TECHNICAL MANUAL

MODEL 8821A-11
and
MODEL 8821A-12

GPS CLOCKS

February 1997

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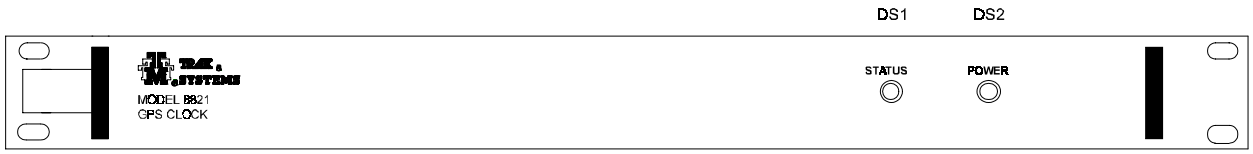

8821FP11 **TRA**

K Systems Model 8821A-11 GPS Clock

TRA

K Systems Model 8821A-12 GPS Clock

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CUSTOMER OPTION SHEET

The Model 8821A GPS Clock covered by this technical manual has the following features and options:

FEATURES

Internal Oscillator:	Option B-4: 10 MHz Crystal Oscillator
Rate outputs:	1 PPS, 10 MHz, Low Rate and IRIG B DC outputs
Code output:	Modulated IRIG B 122 Time Code Output
Computer Interface (s):	RS-232A - Control/Status
	RS-232B - Time Output
Status:	TTL and Form-C RELAY
Chassis slides:	Not provided

OPTIONS

Model 8821A-11 has separate STATUS and POWER indicators but no time display.

Model 8821A-12 has a LED front-panel nine digit Time of Year (TOY) display including two status indicators.

STATIC AWARENESS

The 8821A GPS Clocks contain CMOS IC's that can be damaged by electrostatic discharge during handling. The following practices minimize the likelihood of CMOS IC damage:

1. Use a static-free work station.
2 Avoid plastic, VINYL, and STYROFOAM in work area.
3. Discharge personal static before handling. *Use a grounded antistatic wrist strap.*
4. Minimize handling. Do not remove and replace IC's by hand.
5. Use grounded IC removal and insertion tools.
6. If required, handle the IC's only by the body - **NOT** by the leads. *Use a grounded wrist strap.*
7. Do not slide the IC over any surface.

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TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1-1 GENERAL

This manual contains the description, operating instructions, theory of operation, and maintenance data for TRAK Systems Model 8821A GPS Clocks. It is intended to provide electronics personnel with the information necessary to operate and maintain these instruments.

1-2 LEVEL OF COVERAGE

With the exception of firmware and battery replacement, this manual provides coverage to the replaceable assembly level only. No schematic or logic diagrams of replaceable assemblies are provided. It is not intended that either field or secondary-level maintenance be performed on the replaceable assemblies. Except where specific adjustment procedures are provided, no attempt should be made to repair the replaceable PC card assemblies, the GPS receiver, the oscillator, or the power supplies. These assemblies must be returned to the factory for repair.

1-3 FUNCTIONAL DESCRIPTION

The Model 8821A GPS Clocks shown in Figure 1-1 are identical except the Model 8821A-11 has separate STATUS and POWER indicators, while the Model 8821A-12 has an LED front panel time and status display. The Model 8821A is a cost effective frequency and time source for telecommunications and related applications. This versatile instrument incorporates a six-channel parallel GPS receiver, a disciplined crystal oscillator, and a precise time and frequency generator in a single assembly. Phase offset of the 1 PPS output, referenced to UTC, is typically less than ± 200 nanoseconds when one or more satellites are being tracked.

In addition to the continuous automatic calibration provided by the oscillator disciplining feature, the Model 8821A incorporates automatic leap second correction and built-in calendar for automatic leap year updates. By using the remote setup feature, the operator may set the instrument for automatic daylight savings time corrections. Two RS-232 ports provide facilities for setup and operational status monitoring, virtually eliminating the need for site visits to set up, calibrated, and maintain the instrument. The specifications for the Model 8821A are listed in Table 1-1.

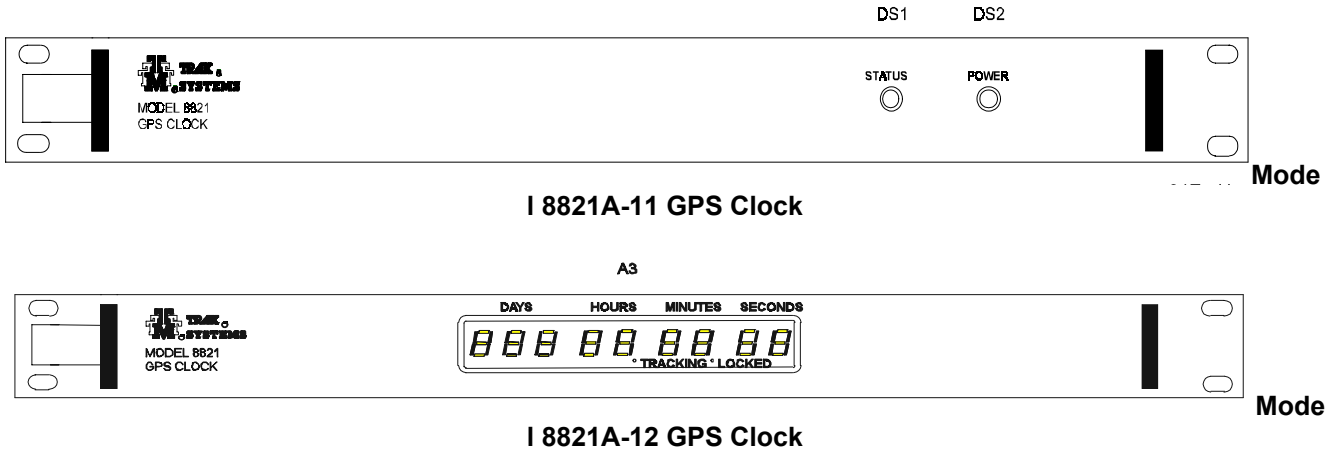

Figure 1-1. TRAK Systems Model 8821A-11 and Model 8821A-12 GPS Clocks

Table 1-1 Model 8821A Detailed Specifications

SPECIFICATION	DESCRIPTION
Time base:	B4A Option is standard disciplined Oven-Controlled crystal Oscillator (OCXO)
Frequency:	10 MHz
Stability while tracking: (one hour averaging)	$<1 \times 10^{-11}$
Synchronization:	The on-board GPS receiver determines the position of the antenna by measuring the pseudo-range to four satellites and computing the position of these satellites using ephemeris data.
Receiver:	L1 C/A code pseudo-ranging
Channels:	Six independent, continuous tracking channels
Frequency:	1575.42 MHz
Corrected Time Outputs:	Within 200 nanoseconds of UTC with S/A present.
Acquisition time:	Typically about two minutes
Position Accuracy:	The position of the Model 8821A's receiver antenna is determined by measuring the pseudo range to four satellites and computing the position of these satellites using ephemeris data.
Navigation Outputs:	Latitude, longitude, and height with a position accuracy of ± 100 meters, 2 drms, are output on RS-232-port.
Timekeeping:	Model 8821A accumulates Universal Time (UTC). This may be changed to local or GPS time using a remote command at rear-panel-port RS-232A. When local time is used, automatic daylight saving time adjustments are made at preprogrammed dates. Leap second and leap year adjustments are made automatically.
RS-232A Port J6:	Rear-panel DE-9 connector J6 provides access to the on-board RS-232 interface that is used for all remote commands, time outputs, navigation, data outputs, and status outputs. Application type, Baud rates, parity, number of data bits and number of stop bits are programmable using switches on internal Main Logic Assembly A1.

Table 1-1 Model 8821A Detailed Specifications (continued)

SPECIFICATION	DESCRIPTION
Remote Setup and Status:	The following is a partial list of available setup and status commands: A complete list of these commands is given in Chapter 3. Set/Request UTC/GPS/LOCAL time Set/Request local time offset Set/Request daylight savings dates Set/Request local position Set/Request time-out interval for GPS loss Set/Request minimum tracking elevation Set/Request antenna delay compensation Request time output Request Tracking/Locked status Request leap second status Request satellites being tracked Request DAC reference value Request firmware version Request failure location
RS-232B Port J5:	Provides ASCII Time Output once-per-second
Internal Battery	An on-card lithium battery maintains setup data and course timekeeping when no external power is applied. If battery is removed or discharged, critical satellite data are lost and acquisition time is extended to 20 minutes.
Temperature:	
Main Unit:	-10° to +50°C
Antenna	-40° to +70°C
Antenna Options:	
L10	Standard antenna with 50 feet of RG-58 coaxial cable.
L11	Standard antenna with 100 feet of RG-213 coaxial cable.
*	(Cable length over 1,000 feet can be provided.)

1-3 FUNCTIONAL DESCRIPTION (cont'd)

Standard features and outputs are described in this chapter. Optional features and outputs are listed in the Customer Option Sheet located at the beginning of this manual and are described in the appendices.

When the supplied antenna is installed and connected application of power to the Model 8821A enables it to automatically track up to six satellites and synchronize precise time accumulators to universal time (UTC). Non-volatile memory stores setup and critical data indefinitely. Only one satellite is required for time and frequency. Four satellites are required for navigation solutions to obtain antenna position.

Two RS-232 ports are provided on the Model 8821. One port allows the instrument to be set up, output time, and be monitored from a remote terminal or computer. The second port provides serial ASCII Time of Year (TOY) once per second.

The Model 8821A can be set up for air, land, marine, or static (fixed antenna position) applications. Flash memory in the Model 8821A allows two different application setups to be stored. This feature allows the user to switch between two applications without having to reconfigure setup parameters. Refer to Paragraph 4-5 for information concerning this feature.

1-4 PHYSICAL DESCRIPTION

The Model 8821A is a single chassis designed for mounting in a standard 19-inch rack. Front-panel height is 1.72 inches and depth is 9 inches exclusive of front panel handles and rear panel connectors. Weight is less than 5 pounds. The GPS receiver module, power supply, and logic assemblies are replaceable using ordinary hand tools.

1-5 POWER REQUIREMENT

The Model 8821A GPS Clock operates from 85 to 265 Vac or 100 to 370 Vdc power. Power for the standard unit is 28 watts max at power up and 10 watts steady state at 25°C after 10 minutes from power up. An internal battery located on Main Logic Assembly A1 provides power to nonvolatile memory that stores all critical Setup data. During power outages, the battery also provides power for time accumulation sufficient to automatically reinitialize the Model 8821A when external power is restored.

1-6 EQUIPMENT SUPPLIED

The Model 8821A is supplied with an antenna unit 4.25 inches in diameter by 6.44 inches high. Weight is 7 ounces. For optimum operation, mount the antenna so that it has an omnidirectional view of the horizon with no obstructions more than 15 degrees above the horizon. An antenna lead-in cable is required for operation. If your purchase order specified the standard lead-in, a 50-foot length of RG-58/U cable with TNC connectors is supplied. If no cable is supplied, refer to Appendix E for antenna installation information.

1-7 OUTPUT CHARACTERISTICS

The Model 8821A output signal characteristics are listed in Table 1-2.

Table 1-2. Output Characteristics

OUTPUT	CHARACTERISTICS	
STATUS	Function:	Provides an indication of phase lock. This signal is in the "valid" state when the unit is actively "locked" to a satellite and is coherent to the reference signal to better than 500 nanoseconds
	"Invalid" Level:	TTL 0.2 ± 0.2 Vdc
	"Valid" Level:	TTL 4.5 ± 0.5 Vdc
	Drive:	TTL 50 ohms
	Relay Outputs:	N), NC & common
	Connection:	Rear-panel DE-9 connector J4
1 PPS OUTput	Pulsewidth:	100 μsec Positive Polarity
	Baseline:	0.2 ± 0.2 Vdc
	ONE level:	4.0 ± 0.5 Vdc
	Coherence:	Within 200 nanoseconds of UTC
	Drive:	50 ohms
	Connection:	Rear-panel BNC connector J7
HI RATE	Frequency:	10 MPPS*
	Waveform:	Sinewave or squarewave (jumper selected at internal terminal block TB1 on Main Logic Assembly A1).
	Squarewave -	(Jumper between A1TB1-2 and 3)
	Polarity:	Positive-going at 'on-time'
	Duty Cycle:	50/50
	ONE Level:	4.0 ± 0.5 Vdc
	ZERO Level:	0 ± 0.5 Vdc
	Jitter:	Less than one nanosecond rms.
	Drive:	50 ohms
	Connection:	Rear-Panel BNC connector J8
	Sinewave** -	(Jumper between A1TB1-1 and 2)
	Frequency:	10 MHz*
	Coherence:	Phase coherent to 1 PPS
	Amplitude:	1 Vrms ± 10 %
	Drive:	50 ohms
	Connection:	Rear-panel BNC connector J8

Table 1-2. Output Characteristics

(Continued)

OUTPUT	CHARACTERISTICS	
LOW RATE	Frequency:	Selected using "SRO" remote setup command at RS-232A port J6. Selectable precision low rate output is '1 PPH', '6 PPH', '12 PPH', 1 PPM', '1 PPS', '10 PPS**'** ******, '100 PPS', '1 MPPS', or CODE to output the IRIG B DC time code.
	Polarity:	Positive going at 'on-time'
	Duty Cycle:	10/90 % (1 MPPS is a squarewave)
	Baseline:	0.2±0.2 Vdc
	ONE Level:	4.0 ±0.5 Vdc
	Coherence:	Within ± 50 ns of 1 PPS output at J7.
	Jitter:	Less than one nanosecond rms
	Drive:	50 ohms
	Connection:	Rear-panel BNC connector J2
IRIG B	Type:	IRIG B122, serial modulated time code.
	Amplitude:	Adjustable 1 to 3.0 volts peak-to-peak Factory adjusted to 3.0 volts peak-to-peak.
	Drive:	50 ohms
	Modulation Ratio:	Adjustable 2:1 to 6:1 Factory adjusted to 3:3:1.
	Coherence:	Coherence to 1 PPS 'On Time' is less than 2 microseconds.
	Connection:	Rear-Panel BNC connector J3
RS-232A	Function:	Port can be connected to a remote computer, modem, or dumb terminal. This interface provides command echoing and responds to asynchronous ASCII command data that provide remote setup of unit, status requests, and time outputs.
	Signal type:	RS-232
	Transfer Time:	Less than 100 milliseconds at 2400 baud
	Baud rate:	300, 1200, 2400, 4800, 9600 ******, 19.2K, 38.4K, or 57.6K
	Parity:	None ******
	Data Bits:	8 ******
	Stop Bits	1 ******
	Connection:	Rear-panel DE-9 connector J6

Table 1-2. Output Characteristics

(Continued)

OUTPUT	CHARACTERISTICS	
RS-232B	Function:	Provides ASCII time output once-per-second..
	Signal type:	RS-232
	Accuracy:	The start bit of the first serial time output character occurs within one millisecond of the leading edge of the 1 PPS OUTput at rear panel connector J7.
	Baud Rate:	300, 1200, 2400, 4800, 9600 **,19.2K, 38.4K, or 57.6K
	Parity:	None **
	Data Bits:	8 **
	Stop Bits	1 **
	Connection:	Rear-panel DE-9 connector J5

NOTE: * Frequency of output is the frequency of installed internal oscillator.
** Factory default.

1-8 ENVIRONMENTAL CHARACTERISTICS

The instrument meets all specifications when operated over the temperature range of -10° C to +50°C and may be stored at locations having the same temperature range. Maximum operating relative humidity is 95% and when factory packaged or in its optional custom carrying case, the instrument withstands normal shock and vibration found in all forms of common-carrier shipment.

