −1 ASSY.

INSTALL CONN P/N 1708−0012−2
ON COMP. SIDE OF PC BOARD

1. R1 AND CR2 ARE NOT USED.

NOTES: UNLESS OTHERWISE SPECIFIED

TITLE: IEEE−488 INTERFACE

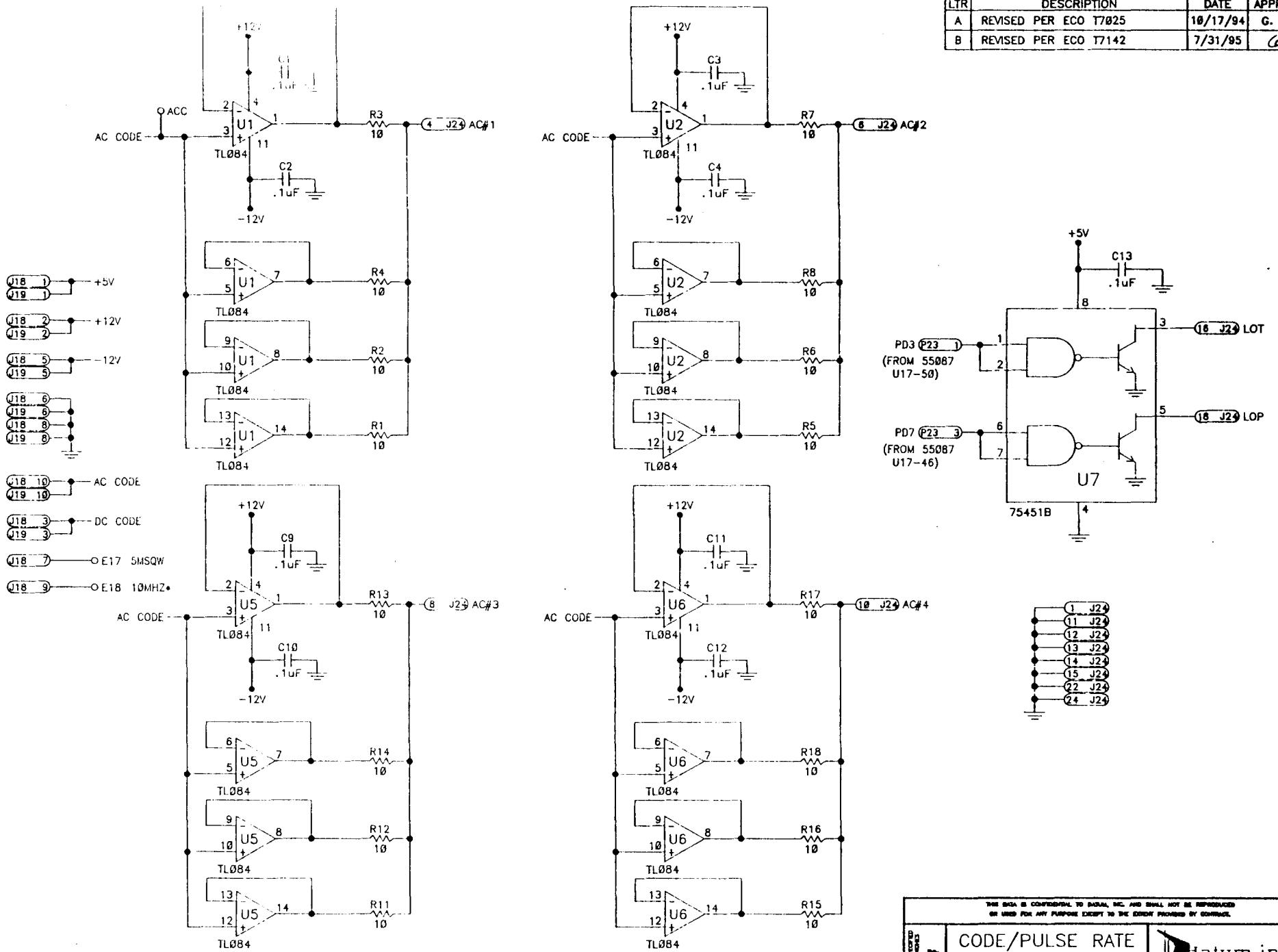
datum inc.
1363 S. STATE COLLEGE BLVD.
ANAHEIM, CALIFORNIA 92806

DWN	ESTHER	11/1/85	DES		
CHK			ENGR		
SCALE	2:1		FSC	31160	

C | A−55089 | B

SHT 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO T7025	10/17/94	G. H.
B	REVISED PER ECO T7142	7/31/95	



2. -2 ASSY. J18, J19, P22 AND P23 ARE P/N 1708-0012-2.

1 -1 USES RS-485 COMPATIBLE DRIVER PART NO. DS96172N OR DS96F172CJ.

