1

General Information

1.1 Scope of Manual

This manual contains the information necessary to operate and maintain a TrueTime 800 Series Time Code Unit (TCU).

This unit may contain Custom Options and/or Configurations. A description can be found starting on sheet **iii** of the index. This description may modify or supersede descriptions or specifications elsewhere in this manual.

1.2 Conventions

The conventions used in this manual are:

Text	=	Indicates body text
Italics	=	Emphasizes important information
	=	Used with bold text to call attention to important information
Caution	=	Used with bold text to identify potential damage to equipment
WARNING	=	Used with bold text to identify potential injury
`text`	=	Used to display output character strings
`text`	=	Used to indicate text you should enter with your keyboard, *exactly* as printed

1.3 Purpose of Equipment

The Model 800 Series is a family of Time Code instruments designed around a versatile microprocessor. The three basic operating modes of these instruments are:

1. As a Time Code Generator that accumulates time from an entered starting time and then provides various outputs based on the accumulated time.
2. As a Time Code Translator that deciphers serial time codes from some external source and provides various outputs based on the decoded time. The Translator operates in both the forward and reverse directions.
3. As a Synchronized Generator it is derived from the input time code and is phase-locked to the input code. If the input fails, the generator continues to update using its time base as the reference. Further, the internal oscillator is disciplined to the frequency of the input code, which further enhances the performance of the unit during periods of input code failure.

The various operating modes are optional and are supplied if they are marked (X) in the Table of Contents.

1.4 Physical Specifications

The physical specifications are:

Height:	1.73 in (4.39 cm)
Width:	Suitable for mounting in a standard 19.0 in (48.26 cm) equipment cabinet
Depth:	14.0 in (35.56 cm) plus mating connectors
Weight:	Approximately 10 pounds

1.5 Environmental Specifications

The temperature specifications are:

Operating Temperature:	0 to +50°C (+32 to +122°F)
Storage Temperature:	-17 to +100°C (0 to +212°F)
Humidity:	To 95% relative, non-condensing
Cooling Mode:	Convection

1.6 Power Specifications

The input power specifications are:

Voltage:	95 to 260 VAC
Frequency:	47 Hz to 440 Hz
Power:	Approximately 15 Watts

1.7 Option Identification

Each of the options that are supplied with this unit are indicated in the Table of Contents by an (X). Custom Options/Configurations are described on page iii of the manual index.

1.8 Signal Specifications

1.8.1 Generator Specifications

General Specifications, Generator

Days Reset:	Resets to day 1 after day 365
Leap Year:	Resets to day 1 after day 366
Advance/Retard Rates:	0.5 µs, 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 500 ms and 1 second

Front-panel Controls and Indicators:

Operating Mode

Generate Time

Status Messages

Leap Year and Time Base Select

Advance/Retard Rate

External Start

Generate Code

Video Mixer Controls

Front-panel Controls Disable

Start and Stop

Internal Oscillator (STD)

Frequency:	10 MHz
Stability:	< 50 PPM, 0 to +50° C
Aging:	< 1 PPM/year

Internal Oscillator (TCXO)

Frequency:	10 MHz
Stability:	< $0.5x10E^{-6}$, 0 to +50°C
Aging:	< 1 PPM/year

Internal Oscillator (OCXO)

Frequency:	10 MHz
Stability:	< $1x10E^{-8}$, 0 to +50°C
Aging:	< $2x10E^{-9}$/day

External Time Base Input

Frequency:	1 MHz
Amplitude:	0.5 to 10 Vpp
Impedance:	10 kΩ to ground

External Start Input

Active Edge:	Selectable, rising or falling. Starts on the next edge after being Armed.
Levels:	Logic Zero: 0 ±0.5 VDC
Logic One:	>+2.5 VDC, <+5 VDC
Impedance:	4.7 kΩ to +5 V

IRIG-B Time Code Output

Amplitude:	Adjustable, 0 to 10 Vpp into 600 Ω to ground
Ratio:	Adjustable, 2:1 to 5:
	NOTE: Rear Panel BNC is typically labeled "GEN CODE"

Timing Signals

Rates:	1 kPPS, 100 PPS, 10 PPS, 1 PPS
Duty Cycle:	50%
Amplitude:	0 to +5 VDC at ±6 mA
Timing:	Rising edge on time

1.8.2 Translator Specifications

General Specifications, Translator

Days Reset:	Resets to day 1 after day 365
Leap Year:	Resets to day 1 after day 366 on the day armed
Advance/Retard Rate:	0.5 µs, 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 500 ms and 1 second

Front-panel Controls and Indicators:

- Operating Mode
- Translator Time
- Status Messages
- Leap Year Select
- Error Bypass Select
- Input Polarity and Filter
- Translate Code
- Forward/Reverse Translation
- Video Mixer Controls

Code Input

Format:	Amplitude modulated IRIG-B
Amplitude:	0.1 to 10 Vpp
Bandwidth:	30 Hz to 50 kHz
Ratio:	2:1 to 6:1
Impedance:	100 kΩ to ground
Polarity:	Selectable, positive or negative
Direction:	Selectable, forward or reverse

Error Bypass

Bypass:	Selectable, 0 to 9 frames and infinite

Timing Signals

Rates:	1 kPPS, 100 PPS, 10 PPS, 1 PPS
Timing:	Rising edge on time
Amplitude:	0 to +5 VDC at ±6 mA
Duty Cycle:	Dependent on input code carrier

1.8.3 Synchronized Generator Specifications

General Specifications, Sync Generator

Days Reset:	Resets to day 1 after day 365
Leap Year:	Resets to day 1 after day 366 on the day armed
Phase Correction:	Automatic, 500 ns corrections

Front-panel Controls and Indicators:

- Operating Mode
- Translator Time and Generator Time
- Status Messages
- Leap Year and Time Base Select
- Error Bypass Select
- Prop. Delay, Input Code Polarity and Filter
- Sync Gen Input Code and Gen Code
- Oscillator Discipline Complete Status
- Video Mixer Controls
- Auto Advance/Retard Direction and Rate

