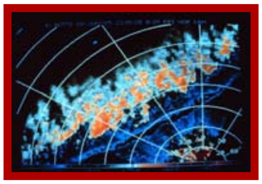


User Manual

Models TPRO-PC and TSAT-PC

Synchronizable Timecode Generator with 16-bit Zero Latency and ISA Bus Interface

and

GPS-based Synchronizable Timecode Generator with 16-bit Zero Latency and ISA Bus Interface

Edition 3.3

Technical Support

Our engineering team is available to answer your questions from 8:30 a.m. to 5:00 p.m. Monday through Friday, U.S. Eastern Time.

Should you need technical assistance, the back cover of this manual gives full information on how to contact us.

NOTICE

THIS PRODUCT IS NOT AUTHORIZED FOR USE AS A CRITICAL COMPONENT IN LIFE-SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PRESIDENT OF DSPCON, INC.

MODEL TPRO-PC and TSAT-PC USER MANUAL
Edition 3.3—October 2004

A Publication of
KSI, Inc.®

DOCUMENT REVISION HISTORY

Revision Date	Revision No.	Revised Section(s)	Comments/Notes
October 2004	3.3	All	Completely reformatted to reflect new design. New contact information added. Language errors corrected; no substantive content modified.

Contents

Chapter 1

Overview

This manual provides comprehensive information on the system architecture, specifications for, and operation of, the KSI Model TPRO-PC and Model TSAT-PC Synchronizable Time Code Generators.

Product Description

The TPRO–PC is a precision clock that automatically synchronizes to standardized time code signals (or, for the TSAT-PC configuration, to the GPS satellite system), and can be read from a host PC bus processor. It is used for time-tagging in 16-bit and 32-bit ISA bus systems. Time-tagging can be caused by reading four 16-bit time registers or by a logic pulse from the outside world (an "external event"). Typically, the 16-bit reads are used for software-initiated time-tagging, (for example time-tagging the time a block of data transfer starts or completes). Reading the first 16-bit time register (for units of microseconds through units of milliseconds) also freezes the tens of milliseconds through hundreds of days.

TPRO-PC

TSAT-PC

External events are usually used for time-tagging hardware-related events (for example, the exact time of a radar transmit pulse) because the added error of variation in software delays degrades the accuracy of a software initiated time-tag. The time-tag data for external events is transferred to the host as a sequence of 10 bytes through a byte-wide hardware FIFO.

Inputs to the TPRO-PC are modulated timecode (or GPS receiver signals for TSAT-PC), host commands (not usually needed) and external event pulses as required for the application.

Outputs are modulated IRIG-B timecode, and a "heartbeat" pulse rate that can be specified by the user program. The TPRO-PC can generate interrupts to the host system as enabled and selected by the host system. Interrupt sources include the heartbeat, external event data FIFO not empty, and start or stop time match.

The clock automatically synchronizes to specified timecode signals. Status bits advise the host of synchronization status. If there is no synchronization source, the TPRO-PC starts counting at 000 days/00 seconds at power-on. The clock time can be set by operator commands.

Blank Page

Chapter 2

Specifications

Table 2.1—TPRO-PC and TSAT-PC Board Specifications	
Physical Dimensions	167.7 mm (6.605 in) X 114.3mm (4.5 in) (equiv.: AT half length)
ISA bus Type	16-bit (AT bus)
Power	+5V ±5% 425 mA maximum +12V ±5% TPRO-PC: 225 mA maximum TSAT-PC: 450 mA maximum –12V± 5% 50 mA maximum
Fabrication	1.68mm ± .2mm (.062 in ± .008 in) FR4, 4-layer with ground and +5V power planes White epoxy component nomenclature
Temperature	0 to 55C operating, -40C to 85C storage
Humidity	0 to 99% non-condensing
Inputs	
Code Input Connector	J1 DB15 Pins 1, 2 and J2 Isolated BNC
Code Input Types	Modulated IRIG-A, IRIG-B, and NASA36.
Code Input Amplitude	100mV to 10V pk/pk
Code Input Modulation Ratio	2:1 to 4:1
Code Input Frequency Error	100PPM maximum (not suitable for tape playback)
Code Input Impedance	>10K
Code Input Common Mode Voltage	200V maximum without damage
External Event Pulse Input	Rising edge TTL
External Event Pulse Connector	J1 DB15S Pin 4
GPS Receiver Input	Compatible with KSI-furnished GPS receiver
GPS Receiver Input (TSAT-PC)	Compatible with KSI-furnished GPS receiver
1PPS (option M only) Input	+30V maximum positive edge, +5 V minimum
Outputs	
Modulated IRIG-B Output Connector	J1 DB15 Pin 9 (Pin 5,7 ground) and J2 BNC
Modulated IRIG-B Output Amplitude	3V±10% pk/pk into 600 ohm load
Modulated IRIG-B Output Source Impedance	300 ohm maximum
Heartbeat	TTL pulse
Output Voltage	3.8V min., 16.0V max (high) 0.4 V max at -6mA (low)
Wave Shape	Pulse or Square wave (Programmable)
Pulse Width	150 nS min, 450 nS max
Pulse Polarity	Negative
Square wave	45% to 55%
Timing	Falling edge on-time (Pulse or Square wave)
Range	1.0 uS - 21.845 mS in 1 uS steps
Power-on Default Rate	100 PPS (pulse)

Table 2.1—TPRO-PC and TSAT-PC Board Specifications	
Match Output	TTL
Output Voltage	3.8 V min at 6 mA (high) 0.4 V max at -6 mA (low)
Setability	1 µS
Options	
–M –HB1PPS –LOR1	Synchronizes to 1 PPS input instead of timecode heartbeat output range 500 Hz - 0.015259 Hz (with 1PPS output as factory default) Three outputs on 3 Pin header (1 MHz, 1 PPS, GND)

Table 2.2—TPRO-PC and TSAT-PC Indicators	
Diagnostic (Red LED)	Flashes short/long patterns for status

Table 2.3—GPS Receiver/Antenna Specifications	
Description	GPS Antenna and Receiver
Manufacturer	Trimble Navigation
Size	5.8" (147 mm) Diameter, 3.9" (100 mm) Height
Weight	13.4 oz (0.38 kg)
Color	White
Mounting Threads	1" diameter, 14 turns/inch, straight (not tapered) Will accept .75" galvanized water pipe for mast
Operating Frequency	1575.42 MHz
Operating Temperature	–30° C to +70° C
Storage Temperature	–55° C to +100° C
Operating Humidity	95% R.H., non-condensing
Waterproof	Submersion to 1 meter
Altitude	–400 m to +18,000 m
Accuracy Position Velocity Time	25 m SEP without SA m/s without SA UTC ± 1 uS (nominal)
Power Dissipation	2.5 Watts continuous
Acquisition Time	<15 minutes (5 to 8 minutes typical)

Blank Page

Chapter 3

Input/Output Pin Assignments

J1 Connector Pinout for TPRO-PC (only)

Table 3.1—TPRO-PC J1 Connector Pinout

Pin	Signal
1	Timecode input +
2	Timecode input (–)
3	Do Not Connect
4	External event (Time Tag) Input (TTL)
5	Ground
6	Heartbeat output (TTL)
7	Ground
8	Match time output (TTL)
9	IRIG-B output (1 kHz sine wave)
10–13	Do Not Connect
14	3.0 MHz reference output
15	External one pulse-per-second sync input (1PPS) (option "–M" only)

The Timecode Input can be applied either to Pins 1 and 2 of J1 or to the J2 BNC connector (this is the connector located closest to J1). The Timecode Input is a differential signal (i.e., (–) Timecode Input (–) is isolated from ground). It is acceptable to connect Timecode Input (–) to ground.