NOTES: UNLESS OTHERWISE SPECIFIED

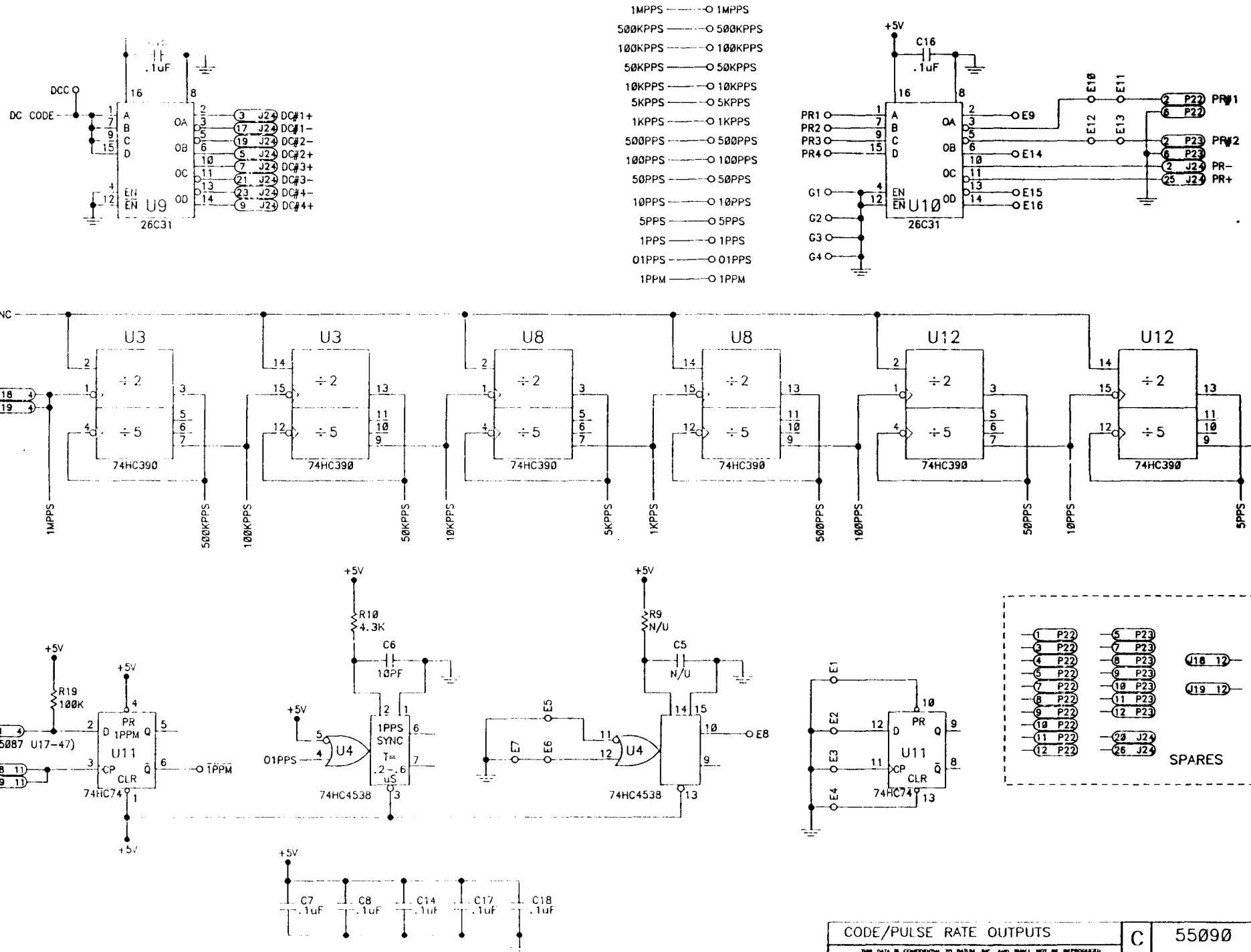
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: .XXX ±.010 .XX ±.02 ANGLES ±1°