Code Input, Carrier

Format:	Amplitude modulated IRIG-B
Tracking Range:	1 kHz ±1x10E^{-5}
Amplitude:	0.1 to 10 Vpp
Impedance:	100 kΩ to ground
Polarity:	Selectable, positive or negative
Direction:	Forward
Ratio:	Adjustable, 2:1 to 5:1

Code Input, DC-shift (Optional, see Top Assembly)

Format:	DC-shift IRIG-B
Tracking Range:	100 PPS ±1x10E^{-5}
Amplitude:	0 VDC, ±0.5 VDC to +5 VDC
Impedance:	74HC input
Timing:	Rising edge on time
Direction:	Forward

Propagation Delay Compensation

Range:	0 to 99.999 ms in 1 μs increments

Error Bypass

Frames:	Selectable, 0 to 9 and infinite

Timing Signals

Rates:	1 kPPS, 100 PPS, 10 PPS & 1 PPS
Duty Cycle:	50%
Amplitude:	0 to +5 VDC at ±6 mA
Timing:	Rising edge on time

1.9 Standard Option Specifications

Parallel BCD

Data:	Milliseconds through days
Amplitude:	HCMOS
Levels:	Logic 0: 0 VDC
	Logic 1: +5 VDC
Drive:	±6 mA
Data Ready Pulse	Width: Approximately 5 μs
Data Ready Rate:	Rate of the LSB of the data
Data Ready Timing:	Rising edge indicates stable data
Connector:	Rear-panel female 50-pin ribbon
	Mating male 50-pin ribbon
Pin Assignment:	See Table 1-1

RS-232, Talker Only

This interface supplies time only on demand. See Chapter 2 for complete programming information. The RS-232 specifications are:

Data:	Milliseconds through days
Data Rate:	9600 baud
Format:	1 start bit, 8 data bits, no parity, 1 stop bit
Resolution:	Generate Mode: 1 ms
	Sync Gen Mode: 1 ms
	Translate Mode: 10 times the carrier frequency and 100 times the carrier frequency in multi-code units.
Connector:	Rear-panel female 9-pin D subminiature
	Mating male 9-pin D subminiature
Pin Assignment:	See Table 1-4

RS-232, Talker/Listener

This interface supplies time on demand and may be used to remotely control the unit. Otherwise the unit specifications are the same as the Talker Only. See Chaper 2 for complete programming information.

Multiple Generate Codes

Formats:	IRIG-A, B, E, E1K, H and H1K
Amplitude:	Adjustable, 0 to 10 Vpp into 600 Ωs to ground
Ratio:	Adjustable, 2:1 to 5:1

Multiple Translate Codes

Formats:	IRIGs A, B, E1K, G
Amplitude:	0.1 to 10 Vpp
Bandwidth:	50 Hz to 50 kHz
Ratio:	2:1 to 6:1
Impedance:	100 kΩ to ground
Polarity:	Selectable, positive or negative
Direction:	Selectable, forward or reverse

Simultaneous Generate Codes

Formats:	IRIGs A, B, E, E1K, H and H1K
Amplitude:	Adjustable, 0 to 10 Vpp into 600 Ω to ground
Ratio:	Adjustable, 2:1 to 5:1

IRIG PB1 (Parallel Binary)

Data:	Nine bits of binary days, 27 bits of ms, time of day.
Data rate:	1 kPPS
Parity1:	Odd for 27 bits of ms plus days
Parity2:	Odd for 27 bits of ms
Data Ready Pulse:	Active low pulse while data is changing. At 0 V for approximately 30 µs.
Drive:	Positive true HCTTL, sink and source 8 mA
Connector:	AMP 205514-1, fixed male jackscrew at pin A (200874-1), fixed female jackscrew at pin FF (200875-1).
Pin Assignments:	See Table 1-2

Reference Frequency Outputs

Frequencies:	100 Hz, 1 kHz, 10 kHz and 100 kHz
Amplitude:	Adjustable, 0 to 1 Vrms into 75 Ω to ground

Video Time Inserter

This option is used to superimpose time-of-year information on a the user's video signal.

Controls:	Time Insertion on/off
	Background on/off
	Background white/black
	Character intensity
	Days information on/off
	Ms information on/off
	Horizontal position
	Vertical position
	Horizontal Character size
	Vertical Character size
Resolution:	Generator: 1 ms
	Synchronized Generator: 1 ms
	Translator: 10 ms
Termination:	Switchable on or off, 75 Ω
Bypass:	When the power is off, the video input signal is directly connected to the output.

True Simultaneous Generator Mode

The Generator continues output Generator Code even while the unit is in the Translator mode.

Extended Baud Rate Range

Data Rate:	Selectable, 300, 600, 1200, 2400, 4800 and 9600 bps
	See Table 1-3

Transformer-coupled Input

Impedance:	600 Ω balanced
Connector:	Female isolated BNC, J1

Balanced Code Output

Amplitude:	Adjustable, 0 to 6 Vpp into 600 Ω
Connector:	5-pin Barrier Strip
Pin Assignment:	Pin 1: High
	Pin 2: Low
	Pin 3: Ground

1.9.1 IEEE-488 Interface

Most standard protocols are supported. The device address is programmable at the front panel. See Chapter 2 for the I/0 command structure.