GPS antenna operates within specifications at temperatures between -40° C and +70° C.

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CHAPTER 2

INSTALLATION

2-1 UNPACKING PROCEDURE

The Model 8821, when not installed in its special carrying case or in a system rack, is packed for shipment in an antistatic bag nested in a molded Styrofoam cushion located in the bottom of a shipping carton. Accessories, such as the antenna, antenna cable, chassis slides, and power cord are also nested in the molded bottom cushion. A separate molded Styrofoam top cushion is placed between the 8821A and the carton top. Unpack the 8821A as follows:

a. Examine shipping container for any signs of damage and rough handling. Record any damage observed.

b. Remove and retain shipping list from outside of carton.

c. Open shipping carton top and lift out molded styrofoam top cushion.

d. Examine contents for any sign of damage and record any damage noted.

e. Remove 8821A and its accessories from the carton.

f. Unpack the 8821A from its antistatic bag and accessories from their shipping bags.

g. Check to ensure that all items listed on the packing list have been removed from the shipping carton.

h. Remove and retain antistatic covers from 8821A's connectors.

i. Retain shipping carton and all packing material for future use.

2-2 NORMAL MOUNTING PROCEDURE

The Model 8821A is designed for mounting in a standard 19-inch rack. Chassis slides can optionally be provided. Unit height is 1.72 inches and unit depth is 9 inches. Weight is 5 pounds. Allow at least four inches behind the unit for cable clearance. Free flow of circulating air should be available to assure an ambient temperature not exceeding 50° C.

2-3 REAR PANEL CONNECTORS

The Model 8821A standard rear panel is shown in Figure 2-1. The connectors for the rear panel are described in Table 2-1.

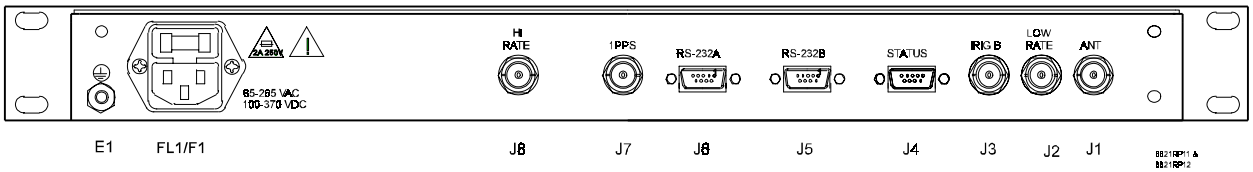


Figure 2-1. Model 8821A Rear Panel

Table 2-1 Rear Panel Connectors

REF DES	FUNCTION	CHASSIS CONNECTOR	MATING CONNECTOR OR CABLE
FL1	85-265 Vac, 100-370 Vdc	Filter Fuse	Power Cord
E1	Ground connector	Stud	
J1	ANTenna connector	TNC female	See Appendix E
J2	LOW RATE output connector (See Table 1-2 for outputs.	BNC female	BNC male
J3	Modulated IRIG B time code output connector	BNC female	BNC male
J4	STATUS Output connector (See Table 2-3 for connections).	DE9 female	DE9 Male
J5	RS-232B ASCII Time Output (See Table 2-2 for connections.)	DE9 female	DE9 Male
J6	RS-232A Control/Status Port (See Table 2-2 for connections)	DE9 female	DE9 Male
J7	1 PPS output signal	BNC female	BNC male
J8	HI RATE (10 MHz*) output	BNC female	BNC male

NOTE: * HI RATE output frequency is frequency of installed internal oscillator.

2-3.1 RS-232A Connector Pin Connections

The pin connections for RS-232A connector J6 and RS-232 B connector J5 are listed in Table 2-2.

Table 2-2. RS-232 Connector Wiring (J5 and J6)

PIN NUMBER	RS-232A CONNECTOR J6 SIGNAL	RS-232B CONNECTOR J5 SIGNAL
1	NC	NC
2	TX data (Data Out)	TX data (Data Out)
3	RX data (Data In)	RX data (Data In)
4	DTR (Data Terminal Ready) *	DTR (Data Terminal Relay) *
5	Ground	Ground
6	DSR (Data Set Ready) *	DSR (Data Set Ready) *
7	NC	NC
8	NC	NC
9	NC	NC

***** Hardware handshake is factory disabled.

2-3.2 STATUS Connector Pin Connections

Three contacts of a Form-C relay and a TTL signal provide tracking status output at 9-pin connector J4. The pin connections for Status Connector J4 are listed in Table 2-3.

Table 2-3. Status Connector J4 Wiring

PIN NUMBER	SIGNAL
1	Normally Open relay
2	Relay Common
3	Normally Closed relay
4	No Connection
5	Ground
6-8	No Connection
9	TTL Status

NOTE: During valid status, the relay is energized.
Status line normally at ONE level.

2-4 ANTENNA INSTALLATION

Refer to Appendix E for full details on antenna installation.

2-5 CONFIGURATION

The Model 8821A has been configured at the factory to meet most customer requirements. With the standard GPS antenna and lead-in connected, the unit initializes and tracks satellites without operator intervention

The Model 8821's RS-232A and RS-232B interface ports are factory configured for **9600 baud**, **8 data bits, no parity**, and **1 stop bit.** If the standard GPS antenna is attached and mounted as described in Appendix E of this manual and you do not require a change in factory default communication protocol, review the setup commands listed in Table 3-2 to determine whether it necessary to change the factory-installed setup parameters. If no change is required, Apply power to the unit and allow it to complete automatic initialization, satellite acquisition, and oscillator disciplining. Time and frequency outputs are available when the Green front-panel STATUS indicator comes on and remains on. This should take approximately 30 minutes. Antenna position is determined and stored once per second. At the end of a 24 hour period, the stored position solutions are averaged and the GPS receiver enters the FIXED position using the stored averaged antenna position. Should power be interrupted, the Model 8821A again enters the 24 hour antenna position averaging mode.

NOTE

The Model 8821A is shipped with a 65 ns default antenna delay compensation. This covers a 50-foot length of RG-58/U cable and does not include any "user delay". If your cable is different and/or you wish to add a user delay of up to 1/2 second refer to Appendix E for cable delay values and to Chapter 3 for Setup parameters.

RS-232A port J6 is the Model 8821A's remote status request and setup command port. If other than the factory default baud rate of 9600 baud and/or remote setup of the unit is required, the baud rate for this port is set with the power off using switch S1 located on Main Logic Assembly A1. This switch is shown in Figure 2-2. The code format is factory set at 8 data bits, no parity, and 1 stop bit, Code format cannot be changed. Remote setup is accomplished via remote interface RS-232-A connector J6 when the unit is powered.

RS-232B Port J5 outputs serial ASCII once per second. Baud rate is factory set at 9600 baud and code format is factory set at 8 data bits, no parity, and 1 stop bit. Code format cannot be changed. Baud rate switch S2 is located on internal Main Logic Assembly A1 and is shown in Figure 2-2. With power off, set switch S2 to the desired baud rate.

Baud rate switches S1 and S2 are accessible with the unit withdrawn from the rack and with the top cover removed. The top cover is removed by twisting each of, the six cover mounting screws one quarter turn counterclockwise and lifting off cover. Once switches have been set, install the cover and tighten six quarter-turn fasteners.

Referring to Paragraph 3-3 Remote Operation, locate appropriate setup commands and change setup parameters as required.

The waveform of the HI RATE output at rear-panel BNC connector J8 may be changed from a sinewave to a squarewave or visa-versa by moving the jumper on Main Logic Assembly A1 terminal block TB1. Jumper TB1-1 and 2 for a sinewave output or TB1-2 and 3 for a squarewave output.

2-5 CONFIGURATION (continued)

Rotary switches S1 and S2 select the baud rate for RS-232A and RS-232B port, respectively. Baud rates and their respective switch position are as follows:

0 = 300 baud	4 = 9600 baud (Factory default)
1 = 1200 baud	5 = 19200 baud
2 = 2400 baud	6 = 38400 baud
3 = 4800 baud	7 = 57600 baud

S3-3 & S3-2 & S3-1	(FORMAT)
0,0,0 =	7,e,2
0,0,1 =	7,o,2
0,1,0 =	7,e,1
0,1,1 =	7,o,1
1,0,0 =	8,n,2
1,0,1 =	8,n,1
1,1,0 =	8,e,1
1,1,1 =	8,o,1

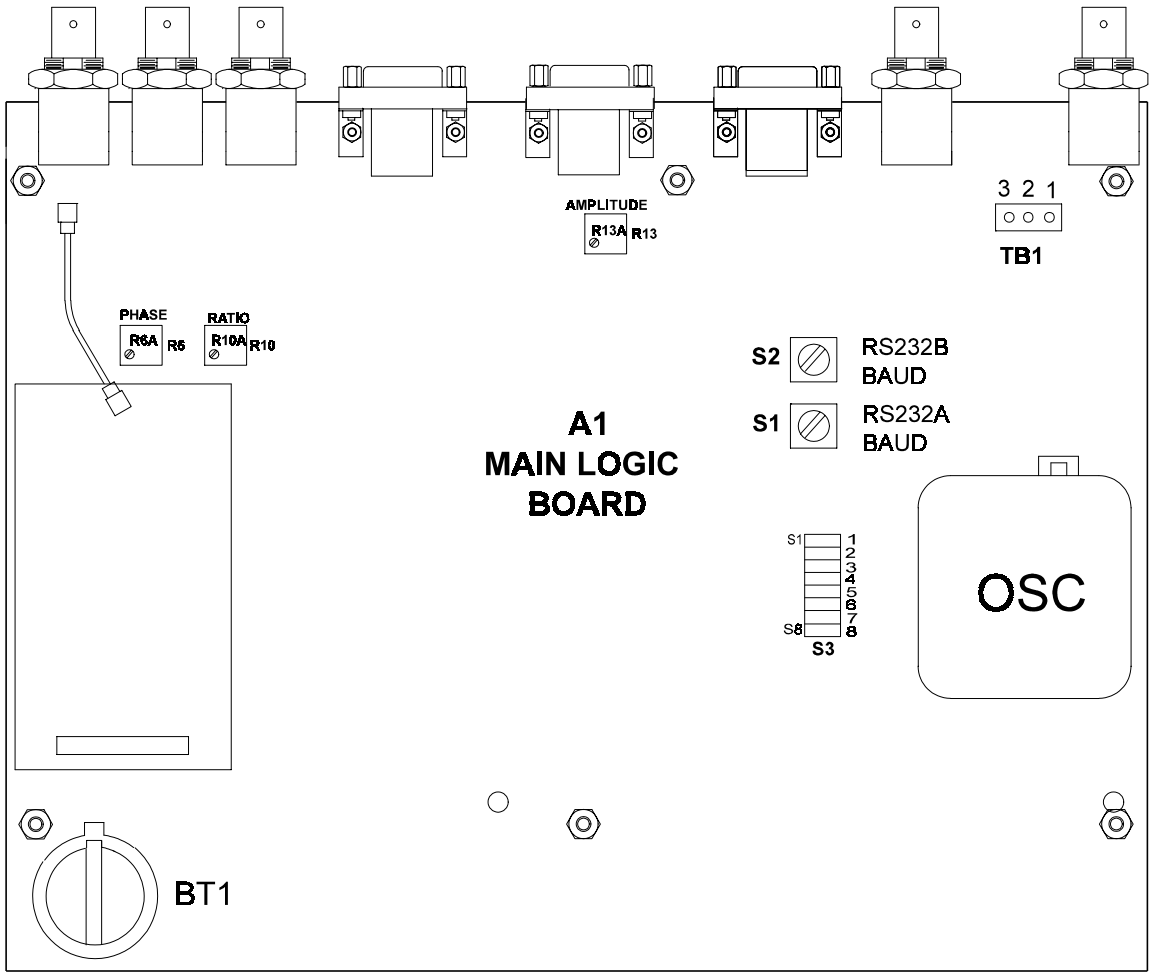
1 = Open
2 = Closed

S3-4	(RTS/CTS/DSR HARDWARE HANDSHAKE)
1 -	ENABLE HANDSHAKE
0 -	DISABLE HANDSHAKE

S3-6 & S3-5	(APPLICATION TYPE)
0,0 -	Air
0,1 -	Land
1,0 -	Marine
1,1 -	Static

The Model 8821A can be setup for air, land, marine, or static applications. Flash memory in the Model 8821 Allows two different application setups to be stored. This feature allows the user to switch between two applications without having to reconfigure setup parameters. Refer to Paragraph 4-5 for information concerning this feature.

R6 is the phase adjustment for the IRIG B output
R10 is the ratio adjustment from exalted to suppressed carrier for IRIG B
R13 is the output amplitude adjustment



NOTES:

1. The following settings are hard-wired and are not adjustable on Model 8821A:

   a. Protocol for both RS-232A and RS-232B is 8 data bits, no parity, one stop bit.
   b. Hardware handshake is disabled.
   c. Application type is Static (factory default is 24 hour antenna position averaging).

2. Jumper A1TB1-1 and 2 for sinewave HI RATE output at rear-panel BNC connector J8 or A1TB1-2 and 3 for squarewave output.

Figure 2-2. Model 8821A Baud Rate Switches and Battery Location

CHAPTER 3

OPERATION

3-1 OPERATING INDICATORS

The front panels of the Model 8821A-11 and Model 8821A-12 are shown in Figures 3-1 and 3-2, respectively and described in the following paragraphs.

3-1.1 Model 8821A-11 Operating Indicators

Front-panel **STATUS** LED DS1 and **POWER** LED DS2 are shown in Figure 3-1. **POWER** LED DS2 lights when power is applied to the unit. STATUS indicator DS1 lights when all of the Model 8821A-11 functions monitored by built-in-test (BIT) circuits are operating correctly. This is a summary fault indicator. The indicator is off when one or more faults are detected.

During power up, satellite tracking and internal OCXO disciplining, the **STATUS** indicator remains off until the OXCO locks to the GPS 1 PPS. During initial cold start of the unit, the **STATUS** indicator lights after approximately 30 minutes.

Figure 3-1. Model 8821A-11 Front-Panel Indicators

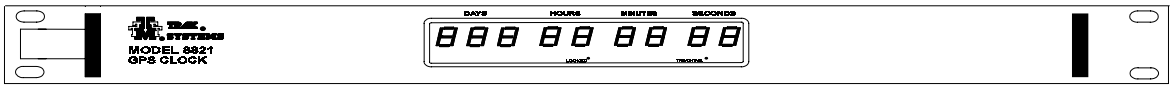


Figure 3-2. Model 8821A-12 Front-Panel Indicators

3-1.2 Model 8821A-12 Operating Indicators

The TRAK Systems Model 8821A-12 GPS Clock front panel shown in Figure 3-2 contains a front panel time-of-year (TOY) display. This display also includes **TRACKING** and **LOCKED** LED indicators located near the bottom edge.

During power up, satellite tracking, and internal OCXO disciplining, the **LOCKED** indicator remains off until the OCXO locks to the GPS 1 PPS. During initial cold start of the unit, the **LOCKED** indicator lights after approximately 30 minutes. The **TRACKING** indicator lights when 8821A is tracking one or more satellites.

3-2 INITIAL SETUP AND OPERATION

The two RS-232 ports on the Model 8821A are factory set to 9600 baud. If a different baud rate is desired for either or both ports, refer to Chapter 2 of this manual for baud rate setting instructions.

Protocol for both ports is 8 data bits, no parity, and one stop bit. These settings are fixed in ROM and cannot be changed.

