ESE

SMPTE/EBU TIME CODE PRODUCTS & ACCESSORIES

READERS

INSERTERS

CONVERTERS

COMPARATORS

GENERATORS

DISTRIBUTION AMPLIFIERS

*Since the beginning of the "Video Era," SMPTE Time Code has been one of the most valuable tools used in video editing. And, since the early 1970's, **ESE** has been manufacturing SMPTE Time Code tools. **ESE**'s diverse line of SMPTE equipment includes Readers, Generators, Inserters, Converters and Comparators. Combination units such as the ES-488U allow the user to read, insert and generate all with a single unit. Also, **ESE** can translate between SMPTE and other codes. Some examples are SMPTE to/from **ESE** or ASCII and IRIG-B to SMPTE.*

Applications

- Schools & Distant Learning Centers
- Government & Military Installations
- Tele-Conferencing Centers
- Post Production Houses
- Broadcast Facilities
- Recording Studios

Features

- GPS Traceability
- Easily Expanded
- "On-Frame" Precision
- Bi-Directional / Multi-Speed
- Digital, Analog & Video Displays
- HD & SD SDI Time Code Products
- SMPTE/EBU, NTP, IRIG-B, **ESE**, & ASCII Time Code Outputs

INTRODUCTION

BACKGROUND

Founded in 1971, **ESE's** first products consisted of a line of Digital Clocks and Timers designed specifically to meet the needs of the broadcast and medical industries. In the mid-'70s **ESE** introduced two Master Clocks, one of which referenced a one second per month crystal time base, and the other WWV (NBS/NIST). These products widened the market of the **ESE** product lines to include school systems, 9-1-1 dispatch centers and military installations.

Later in the '70s, the ES-251our first SMPTE Time Code Product was introduced. Since then, that Product Family has grown considerably. The SMPTE Family now includes more than 50 standard products, highlighted by the ES-185E: GPS referenced SMPTE Time Code Generator /Master Clock and HD-488E/SD: HD & SD SDI SMPTE Time Code Generator/Reader/Inserter.

Through the years **ESE** has also worked with several OEMs, designing and manufacturing products that met unique requirements. These alliances have found **ESE** manufactured products in a variety of applications including post-production, military and television.

As the need for precision timing and time code equipment grows, so does **ESE**. And, with the availability of new technology, so does our product line. With nearly 350 standard products, **ESE** is certain to offer a solution to all of your precision timing requirements.

PRODUCT FAMILIES

Many **ESE** products have a tendency to overlap from one "Product Family" to another. The products described in this brochure, in one way or another, deal with SMPTE/EBU Time Code. If any of our other Product Families are of interest to you, give us a call. Or, send us an e-mail at **ese@ese-web.com**.

- ♦ **DIGITAL VIDEO PRODUCTS**
- ♦ **DISTRIBUTION AMPLIFIERS**
- ♦ **MASTER CLOCK SYSTEMS**
- ♦ **CLOCKS & TIMERS**
- ♦ **"SMPTE/EBU" TIME CODE PRODUCTS**

- ♦ **VIDEO PRODUCTS**
- ♦ **AUDIO PRODUCTS**
- ♦ **CONVERTERS & TRANSLATORS**
- ♦ **"IRIG" PRODUCTS (including Airborne)**
- ♦ **"TIME SYNCHRONIZATION" & "9-1-1" PRODUCTS**

CUSTOM PRODUCTS

Since 1971, **ESE** has manufactured over 2600 different "Specials" (products defined by the customer's specific requirement... designed and built by **ESE**). Many of these "Specials" have evolved into "Standard" Products, some of which are mentioned in this brochure. If you have a custom requirement, give us a call and put our "time" and experience to work for you.

CUSTOMER SATISFACTION

Our goal is to meet or exceed your expectations. All **ESE** products are made in the U.S.A. and guaranteed to operate according to the descriptions and specifications as described within this brochure. Additionally, all **ESE** products carry a warranty as described on page 24.

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HD-488E/SD
HD TIME CODE READER/GENERATOR/INSERTER

The **HD-488E/SD** is a Time Code Reader, Generator and Inserter for HD (High Definition) and SD (Standard Definition) Serial Digital Interface (SDI) video. Linear Time Code (LTC) and RP-188 Time Code are both read and generated by the **HD-488E/SD.** The unit also accepts a multitude of HD formats as well as 4:2:2 (525 and 625 line) digital video signals. If SD SDI video is not required the **HD-488E** may be specified in place of the **HD-488E/SD**. The inserter mode provides the ability to superimpose time and/or user bits onto video with alphanumeric characters. As many as thirty characters of text may also be superimposed onto the video with a choice of 7 different colored fonts. Flexibility is also provided to the user, allowing for selection of the information to be displayed (time, time and user bits or text) on up to three different windows. The three windows are independent of each other and may be blanked.

Features

- Generates/Inserts Time Code • USB Setup Interface • Dual LTC Output • Accepts 4:2:2 (525 and 625 line)

- Universal Power Supply (90-264 VAC) • Accepts Multiple HD Formats • Time Zone Offset

- LCD Setup/Status Display • Numerous Options Available • User Friendly Control

- Seven Selectable Font Colors • Selectable Onscreen Date Formats (YMD, DMY, MDY)

Rear Panel shown with options GPS & NTP

Uses

- Time Code / Time of Day / User Text Window burn • Transcode SMPTE Codes to IRIG-B (w/IRIG option)

- Transcode RP-188 to LTC • Transcode LTC to RP-188 • GPS Sourced NTP Server (w/NTP & GPS options)

- NTP Sourced Master Clock (w/NTP-C option) • Master Time Code Generator • GPS Master Clock (w/GPS option)

- IRIG Sourced NTP Server (w/NTP & IRIG options) • Drive New or Existing Remote Displays with Time of Day

- Transcode IRIG A/B/G to IRIG-B or SMPTE Codes (w/IRIG option) • IRIG-B Generator (w/IRIG option)

The video input and output are accessible via rear mounted BNC connectors. Time code input and output connectors on the rear panel are XLR(When option IRIG is specified the IRIG-B input is via a BNC connector). The **HD-488E/SD** is housed in a single height rack mount enclosure which is black anodized.

A 16 x 2 character LCD shows the current time and status of the **HD-488E/SD**. The front panel controls allow access to all configuration settings as displayed on the 16 x 2 character LCD. The same controls

Power:	90 – 264 VAC, 47 – 63 Hz, 15 Watts max	**HD SDI Input/Output:**	1080i/60, 1080i/59.94, 1080i/50, 1080p/30sF,
Mechanical:	Rackmount Enclosure 1¾" H x 19" W x10" D		1080p/29.97sF, 1080p/25sF, 1080p/24sF,
Time & Setup/Status Display:	16 x 2 character LCD		1080p/23.98sF, 720p/59.94
Time Code Input:	SMPTE (100 mVpp-10 Vpp;	**SD SDI Input/Output:**	SMPTE 259M (270Mb/s)
	10kΩ input impedance)	**Analog Input:**	1 Vpp, terminated
	Optional-IRIG (100 mVpp-10 Vpp)	**Color Frame Input:**	Vertical interval negative TTL/CMOS pulse
		Options:	*ESE*, GPS, IRIG, NTP, NTP-C, OCXO, RS, UL

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SD-488E

SDI TIME CODE READER/GENERATOR/INSERTER

The **SD-488E** is a Time Code Reader, Generator and Inserter for SD (Standard Definition) Serial Digital Interface (SDI) video. Linear Time Code (LTC) and Digital Vertical Interval Time Code (D-VITC) are both read and generated by the **SD-488E**. The unit also accepts 4:2:2 (525 and 625 line) digital video signals. The inserter mode provides the ability to superimpose time and/or user bits onto video with alphanumeric characters. As many as thirty characters of text may also be superimposed onto the video with a choice of 7 different colored fonts. Flexibility is also provided to the user, allowing for selection of the information to be displayed (time, time and user bits or text) on up to three different windows. The three windows are independent of each other and may be blanked.