1.9.2 Pin Assignments

Table 1-1 Parallel BCD Pin Assignments

Pin Number	Assignment	Pin Number	Assignment
(1) [1]	NOT USED	(28) [10]	TMC1
(2) [34]	NOT USED	(29) [43]	TMC2
(3) [18]	NOT USED	(30) [27]	TMC4
(4) [2]	NOT USED	(31) [11]	UHC1
(5) [35]	mSC1	(32) [44]	UHC2
(6) [19]	mSC2	(33) [28]	UHC4
(7) [3]	mSC4	(34) [12]	UHC8
(8) [36]	mSC8	(35) [45]	THC1
(9) [20]	hSC1	(36) [29]	THC2
(10) [4]	hSC2	(37) [13]	UDC1
(11) [37]	hSC4	(38) [46]	UDC2
(12) [21]	hSC8	(39) [30]	UDC4
(13) [5]	tSC1	(40) [14]	UDC8
(14) [38]	tSC2	(41) [47]	TDC1
(15) [22]	tSC4	(42) [31]	TDC2
(16) [6]	tSC8	(43) [15]	TDC4
(17) [39]	USC1	(44) [48]	TDC8
(18) [23]	USC2	(45) [32]	HDC1
(19) [7]	USC4	(46) [16]	HDC2
(20) [40]	USC8	(47) [49]	NOT USED
(21) [24]	TSC1	(48) [33]	DATA VALID
(22) [8]	TSC2	(49) [17]	DATA READY
(23) [41]	TSC4	(50) [50]	GROUND
(24) [25]	UMC1		
(25) [9]	UMC2		
(26) [42]	UMC4		
(27) [26]	UMC8		
( ) REAR PANEL FEMALE CONNECTOR PIN NUMBER			
[ ] MATING MALE CONNECTOR PIN NUMBER			

Table 1-2 IRIG PB1 Connector Pin Assignment

Pin	Signal	Pin	Signal
A	DOY 2 EE 8	d	TOD 2 EE 10
B	DOY 2 EE 7	e	TOD 2 EE 9
C	DOY 2 EE 6	f	TOD 2 EE 8
D	DOY 2 EE 5	h	TOD 2 EE 7
E	DOY 2 EE 4	j	TOD 2 EE 6
F	DOY 2 EE 3	k	TOD 2 EE 5
H	DOY 2 EE 2	m	TOD 2 EE 4
J	DOY 2 EE 1	n	TOD 2 EE 3
K	DOY 2 EE 0	p	TOD 2 EE 2
L	TOD 2 EE 26	r	TOD 2 EE 1
M	TOD 2 EE 25	s	TOD 2 EE 0
N	TOD 2 EE 24	t	P1
P	TOD 2 EE 23	u	P2
R	TOD 2 EE 22	v	SPARE
S	TOD 2 EE 21	w	GND
T	TOD 2 EE 20	x	GND
U	TOD 2 EE 19	y	GND
V	TOD 2 EE 18	z	GND
W	TOD 2 EE 17	AA	INHIBIT
X	TOD 2 EE 16	BB	SPARE
Y	TOD 2 EE 15	CC	SPARE
Z	TOD 2 EE 14	DD	SPARE
a	TOD 2 EE 13	EE	GND
b	TOD 2 EE 12	FF	SPARE
c	TOD 2 EE 11	HH	CHASSIS

Table 1-3 Data Rate Selection

Rate	S1-1	S1-2	S1-3	S1-4
9600	off	on	on	off
4800	off	off	off	on
2400	off	off	on	off
1200	on	off	off	on
600	off	on	off	on
300	on	off	off	off

Table 1-4 Serial Port Pin Assignment

Pin	Assignment
2	RXD
3	TXD
5	Signal Ground

1.10 Limited Warranty

Each new product manufactured by TrueTime is warranted for defects in material or workmanship for a period of one year from the date of shipment ("Limited Warranty"). Defects in material or workmanship found within that period will be replaced or repaired, at TrueTime's option, without charge for material or labor, provided the customer returns the equipment, freight prepaid, to the TrueTime factory under this limited warranty; TrueTime will return the repaired equipment, freight prepaid, to the customer's facility. This one-year Limited Warranty does not apply to any software or to any product not manufactured by TrueTime.

If on-site warranty repair or replacement is required, the customer will be charged the then-current field service rate for portal-to-portal travel time plus actual portal-to-portal travel charges. There is no charge for on-site warranty repair labor.

Products not manufactured by TrueTime but included as integral parts of a system (e.g. peripherals, options) are warranted for 90 days or longer, as provided for by the original manufacturer, from the date of shipment.

Aside from the Limited Warranty set forth above, TrueTime makes no other warranties, express or implied, of merchantability, fitness for purpose or of any other kind or description whatsoever.

By purchasing any product manufactured by TrueTime, the buyer consents to and agrees with TrueTime that as a result of the exclusion of all warranties, expressed or implied, of merchantability, fitness for purpose, or otherwise, except for the limited one-year warranty for defects in material and workmanship for products manufactured by TrueTime, that the Buyer has the sole responsibility to assess and bear all losses relating to

(1) the ability of the product or products purchased to pass without objection under the contract description among merchants and buyers in the trade; (2) the conformity of the product or products to fair average quality within its contract description; (3) the fitness of the product for the ordinary purposes for which such product is used; (4) the consistency of quality and quantity within each unit of product or products and among all units involved; (5) the adequacy of containers, packaging and labeling of the product or products; (6) the conformity of the product, promises or affirmations of fact (if any) made on its label or container; and (7) the conformity of the product to standards of quality observed by other merchants in the trade with respect to products of similar description.

1.11 Limitation Of Liability

By purchasing any product from TrueTime the Buyer consents to and agrees that the Buyer's sole and exclusive remedy for any damages or losses incurred by the Buyer as a result of TrueTime's breach of its one-year Limited Warranty for defects in materials and workmanship or otherwise in connection with any claim respecting the product shall be limited to the repair or replacement of the product or a refund of the sales price of the product.

In no event shall the Buyer be entitled to recover consequential damages or any other damages of any kind or description whatsoever.

1.12 Proprietary Notice

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2

Installation and Operation

2.1 Introduction

This section contains installation instructions and operating procedures.

This unit may contain Custom Options and/or Configurations. If they exist, a description can be found starting on sheet iii of the index. A specifications or operational procedure found there supersedes any defined in Sections One or Two of this manual.