The IRIG-B output can be taken either from pins 7 and 9 of J1 or from the J3 BNC connector (this is the connector located farthest from J1). The IRIG-B output is a single-ended signal (i.e., - it is referenced to ground).

J1 Connector Pinout for TSAT-PC (only)

The GPS antenna cable plugs into the 15-pin J1 connector. Additionally, some pins may interface to the user's equipment. It is the operator's responsibility to modify the antenna cable connector, if necessary, to access the "User Connection" pins.

Table 3.2—TPRO-PC J1 Connector Pinout

J1 Pin	Antenna Pin	Antenna Connection	Antenna Color	User Connection
1	—	—	—	Do not connect
2	—	—	—	Do not connect
3	1	+12 Volts	Red	—
4	—	—	—	Event trigger input
5	9	Ground	Black	Ground
6	—	—	—	Heartbeat output
7	—	—	—	—
8	—	Ground	Shield	Match time output
9	11	1PPS+	Orange/White	—
10	5	RXD+	Yellow	—
11	4	RXD–	Brown	—
12	3	TXD+	Orange	—
13	2	TXD-	Violet	—
14	12	1PPS-	Black/White	—
15	8	Battery	Green	—

Twist the antenna cable wires together as follows:

Red with **Black** .... (Pins 3 and 5)
Orange with **Violet** .... (Pins 12 and 13)
Yellow with **Brown** .... (Pins 10 and 11)
Green with **Blue** .... (Pins 15 and None)
Orange/**White** with **Black**/**White** .... (Pins 9 and 14)

Note that the following antenna cable wires are connected at the **antenna end**, but **not** at J1:

Antenna	Pin Color
6	White
7	Gray
10	Blue

IRIG-B output is provided on BNC connector J3 (the connector farthest from J1).

If board is connected to GPS antenna, do not connect anything to the BNC connector closest to J1.

The pigtail on the 15-pin end of the cable is used for custom options (if any).

Chapter 4

Configuration

I/O Base Address

Configured by Header P3. For each configurable address bit (A11 through A4) there is a jumper position marked on P3 above two header pins of P3. If a jumper connects the two pins for a given address bit, then that bit must be a '0' (low) for the board to recognize the address. If the two pins for a given address bit are not connected, then that address bit must be a '1' (high) for the board to recognize the address. For example, the standard factory base address configuration is 300H. This means that address bits 8 and 9 should be set to '1' and address bits 11, 10, 7, 6, 5 and 4 should be set to '0'. So, the standard factory configuration has jumpers connected in address positions 11, 10, 7, 6, 5 and 4, and not connected in 9 and 8.

Interrupt Request Level

Configured by P2. There should only be one jumper connected on P2 for the user-selected interrupt request level. The factory-configured level is IRQ10.

External Event-Enable

Configured by P4. The operator should disable external events by connecting P4 Pin 'X' to P4 Pin 'D' unless they have a source of external event pulses connected to J1 Pin 4. To enable external events connect P4 Pin X to P4 Pin E instead of P4 Pin D.

Chapter 5

Installation

Before Installing

Caution

Before installing the TPRO-PC in your system, record the serial number, the PWB Revision Level (for example, A1 or A), the firmware version labeled on EPROM U14 (for example, 99204223), and the version labels on FPGA devices U19 (for example, 4302A).

This information is required for telephone support of the product. Please make the record known to anyone who may require support.

Shut down the system, and install the TPRO-PC board in a 16-bit slot. The TPRO-PC has inputs and outputs that should be connected for the users requirements. There are up to three inputs from the external world: input timecode (if used), a TTL external event pulse (if used), and 1 PPS TTL time pulse (if used).

Timecode input to the board is connected at J1 (center Pin or "**+**" side to Pin 1, shield or "**–**" side to Pin 2), or to BNC connector J2. For the TPRO-PC, if input timecode or 1PPS input (Option –M) is not provided, the board will provide "local" timing starting at 000 days, 00 hours, 00 minutes, 00 seconds.

TTL external event pulses are connected at J1. The external event pulses can come from external user equipment, or pulse outputs from the TPRO-PC at J1 can be looped back and used as external event inputs with a simple jumper connection.

If the 1 PPS option (Option –M) is to be used, J1 is used for 1PPS input. The TSAT-PC is provided with a short adapter cable which mates with J1 at one end and with 3 antenna cable connectors at the other end. Connect all the TSAT-PC connectors. Custom factory configurations will have a manual addendum detailing non-standard I/O configuration.

TSAT-PC only

Install the combined antenna/GPS receiver unit at a location with 360° view to within 10° above the horizon. Attach the coaxial 1 PPS connector (TNC) and the 4-conductor serial connector to the antenna unit and route both 100-foot cables to the PC bus computer location.

Start the system.

Operation

The TPRO-PC (and TSAT-PC) operates automatically as soon as the host computer system performs the power-on reset. To change the operating parameters or read data, consult Chapter Seven.

LED Status

An on-board LED (LED1) flashes a status pattern to assist in diagnosing installation errors. The pattern is a sequence of short and long flashes. Trailing short flashes are deleted so the status pattern can repeat more frequently. Table 5.1 details these patterns.