CODE/PULSE RATE OUTPUTS

DWN ESTNER 8/9/95
CHK
DES
DRN G. H. 11/93
SCALE NONE
PSC 31168

datum inc
1363 S. STATE COLLEGE BLVD.
ANAHEIM, CALIFORNIA 92806

SIZE C | 55090 | REV B
SHT 1 OF 2



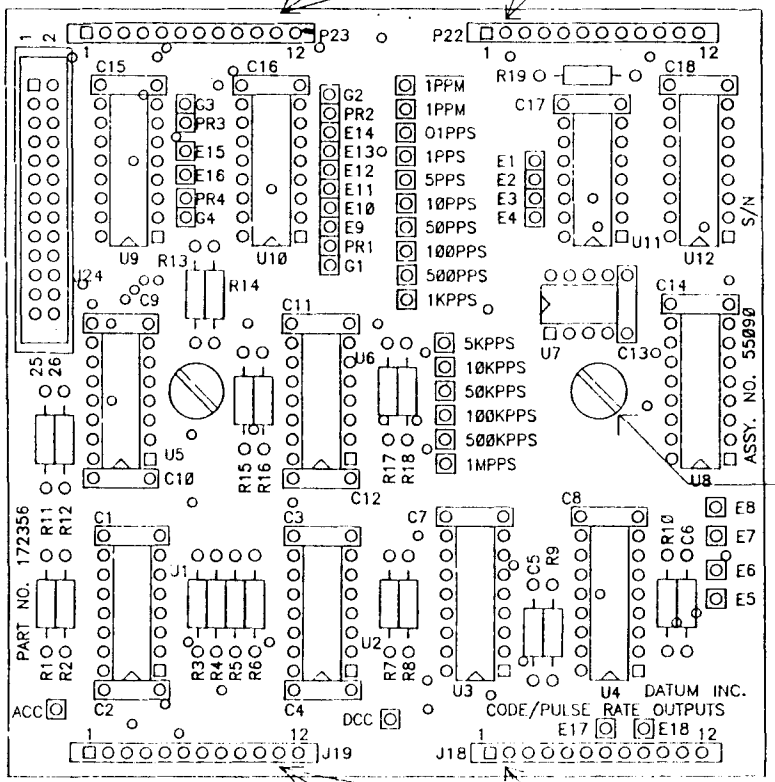
CODE/PULSE RATE OUTPUTS	C	55090	B
THIS DATA IS CONFIDENTIAL TO DATUM, INC. AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT.	SIZE	SHT 2 OF 2	REV

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

ON -2 ASSY. ONLY

INSTALL CONN P/N 1708-0012-2
ON COMP. SIDE OF PC BOARD

INSTALL CONN P/N CA-S36-23B-43
ON SOLDER SIDE OF PC BOARD



SWAGE ONN FASTENER P/N 2325-2007
COMP. SIDE OF PC BOARD

ON -2 ASSY. ONLY

USES STANDOFF P/N 2310-6981
INSTALLED AT NEXT LEVEL

INSTALL CONN P/N 1708-0012
ON SOLDER SIDE OF PC BOARD

ON -2 ASSY. ONLY

INSTALL CONN P/N 1708-0012-2
ON COMP. SIDE OF PC BOARD

2. ON -1 ASSY. U9 AND U10 ARE DS96172N OR DS96F172CJ.
1. R9 AND C5 ARE NOT USED.

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL: .XX ± .010 .XXX ± .005 ANGLES ± 1/2°