2.2 Installation

Unpack the unit and carefully inspect it for shipping damage. Any damage must be reported to the carrier immediately.

Mount the unit in the desired location in the cabinet; at eye level or below is recommended.

Connect any required I/O cables to the appropriate input/output connectors. All multi-pin mating connectors are located in the shipping kit. Connect the AC Input Power cable. Refer to the name plate on the unit for power specifications.

Caution

CAUTION!!! There are extremely dangerous voltages present in this unit. DO NOT remove the top cover without FIRST disconnecting the primary power!!!

Only skilled technicians should have access to the contents of this unit.

2.3 General Information and Operation

This section describes operating procedures for the basic unit and many standard options. The options are noted by a (X) in the Table of Contents. If your particular unit does not contain one or more of the possible options, disregard references in this section that may apply to it. In particular, the LCD display has many functions that may be supplied only with specific options. For example, the LCD can display and be used to change the Translator input code. If this option is not checked in the Table of Contents, the LCD will display IRIG-B for the input code and pressing the ***SETUP*** key will not initiate the flashing cursor.

In general, Model 814's are Generators, Model 820's are Translators and Model 840's are Translator and Generators.

The ***STOP***, ***START***, ***FWD*** and ***REV*** keys are used to control the unit. The keyboard and ***SETUP*** and ***ENTER*** are used to program the unit. The programming operation is described first followed by descriptions of the control switches.

Press the top of the POWER switch. The numeric display and the alphanumeric display will go through a turn-on sequence. During the turn-on sequence, the numeric display will display all eights, the keyboard lamps will all be illuminated and then the numeric display will display 001 00 00 00. The alphanumeric display will show the program number and its revision and then display the ***OPER MODE*** prompt. If the nonvolatile memory option is installed, all parameters entered into the unit will be retained when the power is removed (unless otherwise specified all Model 800 units with multicode options will have this option installed).

Use the front panel potentiometer to set the viewing angle of the alphanumeric (A/N) display so that it is easy to read.

Use the number keys to change the prompt on the A/N display. The following list shows the display versus the key that is pressed. (*Note: Some keys are optional).*

Key Pressed **Displayed Message**

- Key #0 -- `Operating Mode (GEN//TRANS//SYNC GEN)`
- Key #1 -- `Time (TRANSLATOR TIME//GENERATOR TIME)`
- Key #2 -- `OPER STATUS (TRANSLATE//GEN//SYNC-GEN)`
- Key #3 -- `LEAP YEAR//OSC SELECTION// IEEE-488 ADDRESS`
- Key #4 -- `ERROR BYPASS//ADV RET RATE`
- Key #5 -- `EXT START//PROP DELAY//FILTER-POLARITY CONTROL`
- Key #6 -- `TRANSLATE CODE//GENERATE CODE//SYNC-GEN REF CODE`
- Key #7 -- `VIDEO MIXER`

Keys 8-9 are not used.

Notice that several keys are used for the selection of more than one display. Pressing the respective key will toggle or scroll the display.

To change a parameter use the ***SETUP*** and ***ENTER*** keys in conjunction with the number keys.

If the cursor is flashing and you wish to abort the change mode, press ***SETUP***. The cursor will stop flashing and pressing a number key will change the prompt not the parameter.

For Models 820 or 840 use the following example to select Positive Polarity mode and three frames of Error Bypass:

- Press key **#4** until the current Error Bypass selection is displayed.
- Press ***SETUP*** and the cursor will flash. Sequentially pressing and releasing any number key will scroll the possible Error Bypass settings through the display. When `3 frames` is displayed press ***ENTER***.
- Press key **#5** until `FILTER CONTROL` is displayed. Press ***SETUP*** and the display will read `CHANGE FILT CTRL` and the current setting will be displayed. Off/On is the filter status and Inverted/Non-inverted is the polarity setting. Press any number key and the display will scroll through the four possible settings. When `Off/Non-inverted` is displayed, press ***ENTER***.

For Model 814, press ***START*** and use the following procedure to select the Advance/Retard Rate:

- Press key **#4** until the current Advance/Retard selection is displayed.
- Press ***SETUP*** and the current setting will be displayed and the cursor will be flashing. Sequentially pressing and releasing any number key will scroll the possible Advance/Retard selections through the display. When the desired rate is displayed press ***ENTER***.

Experiment with the keys to get the feel of the options that are supplied and the methods of changing the various parameters associated with them. Again, if ***SETUP*** is pressed and the flashing cursor does not appear, the displayed parameter is fixed and may not be changed.

2.4 Detailed Key Information

This section provides details when using the available keys.

Key 0:

Selects the OPERATIONAL MODE display. From this display the Generator, Synchronized Generator and Translator modes may be selected.

Key 1:

Toggles the alphanumeric display between the GENERATOR TIME and the TRANSLATOR TIME displays. Pressing ***SETUP*** will cause the cursor to flash indicating that the time may be changed. Use the number keys and the left/right arrow keys to select the desired time (in the Translator and Sync Gen. modes the preset time will be accepted. However, it will be corrected to the time contained on the input code).

When the time has been properly entered, press the ***ENTER*** key to exit the change operation.

Key 2:

Selects the OPER STATUS display where various Generator/Translator diagnostic messages are displayed. The most common message is the `Time Valid Code` error display. This appears when input code frames containing errors exceed the number in the Error Bypass setting, no code is present or it is the wrong format.

Other messages include `Gen Stopped`, `Gen Normal`, `Trans Stopped`, and `Osc Error`. In normal operation the display will read `Time Valid` or `Gen Normal`.

When the Synchronized Generator mode has been selected, an **`*`** is displayed in the Generator Operational Status display, the unit has calculated the frequency error between the input code and its time base. If the input code fails, input a correction into the time base to compensate for the last known frequency error. This compensation will increase the accuracy of the time base with respect to the input code by approximately one order of magnitude.