Features

- Generates/Inserts Time Code
- USB Setup Interface
- User Friendly Control
- Time Zone Offset
- Universal Power Supply (90-264 VAC)
- Accepts 4:2:2 (525 & 625 line)
- Dual LTC Output
- LCD Setup/Status Display
- Numerous Options Available
- Seven Selectable Font Colors
- Selectable Onscreen Date Formats (YMD, DMY, MDY)

Rear Panel shown with options GPS & NTP

Uses

- Time Code / Time of Day / User Text Window burn
- Transcode SMPTE Codes to IRIG-B (w/IRIG option)
- Transcode LTC to DVITC
- Transcode DVITC to LTC
- GPS Sourced NTP Server (w/NTP & GPS options)
- NTP Sourced Master Clock (w/NTP-C option)
- Master Time Code Generator
- GPS Master Clock (w/GPS option)
- IRIG Sourced NTP Server (w/NTP & IRIG options)
- Drive New or Existing Remote Displays with Time of Day
- Transcode IRIG A/B/G to IRIG-B or SMPTE Codes (w/IRIG option)
- IRIG-B Generator (w/IRIG option)

The video input and output are accessible via rear mounted BNC connectors. Time code input and output connectors on the rear panel are XLR and when option IRIG is specified the IRIG-B input is via a BNC connector. The **SD-488E** is housed in a single height black anodized rack mount enclosure.

A 16 x 2 character LCD shows the current time and status of the **SD-488E**. The front panel controls allow access to all configuration settings as displayed on the 16 x 2 character LCD. The same controls are available on the PC software which is accessible via the rear mounted USB port.

SPECIFICATIONS

Power:	90 – 264 VAC, 47 – 63 Hz, 15 Watts max	**SD SDI Input:**	SMPTE 259M (270Mb/s)
Mechanical:	Rackmount Enclosure 1¾" H x 19" W x10" D	**SD SDI Output:**	SMPTE 259M (270Mb/s)
Time & Setup/Status Display:	16 x 2 character LCD	**Analog Input:**	1 Vpp, terminated
Time Code Input:	SMPTE (100 mVpp-10 Vpp; 10kΩ input impedance) Optional-IRIG (100 mVpp-10 Vpp)	**Color Frame Input:**	Vertical interval negative TTL/CMOS pulse
		Options:	*ESE*, GPS, IRIG, NTP, NTP-C, OCXO, RS, UL
		Similar Products:	HD-488E, HD-488E/SD

SMPTE/EBU TIME CODE
GENERATOR / INSERTER / READER

The **ES-488U** is a combination SMPTE/EBU Time Code Generator, Reader and Inserter. The unit can read and generate both time and user bits, and it can operate in either drop frame or non-drop frame modes. Front panel controls select Time or User Bits, Drop Frame or Non-Drop Frame, Run or Hold and Reader or Generator modes. The micro-processor circuitry automatically detects and corrects for errors in time code when reading. The **ES-488U** has "jam-sync" capability, a color sync input and a reconstituted time code output when in reader mode. Video Inserter controls allow the Brightness to be adjusted and the Size and Position to be adjusted horizontally and vertically.

Reader Features:

- Display "Hold" Control
- Reads Time or User Bits
- Error Detection & Correction
- Reconstituted Time-Code Output
- Eight-Digit .56" Yellow LED Display
- "On Time" Count (Frame Accurate)
- Reads from 1/30th to 30x Play Speed
- Drop Frame & Non-Drop Frame Modes

Generator Features:

- "Hold" Control
- Color Frame Input
- Jam-Sync Capability
- Generates Time & User Bits
- Reset To 00:00:00:00 Switch
- Drop Frame & Non-Drop Frame Modes
- Time Code Synched To Composite Video

Inserter Features:

- Brightness Control
- Vertical & Horizontal Size Control (2% - 20% of screen)
- Vertical & Horizontal Position Control (anywhere, line by line)
- White or Translucent Video Characters Are Located Within Black or Translucent Keyed Background
- Other Features Identical To Reader

Operation Notes:

- Selectable EBU / PAL operation
- Incoming video is passed through unaffected when "Blanking" Switch is "OFF"
- Set/Select Controls set Time up to 23:59:59:00 and User Bits up to 99:99:99:00
- Color Frame Input usage assures frame numbers agree with SMPTE color frame standard
- GEN / READ Control selects Generator or Reader mode and implements the Jam Sync Function
- External composite video signal is the source of signal for video character inserter as well as for synchronizing the generated time code output (two BNC video outputs are provided)

Specifications

Time Code Input:	100 mV - 10 Vpp; 2kΩ input impedance unbalanced	**Drift:**	2 Seconds/Day
Time Code Output:	0 dB into 600Ω, balanced	**Display:**	Eight Digits, Yellow LED, .56" High
Video In/Out:	1 Vpp, 75Ω	**Electrical:**	117 VAC, 50/60 Hz
Color Frame Input:	Field #1 Vertical interval negative TTL/CMOS pulse	**Power:**	10 Watts Maximum
		Mechanical:	1.75" x 19" Rack Mount, 10" Deep
		Options:	J, R, UL

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GPS-BASED
SMPTE/EBU TIME CODE GENERATORS

The **ES-185E** and **ES-102U** are GPS-Based, SMPTE/EBU Time Code Generators. An internal 12-channel GPS receiver provides extremely accurate time and date information anywhere in the world. Both units serve the dual purpose of "real time" SMPTE/EBU Time Code Generator and Master Clock. ASCII (RS-232C), USB and **ESE** (TC89 & TC90) Time Code outputs are also provided, as well as two (2) 1 PPS outputs (20% and 50% duty cycles).

Included with each unit is an antenna with a 16' cable. Additional cable lengths may require an in-line amplifier (**ES-820** or **ES-820N**) and for extra-long lengths, the **ES-AB1A** (Antenna Power Supply) may be required. Consult factory for details.

Features:

- SMPTE/EBU & USB Time Code Output
- Internal 12-Channel Receiver
- Dual 1 PPS Outputs
- Automatic Daylight Savings Time Correction
- Loss of GPS Signal Indicator & Output
- **ESE** & ASCII Time Code Outputs
- Time Advance / Retard Feature For Synchronization Purposes
- Indoor / Outdoor Antenna & 16' Cable
- Time Zone Offset
- Custom Modifications Available

9-DIGIT SMPTE/EBU GENERATOR
(10ηS Accuracy)

The **ES-185E** is a SMPTE Time Code Generator / GPS Master Clock. The unit utilizes a 12-channel GPS Receiver with an accuracy of 10ηS. **ESE** (TC89 & TC90), ASCII (RS-232C) and IRIG-B Time Code outputs are also provided.