Table 5.1—LED Flash Patterns

Flash Position	Meaning of Short (cleared) Flash	Meaning of Long (set) Flash
1	GPS satellite receiver being used for time reference	Modulated timecode input being used for time reference
2	Synchronization to better than 5μsec verified with last 5 seconds	Synchronization to better than 5μsec not verified within last 5 seconds
3	1PPS Pulse from GPS satellite receiver is OK	1 PPS pulse from GPS satellite receiver is bad. In applications with modulated timecode inputs only, this status bit will always be set.
4	GPS satellite receiver serial data being received OK	No serial data being received from GPS satellite receiver. In applications with modulated timecode inputs only, this status bit will always be set.
5	GPS satellite receiver is tracking enough satellites for accurate UTC time.	GPS satellite receiver is not tracking enough satellites for accurate UTC time. In applications with modulated timecode inputs only, this status bit will always be set.
6	Timecode input being decoded	Timecode input not decodable. In applications without modulated timecode inputs, this status bit will always be set.
7	If using 1PPS, set NEXT 1PPS TIME command sequence has been performed. Used for Option –M only	Waiting for "SET NEXT 1PPS TIME" command. Used for Option –M only

Propagation Delay Adjustment

Depending on the actual absolute time accuracy required in the user's application, the TPRO-PC can be commanded to correct for the time required for the timecode signal to travel the distance between the timecode source and the PC bus computer. This delay time, know as "propagation delay time"', is approximately 3.3 microseconds (μs) per kilometer for radio timecode transmission, and approximately 5 μs per kilometer for copper wire transmission. Also, a time delay on the order of 25 μs may be caused by small phase shifts due to reactances at the timecode input. To correct for propagation delay, the TPRO-PC can use a propagation delay correction setting ranging between –1000 (because sometimes sources transmit early) and +8999 μs. The default setting is 0 μs after the TPRO-PC is reset at power-on, or after a RESET command from the operator. The operator can change the setting by a sequence of programmed commands to the command register on the TPRO-PC.

Note

If using the TSAT-PC with a valid GPS signal or 1PPS input (Option – M), propagation delay settings are neither needed nor used.

If absolute microsecond accuracy is required, it is necessary to calibrate the TPRO-PC when it is installed; calibrate for propagation delay correction by comparing the on-board clock time with a portable reference (a 1 PPS GPS pulse is good for this). The appropriate propagation delay correction setting is converged on rapidly by trial and error. This setting does not need to be changed unless the location or cabling of the installation is changed. In most cases, determining the correct propagation delay setting needs the help of a special user program that lets the operator experiment with various propagation delay settings while zeroing in on the correct setting. The normal user program should be capable of using the correct setting once it is determined.

Blank Page

Chapter 6

Register Assignments

Register Assignments

Table 6.1—Register Assignments			
Offset from Base Address	**Bits**	**Read Usage**	**Write Usage**
0	7–0	FIFO data	n/u
1	7	FIFO Output Ready Interrupt Enable	FIFO Output Ready Interrupt Enable
———	6	MATCH Flag Interrupt Enable	MATCH Flag Interrupt Enable
———	5	HEARTBEAT Flag Interrupt Enable	HEARTBEAT Flag Interrupt Enable
———	4	HEARTBEAT Flag	1=Clear flag 0=No change
———	3	MATCH Flag	1=Clear flag 0=No change
———	2	In-sync Flag	———
———	1	Time Code Input Decodable Flag	———
———	0	FIFO Empty Flag	———
2	7–0	n/u	Command Port
3	7–0	n/u	Simulate external event (any data pattern)
4	7–0	n/u	Reset FIFO and Release Microcomputer Reset
5		n/u	n/u
6	7–0	n/u	Assert Microcomputer Reset
8	15–0 (WORD)	Time (Days)	n/u
A	15–0 (WORD)	Time (hours and minutes)	n/u
C	15–0 (WORD)	Time (seconds & 100s, 10s of milliseconds	n/u
E	15–0 (WORD)	Time ($10^3\mu$s–$10^0\mu$s)	n/u

Data Organization

Table 6.2—Data Organization (Base Address + Offset 8)				
Bits	15 12	11 8	7 4	3 0
Data	0	10^2days BCD	10 dayBCD	1 dayBCD

Table 6.3—16-bit Word Data Organization (Base Address + Offset A)				
Bits	15 12	11 8	7 4	3 0
Data	10 hour BCD	1 hour BCD	10 minute BCD	1 minute BCD

Table 6.4— Data Organization (Base Address + Offset C)				
Bits	15 12	11 8	7 4	3 0
Data	10 second BCD	1 second BCD	10^5 µs BCD	10^4 µs BCD

Table 6.5— Data Organization (Base Address + Offset E)				
Bits	15 12	11 8	7 4	3 0
Data	10^3 µs BCD	10^2 µs BCD	10^1 µs BCD	10^0 µs BCD

16-bit Time Tagging

To measure the instantaneous time, a program first performs a word I/O read from the low-order, 16-bit time register at Base Address + E. When the low-order register is read, the 3 high-order time words are stored concurrently in an internal register in the TPRO-PC. They will be stored until the low-order time register is read again. So, whenever the high-order registers are read, the time that is returned is the time at which the low-order register was last read.

External Event Time Tagging

When an external event logic pulse occurs, the TPRO-PC copies 10 bytes of time data into the on-board FIFO. It takes approximately 50 µs until the last of the 10 bytes is copied into the FIFO. The transfer time fluctuates because the microcomputer may be interrupted while putting data in the FIFO. The time data is accurate to the exact microsecond at which the event occurred, and the accuracy is not affected by the transfer time. The operator can simulate the occurrence of an external event pulse by doing a byte I/O write (any data value) to Base Address + 3. The host program reads captured time information (100s of days through units of µs…a total of 10 bytes) sequentially from the FIFO through the TPRO-PC bus interface. The host testing the FIFO EMPTY bit (Bit 0) performs handshaking of the TPRO-PC status register (base+1) for "1" *before* each byte is read from the FIFO output (base+0). It is important that the operator empty the FIFO of stale data when their program is initialized. This can be done by continuously reading the FIFO until the FIFO EMPTY status bit is "0" for at least 100 µs. If the FIFO is full, this could take approximately 512 reads. The data format for FIFO time stamps is:

Table 6.6—FIFO Time Stamp Data Format

Byte	High Nibble	Low Nibble
0	not defined	not defined
1	not defined	not defined
2	0	10^2 days
3	10^1 days	10^0 days
4	10^1 hours	10^0 hours
5	10^1 minutes	10^0 minutes
6	10^1 seconds	10^0 seconds
7	10^5 µseconds	10^4 µseconds
8	10^3 µseconds	10^2 µseconds
9	10^1 µseconds	10^0 µseconds

Chapter 7

Interrupts

Introduction

The TPRO-PC can be programmed to request interrupts at the IRQ level configured by P2 upon selectable conditions. Interrupts can be enabled by writing a "1" into the corresponding interrupt enable bit in Base Address+1.