TITLE: CODE/PULSE RATE OUTPUTS

DWN	ESTHER	8/27/82	DES	
CHK			ENGR	

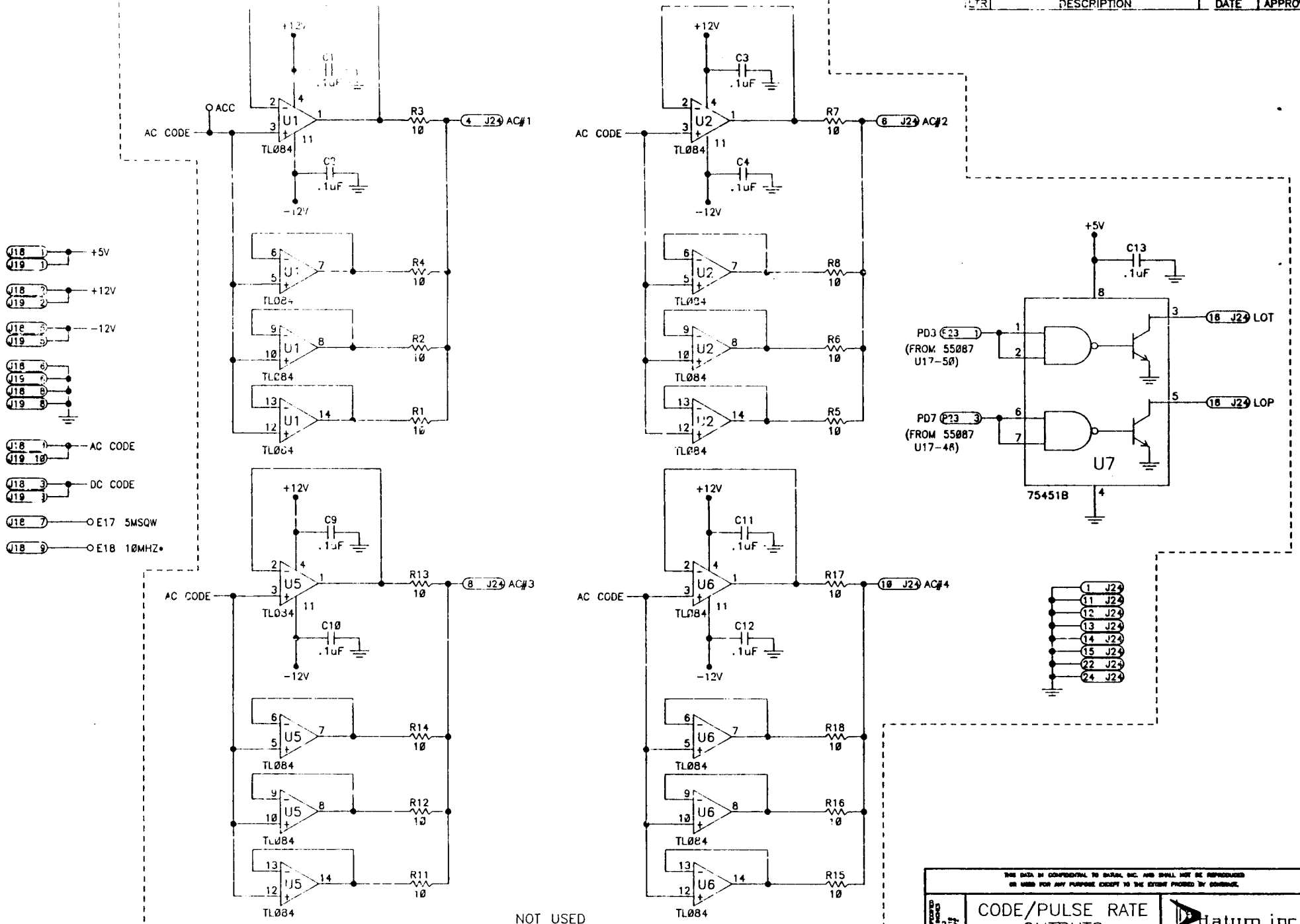
SCALE 2:1 FSC 31160

datum inc.
1303 S. STATE COLLEGE BLVD.
ANAHEIM, CALIFORNIA 92806

SIZE C | A-55090 | B

SHT 1 OF 1 REV

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



NOT USED

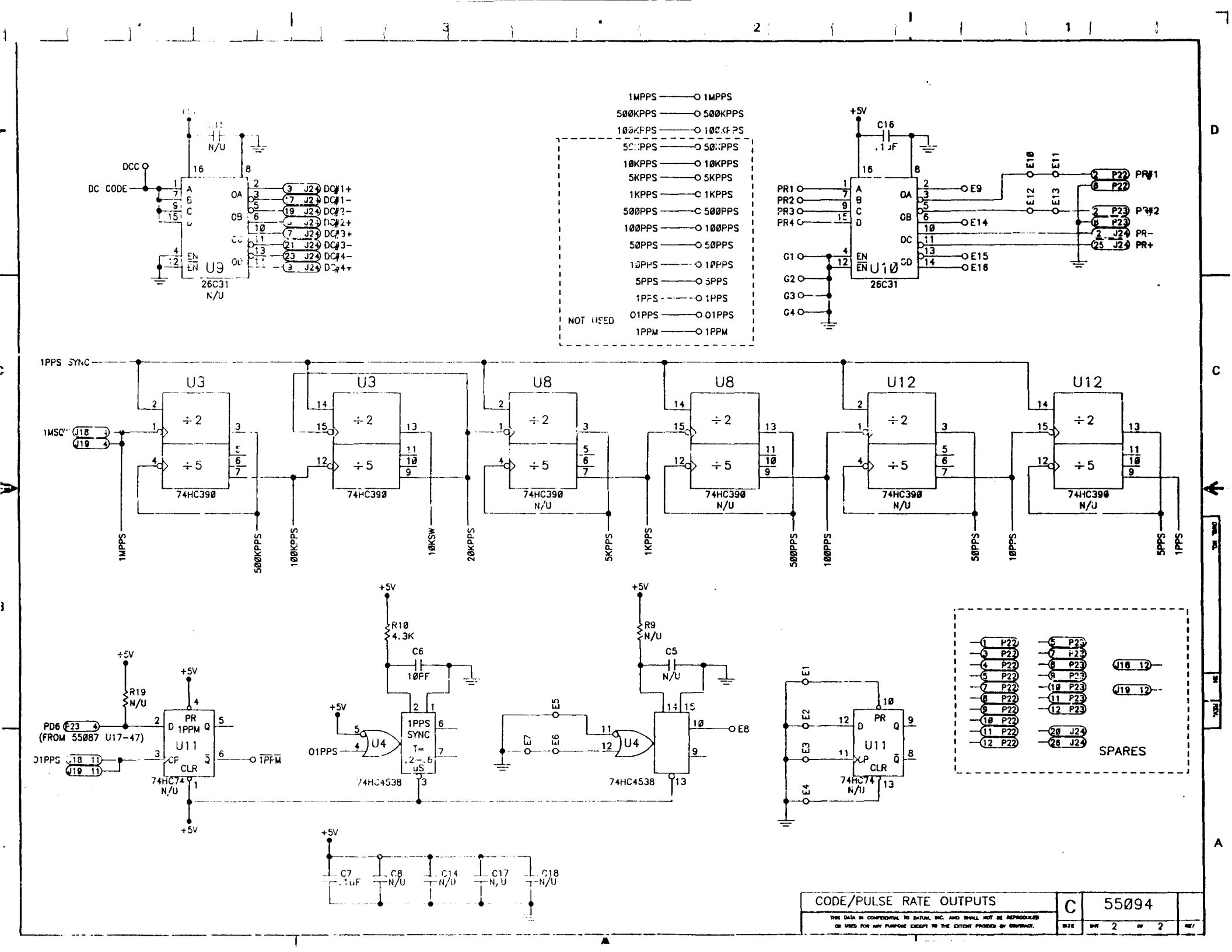
NOTES: UNLESS OTHERWISE SPECIFIED

CODE/PULSE RATE OUTPUTS

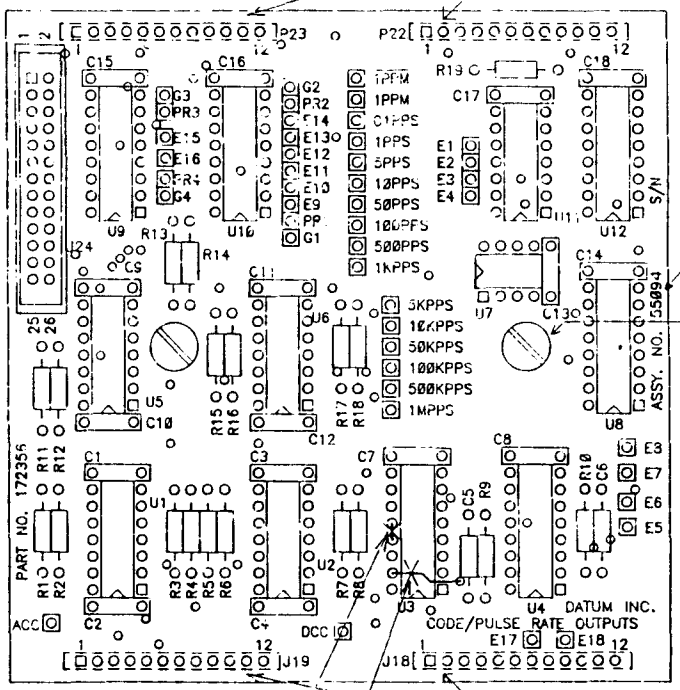
datum inc
1363 S. STATE COLLEGE BLVD.
ANAHEIM, CALIFORNIA 92806

DRN	ESTHER	2/4/94	DES		
CHK			ENGR		
SCALE	NONE		FSC	31168	

SIZE	DWG NO	REV
C	55094	
SHT 1 OF 2		


DCC
DC CODE
C15
N/U
U9
26C31
N/U
DC#1+
DC#1-
DC#2+
DC#2-
DC#3+
DC#3-
DC#4+
DC#4-
1MPPS
500KPPS
100KPPS
50KPPS
10KPPS
5KPPS
1KPPS
500PPS
100PPS
50PPS
10PPS
5PPS
1PPS
01PPS
1PPM
NOT USED
+5V
C16
.1 UF
U10
26C31
PR1
PR2
PR3
PR4
G1
G2
G3
G4
E9
E10
E11
E12
E13
E14
E15
E16
PR+1