The display consists of nine digits of .56" Yellow LEDs that display Day of Year, Hours, Minutes and Seconds. An indoor/outdoor antenna with 16' of cable and 4-hour battery back-up are included.

The **ES-185E** is housed in a rack mount enclosure that measures 1.75" x 19" x 10" deep. Power required is 117 VAC, 50/60 Hz (220 VAC, 50/60 Hz is optionally available).

6-DIGIT SMPTE/EBU GENERATOR
(500ηS Accuracy)

The **ES-102U** is a SMPTE Time Code Generator / GPS Master Clock. The unit utilizes a 12-channel GPS Receiver with an accuracy of 500ηS. **ESE** (TC89 & TC90) and ASCII (RS-232C) Time Code outputs are also provided.

The display consists of six digits of .56" Yellow LEDs that display Hours, Minutes and Seconds. An indoor/outdoor antenna with 16' of cable is included.

The **ES-102U** is housed in a rack mount enclosure that measures 1.75" x 19" x 10" deep. Power required is 117 VAC, 50/60 Hz (220 VAC, 50/60 Hz is optionally available).

SPECIFICATIONS

	ES-185E	ES-102U
Accuracy::	10 ηS of UTC	500 ηS of UTC
Drift:	33 mS/Day, if no signal	33 mS/Day, if no signal
Receiver:	Internal 12-Channel	Internal 12-Channel
Antenna:	Indoor / Outdoor with 16' Cable	Indoor / Outdoor with 16' Cable
Displays:	9-Digit, .56" Yellow LED	6-Digit, .56" Yellow LED
Outputs:	SMPTE, IRIG-B, ASCII, USB, **ESE** (TC89 & TC90), 2) 1 PPS	SMPTE, ASCII, USB, **ESE** (TC89 & TC90), 2) 1 PPS
Video Input:	1 - 2 Vpp, unterminated	1 - 2 Vpp, unterminated
Mechanical:	1.75" x 19" x 10" Deep, rack mount	1.75" x 19" x 10" Deep, rack mount
Electrical:	117 VAC, 50/60 Hz, 15W	117 VAC, 50/60 Hz, 15W
Battery:	4-Hour, 1.2 A Gel Cell	Option "BBU" (4-Hour, 1.2 A Gel Cell)
Options:	Ant, DC, EBU, HR, J, K, NTP6, UL	Ant, BBU, DC, EBU, HR, J, K, UL, 10ηS

NTP REFERENCED TIME CODE GENERATOR

The **ES-188E** is an NTP referenced Master Clock and Time Code Generator. It displays nine digits (Day of Year, Hour, Minute & Second) of time as received via a user selected NTP server. Simultaneously, the **ES-188E** generates several types of time code (**ESE**-TC89, **ESE**-TC90, USB, RS232C/ASCII, SMPTE/EBU and IRIG-B) and a 1PPS signal. These outputs allow the **ES-188E** to easily interface with new or existing computer, automation and clock systems.

Features:

- **ESE**, USB, ASCII (RS-232C), SMPTE/EBU & IRIG-B Time Code Outputs   • NTP Ethernet Port
- Automatic Daylight Savings Time Correction   • NTP Update Output   • 1 PPS Output
- USB Set-up Interface & Software   • Dual Battery Back-Up (Coin-Cell & Gel-Cell)
- Optional DC Operation for Field and Ground Mobile Applications   • NTP Sync Indicator
- Time Advance/Retard Feature for Synchronization Purposes • Time Zone Offset

Specifications

Electrical: 117 VAC, 50/60 Hz	**Outputs**: **ESE** Time Code: drives 100 Slaves @ 4000'
Power: 15 Watts Maximum	USB: Universal Serial Bus, Date & Time Output
Mechanical: 1.75" x 19" Rack Mount, 10" Deep	RS-232C: Date & Time Output
Displays: Nine Digits, Yellow LED, .56" High	SMPTE: 600Ω Balanced or Unbalanced
Accuracy: Network dependent, generally less than 1mS	IRIG-B: 3 Vpp (mark amplitude), 600Ω,
Drift: 33mS/day (if no NTP signal)	AM or TTL selectable
Input: Ethernet: 10/100 Base-T	1 PPS: TTL, 50% Duty Cycle
Battery: Coin-Cell & Gel-Cell (displays are blank)	**Clock Set-up**: USB, RS-232C, Network (Telnet or Windows®)
Video Input: RS-170A Composite Video/Blackburst, 1Vpp, 75Ω	**Options**: DC, HR, J, NPR, NTP6, UL

CRYSTAL CONTROLLED TIME CODE GENERATOR

The **ES-160E** is a Master Clock/Time Code Generator. The unit employs a voltage controlled/temperature compensated crystal oscillator which provides the **ES-160E** with an accuracy of one second per month. Six .56" yellow LED's display real time while the unit simultaneously generates several types of time (and date) code (SMPTE/EBU, **ESE**-TC89, **ESE**-TC90 and RS232C/ASCII) and a 1 PPS signal.

Features:

- SMPTE/EBU, ASCII (RS-232C) and **ESE** (TC89 & TC90) Time Code Outputs   • 12 or 24 Hour Display
- Automatic Daylight Savings Time Correction   • Dual Battery Back-Up (Coin-Cell & Gel-Cell)
- External Time Sync Input   • 1 PPS Output   • One Second per Month "VCTCXO" Crystal Accuracy

Specifications

Electrical: 117 VAC, 50/60 Hz	**Outputs:** 1 PPS: TTL, 50% Duty Cycle
Power: 15 Watts Maximum	**ESE** Time Code: drives 100 Slaves @ 4000'
Mechanical: 1.75" x 19" Rack Mount, 10" Deep	SMPTE: 600Ω Balanced or Unbalanced
Displays: Six Digits, Yellow LED, .56" High	RS-232C: ASCII Date & Time @ 9600 Baud,
Accuracy: +/-33mS/day	8 Data, No Parity, 1 Stop
Video Input: RS-170A Composite Video/Blackburst, 1 Vpp, 75Ω	**Battery:** Coin-Cell & Gel-Cell (displays are blank)
Time Sync Input: TTL, 1 PPS or Slower	**Options:** DC, HR, J, NTP6, UL

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SMPTE/EBU
TIME CODE GENERATORS

The **ES-461U** and **ES-263** are SMPTE/EBU Time Code Generators. Front panel thumbwheel switches allow the user to preset the unit's Hours, Minutes and Seconds (Hours & Minutes only on the ES-263) or User Bits. Each unit accepts composite video or composite sync and operates in drop frame or non-drop frame mode. Features include a video sync input, a color frame pulse input and a clock "Hold" function.