3-2 INITIAL SETUP AND OPERATION (cont'd)

The Model 8821A provides usable outputs approximately 30 minutes after power-on (8821A-11 STATUS light on or 8821A-12 LOCKED indicator on). During the first 24 hours of operation after power is applied the unit automatically computes an accurate position. After 24 hours, the computed averaged position is substituted for current calculated position for oscillator disciplining. This step improves phase coherence of the Model 8821A outputs to UTC by a factor of about five-to-one. It also enables more precise setting of oscillator center frequency. This, in turn, assures minimum phase drift during any times that GPS coverage is lost.

After 24 hours, the oscillator center frequency is accurately adjusted to better than 5×10^{-10}. Once the oscillator has been disciplined for 24 hours, removal of the GPS signal yields a coasting drift of $<5 \times 10^{-9}$ per day.

To assure that proper position is computed each time the unit is used, position averaging is repeated each time that power is restored to the instrument.

From the above, it can be seen that best operation of the Model 8821A is obtained when it is supplied by uninterrupted power.

The Model 8821A can be set up for air, land, marine, or static applications. Flash memory in the Model 8821A allows two different application setups to be stored. This feature allows the user to switch between two applications without having to reconfigure setup parameters. Refer to Paragraph 4-5 for information concerning this feature.

3-3 REMOTE OPERATION

3-3.1 RS-232 Operation

The Model 8821A can be operated from a remote computer or terminal using RS-232A port J6. The two remote operating modes provided for this port are:

3-3.1.1 Computer Mode

The Computer Mode is the default mode of RS-232A communications port and is used when controlling the Model 8821A from a remote computer. No echoing of input commands is given, and the once-per-second time output, if commanded, is active. When writing interface programs, do not issue three or more successive carriage return <CR> commands. This will switch the port communications mode to Local Echo. To reenter the Computer Mode after using the Local Echo mode, issue a control E <^E>.

3-3.1.2 Local Echo Mode

Use this mode when controlling the Model 8821A from a terminal keyboard. Enter the Local Echo Mode by typing three successive carriage returns <CR>. A '8821>' prompt is displayed when in this mode, and all input keystrokes are echoed to the screen. While in the Local Echo mode, once-per-second time outputs from this port are suspended. To exit this mode, type a control E <^E>.

NOTE

Before attempting to use either RS-232 port, assure that the remote computer or terminal and the Model 8821A are set to the same baud rate and serial-data format. Configure Model 8821A 's RS-232 ports, as described in Paragraph 2-5.

3-3 REMOTE OPERATION (cont'd)

All requests and commands are initiated from the host computer or terminal. All entries must be terminated with a carriage return. The 8821's response ends with a carriage return and line feed. The Model 8821A Remote Time Request, Status Request, and Setup Command-data formats are described in Paragraph 3-3.2 following.

3-3.2 REMOTE COMMANDS

The Model 8821A remote status request commands, descriptions, and factory default parameters are listed in Table 3-1.

The Model 8821A remote setup commands, descriptions, and factory default parameters are listed in Table 3-2.

The factory defaults for operational parameters subject to change are listed in Table 3-3.

Table 3-1. Summary Of Request Commands

COMMAND	DESCRIPTION	DEFAULT
RQUT	UTC time	N/A
RQLT	Local time	N/A
RQGT	Request Current GPS time	N/A
RQTS	Outputs time once per second in format A	N/A
RQTS Y	Outputs time once per second in format B	N/A
RQTS P	Outputs time once per second in format C	N/A
RQTS Y,P	Outputs time once per second in format D	N/A
RQTX	Suspends the once per second time output	N/A
RQTO	Request current time offset values	N/A
RQLS	Request Leap Second Status	N/A
RQSS	Request list of selected satellites	N/A
RQST	Request list of satellites being tracked	N/A
RQLN	Request last navigation solution	N/A
RQLP	Request user selected position	N/A
RQAP	Request results of average position computation	N/A
RQSD	Request visible satellite position, tracking status, Signal to noise ratio, and DOPS	N/A
RQDS	Request daylight savings or standard time mode	N/A
RQBS	Request firmware data	N/A
RQFS	Request fault status	Off
RQLK	Request 1 PPS ref locked status	N/A
RQIR	Request difference between internal 1 PPS and selected time reference	UTC is selected time reference
RQDR	Request oscillator DAC value	N/A
R1	Request time information	N/A
R2	Request position information	N/A
R3	Request miscellaneous Clock data	N/A
R4	Request satellite tracking information	N/A
R5	Request satellite information	N/A
R6	Request satellite health	N/A
R7	Request unit Model No. and firmware revision	N/A
R8	Request Average Position and Application type	N/A

3-3.2 REMOTE COMMANDS (cont'd)

Table 3-2. Summary Of Setup Commands

COMMAND	DESCRIPTION	DEFAULT
SUT	Set UTC time and request current time.	N/A
STM	Set and request time mode.	UTC
SDD	Set and request spring and fall dates for daylight savings and standard times.	Spring Date: 4/1 Fall DATE: 10/28
SDREF	Set DAC value	
SSV	Set and request satellites to be used.	Automatic
SLP	Set and request user entered position	N/A
SPS	Set and request position source	Computed average position
SMD	Set and request max. DOPS	VDOP: 4, HDOP:4
SEL	Set and request minimum satellite tracking elevation	5°
SDC	Set and request user and antenna delay compensation.	65 ns antenna delay 0 ns user delay
STI	Set and request receiver unlock time-out delay	30 Minutes
SST	Cold starts GPS receiver	N/A
SRO	Set low rate output	10 PPS
RST	Resets units CPU	N/A
LEP SEL ROM1 or ROM2	Select ROM1 or ROM2 firmware.	ROM1

Table 3-3. Factory Default Settings

PARAMETER	DEFAULT SETTING
Application type:	Static
Position source:	Average
User entered position:	00 00.000N,000 00.000W,+0.0M
Date & Time:	Updated by internal battery backed clock
Time Mode:	UTC
Local Time Offset	-5 Hours
GPS Time Offset	11 Seconds
Daylight savings/Standard:	Daylight Savings
Spring Date:	4/1
Fall Date:	10/28
Delay compensation:	0 ns user offset, 65 ns antenna delay
GPS Receiver unlock timeout interval:	30 Minutes
Max Dilution of Precision:	VDOP 4 HDOP 4

3-3.2.1 Remote Requests

Remote Requests

Time outputs are resolved to 10 milliseconds. To obtain more accurate time output at RS-232B port J5, select the Once-Per-Second auto-timed output using the “RQTS” command. The time mode is specified using the STM command.

Request UTC Time

Host sends: RQUT <CR>

8821 replies: RQUT ddd:hh:mm:ss.ff0,Q<CR><LF>

where:

ddd = day of year
hh = hours
mm = minutes
ss = seconds
ff0 = milliseconds with 10 ms resolution.
Q = Quality byte:
0 = Unknown
4 = Phase < 1 us

Request LOCAL Time

Host sends: RQLT <CR>

8821 replies: RQLT yyyy,MM,dd,hh:mm:ss.ff0,Q<CR><LF>

where:

yyyy = year
MM = month
dd = day of the month
others as previously described

Request GPS Time

Host sends: RQGT <CR>

8821 replies: A: RQGT yyyy,MM,dd:hh:mm:ss.ff0,Q<CR><LF>

where:

yyyy = year
MM = month
dd = day of the month
others as previously described

3-3.2.1 Remote Requests (continued)

The RQTS command sets up the Model 8821 to output time once per second. It is only available through the RS-232A port J6. The command is accepted in either the Local Echo Mode or the Computer Mode; however, outputs are suspended as long as the unit is in the Local Echo Mode. The time mode is specified using the STM command. The "*" is output approximately 500 μs after 'on-time'; time output follows about 300 ms later. These times will vary when the user enters commands and for about 10 seconds after the 24 hour averaging period has elapsed, while the average position is computed.

Request Time Once-Per-Second -

Host sends: RQTS<CR> to select Format A
RQTS Y<CR> to select Format B
RQTS P<CR> to select Format C
RQTS Y,P<CR> to select Format D

8821 replies: RQTS DONE<CR>

Once-Per-Second Formats:

A: *RQTS t,ddd:hh:mm:ss.0,Q <CR><LF>
B: *RQTS t,yyyy,mm,dd:hh:mm:ss.0,Q <CR><LF>
C: *RQTS t,ddd:hh:mm:ss.0,Q,dd:mm.fffN,ddd:mm.fffW,Shhhhh.f <CR><LF>
D: *RQTS t,yyyy,mm,dd:hh:mm:ss.0,Q,dd:mm.fffN,ddd:mm.fffW,Shhhhh.f <CR><LF>

where:

t=	U for UTC, G for GPS and L for local	
ddd =	day of year	
hh =	hours	
mm =	minutes	
ss =	seconds	
Q =	Quality byte :	
	0 =	Unknown
	4 =	Phase < 1 us
dd:mm.fffN	is Latitude, where N is North or S is South.	
ddd:mm.fffW	is Longitude, where W is West or E is East.	
Shhhhh.f	is Height in meters.	
S =	+ (positive) or - (negative) elevation	

To terminate requests:

Host sends: RQTX <CR>

8821 replies: RQTX DONE<CR><LF>

3-3.2.1 Remote Requests (continued)

Request current time offsets values -

Host sends:	RQTO <CR>
8821 replies:	RQTO UTCshh,mm DST+h <CR><LF>
where:	s = signed hours (range is -12 to +12) of Local Time Offset mm = minutes of Local Time Offset +h = is either "+0" or "+1" hours of Daylight Saving Time Offset

3-3.2.1 Remote Requests (continued)

Request leap second status -

	Host sends:	RQLS <CR>
	8821 replies:	RQLS yy,mm,dd<CR><LF>
	where:	yy = year; e.g. 1994 mm = month dd = day of month

Note: Default is all zeros

3-3.2.1 Remote Requests (continued)

Request list of selected satellites-

Host sends:	RQSS <CR>
8821 replies:	RQSS 01h,02h,03h,.....14h,15h, 16h<CR><LF>, RQSS 17h, 18h, 19h, ...30h, 31h, 32h,<CR><LF>
where:	h - is an "H" for a healthy satellite and h - is a "U" for a unhealthy satellite h.- is a "—" for a forced unhealthy satellite h - is an "X" for an illegal response h - is a "?" for an uninitialized value

3-3.2.1 Remote Requests (continued)

Request list of satellites being tracked -

Host sends:	RQST <CR>
8821 replies:	RQST sv,sv,sv,sv,sv,sv,sv,sv<CR><LF> OR RQST NONE<CR><LF> if no satellites are being tracked.

NOTE: The “RQST sv” line is shown in its longest form. The actual response length will vary depending on the number of satellites being tracked at the time.

3-3.2.1 Remote Requests (continued)

Request navigation solution being received from GPS receiver -

NOTE: The position returned from this request is the position the GPS receiver is using to output precise time. If the position source is “NA” or “N”, the position returned from this command will update every second to the new position computed by the receiver. If the position source is “U” or “A”, the receiver will then return either the user input or the average position respectively.

Host sends:	RQLN <CR>	
8821 replies:	RQLN dd:mm.fffN,ddd:mm.fffW,Shhhhh.f<CR><LF>	
where:	dd:mm.fffN	is Latitude, where N is North or S is South.
	ddd:mm.fffW	is Longitude, where W is West or E is East.
	Shhhhh.f	is Height in meters.
	where S = + (positive) or - (negative) elevation	

3-3.2.1 Remote Requests (continued)

Request position the position entered by the user-

NOTE: This position is only used if the position source is set to “U”.

Host sends:	RQLP <CR>	
8821 replies:	RQLP dd:mm.fffN,ddd:mm.fffW,Shhhhh.f<CR><LF>	
where:	dd:mm.fffN	is Latitude, where N is North, or S is South
	ddd:mm,fffW	is Longitude, where W is West, or E is East
	Shhhhh.f	is Height in meters
where:	S = + (positive) or - (negative) elevation	

3-3.2.1 Remote Requests (continued)

Request the results of the average position computation-

NOTE: This position is only used if the position source is set to “A” and will not be updated until the average computation is complete.

Host sends:	RQAP <CR>	
8821 replies:	RQAP dd:mm.fffN,ddd:mm.fffW,Shhhhh.f<CR><LF>	
where:	dd:mm.fffN	is Latitude, where N is North, or S is South
	ddd:mm,fffW	is Longitude, where W is West, or E is East
	Shhhhh.f	is Height in meters
where:	S = + (positive) or - (negative) elevation	

3-3.2.1 Remote Requests (continued)

Request Currently Visible Satellite Position and Tracking Status and Dilution of Precision (DOP) Values -

Host sends:	RQSD <CR>
8821 replies:	RQSD PRN sv, AZ=AAA, EL=EE, SN=SS.S,TRK=t<CR><LF> VDOP = XXX.X, HDOP = XXX.X, PDOP = XXX.X, TDOP = XXX.X<CR><LF>
where:	sv is the satellite number aaa is the azimuth in degrees ee is the elevation is degrees ss.s is the signal to noise ratio t is the tracking status (“Y”= tracking, “N”= not tracking) XXX.X is the appropriate dilution of precision

The “RQSD” line is repeated for each satellite currently visible up to a maximum of 12 satellites. In addition, each comma is followed by a space character.

3-3.2.1 Remote Requests (continued)

Request daylight savings or standard time mode -

Host sends:	RQDS <CR>
8821 replies:	RQDS m<CR><LF>
where:	m is "D" if Daylight or "S" if standard

3-3.2.1 Remote Requests (continued)

Request firmware data -

Host sends:	RQBS<CR>
8821 replies:	RQBS 80188=000000 6811=BBBBB 6805=000000 RCVR1=DDDD RCVR2=EEE<CR><LF>
where:	BBBBB is the firmware version of the 68HC11 processor. DDDD is the software version of the GPS receiver. EEE is the revision number of the GPS Receiver software

3-3.2.1 Remote Requests (continued)

Request built in test status -

Host sends:	RQFS
8821 replies:	RQFS A,B,C,D,E,F,G,H,I,J,K
where:	A is GPS Receiver fail status (G=Good,F=Fail) B is Oscillator status (G=Good,F=Fail) C is 10 MHz output status (G=Good,F=Fail) D is 1 PPS output status (G=Good,F=Fail) E is GPS Receiver battery backup status (G=Good,F=Fail) F is Oscillator unlock time-out status (G=Good,F=Fail) G is Time interval counter status (G=Good,F=Fail) H is Oscillator manual calibration status (G=Good,F=Fail) I is Antenna Status (G=Good,F=Fail) J is Low Rate output status (G=Good,F=Fail) K is IRIG B output status (G=Good,F=Fail)

Set mode:

Host sends:	RQFS string <CR>
where:	string is ON to enable automatic output of the above message when a change in fault status is detected string is OFF to disable automatic output
8821 replies:	RQFS DONE <CR><LF>

3-3.2.1 Remote Requests (continued)

Request internal 1PPS reference locked status -

Indicates the locked status of the internal 1PPS reference versus either the GPS or UTC time reference. The time reference is selected using the 'STM' remote I/O command. Note that the times displayed are referred to the selected time mode.

Host sends:	RQLK<CR>
8821 replies:	RQLK NO LOCK SINCE POWERUP<CR><LF> or RQLK FREE RUN SINCE ddd:hh:mm:ss<CR><LF> or RQLK LOCKED SINCE ddd:hh:mm:ss<CR><LF>

3-3.2.1 Remote Requests (continued)

Request difference between the internal 1PPS reference and the selected time reference -

Host sends:	RQIR<CR>
8821 replies:	RQIR ttt REF - mmm "string"<CR><LF>
where:	ttt (time ref) is "INT" if internal reference mmm (measurement ref) is "UTC" or "GPS" "string" is either the difference (in nanoseconds) or a status message

3-3.2.1 Remote Requests (continued)

Request DAC reference value -

Indicates the voltage level which when applied to the internal oscillator control input will place the oscillator at its' 10 MHz center frequency. This value is used to indicate when the oscillator needs calibration.