(*Note: A unit is programmed to wait for 10 to 15 minutes after power on before the frequency error is calculated. This allows the internal oscillator to stabilize before measurements are taken. A* `w` *in the display indicates a warm-up period. A* `c` *in the display indicates the calculation period*).

Key 3:

Selects either the internal oscillator or the external oscillator as the Generator or Sync Generator time base. Select the LEAP YEAR function and select the IEEE-488 address. Press ***SETUP*** and ***ENTER*** simultaneously while using this key to modify the particular display that is in view.

1. When OSC SELECTION displays `Internal`, the Generator or Synchronized Generator will use the internal time base. When OSC SELECTION displays `External`, the Generator or Synchronized Generator will use an external 1 MHz oscillator provided by the user. *(Note that* `External` *is selected but no external oscillator is provided, the OPER STATUS display will read* `OSC Input Error` *and time will not advance).*
2. The LEAP YEAR function, when Disabled, will enable the days to be reset to day one after a count of 365 has been accumulated. When LEAP YEAR is Enabled the days will be reset to day one after a count of 366 days. Press ***SETUP*** and ***ENTER*** simultaneously while number keys to enable or disable the LEAP YEAR as desired. Leap year is used in the translator mode only. In all other modes the date is used to determine leap year.
3. Use IEEE-488 ADDRESS to select the address of the IEEE-488 Interface. Press button number **3** repeatedly until the IEEE-488 ADDRESS prompt shows. Press ***SETUP*** to enter an address which may be any value from **`00`** to **`30`**. Use the right- or left-arrow key to position the cursor beneath the digit that you wish to change, then use the number keys to enter the digit. When the desired address is displayed, press ***ENTER***. The selected address is saved in non-volatile RAM. Consequently, the address upon subsequent power-ups will be that used at the previous power-down.

Key 4:

Use to display or modify the Error Bypass or Advance/Retard parameters. Press the ***SETUP*** and ***ENTER*** simultaneously and a number key to modify the particular display in view.

1. ERROR BYPASS is the number of input code frames containing errors that will be ignored before they are loaded into the internal time registers. From the `CHANGE ERROR BYPASS` display, the number keys allow scrolling through the possible selections on the display. ERROR BYPASS is active in both the Translator and Sync Generator modes.
2. ADV/RET RATE is used to manually synchronize the Generator to an external reference. From the `CHANGE ADV/RET RATE` display, the number keys scroll through the possible rate selections on the display. The choices can be sequentially made larger or smaller by pushing the **odd** or **even** number keys. The "Disabled" state cancels both the advance and retard. When the desired rate has been selected, the left- and right-arrow keys are used to implement the retard and advance each time the respective key is pressed. When an advance or retard is performed by the internal logic, the LED above the respective arrow key is momentarily illuminated.
3. In the Synchronized Generator mode, the indicators above the arrow keys are illuminated when the internal logic automatically performs an advance or retard. The relative rate of flashing is an indication of the frequency error between the input code and the Generator time base. If the input code has failed and the **`*`** has been illuminated in the Translator Time Status display, the respective LED above the arrow keys will flash at the rate at which the automatic 500 ns advance or retard corrections are being inserted.

Key 5:

Use to select the polarity of the input code, turn the filter on and off, control the Generator External-Start operation and set the propagation delay.

1. Press key **5** until `FILTER CONTROL` is displayed. Press ***SETUP*** and the display will read `CHANGE FILT CTRL` and the current setting will be displayed. Off-On is the filter status and inverted/non-inverted is the polarity setting. Press any number key and the display will scroll through the four possible settings. When `Off/Non-inverted` is displayed, press ***ENTER***.
2. The EXT START display may be selected by pressing key **5** when the unit is in the Generate mode and is stopped. Pressing ***SETUP*** allows the user to select either the positive or negative going edge of the External Start input pulse, which is used to start the unit. Press the ***SETUP*** and ***ENTER*** simultaneously**,** then any number keys to select the desired edge, either rising or falling. Pressing the ***ENTER*** key will enable the LED above the START switch, which will flash on the occurrence of each External Start edge. The flashing LED indicates that the External Start input is active. The display should read `Push Start to engage Ext Start`. When the START switch is pressed, the next edge of the External Start pulse will start the unit.
3. PROPAGATION DELAY is used in the Sync-Generate Mode to compensate for transmission delays from the source of the input code. Press the ***SETUP*** and ***ENTER***

simultaneously and any number keys to select the desired delay.The unit will synchronize to the input code and the time will be early with respect to the input code by the amount set into the Propagation Delay.

Key 6:

Selects the GENERATE CODE, TRANSLATE CODE and SYNC GEN REF CODE displays. Pressing ***SETUP*** will cause the cursor to flash indicating that the Code Selection may be changed. Repeatedly pressing a number key will scroll the possible formats through the display. Press the ***ENTER*** key to save the code selected.

Key 7:

Programmes the various parameters associated with the Video Time Inserter (Mixer) option.

To program for this option repeatedly press this key to scroll through the possible change displays, then use the ***SETUP*** key to select the desired feature. Use of the ***ENTER*** key is not required. The following list shows each of the possible displays in the order of appearance with a brief description of each feature.

1. VIDEO PORT SELECT: When the second video port option is installed, this display provides port selection (1 or 2). The variables described below pertain only to the port selected.
2. VIDEO MIXER ON-OFF: *ON* selects the time insertion mode; *OFF* passes the video signal through without time information.
3. BACKGROUND OFF-WHITE-BLACK: The time is surrounded by a white, black or no mask as determined by this parameter.
4. INTENSITY: From this display, the arrow keys are used to increase or decrease the intensity of the digits.
5. DAYS DIGITS ON-OFF: This display allows the user to either enable or defeat the three days digits in the inserted time.
6. FRAC SEC: This display enables user to change the resolution or completely cancel out the insertion of the fractional-seconds time information. The possibilities are: None, milliseconds resolution, hundredths-of-seconds resolution and tenths-of-seconds resolution.
7. HORIZ POSITION: Pressing the left and right arrow keys will move the horizontal position of the inserted time.
8. VERT POSITION: Pressing the left and right arrow keys will move the vertical position of the inserted time.
9. HORIZ CHAR SIZE: Pressing the left and right arrows will increase and decrease the horizontal size of the inserted characters. Use this display in conjunction with the VERT CHAR SIZE to achieve the desired aspect ratio.
10. VERT CHAR SIZE: Pressing the left and right arrows will increase and decrease the vertical size of the inserted characters.