Features:

- "Hold" Control
- Video Sync Input Accepts Either Composite Video Or Sync
- Drop Frame & Non-Drop Frame Mode
- Custom Modifications Available
- Time & User Bits Are Presetable

RACK MOUNT GENERATOR

The **ES-461U** is a microprocessor-based, presettable SMPTE Time Code Generator. SMPTE Time or User Bits can be preset via the unit's front panel thumbwheel switches. Or, the unit can be Jam-Synched to an external source of SMPTE via the rear mounted female XLR connector. The SMPTE output is accessible via the rear mounted male XLR connector. Two BNC connectors provide a loop-thru Video Sync Input that accepts either composite video or sync. A Color Frame Input is also provided via a BNC connector.

The **ES-461U** is housed in a rack mount enclosure that measures 1.75" x 19" x 10" deep, with a black anodized front panel. Power required is 117 VAC 50/60 Hz and 220 VAC 50/60 Hz is optionally available. EBU operation can be optionally specified. Option "UL" provides a UL Approved wall mount power supply.
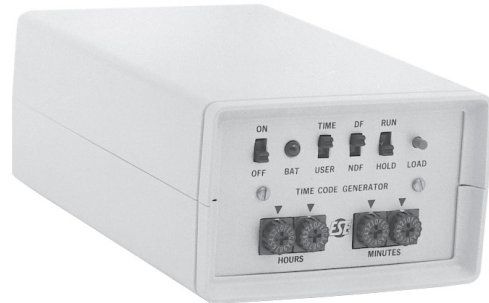
PORTABLE GENERATOR

The **ES-263** is a portable, presettable SMPTE Time Code Generator. The microprocessor-based unit can be preset using the front panel mounted controls (only hours and minutes are presettable as seconds and frames are automatically set to 00:00). The **ES-263** can generate Time Data or User Bits (User Bits are presettable with hexadecimal values "0 - F"). SMPTE Time Code (unbalanced) is output via a rear mounted RCA, and the Video Sync Input (composite video or sync) is via a rear mounted BNC connector.

The unit is housed in a small portable enclosure that includes a convenient belt clip. The internal battery provides up to ten hours of operation per charge. An AC/wall adapter/charger is also included. PAL and/or EBU operation can be optionally specified.

SPECIFICATIONS

	ES-461U	ES-263
Time Code Output:	0 dB into 600Ω, balanced	2 Vpp, unbalanced
Time Code Input:	100 mVpp - 10 Vpp, unbalanced	N/A
Video In/Out:	1 - 2 Vpp, unterminated	1 - 2 Vpp, unterminated
Color Frame Input:	TTL or CMOS Field #1 negative pulse	N/A
Drift:	2 Seconds/Day	2 Seconds/Day
Mechanical:	1.75" x 19" x 10" Deep, rack mount	3.6" W x 2.3" H x 6" D, 1 lb.
Electrical:	117 VAC, 50/60 Hz, 5 W	Internal Battery; 117 VAC Adapter/Charger
Battery:	N/A	1.2 A Gel Cell @ 12 VDC, 120 mA
Options:	EBU, J, UL	EBU, PAL

BI-DIRECTIONAL MULTI-SPEED SMPTE/EBU TIME CODE DIGITAL DISPLAYS

ESE's Bi-Directional Multi-Speed SMPTE/EBU Time Code Readers include the **ES-456UE** and **ES-956U**. Both have eight-digit, yellow LED displays and read drop frame or non-drop frame time code. Each unit features "on-time" frame count, a "Hold" control and automatic error correction. Rear mounted controls select whether SMPTE/EBU Time Data or User Bit Data are to be displayed.

The units described below are designed to decode and display SMPTE or EBU Time Code. The time code may originate from any *ESE* Master Clock, an *ESE* Converter or any other source of SMPTE/EBU Time Code.

Other size displays and different enclosures are available if "play-speed" only is required (see pages 8 & 9).

Features:

- Perfect Synchronization with Master Or "Source" Of Time Code
- Optional Rack Mount Enclosure
- Simple Installation & "Hands-Off" Operation
- Drop Frame Or Non-Drop Frame Operation
- Reads From 30x To 1/30th Speed
- Reads Forward Or Reverse
- Displays "User Bits" Or "Time" Data
- Error Detection & Correction
- Drop Frame Indicator
- EBU Operation

**MULTI-SPEED BI-DIRECTIONAL
SMPTE/EBU TIME CODE READER**

**MULTI-SPEED BI-DIRECTIONAL
READER with 2.3" LED DISPLAYS**

The **ES-456UE** is a Multi-Speed Bi-Directional SMPTE/EBU Time Code Reader. Hours, minutes, seconds and frames are displayed on the eight .56" LEDs. The **ES-456UE** tracks time code at speeds from 30x play speed to 1/30th play speed in forward or reverse. Time or User Bits are selected via a rear mounted toggle switch.

The **ES-956U** is a SMPTE/EBU Time Code Reader with 2.3" high yellow LED displays. The unit reads at speeds from 30x play speed to 1/30th play speed in forward or reverse. The eight digit display features on-time frame count, error detection and correction, a drop frame indicator, a time code error indicator and a "Hold" input. User Bits may be selected. The unit is housed in a wall mount enclosure.

SPECIFICATIONS

	ES-456UE	ES-956U
Power:	10 Watts	10 Watts
Electrical:	117 VAC, 50/60 Hz	117 VAC, 50/60 Hz
Input:	SMPTE Time Code	SMPTE Time Code
Display:	8-Digit, Yellow .56" LED	8-Digit, Yellow 2.3" LED
Viewing Distance:	20 Feet	70 Feet
Enclosure:	Desk Top	Wall Mount
Mechanical:	2.25" H x 9" W x 6" D	5" H x 19" W x 3.5" D
Options:	Black, Blue, Green, J, P, Red, RS, UL	Blue, Green, J, Red, UL

SMPTE/EBU
TIME CODE READERS

These eight-digit displays are designed to auto-detect, read and display SMPTE or EBU time code. Each is capable of reading in either direction (forward or reverse) at speeds ranging from 1/15th to 3x play-speed.

Setup Features allow the unit to display time in either 12 or 24 hour format and to display "User Bits" data. An Error Detection and Correction Feature maintains flicker-free operation in the event of poor quality or loss of time code. An Error Detection Indicator is also included, and the Error Feature may be turned-off via an internal DIP switch.

Pressing the front mounted "Hold" push-button allows the display to be "frozen." A rear mounted toggle switch (front panel mounted when option "P" is specified) selects whether "time" or "user bits" are displayed. Note: Controls for the ES-493U, ES-443U, and ES-978 are provided on the rear mounted terminal block.

Several Options are available with "U" Series Readers. Option "TZ" allows the unit to be "offset" to other time zones via an internal set of DIP switches. *ESE* and ASCII (RS-232C) time code outputs are also optionally available which allow these units to function as Time Code Converters. Most units are available with a rack mount enclosure, option "P". Other options are listed below.

Each Reader requires only a single pair of wires (or coax) between itself and the Master Clock (or other source of time code). The wiring arrangement can be parallel, serial or both. Please note that extra long cable runs may require a Distribution/Isolation Amplifier, please refer to the Distribution Amplifiers Brochure.