Host sends:		RQDR<CR>
8821 replies	:	RQDR dddd<CR><LF>
where:		dddd is DAC setting

NOTES: The dddd field is not padded with zeros and contains only the digits necessary to represent the value.

DAC value ranges are between 500 and 3500. If DAC value is out of rang, see SDREF remote setup command in Paragraph 3.3.2.2 to set DAC value and Paragraph 4.6 for internal oscillator adjustment.

3-3.2.1 Remote Requests (continued)

The following paragraphs describe the Remote Status Request Commands used to interface to the TRAK GPS control program. All data is supplied in a "packed" ASCII format, with no format characters (comma, semi-colons, etc.) separating the data.

Request Time Information

Host Sends: R1

8821 replies: YYYYDDDHHMMSSOOOmmssssffffdlggt

where:
- YYYY ..... is year; e.g. 1991
- DDD ..... is the day of year
- HH ..... is the hour
- MM ..... is the minutes
- SS ..... is the seconds
- OOO ..... is the local time hours offset
- mm ..... is the local time minutes offset
- ssss ..... is the Spring DST date (month and day), e.g. 0428 = April 28
- ffff ..... is the Fall DST date (month and day), e.g. 1026 = October 26
- d ..... is the Daylight Savings Time indicator (“0” = not activated, “1” = activated)
- l ..... is the leap second indicator (“0” = no leap second scheduled, “1” = leap second scheduled).
- gg ..... is the GPS seconds offset from UTC
- t ..... is the time mode where “L” = local time, “G” = GPS time or “U” = UTC time.

3-3.2.1 Remote Requests (continued)

Request Position Information

Host Sends: R2

8821 replies: DDMMSSSHdddmmsssRHHHHH.HF

where:
- DD ..... is degrees latitude
- MM ..... is minutes latitude
- SSS ..... is decimal minutes latitude
- H ..... is Latitude Hemisphere (N = North, S = South) latitude
- ddd ..... is degrees longitude
- mm ..... is minutes longitude
- sss ..... is decimal minutes longitude
- R ..... is Longitude Meridian (W = West, E = East)
- HHHHH.H .. is altitude (meters)
- F ..... is information used with the TRAKGPS program

3-3.2.2 Remote Requsts (continued)

Request Miscellaneous Clock Data

Host Sends: R3

8821 replies:

ABBBCCDDDEFGGGGGGHHHHHHIIIIIIJJJJKKKLLLLMMNOPQRRUUUUUUUUUUUAAAAAA

where:

A ..... is the 1PPS source (“I” = Internal)
BBB ..... is the reference frequency source (“ I” = Internal)
CC ..... is high rate output (“10” = 10 MPPS)
DDDEF ..... is the low rate output code value, where

- DDD the base value (“001”, “006”, “010”, “012”, or “100”)
- E is the low multiplier (“N” = none, “K” = Kilo, “M” = Mega)
- F is the rate (“S” = Seconds, “M” = Minutes, “H” = Hours) e.g. “001KS” = 1 KPPS

GGGGGG.. is the software version number for the 80188 processor
HHHHHH... is the software version number for the 68HC11 processor
IIIIII..... is the software version number for the 68HC05 processor
JJJJ ..... is the GPS Receiver firmware version number
KKK ..... is the GPS Receiver revision number
LLLL ..... is time code output ("IRIG” = IRIG B)
LL ..... is the printer baud rate where:

03 = 300 Baud
06 = 600 Baud
12 = 1200 Baud
24 = 2400 Baud
48 = 4800 Baud
96 = 9600 Baud
19 = 19200 Baud

M ..... is printer parity (“N” = None)
N ..... is the number of printer data bits (“8”)
O..... is the DSR status (“E” = Enabled)
P ..... is the printer log enable indicator (“D” = Disabled)
QQ..... is the printer log interval (minutes)
UUUUUUUUU is the signed user offset
AAAAAA .... is the receiver delay compensation

3-3.2.1 Remote Requests (continued)

Request Satellite Tracking Information

Host Sends: R4

8821 replies: MMDDDDTVVRRRRRRVVV.VHHH.HNNN.NEEE.E

where:

MM ..... is the position source where MM is:

- “N ” (Navigation solution),
- “U ” (User entered position),
- “NA” (Averaged position - still computing average) or
- “A ” (Averaged position - average computation done)

DDDD ..... is the DAC reference value

T ..... is the number of satellites being tracked

VV..... is the number of satellites in view

RRRRRR... is discipline status, where it is:

- The difference between the internal 1 PPS and GPS 1 PPS (in nanoseconds),
- “WR” (Waiting for GPS Engine to indicate locked),
- “FC” (Course adjustment of oscillator), or
- “CE” (Counter error)

VVV.V ..... is the Vertical DOP value

HHH.H ..... is the Horizontal DOP value

NNN.N ..... is the Position DOP value

EEE.E ..... is the Time DOP value

3-3.2.1 Remote Requests (continued)

Request Satellite Information

Host Sends: R5

8821 replies: ssaaeenn.n (Repeated eight times)

where:
- ss ..... is the satellite PRN number
- aaa ..... is the satellite azimuth
- ee ..... is the satellite elevation
- nn.n ..... is the satellite signal-to-noise ration

NOTE

Only PRN numbers being tracked are displayed. All other PRN data sets are zeroed.

For instance, if PRN numbers 3, 16, 17, 23, 24, and 26 are being tracked, the information could be displayed as follows:

033354248.0173132741.0202301141.0232541740.0240972642.0261356849.0

123123123123123123

PRN 03 PRN 17 PRN 20 PRN 23 PRN 24 PRN 26

If PRN 17 disappears (assuming no other changes) from view the output would look as follows:

033354248.0202301141.0232541740.0240972642.0261356849.000000000000

3-3.2.2 Remote Requests (continued)

Request Satellite Health

Host Sends: R6

8821 replies: SSSSSSSSSSSSSSSSSSSSSSSSSSSSSS

where: S ..... is an ‘H’ to indicate a satellite declared healthy,
a ‘U’ to indicate a satellite declared unhealthy,
a ‘-’ to indicate a satellite forced unhealthy.

NOTE

The health of all 32 possible PRN numbers is displayed starting with PRN 1 and ending with PRN 32

3-3.2.1 Remote Requests (continued)

Request Units Model Number and Main Processor Version

Host Sends:	R7
8821 replies:	VVVVXXXXXX
where:	VVVV ..... is the units model number
XXXXXX	is the software version for the 68HC11 processor

3-3.2.1 Remote Requests (continued)

Request Average Position Information

Host Sends: R8

8821 replies: DDMMSSSHdddmmsssRHHHHH.HA

where:
- DD ..... is degrees latitude
- MM ..... is minutes latitude
- SSS ..... is decimal minutes latitude
- H ..... is Latitude Hemisphere (N = North, S = South) latitude
- ddd ..... is degrees longitude
- mm ..... is minutes longitude
- sss ..... is decimal minutes longitude
- R ..... is Longitude Meridian (W = West, E = East)
- HHHHH.H.. is altitude (meters)
- F ..... is application type (A=Air,L=Land,M=Marine,S=Static)

3-3.2.2 Remote Setup Commands

The following paragraphs describe the Remote Setup Commands. All Setup commands perform dual functions. When terminated with a NULL string, the value the parameter is set to is returned to the host. When terminated with a valid string, appropriate parameter is set in the Model 8821A to the value specified by the host. Note that the time displayed in the request mode is referenced to the selected time mode.

SET/REQUEST UTC time - (Optional). This command is never required but is provided to allow the unit to be used as a time code generator, without the need of a satellite.

Request mode:

Host sends: SUT <CR>

8821 replies: SUT ddd:hh:mm:ss.ff0,Q<CR><LF>

where:
ddd = day of year
hh = hours
mm = minutes
ss = seconds
ff0 = milliseconds with 10 ms resolution. (Third character is always a zero)

Q = Quality byte .
0 = Unknown
4 = Phase <1 ns

Set mode:

Host sends: SUT yyyy,MM,dd,hh,mm,ss <CR>

where:
yyyy = year; e.g. 1991
MM = month
dd = day of month
others: as previously described

8821 replies: SUT DONE <CR><LF>

3-3.2.2 Remote Setup Commands (continued)

SET/REQUEST time mode -

This command selects GPS, UTC. or Local for all time outputs in the unit. Hours and minutes offset between time zones can be entered. If GPS is selected, the offset between GPS and UTC is updated automatically when the unit tracks satellites.

Any changes to these parameters should be made after powerup and before antenna position averaging takes place. GPS is not normally used.

SET/REQUEST time mode -

Request mode:

Host sends:	STM<CR>
8821A replies:	STM m,ooo, mm<CR><LF>
where:	m - is a "G" if GPS m - is a "U" if UTC m - is a "L" if LOCAL ooo - is the signed offset value in hours (±HH), for Local or non-signed value in seconds for GPS offset. mm - is the offset in minutes (0-59) for Local

Set mode:

Host sends:	STM m,ooo,mm<CR>
where:	m - is a "U" for UTC m- is a “G” for GPS m - is an "L" for Local ooo - is the signed offset value in hours (±HH), for Local or non-signed value in seconds for GPS offset. mm is the offset in minutes (0-59) for Local
8821A replies:	STM DONE<CR><LF>(After 8821A has completed task).

Note: The minor time mode is set to UTC if UTC or LOCAL are selected and GPS if GPS is selected. It is not necessary to enter the hours and minutes offset when switching to LOCAL time. The unit will use the last entered offset values if none are specified.

3-3.2.2 Remote Setup Commands (continued)

SET/REQUEST DST dates -

This command enters the day light savings time (DST) Spring and Fall change dates. Refer to Table 3-3 for factory default dates. Local standard time may be selected when DST is not used..

Request mode:

Host sends: SDD <CR>

8821 replies: SDD mm,dd,mm,dd,M<CR><LF>

where: 1st mm,dd - is Spring's date and
2nd mm,dd - is Fall's date
M is a "D" if daylight or an "S" if standard

Set mode:

Host sends: SDD mm,dd,mm,dd,M<CR>

where: 1st mm,dd - is Spring's date and
2nd mm,dd - is Fall's date
M is a "D" if daylight or an "S" if standard

8821 replies: SDD DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

Set DAC reference value

Sets the voltage level that, when applied to the internal oscillator control input, will place oscillator at its' 10 Mhz center frequency.

Host sends:	SDREF dddd<cr>
8821 REPLIES:	SDREF DONE<CR><LF>
where:	dddd is DAC setting

NOTE: The dddd field is not padded with zeros and contains only the digits necessary to represent the value.

When the RQDR request command indicates a value outside the 500-to-3500 range, the DAC value is set to 2048 using the SDEF command and the oscillator located on the Model 8821A's Main Logic Board is adjusted to 10 MHz as described in Paragraph 4-6.

3-3.2.2 Remote Setup Commands (continued)

SELECT/REQUEST desired satellites to be used. (Must use SV PRN numbers) -

NOTE: This setup command is not normally required by a Model 8821A user.

Satellite health status is updated using a slow background task. For this reason, complete satellite health status is not available for approximately 5 minutes after a power-up. In addition, any changes the user makes using the "SSV" command may also take up to 5 minutes to be reflected in the satellite health status. This is not to say that the actual "SSV" command actions take up to 5 minutes as they are almost instantaneous. The exception to the above rule is that up to 12 currently visible satellites are always immediately updated. Also, health for satellites that are not in the GPS receiver's almanac will always be indicated by "U", even if the user attempts to force them unhealthy. Forcing a satellite to the natural state means that the satellite health will be determined by the almanac information for that satellite.

Request mode:

Host sends: SSV <CR>

8821 replies: SSV 01h,02h,03h,.. . 14h,15h,16h<CR><LF>
SSV 17h,18h,19h,... 30h,31h,32h<CR><LF>

where: h - is an "H" for a healthy satellite and
h - is a "U" for a unhealthy satellite
h - is a "-" for a forced unhealthy satellite
h - is a "X" for an illegal response from the receiver

8821 replies: SSV DONE<CR><LF>

Set mode:

Host sends: SSV m,sv,sv,sv <CR>

where: m - is an "N" or 00 to set all satellites to a natural state
is an "A" to force satellites indicated to a natural state
is an "R" to force satellites indicated unhealthy
is an "O" to force the 8821 to track only referenced satellites
(all others forced unhealthy)
sv - is (are) the referenced satellite PRN number(s).

8821 replies: SSV DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

SET/REQUEST local position -

NOTE: Most users will accept the default 24 hour averaging mode and will not need this command

The position entered using this command may be used in two ways: if the position source is “N” or “NA” the GPS receiver will accept and use the entered position, but will update it as navigation solutions are computed; if the position source is “U”, the entered position will be used and no position solutions will be performed. If the position source is “A”, the entered position will not be used, but will be stored for later retrieval should the user decide to change the position source. Refer to SPS command, following, for further clarification of when this command is used.

Request mode:

Host sends:	SLP <CR>
8821 replies:	SLP dd:mm.fffN,ddd:mm.fffW,Shhhhh.f<CR><LF>
where:	dd:mm.fff is Latitude (N is North or S is South) ddd:mm.fff is Longitude (W is West or E is East) Shhhhh.f is Height in meters where S = + (positive) or - (negative) elevation

Set mode:

Host sends:	SLP dd:mm.fffN,ddd:mm.fffW,Shhhhh.f<CR>
where:	dd:mm.fff is Latitude (N is North or S is South) ddd:mm.fff is Longitude (W is West or E is East) Shhhhh.f is Height in meters where S = + (positive) or - (negative) elevation
8821 replies:	SLP DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

SET/REQUEST position source -

NOTE: Normal user will accept 24 hour antenna position averaging provided. If a surveyed antenna position is available, this position can be entered in SLP (previous) command and “U” selected here. Doing so bypasses the factory default 24 hour averaging period and provides a very small improvement in time accuracy. The “N” mode by passes all averaging and uses the current position from the GPS receiver.

If the application type setting is set to select the static mode of operation at power-up, the unit will automatically select the “SPS A” option and begin a 24 hour average of the once-per-second navigation solutions from the GPS receiver. At the completion of the averaging period, the computed
average will be used by the GPS receiver and no more navigation solutions will be performed. Should the user change the position source to “N”, “A” or “U” during an average, the averaging operation will be halted and re-set. All averaging data will be erased. If the user changes the position source to “U”, the unit will enter this mode on the next power-up and will not perform an average position operation.

Request mode:

Host sends:	SPS <CR>
8821 replies:	SPS m<CR><LF>
where:	m - is an "N" if the receiver navigation solution is selected m - is a "NA" if the computed average position is selected and the average position computation has not completed yet. m - is a "A" if the computed average position is selected and the average position computation has completed. m - is an "U" if the user entered position is selected

Set mode:

Host sends:	SPS m <CR>
where:	m - is an "N" if use of the receiver navigation solution is desired m - is a "A" if use of the computed average position is desired m - is an "U" if use of the user entered position is desired
8821 replies:	SPS DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

SET/REQUEST max DOPs -

Request mode:

Host sends:	SMD<CR>
8821 replies:	SMD hh, vv<CR><LF>
where:	hh is the Horizontal DOP (1 to 99) vv is the Vertical DOP (1 to 99)

Set mode:

Host sends:	SMD hh,vv<CR>
where:	as stated above.
8821 replies:	SMD DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

SET/REQUEST minimum tracking elevation -

Request mode:

Host sends: SEL<CR>

8821 replies: SEL ee<CR><LF>

where: ee is the minimum elevation in degrees

Set mode:

Host sends: SEL ee <CR>

where: ee is the new minimum elevation in degrees

8821 replies: SEL DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

SET/REQUEST user offset and antenna delay compensation -

Request mode:

Host sends: SDC <CR>

8821 replies: SDC suuuuuuuuu,aaaaaa<CR><LF>

where: suuuuuuuuu is the signed user offset in nanoseconds up to 500000000ns.
aaaaaa is the antenna delay compensation in nanoseconds up to 99999ns.
s= + or -

Set mode:

Host sends: SDC suuuuuuuuu,aaaaaa<CR>

where: format is as described above.