FWD is used to start the Translator in the forward direction. The FWD indicator will be illuminated when the unit is in the forward mode. Pressing ***STOP*** will halt the Translator.

REV is used to start the Translator in the reverse direction. The REV indicator will be illuminated when the unit is in the reverse.

START is used in the Generator mode to start the time accumulation. Pressing ***START*** will begin the count and the START indicator will be illuminated. Pressing ***STOP*** will stop the count, extinguish the START indicator and illuminate the STOP indicator. In the Sync Gen mode the START indicator is always illuminated.

2.5 Front Panel Lockout

The possibility of changing variable parameters by unauthorized users may be prevented by use of the Front Panel Lockout feature. Pressing Key ***0#***, then ***ENTER***, then Key ***0#*** again, will select the LOCKOUT CONTROL display. Pressing a number key will alternate the display between `Panel Enabled` and `Panel Disabled`. When the `Panel Disabled` is selected and the user attempts to change a parameter, the message `PANEL LOCKOUT, Refer to Manual` will be displayed. Display of parameters is still available when the Lockout feature is enabled.

2.6 RS-232 Talker Interface Option

The RS-232 interface will respond to four commands. The commands are: FREEZE, TIME, LINE TERMINATOR, and AUTO. The following table describes each command with its corresponding ASCII code.

Table 2-1 I/O Commands

Command	ASCII	Description
TIME	T (HEX 54)	Freeze and return time. If previously frozen return that time.
FREEZE	F (HEX 46)	Freeze the time. Time saved then returned later via the "T" command.
LINE TERM	L (HEX 4C)	Line terminator selection.
AUTO	A (HEX 41)	Automatic time output mode

When transmitting a command, it is not necessary to end the command with a carriage return or line feed. If they are sent they will be ignored.

FREEZE COMMAND: If the Model 800 receives the FREEZE Command, it will save the current time in an internal buffer. The saved time may be returned over the interface at any time in the future.

TIME COMMAND: The Time command is used to return the time. If a FREEZE command was previously sent, then the time saved when the Freeze command was received will be returned. If no previous Freeze command was sent, then the current time is saved and returned immediately.

The time data is transmitted in ASCII in the following format:

DDDHHMMSSmmm<LT>

where

DDD	is day of year
HH	is hours
MM	is minutes
SS	is seconds
mmm	is milliseconds
<LT>	is the selected line terminator

The time data is transmitted immediately after receipt of the Time command. The data is transmitted hundreds of days through milliseconds, followed by the line terminator if required.

LINE TERMINATOR COMMAND: This command allows the user to choose the end of transmission character(s). The choices are: “Carriage Return”, “Line Feed”, “Carriage Return”, “Line Feed” and “No line terminator”. The selection is made by sending an ASCII “L” followed by a number to the Model 800. The following table shows the line terminator choices and the selection codes.

Numeric Code	Line Terminator Selection
0	None
1	Carriage Return only
2	Line Feed Only
3	Carriage Return & Line Feed

AUTO COMMAND: This command will place the unit in the automatic time output mode and is not valid in translator mode. Time of year will output once per second. The output string format is:

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

where

<SOH>	is start of header (Hex 01)
DDD	is day of year
HH	is hours
MM	is minutes
SS	is seconds
:	is colon (Hex 3A)

Q	is space (Hex 20)
<CR>	is carriage return (Hex OD)
<LF>	is line feed (Hex OA)

The start bit for the carriage return character <CR> begins at the one second mark, +0 to +1 bit time. Time will continue to output once per second until the port receives another command.

2.7 RS-232 Talker/Listener Interface Option

The RS-232 Talker/Listener Interface is optional. It is present in your unit only if marked with an X in the index of this manual. This interface is a serial, asynchronous, bi-directional data port with RS-232 signal levels. Unless otherwise indicated in the index of this manual, it sends and receives ASCII coded characters at 9600 bps using one start bit, eight data bits and one stop bit with no parity. Refer to Chapter 1 for specifications and connector pin assignment. The commands used to request or enter data or parameters are described under “I/O Interface Commands”.

2.8 IEEE-488 Interface Option

The IEEE-488 Interface is optional. It is present in your unit only if marked with an X in the index of this manual. This interface is a parallel, bi-directional data port compatible electrically, mechanically and functionally with the ANSI/IEEE standard 488-1978. Data is sent and received using ASCII coded characters. Select the address with the front-panel keypad key **3** as explained earlier in this Section. Refer to Chapter 1 for specifications and connector pin assignment. The commands used to request or enter data are described under “I/O Interface Commands” below.

2.9 I/O Interface Commands

Use the two-character commands listed below to communicate with the I/O interface. Generally, the command followed by a ASCII carriage return character requests current data or parameters. To load data, use the same command followed by the data. Many of the listed commands function only if the corresponding option is installed. The options installed unit are marked with an X in the index of this manual. Table 2-1 lists the commands alphabetically.

Table 2-2 I/O Commands

Name	Commands
AUTO TIME OUTPUT	AU (RS-232 only)
ERROR	EB
FILTER POLARITY ENABLE	FP
FORWARD	FW
TIME FREEZE	FZ
GENERATOR CODE SELECT	GC
SYNC GEN INPUT CODE	IC
LINE TERMINATOR	LT (RS-232)
LEAP YEAR STATUS	LY
MODE	MD
PROPAGATION DELAY	PD
REVERSE	RV
START GENERATOR	SG
STOP GENERATOR	ST
TRANSLATE CODE SELECT	TC
TIME	TI

2.10 Command Descriptions

In the following command descriptions, the symbol <CR> indicates an ASCII carriage return character and the symbol <LT> indicates the Line Terminator for RS-232 strings. IEEE-488 transmissions will always terminate with a carriage return character.