Table 7.1—Enabling Interrupts

Interrupt Condition	Condition Asserted By	User Action To De-assert Condition
FIFO Not Empty	External event or user command causes on board microprocessor to write data into FIFO	I/O Read data from FIFO until FIFO empty or Write to Base +4
Match Flag Set	User programmed START or STOP MATCH time is detected	I/O Write to base +1 with bit 3 =1
Heartbeat Flag Set	Periodic heartbeat pulse has occurred	I/O Write to base+1 with bit 4=1

Commands

Commands are sent to the TPRO-PC command register (Base Address+2) as a sequence of bytes. All commands should be spaced at least 100µs apart so the TPRO-PC firmware has sufficient time to handle each command. Without any commands, on cold or warm start the TPRO-PC will automatically synchronize to modulated timecode input or (for TSAT-PC) to a valid GPS receiver input.

There are commands for:

- Setting time
- Setting propagation delay correction for modulated code input
- Disabling synchronization to input

- Re-enabling synchronization to input
- Simulating power-on reset of TPRO-PC firmware
- Reading TSAT-PC GPS antenna latitude
- Reading TSAT-PC GPS longitude
- Reading TSAT-PC GPS altitude
- Reading TSAT-PC GPS speed/course over ground # satellites visible, # satellites tracked
- Reading TSAT-PC GPS dilution of precision multipliers

Table 7.2—List of TPRO-PC Commands

Command	High Nibble	Low Nibble
SET TIME SET REGISTER 10^3 µs	0	0–9
SET TIME SET REGISTER 10^2 µs	1	0–9
SET TIME SET REGISTER 10^1 µs	2	0–9
SET TIME SET REGISTER 10^0 µs	3	0–9
SET NEXT 1PPS TIME	4	C
ENABLE RESYNC	4	D
DISABLE RESYNC	4	E
RESET TPRO-PC FIRMWARE	4	F
SET TIME SET REGISTER 10^2 DAYS	5	0–3
REPORT DOPS	5	B
REPORT COG/SATS	5	C
REPORT ALTITUDE	5	D
REPORT LONGITUDE	5	E
REPORT LATITUDE	5	F
SET TIME SET REGISTER 10^1 DAYS	6	0–9
SET TIME SET REGISTER 10^0 DAYS	7	0–9
SET TIME SET REGISTER 10^1 HOURS	8	0–2
SET TIME SET REGISTER 10^0 HOURS	9	0–9
SET TIME SET REGISTER 10^1 MINUTES (10^1 minutes also used for 16^3 heartbeat counts)	A	0–F
SET TIME SET REGISTER 10^0 MINUTES (10^0 minutes also used for 16^2 heartbeat counts)	B	0–F
SET TIME SET REGISTER 10^1 SECONDS (10^1 seconds also used for 16^1 heartbeat counts)	C	0–F
SET TIME SET REGISTER 10^0 SECONDS (10^0 seconds also used for 16^0 heartbeat counts)	D	0–F

Table 7.2—List of TPRO-PC Commands		
Command	**High Nibble**	**Low Nibble**
COPY TIME SET REGISTER TO CLOCK TIME	E	0
COPY TIME SET REGISTER TO START/STOP HOLD	E	1
COPY START/STOP HOLD TO START MATCH REGISTER (DAYS, SECONDS) AND TIME SET REGISTER (HOURS, MINUTES, SECONDS) TO START µS	E	2
COPY START/STOP HOLD TO STOP MATCH REGISTER (DAYS, SECONDS) AND TIME SET REGISTER (HOURS, MINUTES, SECONDS) TO STOP µS	E	3
CLEAR MATCH FLAG	E	4
COPY TIME SET REGISTER (MINUTES, SECONDS) TO HEARTBEAT DIVIDE PULSE GENERATE (no forced jam)	E	5
COPY TIME SET REGISTER (MINUTES, SECONDS) TO HEARTBEAT DIVIDE PULSE GENERATE (with forced jam)	E	6
COPY TIME SET REGISTER (MINUTES, SECONDS) TO HEARTBEAT DIVIDE SQUARE WAVE GENERATE (no forced jam)	E	7
COPY TIME SET REGISTER (MINUTES, SECONDS) TO HEARTBEAT DIVIDE SQUARE WAVE GENERATE (with forced jam)	E	8
REPORT FIRMWARE ID IN FIFO	E	9
CLEAR SET TIME REGISTER	F	0

Setting Time

The operator can set the TPRO-PC to *use* an input reference for applications where the input reference is *not used*. If the operator does not preset a time, a default preset of 0 days through seconds is used. The operator must disable input synchronization before setting time, or the TPRO-PC firmware will just switch back from the commanded time to the input time as soon as the input is validated.

The sequence of commands for setting time is:

Send CLEAR TIME SET REGISTER command (F0h)

Send SET TIME SET REGISTER commands (5<bcd> through 8<BCD>) for 10^2 days through 10^0 seconds in any order

Send COPY TIME SET REGISTER command (E0h)

At least 100 µs should be allowed between sending each command byte. For example, to set time to 123 days 01 hours 23 minutes 45 seconds, send the sequence F0 51 62 73 80 91 A2 B3 C4 D5 E0. As each SET TIME SET REGISTER command is sent, the corresponding digit is set in an internal time set buffer in the TPRO-PC. When the COPY TIME SET REGISTER command (E0) is received, the time set buffer is copied to the clock.

Setting Propagation Delay Correction

The operator can set the compensation for propagation delay between the timecode source and the TPRO-PC location. On cold or warm start, the TPRO-PC assumes a propagation delay correction of 0 µs. The sequence of commands for setting propagation delay correction is:

Send CLEAR TIME SET REGISTER command (F0h)

Send SET TIME SET REGISTER commands (0<bcd> to 3<bcd>) for 10#µs, 10#µs, 10#µs,
10#µs, digits in any order

Send SET COPY TIME SET REGISTER command (E0h)

Remember to delay at least 100 µs between sending each command byte. For example, to set a propagation delay correction value of 1234 µs, send the sequence F0 31 22 13 04 E0. Some central timing facilities transmit timecodes advanced by 1 millisecond. To correct for the advanced timecode, it may be desirable to use a negative propagation delay correction setting. Propagation delay settings of 9000µs to 9999µs are used to set NEGATIVE propagation delay correction values of –1000µs ec to –1µs, respectively. For example, to set –500 µs, use a setting of 9500 µs. So, the propagation delay correction range of the TPRO-PC is –1000 µs to +8999 µs. The TPRO-PC can distinguish between COPY TIME SET commands used for setting propagation delay and COPY TIME SET commands used for setting time by noting that different intervening commands have occurred after the CLEAR TIME SET REGISTER command.

Disabling Synchronization to Input

To prevent the TPRO-PC from synchronizing its time to input signals, send the DISABLE RESYNC (4Eh) command to the TPRO-PC. This command is normally used when the TPRO-PC time is set using the Set Generation Time procedure.