8821 replies: SDC DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

SET/REQUEST receiver unlock time-out delay -

Request mode:

Host sends: STI <CR>

8821 replies: STI dd<CR><LF>

where: dd is the time-out in minutes (1 to 99)

Set mode:

Host sends: STI <CR>

8821 replies: STI dd<CR><LF>

where: dd is as described above.

8821 replies: STI DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

Receiver restart command -

Request mode:	(there is no request mode)
Set mode:	
Host sends:	SST X <CR>
Where:	X is C for a Cold Start
8821 replies:	SST DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

SELECT/REQUEST rate output -

Request mode:

Host sends: SRO<CR>

8821 replies: SRO string<CR><LF>

where: string - is "1PPS", "10PPS", "100PPS", "1KPPS", "10KPPS", "100 KPPS", "1M PPS", "1PPM", "1PPH", "6PPH", or "12PPH" or ”CODE” to output the IRIG B DC timecode.

Set mode:

Host sends: SRO, string<CR>

where: string - is 1PPS", "10PPS", "100PPS", "1KPPS", "10KPPS", "100KPPS", "1MPPS", "1PPM", "1PPH", "6PPH", or "12PPH"

8821 replies: 8821 DONE<CR><LF>

3-3.2.2 Remote Setup Commands (continued)

Reset unit command -

This command causes a complete reboot of the unit.

Request mode:	(there is no request mode)
Set mode:	
Host sends:	RST<CR>

3-3.2.2 Remote Setup Commands (continued)

Select ROM command -

This command allows the user to change the selected ROM stored in non-volatile memory. Provided the CRC value is valid, the application code in the specified ROM will be executed the next time the unit is reset. Also note that the alternate ROM will be re-programmed if an upload sequence is initiated.

Request mode:	(there is no request mode)
Set mode:	
Host sends:	LEP SEL ROMX<CR>
Where:	X is 1 for rom1 and 2 for rom2

3-4 RS-232B Operation (J5)

The port provides a time of day output at a once per second rate. The “T” is output approximately 500 us after on-time, time output follows about 300 ms later. These times will vary for about 10 seconds after the 24 hour averaging period has elapsed, while the average position is computed. Note that the “S” field powers-up in the “O” condition until the receiver locks for the first time.

Output message: Tyyyy,ddd:hh:mm:ss,Q,S,ffffffff,XX<CR><LF>

where: ...yyyy is for digit year
ddd is doy of the year
hh is hours
mm is minutes
ss is seconds
Q is “G” if the BIT status is good and “F” if the BIT detected a failure
S is “S” is the receiver is in sync and “O” if the receiver has been out of sync longer than the time-out period (see sti command)
ffffffff is seconds of the year
XX is the message checksum and is computed by totaling the ASCII codes for all characters between the “T” and the last “,” and truncating the value to the least significant byte. The checksum is represented by two hexadecimal digits.

CHAPTER 4

MAINTENANCE

4-1 GENERAL

The Model 8821A GPS Clock's high reliability and Built-In-Test circuits minimizing required maintenance time.

4-2 MAINTENANCE PHILOSOPHY

The Model 8821A GPS Clock's front-panel STATUS indicator allows rapid recognition of system faults. With the GPS antenna attached and power applied, initialization, satellite acquisition, and oscillator locking occur automatically. The green front-panel STATUS indicator remains off for approximately 30 minutes.

Unless a surveyed antenna position has been remotely entered, it takes 24 hours for the GPS receiver to determine the average antenna position. Should the STATUS indicator fail to light, refer to Paragraph 3-3, Remote Operation, and enter a RQFS command to determine the status of the various operations monitored by the internal built-in test (BIT) circuits. The default mode for this status request is OFF which means that the fault status output stream is not automatically output during operation. The RQFS command is as follows:

Request built in test status -

Host sends:	RQFS
8821 replies:	RQFS A,B,C,D,E,F,G,H,I,J,K
where:	A is GPS Receiver fail status (G=Good,F=Fail) B is Oscillator status (G=Good,F=Fail) C is 10 MHz output status (G=Good,F=Fail) D is 1 PPS output status (G=Good,F=Fail) E is GPS Receiver battery backup status (G=Good,F=Fail) F is Oscillator unlock time-out status (G=Good,F=Fail) G is Time interval counter status (G=Good,F=Fail) H is Oscillator manual calibration status (G=Good,F=Fail) I is antenna status (G=Good, F=Fail) J is the Low Rate output status (G=Good, F=Fail) K is the IRIG B output status (G=Good, F=Fail)

Set mode:

Host sends:	RQFS string <CR>
where:	string is ON to enable automatic output of the above message when a change in fault status is detected string is OFF to disable automatic output
8821 replies:	RQFS DONE <CR><LF>

When the faulty function is isolated, contact TRAK Systems for repair or replacement instructions.

The replaceable assemblies in the Model 8821A are listed in Table 5-1. No attempt should be made to repair an assembly. These assemblies should be returned to the factory for repair.

4-3 PREVENTIVE MAINTENANCE

Preventive maintenance of the Model 8821A consists mainly of cleaning and general inspection to maintain the best environment for module operation. DO NOT operate the Model 8821A for a prolonged period with the cover removed.

4-4 BATTERY REPLACEMENT

The Lithium battery on Main Logic Assembly A1 powers the static RAM storing the data in the GPS receiver module and real time clock. When the instrument is unpowered, this battery has a useful life of approximately five (5) years. Prior to the end of this five-year period, the battery should be changed to avoid unexpected loss of stored GPS Receiver satellite information.

The static RAM in the GPS Receiver Assembly A2 is powered by the instrument's power supply when external power is applied to the Model 8821A and by the internal Lithium battery when power is removed. If battery replacement is done before battery failure, power to the instrument should be left on during battery replacement. Since the instrument's internal power supply is ORed with the Lithium battery, the battery can be replaced with power applied without loss of stored data.

When battery failure occurs with external power removed from the instrument, stored operational parameters are lost and satellite data must be reacquired by applying power to the unit and wait the default 24-hour antenna position averaging period.

The following procedure assumes that battery failure occurred while external power was removed from the instrument. Perform the following procedures to replace the Lithium battery on Main Logic assembly A1:

The battery on Main Logic Assembly A1 can be replaced with any of the following batteries:

Panasonic	-	Part Number - BR2032
SANYO	-	Part Number - CR2032
Electro-Chem	-	Part Number - CR2032

To remove and replace the battery on Main Logic Assembly A1, proceed as follows:

a. Loosen eight (8) quarter-turn fasteners in instrument top cover and remove cover.

b. Referring to Figure 2-2, locate battery on Main Logic Assembly A1.

c. Remove rubber cover from battery by pulling straight up. **Note:** considerable force is required to remove rubber cover.

d. Noting the polarity of the installed battery on Main Logic Assembly A1, gently lift the (+) battery terminal and lift the battery out of its holder. See warning below.

e. Gently lift (+) battery terminal again and insert replacement battery with positive (+) terminal upward.

f. Replace protective rubber cover on battery.

g. Replace instrument top cover and tighten fasteners.

4-4 BATTERY REPLACEMENT (continued)

WARNING

The battery removed is a fire, explosion, and severe burn hazard. Do not recharge, disassemble, heat above 212 degrees F, incinerate, or expose contents to water.

4-5 FIRMWARE MAINTENANCE

The Model 8821A is set up using a remote computer or dumb terminal connected to rear-panel RS-232A Port J8 and the remote setup commands described in Paragraph 3-3.2.2. When it is desired to create and store setup commands for a second application requiring different daylight savings time corrections, positioning mode, or when it is necessary to upload new firmware to the Model 8821A and test it while the older version is stored, the unit's dual flash memory feature is used.

The Model 8821A-11 can store two different application-code or firmware versions in flash memory. using the LEP SEL ROMX and RST remote commands. The user can then alternate between the two as desired. Validation and programming of the flash memory is handled by the boot routine described below.

After power-up, the boot routine computes a cyclic redundancy check value for both flash devices and the instructions stored in the last programmed device (non-volatile ram) are selected for execution. This takes approximately 6 seconds. A startup message is then output and a 5 second timer is started. During this period, the host computer connected to R3-232A Port J8 may initiate a program upload sequence,, select a particular ROM for execution (which may override the previously selected ROM), or do nothing and let the timer lapse. After the 5 second time period elapses or a program upload has been completed, the boot routine recomputes the CRC for both devices and again selects the last programmed device. The application code is then executed.

The device not selected for execution is used for reprogramming but becomes the newly selected device after the programming is complete. Note that caution must be used when overriding the selected device with the "LEP SEL ROMX" command as it can affect which device is reprogrammed.

If the selected device fails the CRC, the alternate device becomes the selected device. If both devices fail the CRC then the boot routine enters a permanent spin loop in which it waits for a program upload sequence to begin.

The primary flash device is referred to as "ROM1" and the secondary device is "ROM2". The following is an example of the timing and output messages:

- **Power-up is followed by a 6 second pause while the CRC value for both devices is computed.**
- `LEP VER 2D010<CR><LF>`
- **A 5 second period begins during which time commands may be entered.**
- **Another 6 second pause begins while the CRC values are re-computed.**
- `ROM1 CRC:OK  DATE:12/09/95 10:00:00 VER:DB010<CR><LF>`
- `ROM2 CRC:FAIL DATE:??/??/?? ??:??:?? VER:?????<CR><LF>`
- `ROM1&2 CRC FAIL-PROCESSOR HALTED<CR><LF>` **both ROMS failed CRC check - unit waits for program upload sequence.**
- `SELECTED ROMX CRC FAIL<CR><LF>` **unit cannot run code from selected ROM, the alternate ROM will be used instead**
- `SELECTED ROM:ROM1<CR><LF>` **indicates that ROM1 will be executed**

4-5 FIRMWARE MAINTENANCE (cont'd)

During the 5 second pause after the first line the host computer may send the following messages:

- `RST` **to cause a system reset**
- `LEP SEL ROM1<CR><LF>` **to force the selection of ROM1**
- `LEP SEL ROM2<CR><LF>` **to force the selection of ROM2**

NOTE: During the 6 second period the CRC values are being computed, the boot routine cannot receive commands from the host computer.

4-6 10 MHz OSCILLATOR ADJUSTMENT

When the RQDR request command indicates a value outside the 500-to-3500 range, the Model 8821A's internal 10 MHz Oscillator requires adjustment. The 10 MHz Oscillator is located on Main Logic Assembly A1 as shown in Figures 5-1 for the Model 8821A-11 and Figure 5-2 for the Model 8821A-12. The adjustment screw is located on the oscillator modules' rear surface.

NOTE

The following procedure is accomplished after the 8821A has been powered for 24 hours, the RQFS C output status command indicates a 10 MHz output fault (F) and the RQDR, request command indicates a value outside the 500-to-3500 range.

To access and adjust the Model 8821A's internal 10 MHz Oscillator, proceed as follows:

a. Loosen eight (8) quarter-turn fasteners in instrument top cover and remove cover.

b. Referring to Figure 2-1, Connect frequency counter to rear-panel HI-RATE BNC connector J2.

c. Referring to remote setup command SDEF described in Paragraph 3-3.2.2, set DAC value to 2048.

d. Using appropriate alignment tool, turn 10 MHz Oscillator adjustment screw until frequency counter indicates 10 MHz.

e. Using remote status request command RQFS, observe that RQFS C status is "G".

f. Replace top cover and tighten eight (8) quarter-turn fasteners.

CHAPTER 5

REPLACEABLE PARTS LIST

5-1 GENERAL

Table 5-1 lists the replaceable parts in your instrument. Figures 5-1 and 5-2 illustrates the location of Model 8821A replaceable assemblies for the Model 8821A-11 and 8821A-12, respectively. Table 5-2 provides manufacturer's code identification.

Table 5-1. Model 8812A Replaceable Parts List

REF DES	DESCRIPTION	MFG CODE	PART NO	QTY
A1	MAIN LOGIC PC BD ASSY	11165	*4005902-102	1
A1	MAIN LOGIC PC BD ASSY	11165	**4005902-101	
A2	GPS RECEIVER ASSY	11165	4701917	1
A3*	NINE DIGIT DECIMAL DISPLAY	11165	4003811-101	1*
F1	FUSE, 2A, 250V, SLOW BLOW	11165	4700548	1
PS1	POWER SUPPLY	11165	2005407-103	1
-	ANTENNA	11165	2006077-101	1

NOTE: **8812A-11 only
*8812A-12 only

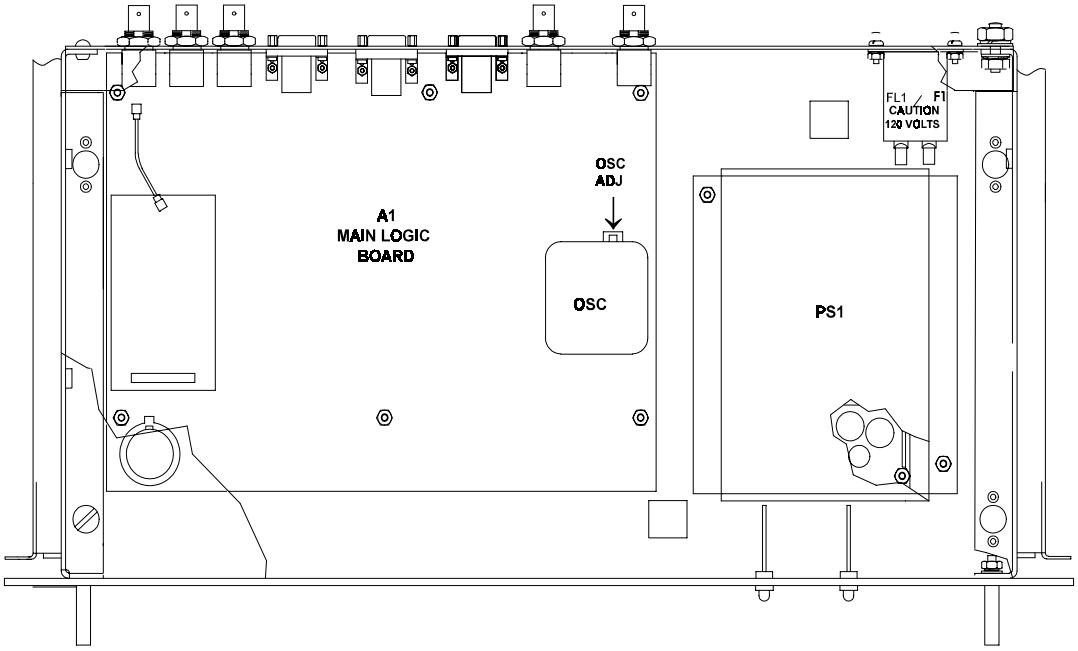


Figure 5-1. Model 8821A-11 Major Assembly Locations

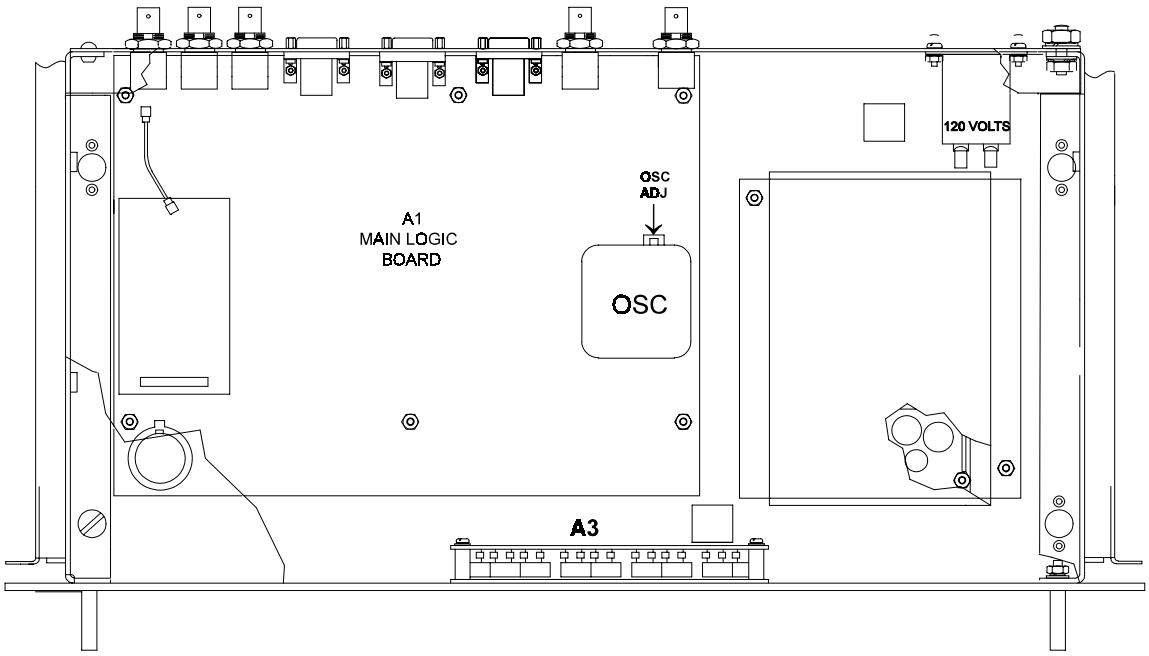


Figure 5-2. Model 8821A-12 Major Assembly Locations

Table 5-2. Manufacturer's Code Number Identification

CODE	MANUFACTURER
11165	TRAK Systems Div. of TRAK Microwave Corp., Tampa, FL 33634