RS-232 LINE TERMINATOR (LT)

RS-232 command only. The user may specify the character(s), if any, that are used to terminate all transmissions from the 800 TCU. See table below for the line terminator code description.

Example Read: **LT<CR>**

Example Response: 0<CR>

No line terminator selected

Example Write: **LT3<CR>**

All outputs are ended with a line feed and a carriage return

.

Code	Line Terminator
0	none
1	carriage return
2	line feed
3	carriage return and line feed

AUTO TIME OUTPUT (AU)

RS-232 command only. This command will place the unit in the automatic time output mode. Time-of-year will output once per second and continue until another command is received.

The output string format is:

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

where

The start bit for the carriage return character <CR> begins at the one second mark, +0 to +1 bit time. Time will continue to output once per second until the port receives another command *(Note: This output is not available in Translator mode).*

ERROR BYPASS (EB)

This command is provided to return or load the number of frames of Error Bypass. The two-character response code returned or transmitted for a particular setting will be one of the following:

Response Code	Bypass
00	No Bypass
01	1 frame
02	2 frames
.	.
.	.
.	.
08	8 frames
09	9 frames
10	infinite bypass

Example Read: **EB<CR>**

Example Response: 03<LT>

Unit has 3 frames of Error Bypass selected

Example Write: **EB00<CR>**

Select no Error Bypass

FORWARD (FW)

This command is used to place the Translator in the forward direction.

Example Read: **FW<CR>**

Translator is placed in the forward direction

TIME FREEZE (FZ)

This command will cause the 800 TCU to freeze its current time. The next TIME "TI" command will cause the time previously frozen to be returned.

Example Read: **FZ<CR>**

The current time in the 800 TCU is frozen

GENERATOR CODE SELECTION (GC)

This command is provided to return or load the Generator code. The response code returned or transmitted for a particular code will be one of the following:

Response Code	Time Code
0	IRIG-G
1	IRIG-A
2	IRIG-B
3	IRIG-E
4	XR3
5	2137

Example Read: **GC<CR>**

Example Response: 2<LT>

Unit has IRIG-B selected.

Example Write: **GC0<CR>**

Select IRIG-G Generate code.

SYNC GENERATOR INPUT CODE (IC)

This command is used to return or load the Sync Generator input code selection. The response code returned will be one of the following:

Response Code	Time Code
0	N/A
1	N/A
2	IRIG-B
3	N/A

Example Read: **IC<CR>**

Example Response: 2<LT>

Unit has IRIG-B selected.

Example Write: **IC2<CR>**

Select IRIG-B Translate Code

LEAP YEAR (LY)

This command is used to return or set the 800 TCU time radix control. The response code returned or transmitted will be either a 0 (no Leap Year) or a 1 (Leap Year enabled).

Example Read: **LY<CR>**

Example Response: 1<LT>

Year radix at 366 days.

Example Write: **LY0<CR>**

Leap Year disabled (radix at 365 days).

MODE (MD)

Mode command is used to return or set the 800 TCU operating mode. The response code returned or transmitted for a particular mode will be one of the following:

Response Coded	Mode
0	Generator
1	Translator
2	Synchronized Generator

Example Read: **MD<CR>**

Example Response: 1<LT>

Unit is in Translator mode.

Example Write: **MD0<CR>**

Place 800 TCU in the Generator mode.

PROPAGATION DELAY (PD)

This command is used to return or set the 800 TCU Propagation Delay. The format of the data is as follows: 12345

Character	Data
1	Tens Milliseconds
2	Units Milliseconds
3	Hundreds Microseconds
4	Tens Microseconds
5	Unit Microseconds

Example Read: **PD<CR>**

Example Response: 12345<LT>

This example indicates a Propagation delay of 12345 microseconds

Example Write: **PD0000<CR>**

This sets the Propagation delay to zero milliseconds

The data must be transmitted in order (units microseconds through tens milliseconds) with no fields missing followed by a carriage return.

FILTER POLARITY ENABLE (FP)

The Filter/Polarity command is used to return or set the 800 TCU current Translator input polarity. The response code returned or transmitted will be a value from 0 through 3 as defined in the table below:

Response Code	Filter/Polarity
0	Filter ON / Non-inverted
1	Filter ON / Inverted
2	Filter OFF / Non-inverted
3	Filter OFF / Inverted

Example Read: **FP<CR>**

Example Response: 1<LT>

Translator input filter is ON and inverted.

Example Write: **FP0<CR>**

Translator input filter is ON and Non-inverted.

REVERSE (RV)

This command is used to place the Translator in the reverse direction.

Example: **RV<CR>**

START GENERATOR (SG)

This command may be used to start the Generator.

Example: **SG<CR>**

STOP GENERATOR/TRANSLATOR (ST)

This command may be used to stop the Generator or Translator depending on the operational mode.

Example: **ST<CR>**

TRANSLATE CODE SELECT (TC)

This command is provided to return or load the Translate code. The response code returned or transmitted for a particular code will be one of the following:

Example Read: **TC<CR>**

Example Write: **TC4<CR>**

The Translate Code is loaded with XR3 Time Code

Response Code	Time Code
0	IRIG-G
1	IRIG-A
2	IRIG-B
3	IRIG-E
4	XR3
5	2137

TIME (TI)

The TIME command may be used to read time from the 800 TCU or to preset the Generator major time registers. The ASCII time data is transmitted over the RS-232 interface in the format:

QDDDHHMMSSmmm<LT>

and over the IEEE-488 interface in the format:

DDDHHMMSSmmmQ<CR>

where

Q is the time quality character (hex 30 or hex 31)

DDD is day of year

HH	is hours
MM	is minutes
SS	is seconds
mmm	is milliseconds
<LT>	is the selected line terminator

In the Synchronized Generator and Translator modes, the time quality character will be an ASCII one (hex 31) if the unit has good reference code and an ASCII zero (hex 30). In the Generator mode the time quality character will always be an ASCII one character.