Re-enabling Synchronization to Input

To release the TPRO-PC from a DISABLE RESYNC command, send the ENABLE RESYNC (4Dh) command to the TPRO-PC. The cold or warm start condition for the TPRO-PC is resync enabled.

Simulating Power-on Reset of TPRO-PC Firmware

The RESET (4Fh) command to the TPRO-PC resets the on-board Z80 microcomputer.

Programming the MATCH (Start/Stop) Output

For Pin 8

This output goes high at the start time, and low at the stop time. The MATCH interrupt occurs at the start time. The MATCH flag goes true at the start time and remains true until the operator clears it with a software command.

First, disable the Match interrupt by ANDing BF to Base+1. Put the days-seconds into the Time Set Register by writing to Base+2:

F0	; Clear time-set register
51 62 72 80 91 A2 B3 C4 D5	; 123:01:23:45 day-second
E1	; Copy into Hold register

Then, put 100s of mS through 1s of uS into the HH:MM:SS part of time register by writing to Base+2:

81 92 A3 B4 C5 D6 ; xx.123456 seconds

This has specified a time of 123:01:23:45.123456

Write either E2 (load start time) or E3 (load stop time) to Base+2. (Note that the E2 or E3 command must be sent at least 250 mS before the commanded time occurs.)

Enable Match interrupt (if desired) by ORing hex 40 to Base+1.

The board can also be polled to determine if the start time has occurred. Read the value at Base+1, then AND this value with hex 08. If the result (MATCH flag) is non-zero (i.e., if bit 3 is set) the start time has occurred. It is necessary to clear this flag (by writing a one to bit 3 at Base+1) before the next start time can be detected. (Note that the actual value written must take into account the other bits in this register.

The MATCH flag may be set during power-on reset. This is normal.

Programming the Heartbeat Output

(Not applicable for boards with Option –HB1PPS)

The heartbeat can be programmed to be either a pulse or a square wave. The specified rate must be an exact multiple of 1.000 uS. The range of programmable rates is:

Minimum Rate (lowest frequency)........21.845 mS (45.7771 Hz)
Maximum Rate (highest frequency)........1.000 uS (1.000 MHz)
Pulse Width (time low, pulse mode only)........150 nS min, 450 nS max

To specify the rate (or frequency), compute the divide number N as follows. Note that N must be exactly divisible by 3, meaning that the specified period must be an exact multiple of 1.000 uS.

To specify a period for either a pulse or a square wave, compute N as follows:

N = 3t / 10-6 .... "t" is the period in seconds

To specify a frequency for either a pulse or square wave, compute N as follows:

N = 3 * 106 / F .... "F" is the frequency in Hertz

Not all values of N are acceptable. Verify that the computed value is evenly divisible by 3 and that it is in the range of 3 to 65,535, inclusive.

Convert N into hexadecimal (base 16) notation. For example, if the desired output frequency is 10 kHz, N=300 (base 10), converted to hexadecimal notation yields N=012C (base 16). Send the hexadecimal number to the card by outputting the following sequence of bytes to the command register (base address +2). Note that the computed number appears in the least significant nibble of these bytes:

A0 B1 C2 DC ; this loads 012C into the "heartbeat counts" register

Finally, determine whether the output should begin using the new divide number immediately ("forced jam") or at the end of the next period ("no forced jam"). Then send the appropriate byte to the command register, as follows:

Pulse, starts at end of next period E5
Pulse, starts immediately E6
Square wave, starts at end of next period E7
Square wave, starts immediately E8

To use the heartbeat to generate a periodic interrupt, first specify the frequency as described above (pulse or square wave), then enable the interrupt by ORing hex 20 to Base+1. To disable this interrupt, AND hex DF to Base+1 (Note that this operation may affect other bits in this register).

Software can also poll the board to determine if a heartbeat has occurred. Read Base+1, then AND this value with hex 10. If the result is non-zero (i.e., if bit 4 is set) then a heartbeat has occurred. It is necessary to reset this flag before detecting the next heartbeat. Reset the flag by writing hex 10 to Base+1 (Note that this operation may affect other bits in this register.).

Example 1: Output a pulse once every 5 mS. Begin outputting immediately. First, compute $N=(3 * (5*10^{-3})) / (10^{-6}) = 15000$ (base 10). Next convert 15000 to hexadecimal. Thus, 15000 base 10 becomes 3A98 base 16. Finally, send the command sequence: **A3 BA C9 D8 E6** to the command register at base address +2.

Use the DOS Debug program to test the heartbeat output as follows:

```
C:\> debug
-o 302 a3      ; 3 to divide register most significant nibble
-o 302 ba      ; A to divide register
-o 302 c9      ; 9 to divide register
-o 302 d8      ; 8 to divide register least significant nibble
-o 302 e6      ; command E6 for pulse with forced jam
-q             ; quits the Debug program
```

Example 2: Output an 8 kHz square wave. Begin outputting at the end of the next heartbeat period.

Compute N= ($3*10^6$) / ($8*10^3$) = 375 (base 10). Convert 375 to hexadecimal. Thus, 375 base 10 becomes 177 base 16. Send the command sequence A0 B1 C7 D7 E7 to the command register at base address + 2.

Use the DOS Debug program to test the heartbeat output as follows:

```
C:\> debug
-o 302 a0       ; 0 to divide register most significant nibble
-o 302 b1       ; 1 to divide register
-o 302 c7       ; 7 to divide register
-o 302 d7       ; 7 to divide register least significant nibble
-o 302 e7       ; command E7 for square wave with no forced jam
-q              ; quits the Debug program
```

The examples above assume that the board's base address jumpers are set to 300 (default). The Debug program comes with DOS; it is not supplied by KSI. Debug commands consist of the letter "o", space, I/O address, space, and the byte to be output.

Programming the Heartbeat Output

(For boards with –HB1PPS Option only)

The heartbeat output (P1 Pin 6) can be programmed to be either a pulse or a square wave. The specified rate must be an exact multiple of 1.000 mS. The range of programmable rates is:

Minimum Rate (lowest frequency) ....65.534 Seconds (0.0152593 Hz)
Maximum Rate (highest frequency) ....2 mS (500 Hz)
Pulse Width (time low, pulse mode only)..................1 mS (typical)
Programming Resolution..................1 mS

To specify the rate (or frequency), compute the divide number N as follows.

To specify a period for a pulse or square wave, compute N as follows:

N = t / .001 ....“t” is the period in seconds

To specify a frequency for a pulse or square wave, compute N as follows:

N = 1000 / F.."F" is the frequency in Hertz

Verify that the computed value is in the range of 2 to 65,534, inclusive.