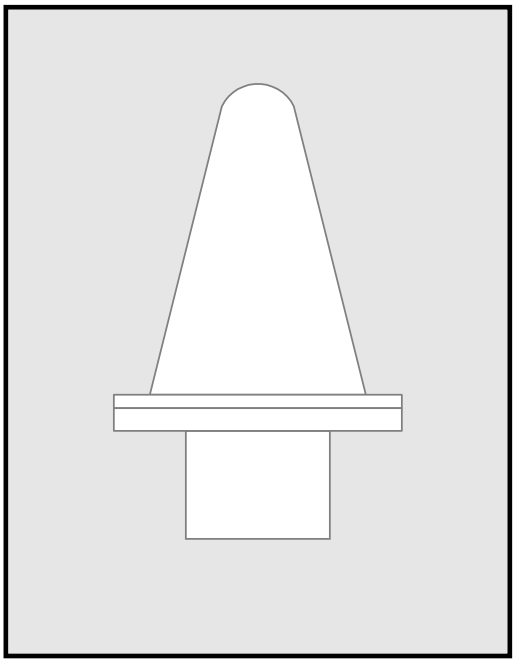
APPENDIX A-D
INTENTIONALLY DELETED

Appendix E

GPS Antenna, Installation, and Cable Options

Application Note 3.1

(January 2001)



GPS Antenna
(Typical View)

- **Triple Band Pass Filter**
- **LNA, 30 dB Gain**
- **Surge Protect Circuitry**
- **Conical Radome**

Antenna Types

Two antenna types are described, one for 12 volt systems and the other for 5 volt systems. Except for operational voltage, connector types, and mast adapters, both have identical characteristics.

Specifications

Operating Frequency: 1572.42 MHz

Filtering: Triple filter, -60 dB @ 1575.4, ±50 MHz

Gain: 30 dB, 2.2 dB maximum noise figure

Protection: 80V, IEC1000-4-5

Polarization: Right hand, circular

Power supply voltages:
5 volt antenna, +5Vdc, ± 0.5Vdc
12 volt antenna, +4.5Vdc to +15 Vdc

Power supply current: 20 ma (typical), 27 ma (maximum), both types

Connector types:
5 volt antenna, “N” female
12 volt antenna, “TNC” female

Radome color: White

Radome shape: Conical

Dimensions: Diameter, 3.5 inches and Height, 4.0 inches (excluding mast adapter)

Weight: .7 pounds (excluding mast adapter)

Temperature:
Operational, -40° C to +85° C
Storage, -45° C to +90° C

Antenna Installation

1-0 General

Depending on model, one of two antenna types and 50 feet of RG-58/U coaxial cable is supplied with every TRAK Time and Frequency Systems (TFS) GPS system. Each type antenna requires a different assembly and mounting procedure. Before the antenna is assembled and installed, important considerations of personal safety, antenna location, coaxial cable length / type, and lightning protection are required. Suggestions are outlined in the following paragraphs.

1-1 Personal Safety

Personal safety is a common sense consideration. Do not attempt to install antenna during rain, lightning, or high winds. Stay clear of power lines and other dangerous objects.

1-2 Antenna Site Selection

The antenna should be mounted in a location that has an unobstructed view of the sky, as much as possible. A hemispheric view 10 to 15 degrees above the horizon is ideal. Roof mounting or mounting on the cable bridge between antenna tower and equipment shelter is usually acceptable. Height is not important, a clear view of the sky is. In northern areas subject to high degrees of snow and ice, do not mount near high structures where falling ice can damage the antenna.

1-3 Coaxial Cable Selection

50 feet of RG-58 type coaxial cable is supplied as standard with every GPS model. If a length of greater than 50 feet is required, refer to Table 1 for cable lengths vs. cable types.

1-4 Lightning Protection

Surge suppressors are not supplied as standard with antennas and coaxial cables. These must be ordered as options. Option L60 is used with the 12 volt antenna (TNC connectors) and Option L60N is used with the 5 volt antenna (N connectors).

The surge suppressor should be installed at the point where the coaxial cable enters the building or equipment shelter. It is imperative that the surge suppressor ground lug be connected to a good low impedance earth ground. Some installations require the outer conductor of the coaxial cable also be connected to a low impedance earth ground. Andrew ¼ inch Superflex coaxial cable with an Andrew ground strap (Option L61) is ideal for this requirement.

1-5 Antenna used in 12 Vdc systems (TFS part number 1001661-131)

This antenna is identified by the TNC female connector on the antenna base and a threaded mast adapter, see Figure 1. This antenna is used with the following TFS models: 8812, 8820, 8821, 8900, and 9000.

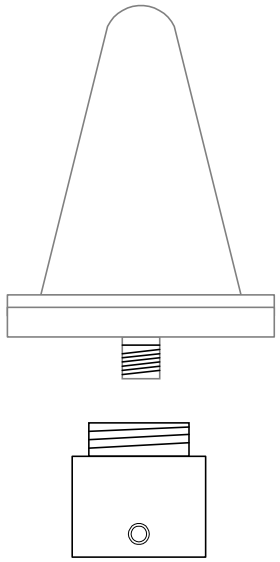


Figure 1, 12 volt antenna

1-5-1 Antenna and Mast Adapter Assembly

Pass the coaxial cable with male TNC connector through the threaded mast adapter and connect the cable to the antenna connector. Screw the mast adapter into the base of the antenna. Refer to Figure 1.

1-5-2 Antenna Mounting

The mast adapter accepts a mast in the ¾ to 1 inch diameter range. The mast is not supplied due to the wide variety of mounting requirements in field installations.

1-6 Antenna used in 5 Vdc systems (TFS part number 4702337)

This antenna is identified by the N female connector on the antenna base and a mast adapter attached to the antenna base with four screws, see Figure 2. This antenna is used with TFS model 9100.

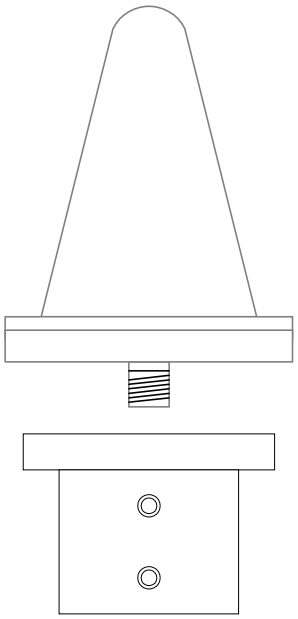


Figure 2, 5 volt antenna

1-6-1 Antenna and Mast Adapter Assembly

Pass the coaxial cable with male N connector through the mast adapter and connect the cable to the antenna connector. Attach the mast adapter to the base of the antenna with the four captive screws provided. Refer to Figure 2.

1-6-2 Antenna Mounting

The mast adapter accepts a mast in the 1.5 to 1.7 inch diameter range. The mast is not supplied due to the wide variety of mounting requirements in field installations.

Coaxial Cable and Accessories Selection

2-0 General

50 feet of RG-58 type coaxial cable is supplied as standard with every GPS model. If a length greater than 50 feet or non-RG-58 cable is required, options are available. A 20 dB line amplifier is available when using long cable runs, consult factory for special applications and considerations.

2.1 Available Antenna Cable Options

Available antenna cable options and accessories are shown in Table 1.. If a longer cable is required, consult factory for cable type and GPS line amplifier (if required).

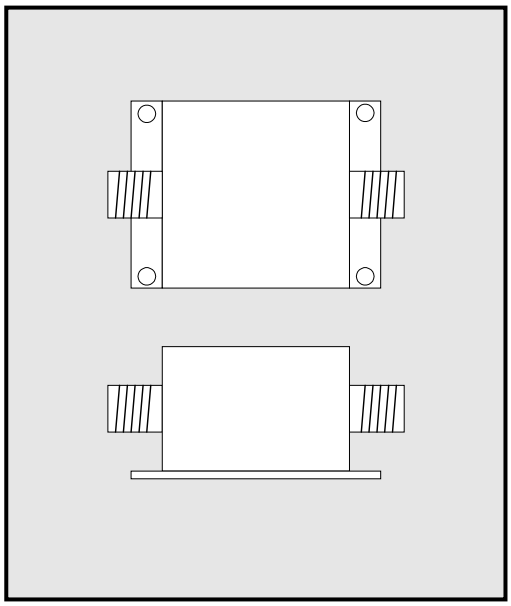
Table 1, Standard Coaxial Cable Options

Antenna Option	Option No	Description	Used On
1001661-131	L9A	Antenna & mast adapter, TNC connector, 12VDC	Note 1
1001661-209	**L10A**	**L9A & 50' RG-58**	Note 1
1001661-210	**L11A**	**L9A & 100' RG-213**	Note 1
1001661-211	**L12A**	**L9A & 200' RG-213**	Note 1
1001661-221	**L22A**	**L9A & 250' Belden 9913**	Note 1
1001661-222	**L23A**	**L9A & 2 x 250' Belden & 20 dB amp**	Note 1
1001661-225	**L26A**	**L9A & 100' RG-213 (TNC-N)**	Note 1
1001661-227	**L28A**	**L9A & 2 x 200' Belden 9913 & 20 dB amp**	Note 1
1001661-228	**L29A**	**L9A & 175' RG-213 & 75' RG-213 & 20dB amp**	Note 1
1001661-230	**L30A**	**L9A & 165' RG-213**	Note 1
1001661-150	L50	¼" Andrews TNC- 50' w/ spare TNC connector	Note 1
1001661-151	L51	¼" Andrews TNC- 100' w/ spare TNC connector	Note 1
1001661-152	L52	¼" Andrews TNC- 200' w/ spare TNC connector	Note 1
1001661-157	L9N	Antenna & mast adapter, "N" connector, 5 VDC	Note 2
1001661-158	**L70**	**L9A & L60 & L51 & L61 (100' cable)**	Note 1
1001661-159	**L71**	**L9A & L60 & L50 & L61 (50' Cable)**	Note 1
1001661-156	**L72**	**L9A & L60 & L52 & L61 (200' Cable)**	Note 1
1001661-160	L60	Lightning /surge suppressor (TNC-TNC)	Note 1
1001661-161	L61	¼" Andrews grounding kit	Note 1, Note 2
1001661-162	L62	¼" Andrews cutting tool	Note 1, Note 2
1001661-163	L50N	¼" Andrews N- 50' w/ spare N connector	Note 2
1001661-164	L51N	¼" Andrews N- 100' w/ spare N connector	Note 2
1001661-165	L52N	¼" Andrews N- 200' w/ spare N connector	Note 2
1001661-166	L60N	Lightning /surge suppressor (N-N)	Note 2
1001661-167	**L70N**	**L9N & L60N & L51N & L61 (100' cable)**	Note 2
1001661-168	**L71N**	**L9N & L60N & L50N & L61 (50' Cable)**	Note 2
1001661-169	**L72N**	**L9N & L60N & L52N & L61 (200' Cable)**	Note 2

Note 1: These assemblies are designed for the 12 volt, TNC connector series which include; 8812, 8820A, 8821, 8900, and 9000.These units Use the L9A antenna, 4.5 to 15 VDC. Standard Antenna Option for these Models unless otherwise specified 1001661-209

Note 2*:* These assemblies are designed for 5 Volt, “N” connector series, which include the 9100. These units use the L9N antenna option. Standard antenna option for these models unless otherwise specified is 1001661-157 (L9N) & 1001661-163 (L50N)

Note 3*:* Bold options are complete antenna & cable options.



GPS Line Amplifier

(Typical Views)

Specifications

- **DC pass through for active antenna**
- **20 dB Gain**

Operating Frequency: 1.1 – 1.7 GHz

Gain: 20 dB, minimum

Noise Figure: < 3.5 dB

Input / Output Impedance: 50Ω

Reverse Isolation: 35 dB minimum

Operating Voltage: 3.6 – 15 Vdc (min-max)

Operating Current: < 10 ma (amplifier only)

Operating Temperature: -40^0 C to $+75^0$ C

Dimensions:
Height: 1.3”
Body length (ex. connectors): 2.5”

Base plate length: ***3.25”***
Width: 2.5”

Weight: 10 oz.

GPS Line Amplifier Installation

3-0 General

The GPS Line Amplifier provides necessary gain lost in installations requiring long coaxial cable runs. It's operational voltage, along with the antenna, is supplied by the GPS receiver.

3-1 Installation

The GPS Line Amplifier is not contained in a weather proof housing and therefore must be installed in a protected area. Also, the amplifier must be installed as close to the antenna as permitted by the weather protected area. Consult factory for additional installation information.

APPENDIX F
TIME CODE FORMATS

APPENDIX C

TIME CODE FORMATS

APPENDIX C

TIME CODE FORMATS

INTRODUCTION: The commonly used time code formats are shown in this appendix. The IRIG B and NASA 36-Bit one-second time codes are most commonly used for general-purpose time distribution and magnetic tape annotation applications requiring time of year data. The XR3 and 2137 codes are commonly used for magnetic tape annotation where day of year data are not required.

IRIG A: Ten frames per second. BCD coding 0.1 seconds through hundreds of days. Binary seconds of the day optional. Modulated code used 10 KHz carrier

IRIG B: One frame per second. BCD coding units seconds through hundreds of days. Binary seconds of the day optional. Modulated code used 1 KHz carrier.

IRIG E: Ten-second time frame. BCD coding tens of seconds through hundreds of days. Modulated code normally uses 100 Hz or 1 KHz carrier

IRIG G: One-Hundred frames per second. BCD coding tens of milliseconds through hundreds of days. Highest speed standard serial code. Modulated code used 100 KHz carrier.