The preset time information must be transmitted in order (days, hours, minutes and seconds) with no fields missing and followed by a carriage return.

Example Write: **`TI365235945000<CR>`**

This command presets the time to 365 days, 23 hours, 59 minutes and 45.000 seconds.

3

Theory of Operation

3.1 Introduction

The following pages describe the circuits on each of the circuit boards present in this unit.

The central board in the unit is the Processor Assembly. It contains the processor and the front panel I/O logic. The descriptions of the remaining boards depend upon a prior understanding of the processor board. TrueTime suggests reading the description of the processor board first. References to the "MPU" refer to the processor on the Processor Assembly unless otherwise specified.

3.2 Individual Circuit Board Descriptions

The following pages contain the circuit card descriptions. They are inserted in numerical order.

4

Maintenance

4.1 Introduction

Effective maintenance and troubleshooting of this system requires a thorough understanding of equipment characteristics, operating procedures, theory of operation and knowledge of both linear and logic circuit elements. The equipment characteristics, operating procedures and the theory of operation for the system processor are provided in Chapter 1 through Chapter 3 of this manual.

All work performed on this equipment will be either preventative or corrective maintenance. Preventative maintenance is defined as what is required to maintain peak operating efficiency and to reduce the possibility of equipment malfunction. Corrective maintenance is defined as troubleshooting and correcting equipment malfunctions. Both types of maintenance procedures are described in the following paragraphs of this section.

4.2 General Information

This information includes a list of warnings and cautions and procedures for locating drawings and circuits.

4.2.1 Warnings and Cautions

The following is a list of warning and cautions to be observed while performing maintenance on this equipment. Failure to observe these warnings and cautions can result in serious injury, loss of life, or equipment damage.

Warnings

WARNING

Exercise extreme care when working in or around energized electrical equipment. Dangerous voltages are present that can cause serious injury or loss of life. The power supply in particular, has high voltages associated with it.

Disconnect equipment from the primary power prior to cleaning, inspecting, or disassembly. Dangerous voltages are present that can cause serious injury or loss of life.

Cautions

Exercise extreme care when handling this equipment. It contains precision parts that can be damaged by improper handling.

DO NOT TOUCH connector pin surfaces. Foreign material deposited on contact surfaces can cause corrosion, resulting in equipment damage and failure.

Turn off power prior to removing and inserting the circuit boards.

4.2.2 Locating Drawings

Reduced drawings of all mechanical assemblies and circuit cards that are used in the TCU are located at the end of this manual. A list of the drawings that are supplied in this manual are provided in the Index.

4.2.3 Locating Circuits

Chapter 3 provides a written description of each of the circuit boards used in the TCU. Use this information in conjunction with the line drawings when troubleshooting this equipment.

4.2.4 Circuit Board Extraction

The circuit boards are removed by first removing the retaining hardware and output connectors before removing them from chassis. When installing the circuit boards, install the correct hardware and make sure that any connectors are installed exactly as removed. Make cetrain the connector is firmly seated and the output connectors and hardware are correctly installed.

4.3 Preventive Maintenance

Preventive maintenance consists of a systematic routine that maintains maximum efficiency and reduces the possibility of a malfunction. This routine includes inspection, cleaning, and adjustment of the equipment.

4.3.1 Inspection

This equipment consists primarily of solid state circuits that require no routine maintenance. Periodic inspection and testing will be required to insure that the equipment still meets its performance specifications.

At the time that the tests are performed, the equipment should be inspected for damaged components, loose or frayed connections, and corrosion on metal surfaces. In the event that a malfunction or damage is found, it must be corrected immediately.

4.3.2 Cleaning

When the equipment is inspected and tested, it should also be cleaned. Accumulations of dust and dirt can impair cooling and generally distracts from equipment appearance.

A soft cloth and a commercial cleaner (such as Windex“) may be used to clean the paint and the lens. Be careful not to get the cleaner into any switches.

4.4 Corrective Maintenance

Corrective maintenance procedures are used to help maintenance personnel isolate an equipment malfunction.

These procedures imply a troubleshooting technique that uses the drawings and aids supplied in the manual along with a thorough knowledge of troubleshooting sophisticated electronic equipment.

4.4.1 Basic Troubleshooting Procedures

The following suggestions are general in nature, based upon established troubleshooting techniques. When followed, they aid in minimizing equipment down time. Any procedure given, however, is only a guide and may be deviated from whenever expedient.

4.4.2 Operating Procedures

Often what appears to be a malfunction, is the result of improper operation or application of the equipment. Upon encountering a problem thoroughly evaluate the operating procedures that were used when the malfunction occurs. Check external loads where applicable.

4.4.3 Visual Indicators

Use the visual indicators, particularly the alphanumeric display, as a troubleshooting aid. Note any indications which vary from those which would normally be expected. The STATUS display gives error messages wherever possible. They may be useful in determining a failure mode.

4.4.4 Power Circuits

Verify that power supply(s) are operating to their specification(s). Verify that the primary power fuse has not blown and that primary power is present.

4.4.5 Replacing Components

It is imperative that the IC's are replaced with exactlythe same type of component. Do not guess in this area. Use the parts lists to find the exact IC part number if there is a question. Be sure not to bend under the IC legs when replacing them.

When replacing soldered in components use a low temperature iron and be careful not to disturb the etch. Use a resin-core flux and clean the soldered joints carefully with alcohol. Do not allow the cleaner to penetrate the pots or switches.

Do not remove or insert circuit board assemblies while power is applied.