Convert N into hexadecimal (base 16) notation. For example, if the desired output period is once every 25 seconds, N=25,000 (base 10), converted to hexadecimal notation yields N= 0x61a8. Send the hexadecimal number to the board by outputting the following sequence to the command register.

```
0x00f0                              ; Clear the Holding Register
0x00a6 0x00b1 0x00ca 0c00d8         ; specifies N = 0x61a8
```

The heartbeat output can be programmed to be a square wave or a pulse, and can be programmed to begin immediately or at the beginning of the next cycle. Send one of the following commands to command port:

```
0x00e5      ; Pulse mode, starts at beginning of next cycle
0x00e6      ; Pulse mode, starts immediately
0x00e7      ; Square wave, starts at beginning of next cycle
0x00e8      ; Square wave, starts immediately
```

Notes

#1 *The heartbeat output is present regardless of whether the board is in-sync or freewheeling.*

#2 *The power-on default is 1PPS, pulse mode.*

Blank Page

Chapter 8

Reading GPS Latitude and Longitude

The Report Latitude (5Fh) and Report Longitude (5Eh) commands cause the TPRO–PC to respond by putting 10 bytes of data in the on-board FIFO in the formats shown in the tables below. The data is valid only for TSAT–PC models tracking at least 4 satellites.

Table 8.1—Latitude Command FIFO Data Response

Byte	High Nibble	Low Nibble
0	Not defined	Not defined
1	Not defined	Not defined
2	not defined	10^2 degrees
3	10^1 degrees	10^0 degrees
4	10^1 minutes	10^0 minutes
5	10^{-1} minutes	10^{-2} minutes
6	10^{-3} minutes	10^{-4} minutes
7	Not defined	Not defined
8	Not defined	Not defined
9	Not defined	Not defined

Table 8.2—Longitude Command FIFO Data Response

Byte	High Nibble	Low Nibble
0	Not defined	Not defined
1	Not defined	Not defined
2	Not defined	10^2 degrees
3	10^1 degrees	10^0 degrees
4	10^1 minutes	10^0 minutes
5	10^{-1} minutes	10^{-2} minutes
6	10^{-3} minutes	10^{-4} minutes
7	Not defined	Not defined
8	Not defined	Not defined
9	Not defined	Not defined

Reading TSAT–PC GPS antenna altitude, course over ground, and satellite tracking. The Report Altitude (5Dh) and Report COG/SATS (5Ch) commands cause the TPRO–PC to respond by putting 10 bytes of data in the on-board FIFO in the formats shown in the tables above. The altitude and COG data is valid only for TSAT–PC models that are tracking at least 4 satellites.

Table 8.3— Altitude Command FIFO Data Response

Byte	High Nibble	Low Nibble
0	Not defined	Not defined
1	Not defined	Not defined
2	0	0
3	10^5 meters	10^4 meters
4	10^3 meters	10^2 meters
5	10^1 meters	10^0 meters
6	10^{-1} meters	0
7	Not defined	Not defined
8	Not defined	Not defined
9	Not defined	Not defined

Table 8.4—COG/SATS Command FIFO Data Response

Byte	High Nibble	Low Nibble
0	Not defined	Not defined
1	Not defined	Not defined
2	0	0
3	0	0
4	0	0
5	10^2 degrees COG	10^1 degrees COG
6	10^0 degrees COG	10^{-1} degrees COG
7	0	# SATS tracked
8	0	# SATS in view
9	Not defined	Not defined

Blank Page

Chapter 9

Reading Dilution of Precision

The Report DOPS (5B) command causes the TPRO-PC to respond by putting 10 bytes of data in the on-board FIFO in the format shown in the table below. The data report tells the operator (for 3 orthogonal directions) how much the actual satellite constellation used for tracking degrades the theoretical-best GPS accuracy. The DOPS data is valid *only* for TSAT-PC models that are tracking at least 4 satellites.

Table 9.1— External 1 PPS Time Synchronization (Option –M)

Byte	High Nibble	Low Nibble
0	Not defined	Not defined
1	Not defined	Not defined
2	10^{1} EDOP multiplier	10^{0} EDOP multiplier
3	10^{-1} EDOP multiplier	10^{-2} EDOP multiplier
4	10^{1} NDOP multiplier	10^{0} NDOP multiplier
5	10^{-1} NDOP multiplier	10^{-2} NDOP multiplier
6	10^{1} VDOP multiplier	10^{0} VDOP multiplier
7	10^{-1} VDOP multiplier	10^{-2} VDOP multiplier
8	Not defined	Not defined
9	Not defined	Not defined

Option –M provides a 1PPS synchronization input on Pin 15 of the D-type connector. Pin 7 can be used for the ground return for this signal. A differential timecode input (IRIG-B, IRIG-A, NASA-36 or autodetect) can be applied to the BNC connector.

If both 1PPS and Timecode inputs are present, the board syncs to the incoming timecode and ignore the 1PPS. Note that commands 4D and 4E apply both to the 1PPS and the timecode input. Commands E0 and E9 are not supported.

Note

The board expects the 1PPS input to be continuous. If the 1PPS signal stops pulsing after the board establishes initial sync, the board will continue to increment time ("freewheel"). However, if the 1PPS signal resumes after a period of freewheeling, the board may reset the time to 001:00:00:00.000000. This is due to the fact that the 1PPS occurs outside of the narrow window in which the board expects it, either because the 1PPS has moved or because the board's time has drifted during freewheeling.

Specifications of the 1PPS input are:

Input Voltage (high) .... +2.4 V (min), +16.0 V (max)
Input Current (high) .... 500 uA (max) at +5.0 V, 12 mA (max) at +16.0 V
Input Voltage (low) .... -0.2 V (min), +0.8 V (max)
Input Current (low) .... 500 uA (max)
Rise/Fall Time .... 500 nS (max)
Trigger Edge .... Rising
1PPS Accuracy .... Must be better than 100 ppm (cannot be supplied from a tape playback)

Blank Page

Chapter 10

Preventative Maintenance

Oscillator Aging Adjustment

The oscillator aging adjustment for the TPRO-PC corrects for the effects of aging on the natural crystal oscillator frequency to insure that the undisciplined frequency of the 10 MHz oscillator is 10.000000 MHz ±10 Hz.

Preventative maintenance should be performed once every 2 years.

Necessary items are:

- A digital frequency counter with 1 PPM or better accuracy and 1 HZ or better resolution (be *sure* that the counter is calibrated)
- A trimmer capacitor adjustment tool (non-metallic screwdriver)
- If the unit is equipped with a custom crystal oscillator, consult the oscillator data sheet for adjustment method.

Then:

- Disconnect J1
- Connect a *calibrated* frequency counter to the 1 MHz signal at J1 Pin 14. (Use Pin 5 or 7 for ground); or, connect to 10MHz-test point W4 and use W5 for ground.
- *Before* powering up the system, disconnect the timecode input and/or the external 1PPS input to the board so that the oscillator will be undisciplined.
- Power the system up and wait at least five minutes for the on-board crystal oven temperature to stabilize. Then adjust C14 for 1MHz ±1Hz (or 10MHz±10Hz if connected to W4).
- Power down the system, and reconnect any disconnected inputs.