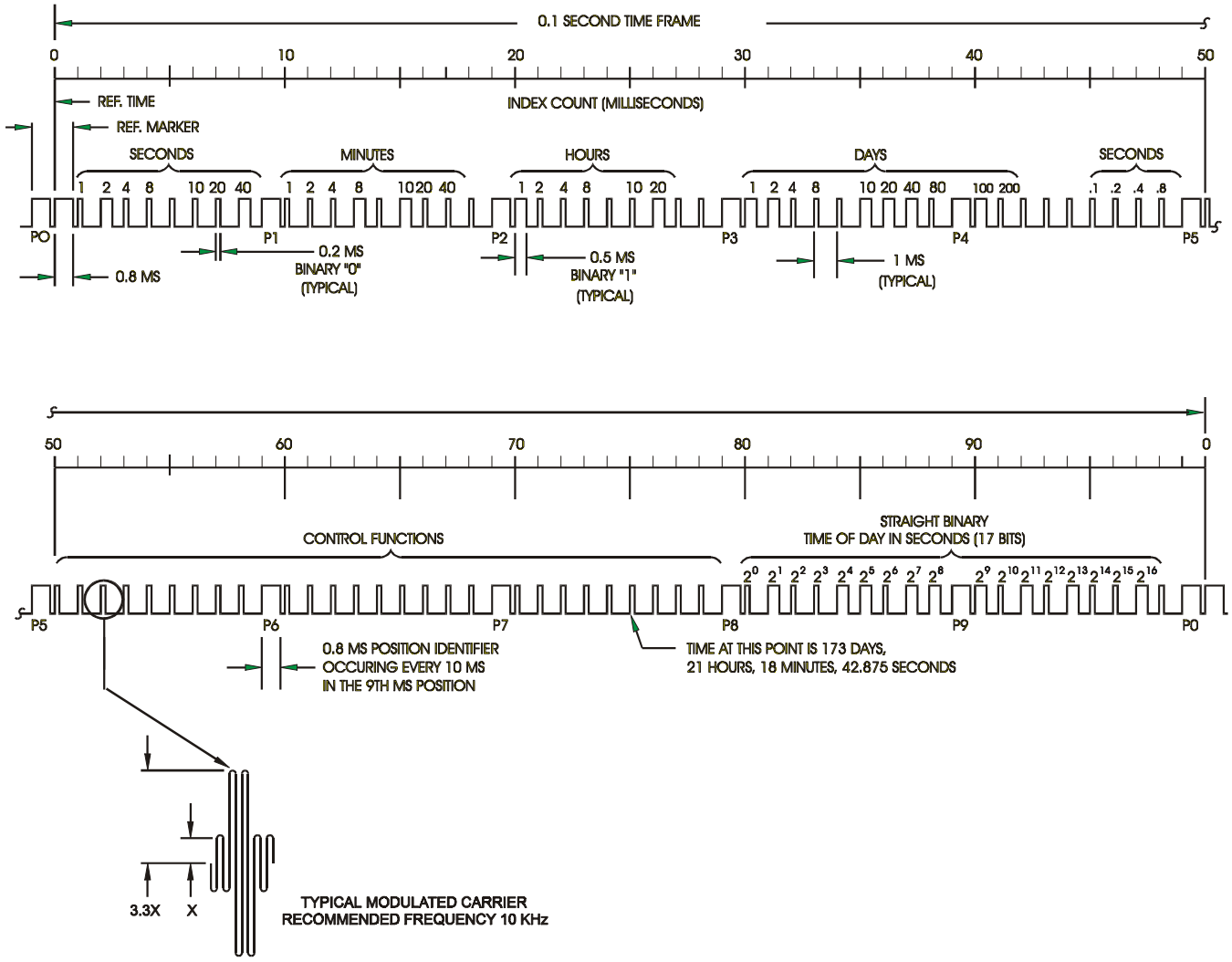
NASA 36-Bit: One frame per second. BCD coding unit seconds through hundred of days. Modulated code uses 1 KHz carrier.

XR3: One frame per second. BCD coding unit seconds through tens of hours (days data not encoded). Ideal for tape recording and playback uses. Modulated code has 250 Hz carrier

2137: Same as XR3 except that carrier frequency is 1 KHz.

IRIG H: One frame per minute. BCD coding units minutes through hundreds of days. Normally used in DC level shift form for strip chart recording. Modulated code normally used 100 Hz or 1 KHz carrier.

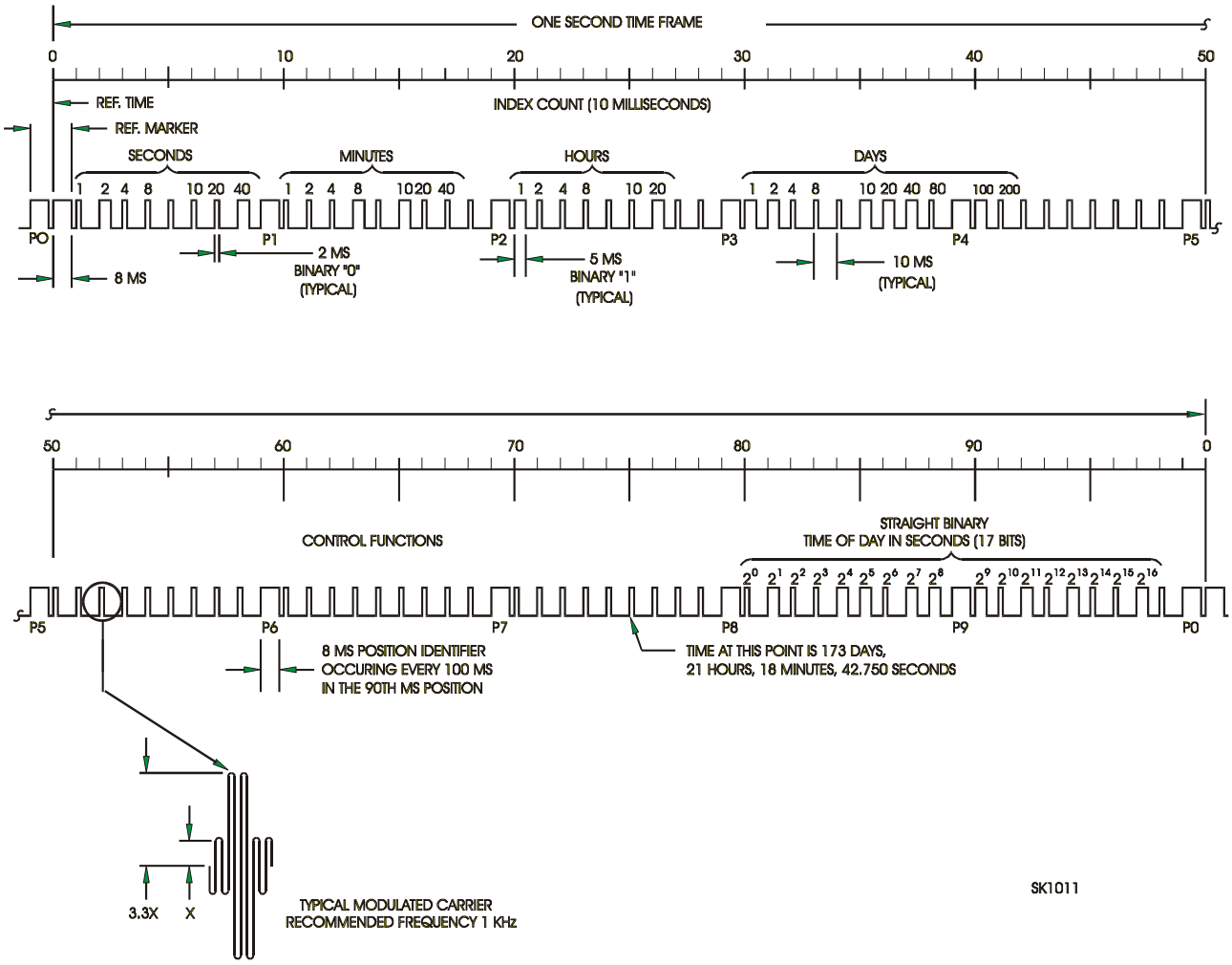
IRIG A CODE FORMAT



The IRIG A time code has a tenth-second (100 ms) time frame and contains BCD time information representing tenths-of-seconds, seconds, minutes, hours, days, and straight-binary-time –of –day (SBTOD) in seconds. Provisions are made in the code for control functions. An 0.8 millisecond frame reference marker appears during the first millisecond of each frame, and 0.8 millisecond position identifiers appear during the 9th millisecond of each 10 ms period.

The BCD time data appear in the first five 10 ms time periods of each tenth-second frame, control functions (when used) appear in the next three 10 ms time periods, and the SBTOD data appear in the last two 10 ms time periods. Binary ZEROs and fill bits are 0.2 ms long, and binary ONEs are 0.5 ms long. Modifications to the code include deletion of days data, deletion of SBTOD data and deletion of both of these data groups.

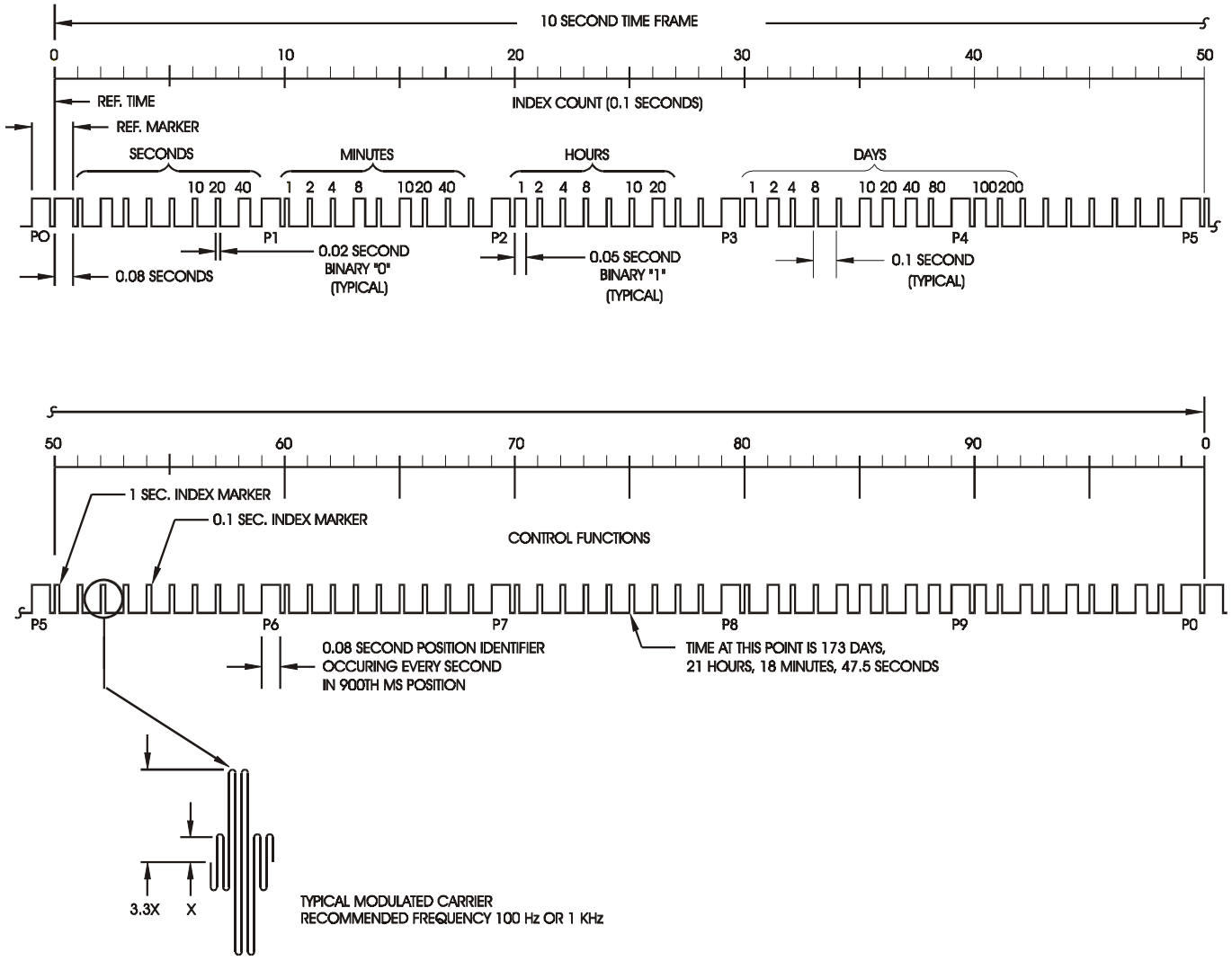
IRIG B CODE FORMAT



The IRIG B time code has a one-second time frame and contains BCD time information reprenting seconds, minutes, hours, days and straigh-binary-time-of-day (SBTOD) in seconds. Provisions are made in the format for control functions. An 8-millisecond frame reference marker appears during the first 10 ms of each frame, and 8-millisecond position identifiers appear during the 90th millisecond of each 100 millisecond period. The BCD time data appear in the

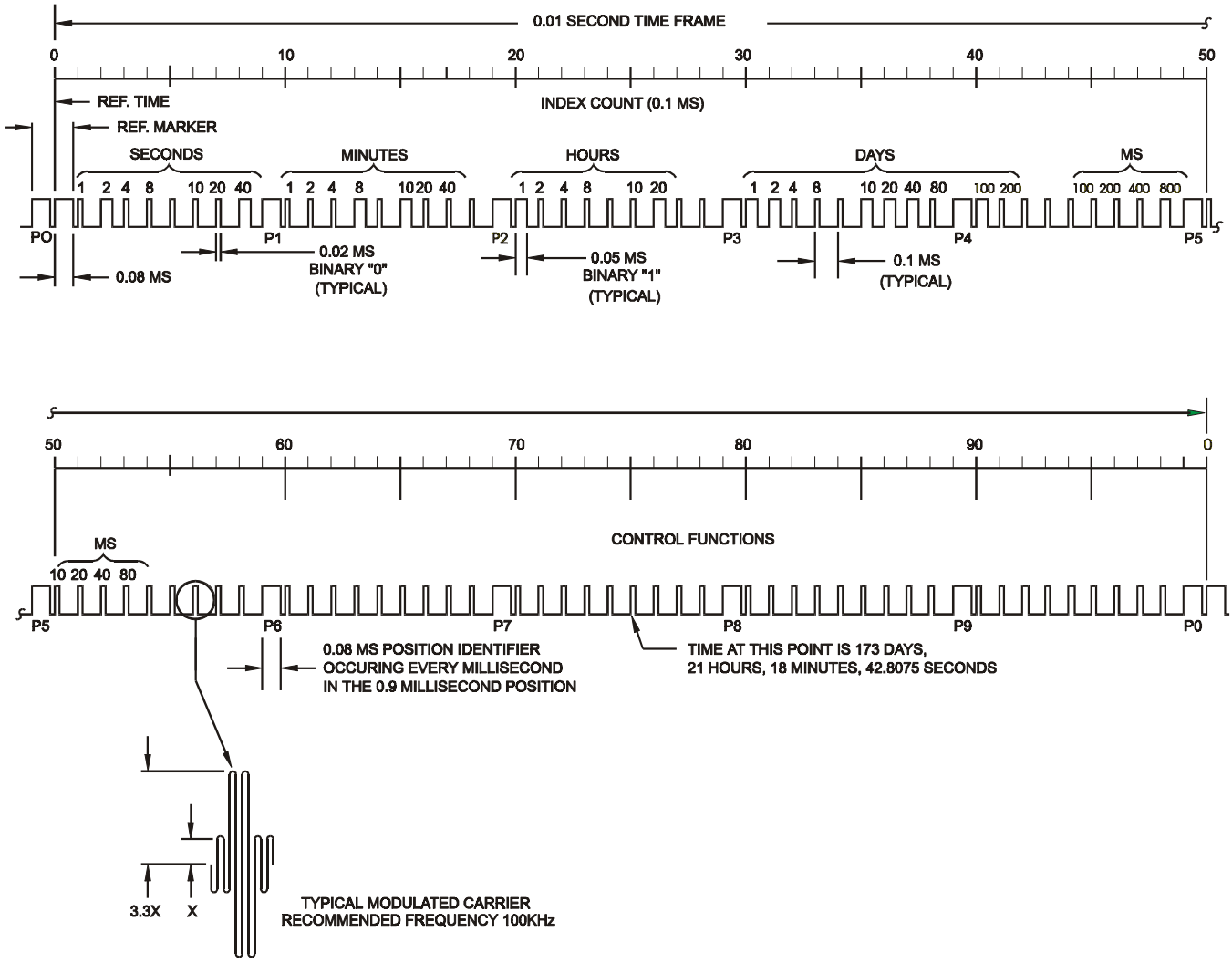
First five 100 millisecond time periods of each one-seond frame, control functions (when used) appear in the next three 100 millisecond time periods, and the SBTOD data appear in the last two 100 ms time periods. Binary ZEROs and fill bits are 2 ms long, and Binary ONEs are 5 ms long. Modificaitons to the code include deletion of the days data, deletion of the SBTOD data, and deletion of both of these data groups

IRIG E CODE FORMAT



The IRIG E time code has a ten-second time frame and contains BCD time information representing tens-of-seconds, minutes, hours, and days. Provisions are made in the format for control functions. An 0.08 second (80ms) frame reference marker appears during the first 100 milliseconds of each frame, and .08 second (80) ms position identifiers appear during the 900th millisecond of each one-second period. The BCD time data appear in te first five one second periods of each ten-second frame and control functions (when used) appear in the next three one-second time periods. Binary ZEROs and fill bits are 0.02 seconds (20 ms) long, and binary ONEs are 0.05 seconds (50 ms) long.