PR-1
PR+2
PR-2
PR-
PR+
1PPS SYNC
U3
U8
U12
74HC390
N/U
÷2
÷5
1MSQ
500KPPS
100KPPS
10KSW
20KPPS
5KPPS
1KPPS
500PPS
100PPS
50PPS
10PPS
5PPS
1PPS
R19
N/U
PD6
(FROM 55087 U17-47)
01PPS
U11
74HC74
PR
1PPM
CLR
1PPM
R10
4.3K
C6
10PF
U4
1PPS
SYNC
T=
.2-.6
uS
74HC4538
R9
N/U
C5
N/U
E1
E2
E3
E4
E5
E6
E7
E8
SPARES
C7
.1uF
C8
N/U
C14
N/U
C17
N/U
C18
N/U
CODE/PULSE RATE OUTPUTS
THIS DATA IS CONFIDENTIAL TO DATUM, INC. AND SHALL NOT BE REPRODUCED OR USED FOR ANY PURPOSE EXCEPT TO THE EXTENT PROVIDED BY CONTRACT.
C
55094
SHT 2 OF 2

LTR	DESCRIPTION	DATE	APPROVED



INSTALL CONN P/N CA-S36-23B-43
ON SOLDER SIDE OF PC BOARD

RE-STAMP ASSY NO.

SWAGE FASTENER P/N 2325-2007 (X2)
COMPONENT SIDE OF P.C. BOARD

INSTALL CONN P/N 1708-0012
ON SOLDER SIDE OF PC BOARD

CUT ETCH AT U3-15 (COMP.SIDE)

CUT ETCH FROM U3-13 TO U3-12 (SOLDER SIDE)

ADD WIRE WRAP PINS ON: PR1, PR2, PR3, PR4, G1 AND G4.