IRIG-B Output Adjustment

IRIG-B output adjustment is seldom needed in the field. With the TPRO-PC at approximate operating temperature, adjust R20 ("FRQ") for zero crossover discontinuity at the transition from large to small amplitude cycles. This adjustment ensures that the sine wave phase is in proper lock to the amplitude modulation signal. R25 ("SYM") adjusts sine waveform symmetry.

Blank Page

Chapter 11

Options and Accessories

Options

–HB1PPS

(Cannot be combined with option –LOR1)

The heartbeat output (P1 Pin 6) can be programmed as either a pulse or a square wave. The specified rate must be an exact multiple of 1.000 mS. The range of programmable rates is:

Minimum Rate (lowest frequency) .... 65.534 Seconds (0.0152593 Hz)
Maximum Rate (highest frequency) .... 2 mS (500 Hz)
Pulse Width (time low, pulse mode only) .... 1 mS (typical)
Programming Resolution .... 1 mS

The default rate at power-up is 1Hz, pulse mode.

Refer to Section 7.10 of the Operation and Maintenance Manual for detailed programming information.

–LOR1

(Cannot be combined with options –HB1PPS)

This option provides the board with three different signals on a three-pin header; a 1 Mega-Hertz Output (1MHZ), 1 Pulse Per Second Output (1PPS), and a Ground Output. The 3-pin header is located on U21 Pins 1, 2, and 3.

The 3-pin header designations are:

- U21 Pin 1 is 1MHZ
- U21 Pin 2 is 1PPS
- U21 Pin 3 is Ground

To set 1PPS, program the Heartbeat output for 1PPS. The 1PPS can be programmed for a rate between 0152593 HZ and 500 Hz.

–M

(Cannot combined with option –TTLLAY2)
(Cannot be installed on TSAT-PC)

Option –M provides a 1PPS synchronization input on Pin 15 of the D-type connector. Pin 7 can be used for the ground return for this signal. A differential timecode input (IRIG-B, NASA36, auto-detect) can be applied to the BNC connector.

If both 1PPS and Timecode inputs are present, the board syncs to the incoming timecode and ignores the 1PPS. Note that commands 4D and 4E (enable/disable sync) apply to both the 1PPS and the timecode input. Commands E0 and E9 are not supported.

Note

The board expects the 1PPS input to be continuous. If the 1PPS signal stops pulsing after the board establishes initial sync, the board will continue to increment time (“freewheel”). However, if the 1PPS signal resumes after a period of freewheeling, the board may reset time to 001:00:00:00.000000. This is due to the fact that the 1PPS occurs outside of a narrow window in which the board expects it, either because the 1PPS has moved or because the board’s time has drifted during freewheeling.

Specifications of the 1PPS input are shown in Table 11.1.

Table 11.1—1 PPS Input Specifications	
Input Voltage (high)	+2.4 V (min), +16.0 V (max)
Input Current (high)	500 µA (max) at –5.0 V, 12mA (max) at +16.0 V
Input Voltage (low)	–0.2 V (min), +0.8 V (max)
Input Current (low)	500 µA (max)
Rise/Fall Time	500 nS (max)
Trigger Edge	Rising
1PPS Accuracy	Must be better than 100 ppm (cannot be supplied from a tape playback)

–RECONN

This option provides reinforced connectors for the board. Both the BNC and the DB-15 connectors are glued to the board to ensure stability under stress conditions.

–TTLLAY2

(Cannot be combined with option –M)
(Cannot be installed on TSAT-PC)
(Works only with IRIG-B)

This option reports decoded IRIG-B input Bits 50 through 98 in the FIFO in response to an operator command. It is used in cases in which the IRIG-B signal is being used for more than time of year.

The operator causes the most recent complete set of bits to be written into the FIFO by writing a "5A" command to the Command port (base +2).

The TPRO-PC firmware responds by writing the sequence of bytes found in Table 11.2.

Table 11.2—Firmware Byte Sequence

Byte	0		5A	(hex)		(command code echoed)				
	1		5A	(hex)		(command code echoed)				
		Bit	7	6	5	4	3	2	1	0
	2		8	4	2	1	88	78	68	58
	3		57	56	55	54	53	52	51	50
	4		67	66	65	64	63	62	61	60
	5		77	76	75	74	73	72	71	70
	6		87	86	85	84	83	82	81	80
	7		97	96	95	94	93	92	91	90
	8, 9		not specified							

Where 2-digit numbers report to bit position in IRIG-B frame, and 8, 4, 2, 1 is the units of seconds for the IRIG-B frame containing reported data. Data is double-buffered so that all data reported corresponds to reported second. Note that 99, 89, 79, 69, 59 are not reported, because they cannot be used for data bits. They are reserved for reference makers.

Accessories

CAB-BO1

(Will not work with TSAT-PC)

This cable provides multiple connections for a variety of inputs and outputs via the DB-15 connector on the board. Female BNC connectors are extended from the DB-15 connector in the following manner.

Inputs	**Pin #**
Time Tag (external event)	4

Outputs	**Pin#**
Heartbeat	6
Match Time	8
3MHz	14

CAB-BO2

(For TPRO-PC with Option –M only)
(Will not work with TSAT-PC)

This cable provides multiple connections for a variety of inputs and outputs via the DB-15 connector on the board. Female BNC connectors are extended from the DB-15 connector in the following manner.

Inputs	**Pin #**
Time Tag (external event)	4
1PPS (Pulse Per Second)	15

Outputs	**Pin#**
HeartBeat	6
Match Time	8
3 MHz	14

TRIM-CAB-D-D-100

(For use with TSAT-PC only)

This cable acts as an extension cord for a board that is using the Trimble GPS Receiver. It consists of a 100′ cable with DB-15 connectors (one male, one female) on the ends. It connects to a board on one end, and to the standard TRIM-CAB-STD cable on the other end. It does not connect directly to the Trimble GPS Receiver.

TRIM-CAB-STD

(For use with TSAT-PC only)

This is the standard 100′ cable for the Trimble GPS Receiver.

Chapter 12

Troubleshooting

Bus Crashes

If, when trying to access the TPRO-PC, the program crashes due to a bus error, the problem may be that the board address configured in P3 does not agree with the program being used.

Bad Data from 16-bit Data Registers

If the program does not crash, but starts to get peculiar data from the 16-bit registers ("illegal BCD", etc.), the problem could be:

- Using an address that maps into a different PC bus device.
- Using a base address that maps into both the TPRO-PC and another PC bus device.
- Accessing high-order bits at base +A, +C or +E before freezing/reading low-order bits at base+8.
- Reading data (especially if there are numerous zeros) before the TPRO-PC has synchronized to the input code.