Features:

- Reads SMPTE Or EBU Time Code
- Error Detection & Correction
- Optional Time Zone Offset
- Optional *ESE* & RS-232C Time Code Outputs
- Display Time Or User Bits
- .56" to 7.0" Display Sizes
- 12/24 Hour Format
- Simple Installation & "Hands-Off" Operation
- Long-Life LED Displays
- Desk Top, Wall & Rack Mount Enclosures
- Perfect Synchronization With Master Clock

SPECIFICATIONS

	LX-453U	ES-453UE	LX-463U	ES-463U	ES-493U	ES-443U	ES-978
Power:	5 Watts	5 Watts	5 Watts	5 Watts	8 Watts	10 Watts	20 Watts
Line Cord:	3-wire, 6'	3-wire, 6'	3-wire, 6'	3-wire, 6'	3-wire, 6'	3-wire, 6'	3-wire, 6'
Electrical:	117 VAC, 50/60 Hz	117 VAC, 50/60 Hz	117 VAC, 50/60 Hz	117 VAC, 50/60 Hz	117 VAC, 50/60 Hz	117 VAC, 50/60 Hz	90-264 VAC, 50/60 Hz
Time Code Input:	SMPTE/EBU	SMPTE/EBU	SMPTE/EBU	SMPTE/EBU	SMPTE/EBU	SMPTE/EBU	SMPTE/EBU
Connector:	BNC	XLR	BNC	XLR	Terminal Block	Terminal Block	Terminal Block
Enclosure:	Desk Top	Desk Top	Desk Top	Rack Mount	Wall Mount	Wall Mount	Wall Mount
Mechanical (HxWxD):	1.7" x 9.6" x 6"	2.25" x 7.1" x 5.35"	3.5" x 12.3" x 6"	3.5" x 19" x 10"	5" x 19" x 3.5"	7" x 43" x 3.5"	7" x 56.25" x 3.5"
Display Height/Color:	.56", Yellow	.56", Yellow	1.0", Yellow	1.0", Yellow	2.3", Yellow	4.0", Red	7.0", Red
Viewing Distance:	20 feet	20 feet	35 feet	35 feet	70 feet	120 feet	250 feet
Options:	Blue, Green, J, Red, RS, TZ, UL	Blue, *ESE*, Green, J, P, Red, RS, TZ, UL	Blue, Green, J, Red, RS, TZ, UL	Black, Blue, *ESE* Green, J, Red, RS, TZ, UL	Blue, Green, J Red, TZ, UL	Amber, Blue, Green, J, TZ, UL	Blue, Green, TZ, UL

SMPTE PRESETTABLE UP/DOWN TIMER

The **ES-466E** is an eight digit, presettable 24 hour SMPTE/EBU timer (00:00:00:00 – 23:59:59:29) with five top-front mounted controls (UP, DOWN, STOP, RESET and PRESET). A SMPTE/EBU output is provided on a rear panel XLR connector. The "Bit Order Forward" toggle switch also located on the rear panel of the **ES-466E** allows the unit to mimic decks that always output "forward" code.

The **ES-466E** offers simple user operation.

Features

- Forward/Reverse or Forward-Only Bit Order
- 24 Hour Up/Down Count Range (00:00:00:00 - 23:59:59:29)
- Thumbwheel Preset of Hours, Minutes & Seconds
- SMPTE Time Code Output

SPECIFICATIONS

Power:	5 Watts Max
Electrical:	110-120 VAC, 50/60Hz
SMPTE Time Code Output:	XLR connector
Enclosure:	2.25" High x 9" Wide x 6" Deep
Options:	D, EBU, *ESE*, J, N, P, R, UL, Z

VERTICAL INTERVAL TIME CODE (VITC) READERS

The **ES-491E** and **ES-496** are 8-digit VITC Readers and are able to accept video from either an NTSC or PAL source. The **ES-491E** has .55" and the **ES-496** has 1.0" yellow LED displays. A front-mounted push-button "HOLD" switch allows the time on the display to be frozen and a "TIME/USER" switch permits time or user bits to be displayed. Internal DIP switches allow manual selection of VITC video lines or automatic VITC Identification Mode. The VITC Input/Output loop is accessible on rear-mounted BNC connectors. A 75Ω "Termination" switch can be used when no other device is to be connected to the video output. Several options are available including 220 VAC operation, RS-232C output, *ESE* TC90 output and LTC (Longitudinal SMPTE or EBU Time Code) output. The **ES-491E** is housed in a desk top enclosure that measures 2.25" H x 9" W x 6" D and a 1¾" x 19" rack mount is optional. The **ES-496** is housed in a 3½" x 19" x 10" rack mount enclosure.

Features

- Eight Bright-Yellow LED Displays
- Drop-Frame Indicator
- Reads Time or User Bits
- Auto or Manual Line Selection
- Accepts NTSC Or PAL
- Front Panel "Hold" Pushbutton
- Reads SMPTE or EBU
- 75Ω Video Termination Switch

Specifications

Video Input:	1 VPP, 75Ω, BNC loop-thru; switchable termination	**Dimensions:**	ES-491E: 2.25" H x 9" W x 6" D
VITC Lines:	10 - 24		ES-496: 3.5" H x 19" W x 10" D
VITC Level:	80 IRE nominal; 50 IRE minimum	**Electrical:**	117 VAC, 50/60 Hz
Enclosure:	ES-491E: Desk-Top	**Power:**	5W maximum
	ES-496: Rack Mount	**Options:**	Blue J, Green, LTC, P, Red, RS, UL

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TIME CODE READERS

These six-digit (or four-digit) displays are designed to be "Universal" Time Code Readers. All models described below are able to auto-detect, read and display SMPTE-LTC, EBU, *ESE* (TC76™, TC89™ or TC90™), ASCII (format A, 0 or 1 @ 9600 baud; RS-232C, RS-422A or RS-485). Optionally NTP-C or NTP-C/PoE may be specified.

Setup Features allow the unit to display time in either 12 or 24 hour format, and if reading *ESE* Time Code to display "Date" information, and if reading SMPTE/EBU to display "User Bits." An Error Detection and Correction Feature maintains flicker-free operation in the event of poor quality or loss of time code. An Error Detection Indicator is also included, and the Error Correction Feature may be turned-off via an internal DIP switch.

Several Options are available with "U" Series Readers. LED color options of Amber, Blue, Green and Red can be specified on the .56", 1", 2", 4" and 7" units. Option "TZ" allows the unit to be "offset" to other time zones via an internal set of DIP switches. *ESE* and ASCII (RS-232C) time code outputs are also optionally available. Most units are available with a rack mount enclosure, option "P". Other options are listed below.

Each Reader requires only a single pair of wires (or coax) between itself and the Master Clock (or other source of time code). The wiring arrangement can be parallel, serial or both. Please note that extra long cable runs may require a Distribution/Isolation Amplifier, please refer to the Distribution Amplifier Brochure.