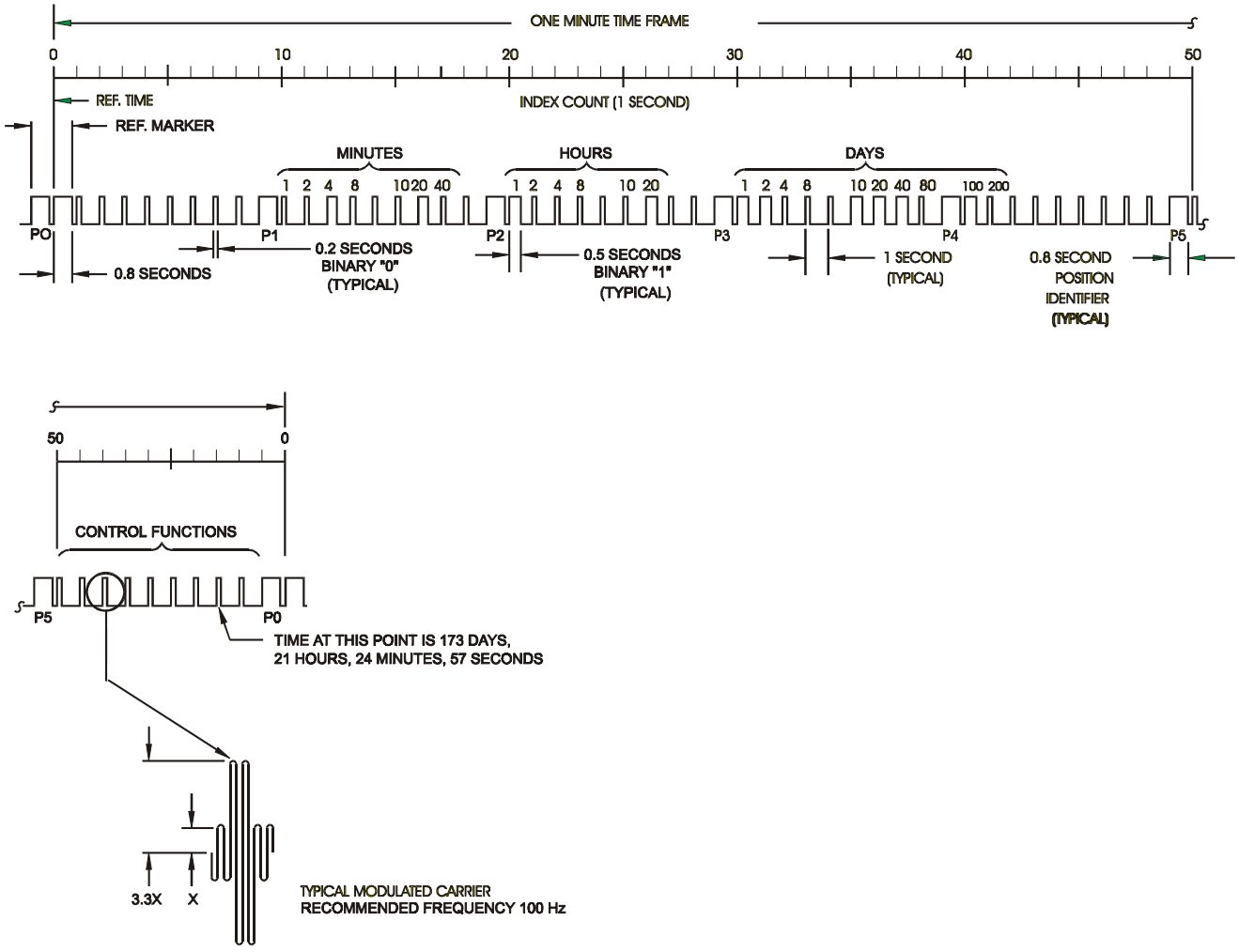
IRIG G CODE FORMAT



The IRIG G time code has an 0.01 second time frame and contains BCD time information representing 0.01 seconds, 0.1 seconds, seconds, minutes, hours and days. Provisions are made in the format for control functions. An 0.05-ms (80 μsec) frame reference marker appears during the first tenth-millisecond of each frame, and 0.08-ms (80 μsec) position identifiers appear

During the last tenth-millisecond of each one millisecond period. The BCD time data appear in the first six one millisecond time periods, and the control functions (when used) appear in the next two one millisecond time periods. Binary ZEROs and fill bits are 0.02 ms (20 μsec) long and binary ONEs are 0.05 ms (50 μsec) long.

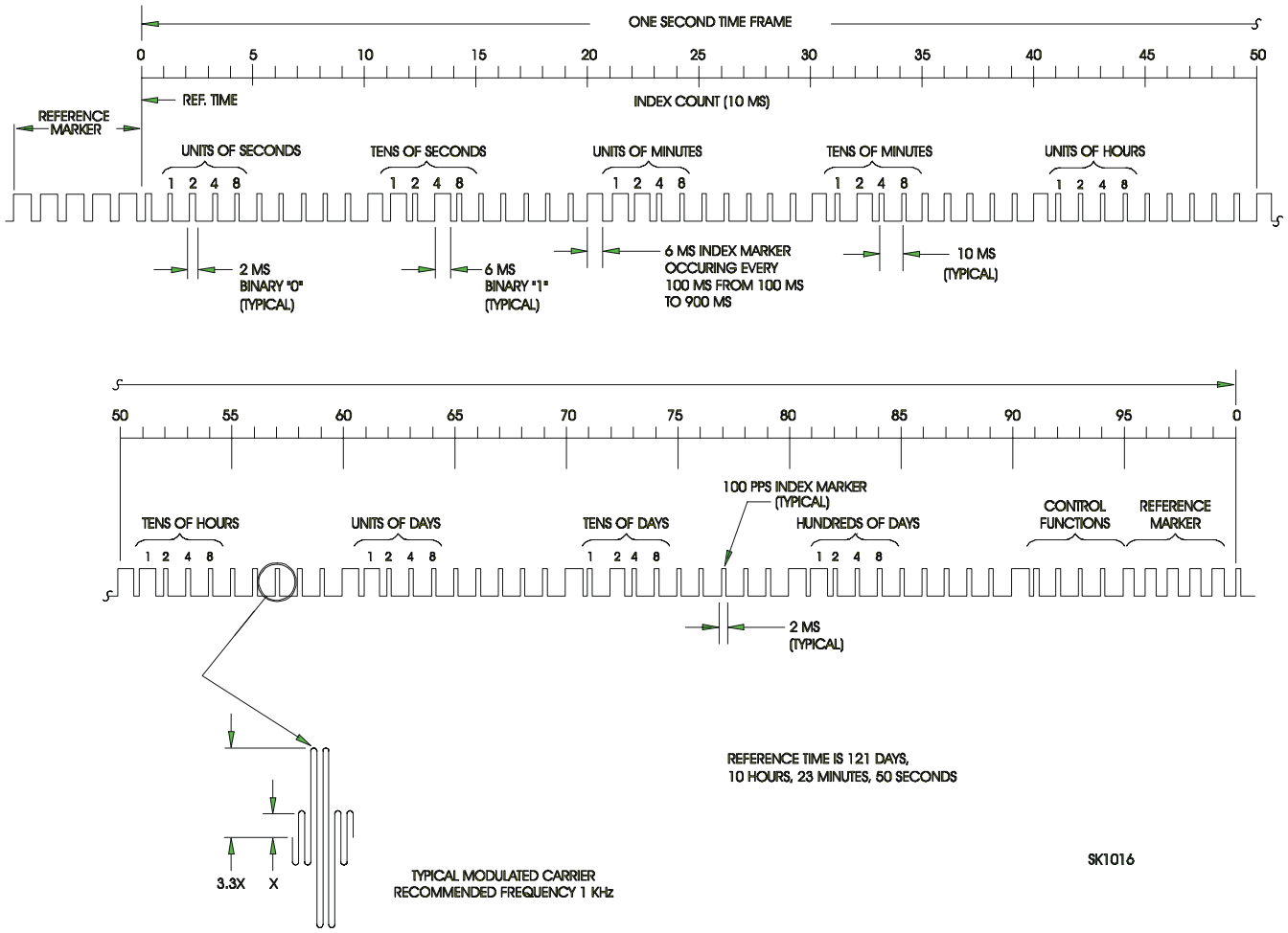
IRIG H CODE FORMATS



The IRIG H time code has a one-minute time frame and contains BCD time information representing minutes, hours, and days. Provisions are made in the code format for control functions. An 0.8 second (800 ms) position identifier appears during the ninth second of each ten-second period. The BCD time data appear

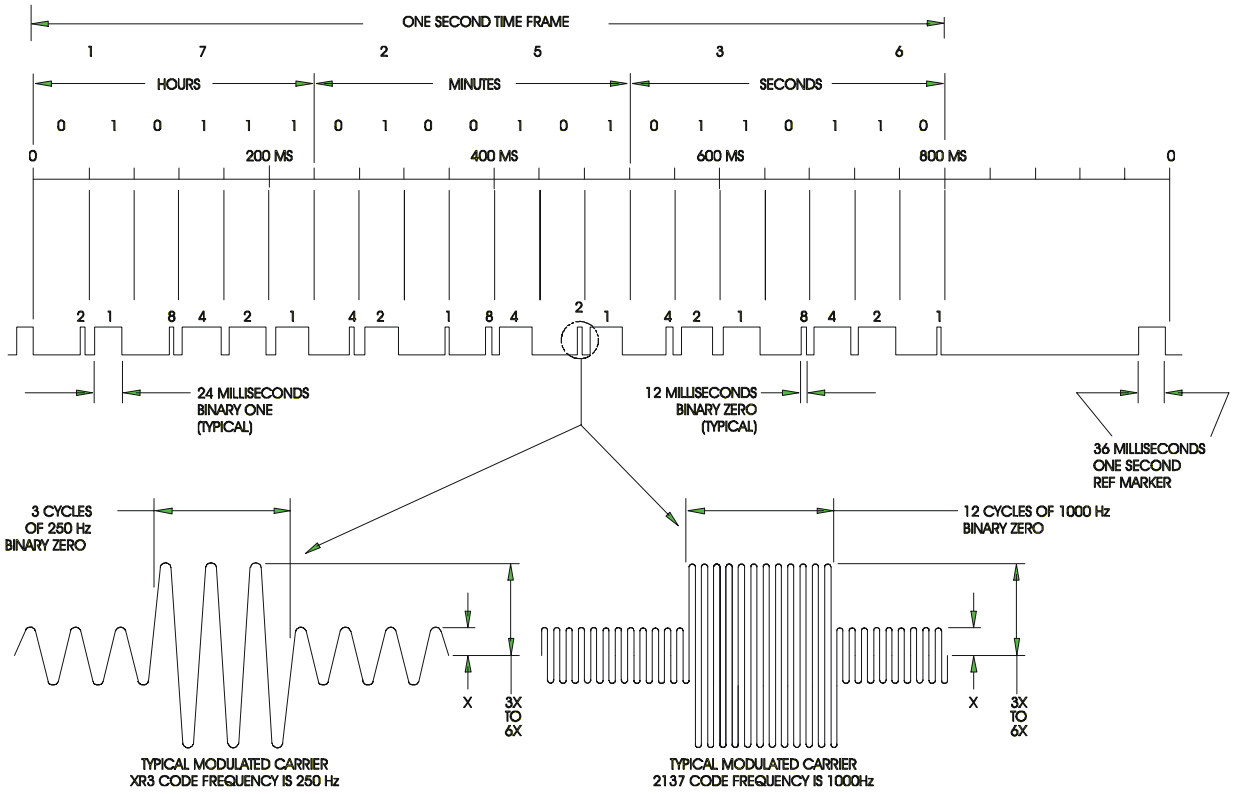
In the second through fifth ten second periods, and control functions (when used) appear during the sixth tne second period. Binary ZEROs and fill bits are 0.2 seconds (200 milliseconds) long and binary ONEs are 0.5 seconds (500 milliseconds) long. IRIG H replaces IRIG C as the standard one-minute format.

NASA 36-BIT FORMAT



The NASA 36-Bit code has a one second time frame. BCD time information representing days, hours, minutes, and seconds is encoded in each frame. Four control function bits may also be encoded. Binary ZEROs are two milliseconds wide and binary ONEs are five milliseconds wide. The frame reference marker comprised five ONEs followed by a ZERO at the beginning of the next frame. Position identifiers (binary ONEs) appear during the first ten milliseconds of each 100 millisecodn period (except at 00 time). The four BCD bits representing each time digit appear LSB first during the forty milliseconds after the frame reference marker and position identifers, with the four control function bits appearing after the last position identifier (at 900 milliseconds).

XR3/2137 CODE FORMAT



The XR3/2137 time code has a one second time frame. The code contains BCD time information representing hours, minutes, and seconds. Each frame has 20 time bits, a gap with a length equal to four bit periods, and a frame reference marker. Each bit period is a 40-ms long. A binary ZERO is 12 ms wide, a binary ONE is 24 ms wide, and the reference marker is 36 ms wide. All of these bits are placed at the end of their repective bit periods. The

XR3 code has a 250 Hz carrier: binary ZEROs have seven normal cycles followed by three boosted cycles, binary ONEs have four normal cycles followed by six boosted cycles, and the reference marker has one normal cycle followed by nine boosted cycles. The 2137 code has a 1000 Hz carrier: binary ZEROs binary ONEs, and reference markers have their last 12, 24, and 36 cycles, respectively, boosted.