ADD JUMPERS

FROM:	TO:
U3-7	U3-12
U3-9	U3-15
U3-13	PR1
PR1	PR2
PR3	G1
PR4	G4

2. MAKE ETCH CUTS BEFORE MOUNTING COMPONENTS.
1. R1-R9, R11-R18, C1-C5, C9-15, C17, C18, U1, U2, U5-U9, U11 AND U12 ARE NOT USED.

NOTES: UNLESS OTHERWISE SPECIFIED

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

TITLE: CODE/PULSE RATE OUTPUTS

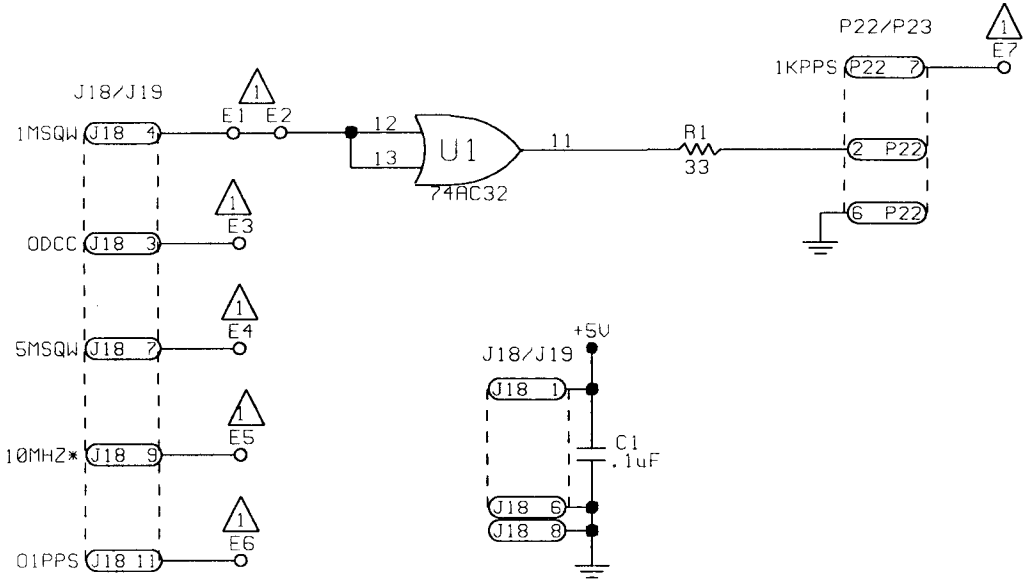
datum inc.
1363 S. STATE COLLEGE BLVD.
ANAHEIM, CALIFORNIA 92806

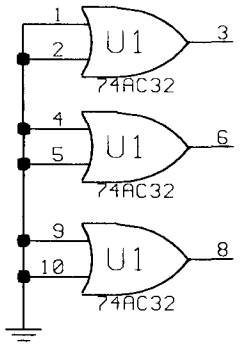
DWN	ESTHER	2/4/94	DES	
CHK			ENGR	

SCALE 1.5 | FSC 31160 | SIZE C | A-55094 | SHT 1 OF 1 | REV

DWG. NO.	SH	REV.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO T6996	8/26/94	
B	REVISED PER ECO T7270	2/14/96	





2. -6 ASSY. J18 AND P22 ARE 1708-0012-2.

1 ON -1 ASSY CUT ETCH BETWEEN E1 AND E2 AND JUMPER E2 TO E3.
ON -2 ASSY CUT ETCH BETWEEN E1 AND E2 AND JUMPER E2 TO E4.
ON -3 ASSY CUT ETCH BETWEEN E1 AND E2 AND JUMPER E2 TO E5.
ON -4 ASSY CUT ETCH BETWEEN E1 AND E2 AND JUMPER E2 TO E6.
ON -5 ASSY CUT ETCH BETWEEN E1 AND E2 AND JUMPER E2 TO E7.

NOTES: UNLESS OTHERWISE SPECIFIED

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

BUFFER ASSY

Datum inc

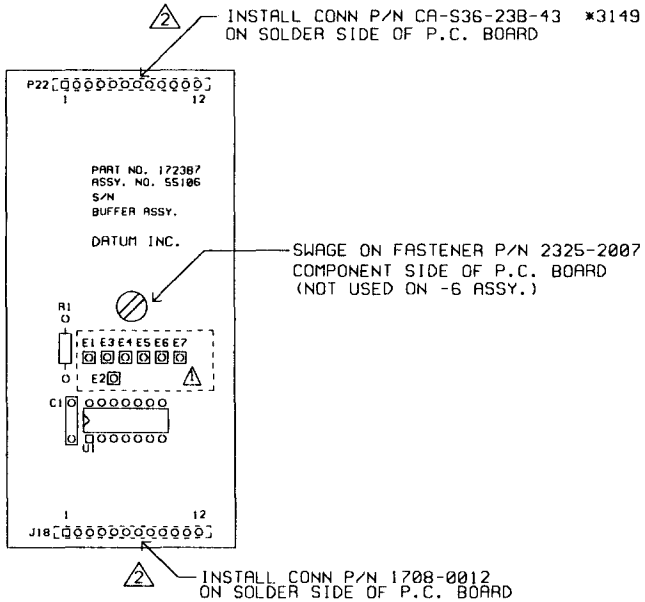
DWN	ESTHER	8/6/94	DES				
CHK			ENGR	G.H.	9/94	B	55106 B
SCALE	NONE		FSC	31160		SIZE	SHT 1 OF 1 REV

FILENAME 55106.SCH
DISK NO. 2098

1

DWG. NO.	SH	REV.
A-55106	1	B

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO T6996	8/26/94	G.H.
B	REVISED PER ECO T7270	2/14/96	G.H.