  Remember that there is an approximate 20-second delay from power-on until the TPRO-PC jam syncs to the input code.
- Performing a TIME SET command sequence with "crazy" values.

Bad Data from FIFO Port

If the program does not crash, but has incorrect data from the FIFO, the problem could be:

- The code does not check the "FIFO NOT EMPTY" bit in the STATUS REGISTER for "1" before reading each byte from the FIFO. If the data contains "00" or seems to slip (e.g., hours show up where minutes are expected) this is very likely the reason.
- Reading data (especially if there are numerous zeros) before the TPRO-PC has synchronized to the input code.

Note

Remember that there is an approximate 20-second delay from power-on until the TPRO-PC jam syncs to the input code. A longer delay of up to one minute occurs for a TSAT-PC doing a start with an up-to-date satellite almanac. A very long delay of up to 45 minutes occurs for a TSAT-PC doing a start with invalid (over 2 weeks old) almanac data or an initial position that is grossly (e.g., over 1000 km) in error.

- Performing a TIME SET command sequence with incorrect values.
- Using an address that maps into memory or into a different device.

Interrupt Crashes

Ascertain that the host interrupt vector/level is correctly initialized.

When using the "FIFO NOT EMPTY" interrupt selection, disable the interrupt and enable it either at the TPRO-PC or at the host interrupt controller while reading the FIFO, otherwise it could cause nested FIFO NOT EMPTY interrupts as each byte is read from the FIFO and the IRQ line may toggle.

Board Never Syncs to Input Code or 1PPS

Loss of sync should be asserted in many cases. If the "loss of sync" status bit is "0" (which indicates an error), its assertion does not mean that there is a fault in the board.

Note

Remember that there is an approximate 20-second delay from power-on until the TPRO-PC jam syncs to the input code. A longer delay of up to one minute occurs for a TSAT-PC doing a start with an up-to-date satellite almanac. A very long delay of up to 45 minutes occurs for a TSAT-PC doing a start with invalid (over 2 weeks old) almanac data or an initial position that is grossly (e.g., over 1000 km) in error.

If the status LED does not indicate a decodable input signal, then the TPRO-PC does not see a signal that it can decode. Check the signal amplitude and connections. Both the "+" (signal) and "–" side of the input code should be connected. Remember that the input is differential for common mode noise rejection. As a last resort, examine the input signal on an oscilloscope and make sure that it meets the input specifications of the TPRO-PC.

When using 1PPS, make sure that it is a good 1PPS. Has a SET NEXT 1PPS TIME command sequence been performed?

Is the timecode carrier frequency stable to ±100 PPM? Does it make periodic large (larger than 5 μsecond) time jumps? Tape playback is very likely to have high-frequency error, unless a calibrated servo track is used for accurate speed control.

Contacting KSI

- Have the serial number, revision level, firmware and FPGA ID that were recorded during installation ready, and include them in any faxes.
- Try to exhibit the problem in as reduced (fewest boards in the system) a configuration as is possible.
- Try to run KSI examples, modified as little as possible, to be sure that what could be a hardware problem is really a software problem.
- Call us, toll free, at 866-KSI-KSI3.

Blank Page

Chapter 13

Optional Preventative Maintenance

Oscillator Aging Adjustment

The oscillator aging adjustment for the TPRO/TSAT-PC corrects for the effects of aging on the natural crystal oscillator frequency to insure that the undisciplined frequency of the 10 MHz oscillator is 10.000000 MHz ±10 Hz.

Although optional, it is strongly recommended that this preventative maintenance be performed once every two years.

Necessary Equipment

- A digital frequency counter with 1 PPM or better accuracy and 1 Hz or better resolution (be sure that the counter is calibrated).
- A trimmer capacitor adjustment tool (non-metallic screwdriver). If you have a custom crystal oscillator in your unit, consult the oscillator data sheet for adjustment method.

Caution

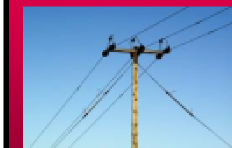
Prior to calibration, make certain that you are properly grounded. Failure to ground yourself in the proper manner can result in electrostatic discharge and damage to the equipment.

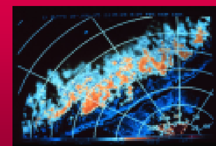
Procedure

1. Power down the system.
2. Connect a *calibrated* frequency counter to the 1 MHz signal at JP9 Pin 4. (Use JP10 Pin 3 for ground.)
3. **Before** powering up the system, disconnect the timecode input and/or the external 1PPS input to the board so that the oscillator is undisciplined.
4. Power the system up and wait at least five minutes for the on-board crystal oven temperature to stabilize. Then adjust the oscillator's on-board trimmer for 1MHz ±1Hz.
5. Power down the system, and reconnect any disconnected inputs.

Blank Page

KSI
A Division of DSPCon, Inc.






High-performance Embedded I/O, Timing, and Computer Products

Proven Hardware

KSI has been providing hardware solutions for over 30 years.

Application Support

Our device drivers support today's major operating systems, including Windows, VxWorks, Linux, Lynx OS and Solaris.

First-class Customer Support

We pride ourselves on providing 1st-class customer service. From pre-sales technical support to installation and software support, KSI is with you every step of the way.

Device Driver Support

KSI can provide custom systems tailored to your application. From a simple network timing box-level solution to a fully integrated data acquisition system, including IRIG time stamping, KSI's system-level solutions meet every timing requirement.

"Out of the Box" Customer Success

Use KSI's products in your next project and see how easy it is to use our solutions right out of the box!

KSI CORPORATION
A division of DSPCon, Inc.
380 FOOTHILL ROAD, SUITE 102, BRIDGEWATER, NJ 08807

Toll Free Phone 866-KSI-KSI3
Toll Free Fax.. 866-593-2080
Website .... www.ksi-corporation.com

Technical Support

General/Hardware

Phone 866-KSI-KSI3
Fax 866-593-2080
Email .... technicalsupport@ksi-corporation.com

Software

Phone 888-377-2668
Fax 866-593-2080
Email .... technicalsupport@ksi-corporation.com

Additional Contact Information

Literature

Phone 866-KSI-KSI3
Fax 866-593-2080
Email .... info@ksi-corporation.com

Repairs/Returns

Phone 866-KSI-KSI3
Fax 866-593-2080
Email .... info@ksi-corporation.com

Shipping Address/Repairs and Returns

Call us for a Return Material Authorization (RMA) number

Ship to: .... KSI, Inc.
Attention: .... RMA–####
(Replace with assigned RMA number)
Address: .... as above