Features:

- Reads SMPTE/EBU, ASCII or *ESE* Time Code • Error Detection & Correction • Optional Time Zone Offset
- Optional *ESE*, & RS-232C Time Code Outputs • Display Date or Time • 0.4" To 7.0" Display Sizes
- 12/24 Hour Format • Simple Installation & "Hands-Off" Operation • Long-Life LED Displays
- Desk Top, Console, Wall & Rack Mount Enclosures • Perfect Synchronization With Master Clock

ES-996U
ES-943U

ES-161UE
ES-166UE
ES-991U

ES-161UEP
ES-166UEP
ES-996UP

ES-171U
LX-161U
ES-166UEQ
LX-166U

SPECIFICATIONS

Model Number	Description	Viewing Distance	Time Code Input	Options
ES-171U	6-digit, 0.4" Red LED in Console mount enclosure	10'	*ESE*, SMPTE/EBU	J, V, UL, W
LX-161U	6-digit, .56" Amber LED in "LX-" enclosure	20'	*ESE*, SMPTE/EBU, ASCII	J, RS, TZ, UL
ES-161UE	6-digit, .56" Amber LED in Desk mount enclosure	20'	*ESE*, SMPTE/EBU, ASCII	*ESE*, J, NTP-C, NTP-C/PoE, P, P2, PoE, Q, RS, TZ, UL
LX-166U	6-digit, 1.0" Amber* LED in "LX-" enclosure	35'	*ESE*, SMPTE/EBU, ASCII	J, RS, TZ, UL
ES-166UE	6-digit, 1.0" Amber* LED in Desk mount enclosure	35'	*ESE*, SMPTE/EBU, ASCII	*ESE*, J, NTP-C, NTP-C/PoE, P, P2, PoE, Q, RS, TZ, UL, Wall
LX-991U	4-digit (Hr, Min), 2.3" Amber* LED in "LX-" enclosure	70'	*ESE*, SMPTE/EBU, ASCII	J, NTP-C, NTP-C/PoE, PoE, TZ, UL
ES-991U	4-digit (Hr, Min), 2.3" Amber* LED in Desk mount enclosure	70'	*ESE*, SMPTE/EBU, ASCII	J, NTP-C, NTP-C/PoE, P, PoE, TZ, UL, Wall
LX-993U	6-digit, 2.3" (1" Sec) Amber* LED in "LX-" enclosure	70'	*ESE*, SMPTE/EBU, ASCII	J, TZ, UL
ES-993U	6-digit, 2.3" (1" Sec) Amber* LED in Wall mount enclosure	70'	*ESE*, SMPTE/EBU, ASCII	J, P, TZ, UL, W
ES-996U	6-digit, 2.3" Red* LED in Wall mount enclosure	70'	*ESE*, SMPTE/EBU, ASCII	CW, J, NTP-C, NTP-C/PoE, P, PoE, TZ, UL, W
ES-941U	4-digit (Hr, Min), 4.0" Red* LED in Wall mount enclosure	120'	*ESE*, SMPTE/EBU, ASCII	J, NTP-C, NTP-C/PoE, PoE, TZ, UL, W
ES-943U	6-digit, 4.0" Red* LED in Wall mount enclosure	120'	*ESE*, SMPTE/EBU, ASCII	J, NTP-C, NTP-C/PoE, PoE, TZ, UL, W
ES-971	4-digit (Hr, Min), 7.0" Red* LED in Wall mount enclosure	250'	*ESE*, SMPTE/EBU, ASCII	CW, NTP-C, NTP-C/PoE, PoE, TZ, UL, W
ES-976	6-digit, 7.0" Red* LED in Wall mount enclosure	250'	*ESE*, SMPTE/EBU, ASCII	CW, NTP-C, NTP-C/PoE, PoE, TZ, UL, W

*Amber, Blue, Green or Red LED display color can be specified, Amber not available on ES-971 or ES-976

Display	Power	Electrical
0.4" LED:	5 Watts	117 VAC, 50/60 Hz
.56" LED:	5 Watts	117 VAC, 50/60 Hz
1.0" LED:	5 Watts	117 VAC, 50/60 Hz
2.3" LED:	8-10 Watts	117 VAC, 50/60 Hz
4.0" LED:	8-10 Watts	117 VAC, 50/60 Hz
7.0" LED:	20 Watts	90-264 VAC, 50/60 Hz

Enclosure	Style	Dimensions
0.4" - Console:	Black ABS Plastic	2.2" H x 4.5" W x 4.5" D
.56" - LX:	Black Texture (High-Tech)	1.7" H x 8" W x 6" D
.56" - Desk:	Black Plastic/Black Aluminum	2.25" H x 7.1" W x 5.35" D
1.0" - LX:	Black Texture (High-Tech)	3.5" H x 10" W x 6" D
1.0" - Desk:	Black Plastic/Black Aluminum	2.25" H x 9" W x 6" D
2.3" - LX:	Black Texture (High-Tech)	3.5" H x 12" W x 6" D
2.3" 4-digit Desk:	Black Plastic/Aluminum	5.5" H x 10.4" W x 6.6" D
2.3" 6-digit Wall:	Black Textured Aluminum	5" H x 12" W x 3.5" D
2.3" 6-digit Wall:	Black Textured Aluminum	5" H x 15" W x 3.5" D
4.0" 4-digit Wall:	Black Textured Aluminum	7" H x 19" W x 3.5" D
4.0" 6-digit Wall:	Black Textured Aluminum	7" H x 26" W x 3.5" D
7.0" 4-digit Wall:	Black Textured Aluminum	9" H x 29" W x 3.5" D
7.0" 6-digit Wall:	Black Textured Aluminum	9" H x 43" W x 3.5" D

SELF-SETTING
5", 12" & 16" ANALOG CLOCKS

The **LX-5105U**, **LX-5112U** and **LX-5116U** are Self-Setting Analog Clocks with 5", 12" and 16" viewing diameters, respectively. The units are designed to operate as Time Code Readers (Slaves), Stand-Alone Clocks or Impulse Clocks. All three can read, decode and display time information from most any Master Clock or other source of time code. A rear-mounted DIP switch permits the clock to display time as received from a source of SMPTE/EBU, *ESE* or ASCII time code (IRIG-B is optional). After a very simple "set-up" procedure and receipt of time code, the clock automatically sets itself to the exact time and continuously slaves to the time code. If time code is lost, an error indicator is lit and the clock continues counting while referencing an internal crystal time base.

Other user defined modes of operation allow the clocks to be synchronized to a Master Clock with a 1PPS alternating 12 VDC/24 VDC output or to be set to real time and allowed to run based on their internal crystal oscillators. The second hand is completely silent and can be programmed for "Sweep" mode or "Step" mode.

The initial set-up allows each clock to have the hours (and/or minutes) offset to that of another time zone. Also, since the unit can continuously track time code, there is no need to twice annually compensate for daylight savings time, assuming the Master Clock (ES-101, ES-102U, ES-185E, ES-160E, ES-188E, ES-911E/GPS or ES-911/TSM) automatically adjusts itself accordingly.