2 -6 ASSY. J18 AND P22 ARE 1708-0012-2 (INSTALL ON COMPONENT SIDE).

1 ON -1 ASSY. CUT ETCH BETWEEN E1 AND E2. JUMPER E2 TO E3 COMP. SIDE *1008
ON -2 ASSY. CUT ETCH BETWEEN E1 AND E2. JUMPER E2 TO E4 COMP. SIDE *1008
ON -3 ASSY. CUT ETCH BETWEEN E1 AND E2. JUMPER E2 TO E5 COMP. SIDE *1008
ON -4 ASSY. CUT ETCH BETWEEN E1 AND E2. JUMPER E2 TO E6 COMP. SIDE *1008
ON -5 ASSY. CUT ETCH BETWEEN E1 AND E2. JUMPER E2 TO E7 COMP. SIDE *1008

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL: .XX ±.01 .XXX ±.010 ANGLES ±1/2°

TITLE: BUFFER ASSY.

datum inc

DWN	DES			
ESTHER	8/30/94			
CHK		ENGR R.EBELING	8/30/94	
SCALE 1:1		FSC 0JPN2		

B A-55106 B

SIZE SHT 1 OF 1 REV

FILE NAME: A-55106B.PCB
DISK NO. 2898 PCAD 8.6

SK9390-52-2 DATUM INC. PROJ:_____QTY:_____
SHIPPING KIT PARTS LIST
REV: ENGR: EE WO:_____PAGE:
DATE: 10-14-93

	PART NUMBER	DESCRIPTION	REF. DES.	QTY PER	UM	STK/MF
1	1704-0009-P	CONN: 9-PIN "D", SOLDER (	STK	2.00	EA	DATUM
2	1790-3980-1	SCREW LOCK	STK	2.00	PR	DATUM
3	1791-2465-7	CONN: HOOD	STK	2.00	EA	DATUM
4	4000-8112	POWER CORD:7 1/2FT	STK	1.00	EA	DATUM
5	8010-SW10	POWER SUPPLY AC TO DC	STK	1.00	EA	DATUM
6	NOTES:					

END OF PARTS LIST FOR SK9390-52-2

APPENDIX A
ASCII CHARACTER CODE TABLE

DEC	OCT	HEX	CHAR	DEC	OCT	HEX	CHAR	DEC	OCT	HEX	CHAR	DEC	OCT	HEX	CHAR
0	000	00	NUL (^)	32	040	20	SP	64	100	40	@	96	140	60	`
1	001	01	SOH (^A)	33	041	21	!	65	101	41	A	97	141	61	a
2	002	02	STX (^B)	34	042	22	"	66	102	42	B	98	142	62	b
3	003	03	ETX (^C)	35	043	23	#	67	103	43	C	99	143	63	c
4	004	04	EOT (^D)	36	044	24	$	68	104	44	D	100	144	64	d
5	005	05	ENQ (^E)	37	045	25	%	69	105	45	E	101	145	65	e
6	006	06	ACK (^F)	38	046	26	&	70	106	46	F	102	146	66	f
7	007	07	BEL (^G)	39	047	27	'	71	107	47	G	103	147	67	g
8	010	08	BS (^H)	40	050	28	(	72	110	48	H	104	150	68	h
9	011	09	HT (^I)	41	051	29	)	73	111	49	I	105	151	69	i
10	012	0A	LF (^J)	42	052	2A	*	74	112	4A	J	106	152	6A	j
11	013	0B	VT (^K)	43	053	2B	+	75	113	4B	K	107	153	6B	k
12	014	0C	FF (^L)	44	054	2C	,	76	114	4C	L	108	154	6C	l
13	015	0D	CR (^M)	45	055	2D	-	77	115	4D	M	109	155	6D	m
14	016	0E	SO (^N)	46	056	2E	.	78	116	4E	N	110	156	6E	n
15	017	0F	SI (^O)	47	057	2F	/	79	117	4F	0	111	157	6F	o
16	020	10	DLE (^P)	48	060	30	0	80	120	50	P	112	160	70	p
17	021	11	DC1 (^Q)	49	061	31	1	81	121	51	Q	113	161	71	q
18	022	12	DC2 (^R)	50	062	32	2	82	122	52	R	114	162	72	r
19	023	13	DC3 (^S)	51	063	33	3	83	123	53	S	115	163	73	s
20	024	14	DC4 (^T)	52	064	34	4	84	124	54	T	116	164	74	t
21	025	15	NAK (^U)	53	065	35	5	85	125	55	U	117	165	75	u
22	026	16	SYN (^V)	54	066	36	6	86	126	56	V	118	166	76	v
23	027	17	ETB (^W)	55	067	37	7	87	127	57	W	119	167	77	w
24	030	18	CAN (^X)	56	070	38	8	88	130	58	X	120	170	78	x
25	031	19	EM (^Y)	57	071	39	9	89	131	59	Y	121	171	79	y
26	032	1A	SUB (^Z)	58	072	3A	:	90	132	5A	Z	122	172	7A	z
27	033	1B	ESC (^[ )	59	073	3B	;	91	133	5B	[	123	173	7B	{
28	034	1C	FS (^\)	60	074	3C	<	92	134	5C	\	124	174	7C	|
29	035	1D	GS (^])	61	075	3D	=	93	135	5D	]	125	175	7D	}
30	036	1E	RS (^)	62	076	3E	>	94	136	5E	^	126	176	7E	~
31	037	1F	US (^_)	63	077	3F	?	95	137	5F	_	127	177	7F	DEL

NOTE: ^ Denotes Control key + character.

APPENDIX B
ACRONYMS AND ABBREVIATIONS

Table B-1 lists is a listing of the acronyms and abbreviations commonly used throughout this manual and in GPS reference documentation.

TABLE B-1. ACRONYMS AND ABBREVIATIONS

TERM	DEFINITION
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.
ACPOS	Accurate position
ALMANAC	A reduced precision subset of the Ephemeris parameters. The Almanac data is used by the GPS 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 approximate 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
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).
CARRIER	A signal that can be varied from a known reference by modulation.
CARRIER FREQUENCY	The frequency of the unmodulated 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.
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.

TABLE B-1. ACRONYMS AND ABBREVIATIONS
(continued)

TERM	DEFINITION
CONTROL SEGMENT	A world-wide network of GPS monitoring and control stations that ensure the accuracy of satellite positions and their clocks.
DATA MESSAGE	A 1500 Bit Message included in the GPS signal which reports the satellite's location, clock corrections and health. Included is rough information on the other satellites in the constellation.
DCE	Data Communications Equipment (see RS232C)
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 RS232C)
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.
FRQ.	Frequency
GDOP, PDOP, TDOP	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) and TDOP (Time Dilution of Precision). TDOP depends on the uncertainty in the clock bias and PDOP only depends on the position. PDOP is composed of HDOP and VDOP and has typically good values between 2 and 7. See HDOP and VDOP.
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 (5) hours.
GPIB	General Purpose Interface Bus (IEEE-488 Interface).

TABLE B-1. ACRONYMS AND ABBREVIATIONS
(continued)

TERM	DEFINITION
GPS	Global Positioning System. Consists of 18 NAVSTAR satellites in six (6) different orbits, the Ground Control and Monitor Stations and the user community.
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 affects the horizontal position (Latiude and Longitude) and the vertical position (Altitude). For 2-D position fixes HDOP is all that counts.
ICD	Interface Control Document
ID	Identification
I/F	Interface
I/O	Input/Output
ION	Ionosphere/Ionospheric
IONOSPHERE	The band of charged particles 80 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.
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 MHz.
LAT	Latitude
LON	Longitude
LSB	Least Significant Bit
MSB	Most Significant Bit
MONITOR STATION	One of five (5) 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.
NAV	Navigation
NAV DATA	The 1500 Bit Navigation Message broadcast by each satellite at 50 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 Ephemeris and health status. This information is used to process GPS signals to obtain the users position and velocity.
NAVSTAR	Name given to GPS satellites.

TABLE B-1. ACRONYMS AND ABBREVIATIONS
(continued)

TERM	DEFINITION
NIST	National Institute of Standards Technology.
ns/nsec	Nanosecond
P CODE	The protected or military code used on both L1 and L2 GPS beacons. This code is available to authorized users.
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 randon-noise like properties. It is a very complicated but repeated pattern of 1's and 0's.
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.
RISE/SET TIME	Refers to the period during which a satellite is visible; i.e. 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.
RS232C	EIA specification
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)
TI	Time Interval
us	Microsecond
USNO	U.S. Naval Observatory
UTC	Universal Time Coordinated. The time standard maintained by the U.S. Naval Observatory. GPS Time is directly related to UTC time.
WK	Week Number

TABLE B-1. ACRONYMS AND ABBREVIATIONS
(continued)

TERM	DEFINITION
WGS-72	World Geodetic System (1972). A mathematical reference ellipsiod used by GPS, having a semi-major axis of 6378.135 kilometers and a flattening of 1/298.26.
WGS-84	World Geodetic System (1984). A mathematical reference ellipsiod used by GPS, having a semi-major axis of 6378.137 kilometers and a flattening of 1/298.257223563.