Features:
- Silent   • Reads *ESE*, ASCII, SMPTE or EBU Time Code   • Simple Installation & "Hands-Off" Operation
- 5", 12" or 16" Dials   • Optional IRIG-B Input   • Time Zone Offset   • Lighted-Dial Option
- Optional NTP* (Network Time Protocol) Input
- Self-Setting   • Sweep or Step Second Hand
- Error Indicator   • Rack Mount Option
- Stand-Alone, Impulse & Reader Modes
- Battery Back-Up

*option not availabel on the LX-5105U

SPECIFICATIONS

Power: 5 Watts Maximum (15 Watts with Light option or LX-5212U)
Electrical: 90-264 VAC, 47-63 Hz
Mechanical: Desk Mount (LX-5105); Wall Mount (LX-5112, LX-5212 & LX-5116)
Dimensions: LX-5105U: 6.95" High x 8.73" Wide x 3.45" Deep;
  LX-5212U: 13.95" x 13.95" x 3.45" Deep;
  LX-5112U: 13.95" x 13.95" x 3.45" Deep;
  LX-5116U: 17.45" x 17.45" x 3.45" Deep
Inputs: **SMPTE/EBU**: 10k Ω, Balanced or Unbalanced, 100 mVPP to 10 VPP
  ESE: TC76, TC89 or TC90, 120k Ω, Unbalanced
  ASCII: 120k Ω, Unbalanced
Impulse: Alternating 12 VDC (or optional 24 VDC), not available on LX-5212U
Viewing Distance: 20, 35, 60 & 80 feet, respectively
Options: IRIG-B, J, Light (not available on LX-5212U), NTP6-C*, NTP6-C/PoE*, P, P2, PoE* UL
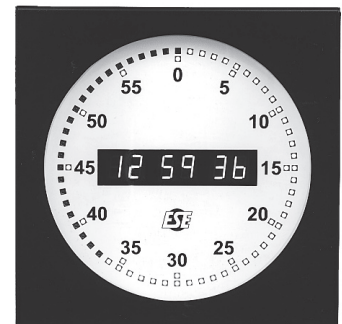
SELF-SETTING
DIGITAL & ANALOG CLOCK

LX-5212U

The **LX-5212U** is a 12" Digital & Analog Clock. The unit is designed to read and display time code (SMPTE/EBU, *ESE*, IRIG-B or ASCII) or run in the "Stand-Alone" mode. Six 1" high amber LEDs display hours, minutes and seconds while 60 LEDs simulate the "Analog" sweep of the second hand. Other LED colors optionally available include Blue, Green and Red. Brightness, Mode and Time Zone Offset controls are accessible on the rear panel. For more details, refer to the Master Clock brochure or contact the *ESE* factory.

SMPTE/EBU TIME CODE VIDEO INSERTERS

The **ES-455U** and **ES-452U** read SMPTE or EBU (optional) Time Code and insert it into a video stream. Time Data (Hours, Minutes, Seconds and Frames) or User Bit Data (hexadecimal characters "0 - F") are selected via a front panel mounted toggle switch, and the data is keyed onto a black or translucent background with white or translucent characters. A front panel mounted "Hold" switch allows the display to be frozen. A rear mounted XLR connector accepts the time code and a pair of BNC connectors provide a video loop thru. On-time frame count, error detection and correction are common to both units.

Features:

- Reads & Inserts 8-Digits Of SMPTE Or (Optional) EBU
- Reads "Time" Data Or "User Bit" Data
- Custom Modifications Available
- Drop Frame Indicator
- Rack Mount Enclosure
- Horizontal & Vertical Position Control
- Solid Or Translucent Characters
- NTSC Operation
- Horizontal & Vertical Size Control
- "On-Time" Frame Count
- "Hold" Switch
- Error Detection & Correction
- Brightness Control

MULTI-SPEED BI-DIRECTIONAL SMPTE/EBU TIME CODE READER / WINDOW DUBBER

The **ES-455U** can read and insert SMPTE/EBU Time Code at speeds ranging from 30x to 1/30th play speed, in both forward and reverse. Five front panel mounted potentiometers control the video display. The Brightness Control varies the intensity of the white characters. The vertical and horizontal Size and Position Controls vary the overall size of the window and its position on the screen. A rear-mounted DB-9 connector allows the display to be remotely "Blanked" or "Frozen".

PLAY-SPEED SMPTE/EBU TIME CODE READER / WINDOW DUBBER

The **ES-452U** is a play speed, forward direction SMPTE/EBU "Window Dub" Inserter. On screen programmability is accessed by simply pressing the Menu button to activate the programming modes. Two front panel mounted potentiometers control the video display. The Character Contrast determines the luminance of the characters. The Background Contrast determines the luminance of the background mask when selected. The display blanking function allows the display to be turned ON and OFF and the display freeze function allows the display to be frozen momentarily.

SPECIFICATIONS

	ES-455U	ES-452U
Time Code Input:	SMPTE or EBU Time Code	SMPTE or EBU Time Code
Code Speed Range:	30x to 1/30th Play Speed, Bi-Directional	Play Speed, Forward Direction
Input Level:	100 mVPP to 10 VPP	100 mVPP to 10 VPP
Input Impedance:	2kΩ	2kΩ
Video Loop:	1 VPP, 75Ω	1 VPP, 75Ω
Controls:	(5) Brightness, Vertical & Horizontal Size & Position	(5) Menu, Up, Down, Character & Background Contrast
Mechanical:	1.75" x 19" x 10" Deep, rack mount	1.75" x 19" x 10" Deep, rack mount
Electrical:	117 VAC, 50/60 Hz, 10W	117 VAC, 50/60 Hz, 10W
Options:	D, DC, J, L2, L4, R, SV, UL	Black, D, DC, J, L2, L4, R, SV, UL

ESE/SMPTE VIDEO INSERTER SERIES

The **LX-266U** series is a family of Reader/Video Inserters which decode ESE or SMPTE timecode and superimpose the Time and Date via a single BNC connector and superimpose the data (Time and Date)upon a video signal(s) looped thru the unit.

Models in the **LX-266U** series are available with one channel up to twelve channels. Units that contain one to four channels have a 1¾" rackmount enclosure and models with five to twelve channels have a 3½" rackmount enclosure.

Features

- Wide Range (100mVPP-10 VPP) AGC Input
- Multiple Mask Selection
- Brightness Control
- Automatic Error Detection and Correction
- Universal Power Supply (120/240 VAC)
- Operates With NTSC or PAL Video
- Vertical and Horizontal Size & Position Controls
- On-Screen Programming
- Superimposed or Keyed Video Characters

LX-266U/4

LX-266U/12

With the ease of on-screen programming, setting the **LX-266U** could never be more simple. Settings include Size, Position, Brightness, Blanking, and Mask Mode. Mask Mode enables the user to select between several styles of background masks which include solid characters on video, solid characters on a solid mask, translucent characters on video or translucent characters on a translucent mask. Front panel Character Contrast and Mask Contrast potentiometers allow variations of black, white and gray.

Specifying option "Text" allows the user to add unique text insertion for each channel, up to 3 lines and as many as 30 characters per line. The optional "Text" feature provides the flexibility of inserting text information in as many as three different methods in combination with the supplied software. The "Text-USB" option provides a USB port for inserting the text information and the "Text-Net" option provides the ability to enter information either via an Ethernet port or a USB port.

SPECIFICATIONS

Power:	2-25 (/1-/12) Watts Max	**ESE/SMPTE Time Code Input**:	1-BNC (per unit)
Electrical:	90-264 VAC, 47-63 Hz	**ESE/SMPTE Input Impedance**:	120KΩ
Video Connectors:	2-BNC (per channel)	**Input Mark Amplitude**:	10 VPP Max., 0.3 VPP Minimum
Display:	12 Digits Keyed or Superimposed on Video, Adjustable Size	**Mark to Space Ratio**:	3:1 Nominal
		Video In/Out:	1 VPP, 75 ohms
Enclosure:	1.75" x 19" Rack Mount, 10" Deep (LX-266U/1, /2, /3, /4)	**Options**:	DC, SV, Text-USB, Text-Net, UL
	3.50" x 19" Rack Mount, 10" Deep (LX-266U/5, /6, /7, /8, /9, /10, /11, /12)		

SMPTE/EBU TIME CODE COMPARATORS

ESE's SMPTE/EBU Time Code Comparators provide the user a convenient method to control/automate "events" based on SMPTE/EBU Time Code. The Product Line includes three basic units - ES-718 (2 Events), ES-738 (10 Events) ES-748 (10 Events).

Features:

- Reads & Compares 8-Digits Of SMPTE/EBU
- Easily Expanded
- Simple Installation & Programming

The **ES-718** is a SMPTE/EBU Time Code Comparator. The unit reads and compares Hours, Minutes, Seconds & Frames and includes two contact closure outputs. The two event times are set using the front panel thumbwheel switches. The duration of each contact closure output is one frame and may be disabled if desired by using a rear-mounted toggle switch.

Each event activates a one second internal audible alarm which may be disabled via a rear-mounted toggle switch.

The **ES-738** is a SMPTE/EBU Time Code Comparator. The unit reads and compares Hours, Minutes, Seconds & Frames and includes up to 100 programmable events via 10 relay contact closure outputs. Each event may be assigned to the desired output. Programming is accessible on the front panel keypad entry system.

Each event activates a one second internal audible alarm which may be disabled via a rear-mounted toggle switch.

The **ES-748** is a SMPTE/EBU Time Code Comparator. The unit reads and compares Hours, Minutes, Seconds & Frames and includes up to 100 programmabe events via to 10 relay contact closure outputs. Each event may be assigned to the desired output. Software is provided to program the event times and relays. A USB port is located on the rear panel to interface with a PC.

Each event activates a one second internal audible alarm which may be disabled via a rear-mounted toggle switch.

SPECIFICATIONS

	ES-718	ES-738	ES-748
Input Level:	100 mVPP to 10 VPP	CMOS Compatible	100 mVPP to 10 VPP
Relays:	2 Reed	10 Reed	10 Reed
Relay Rating:	10 W @ 500 mA	10 W @ 500 mA	10 W @ 500 mA
Mechanical:	1.75" x 19", 9.5" Deep	3.5" x 19", 9.5" Deep	1.75" x 19", 9.5" Deep
Electrical:	110-120 VAC, 60 Hz	110-120 VAC, 60 Hz	110-120 VAC, 60 Hz
Power:	15 Watts	15 Watts	15 Watts
Options:	BBU, DC, J, UL	BBU, DC, J, Relay, UL	BBU, DC, J, NTP, UL

TIME CODE TO USB CONVERTERS

ESE's "TCUSB" line of Time Code to USB converters offers a simple and quick solution for synchronizing a computer to your existing time code equipment. When a serial port or a PCI slot for a Time Code Card is not available or these solutions are undesirable, an *ESE* "TCUSB" is the ideal alternative.

Features:

- Error Detect and Correction (Switchable)
- DIP Switch/Software Configuration
- Linux Real Time Mode
- Time Sync Software Provided
- Dongle measures 5" L x 1.2" W x 1" H
- Powered via USB Interface

ES-56, Edit Code

The **ES-56** converts SMPTE/EBU LTC code or *ESE* Time Code to a USB interface. The device is powered by the USB interface and may be used for computer time synchronization or for obtaining LTC data for editing purposes (when using SMPTE/EBU). The unit features five modes of operation which may be selected by DIP switch or by software: *ESE* Time Code, LTC Forward/Reverse with Frames, or LTC Real Time with 3 selectable date formats (*ESE*, Leitch or SMPTE 309M).

ES-71, Real Time

The **ES-71** converts SMPTE/EBU LTC code or *ESE* Time Code to a USB interface. The device is powered by the USB interface and is intended for computer time synchronization. The unit features four modes of operation which may be selected by DIP switch or by software: *ESE* Time Code, or LTC Real Time with 3 selectable date formats (*ESE*, Leitch or SMPTE 309M).

SMPTE/EBU TIME CODE CONVERTERS

All too often communication between various equipment is impossible due to a "language barrier." When time information must be shared, a Time Code Converter (Translator) may be a very simple solution. With more than a dozen "standard" Time Code Converters (and at least that many "Custom" Time Code Converter products), **ESE** is certain to offer a solution to any language barrier.

Described below are four Time Code Converters that have solved many Time Code "communication" problems when SMPTE/EBU Time Code is being used. If a problem exists that is not addressed in this brochure, please contact the **ESE** factory for a simple solution to your "communication" needs.

Features:

- Translate SMPTE/EBU, **ESE,** ASCII & IRIG Time Codes
- Simple Installation & "Hands-Off" Operation
- Optional 220 VAC and/or "UL" Operation
- Synchronization of Automation Equipment

ES-274U
IRIG-B Time Code
into SMPTE/EBU Time Code

The **ES-274U** is a Time Code Converter that translates IRIG-B Time Code into SMPTE/EBU Time Code. The unit allows video tape (previously striped with IRIG-B) to be easily edited using SMPTE editing equipment.

IRIG-B input, color frame input and loop-thru video sync are accessible on rear-mounted BNC connectors. The SMPTE output is via an XLR connector. Drop frame or non-drop frame mode is selected via a front panel mounted toggle switch. The **ES-274U** is housed in 1.75" x 19" rack mount enclosure, 10" deep.

ES-462U
ESE Time Code
into SMPTE/EBU Time Code

The **ES-462U** is a Time Code Converter that translates **ESE** Time Code (TC76, TC89 or TC90) into SMPTE/EBU Time Code. The unit is frequently used when an older **ESE** Master Clock (one without a SMPTE/EBU output) finds itself needing to interface with SMPTE/EBU equipment.

The **ES-462U** automatically "Jam Syncs" itself upon the first application of AC power, at midnight (00:00:00:00) every day, or if real time differs by more than six frames from that output by the **ES-462U**.

ES-453UE/ESE & ES-453UE/RS
SMPTE/EBU Time Code
into ESE & ASCII Time Code

The **ES-453UE/ESE & ES-453UE/RS** are Time Code Converters that accept SMPTE/EBU Time Code and translates it into **ESE** & ASCII (RS 232C or RS422A) Time Code, respectively.

The .56" eight-digit yellow LED display is perfectly synchronized with the six-digit output of **ESE** or ASCII. User Bits may be selected for display and output via the rear mounted toggle switch. A "Hold" switch is also provided that freezes the time being displayed (only). Option "P" houses each unit in a rack mount enclosure (1.75" x 19", 10" deep).

SPECIFICATIONS

	ES-274U	ES-462U	ES-453UE/ESE & ES-453UE/RS
Power:	5 Watts Maximum	5 Watts Maximum	5 Watts Maximum
Electrical:	117 VAC, 50/60 Hz	117 VAC, 50/60 Hz	117 VAC, 50/60 Hz
Mechanical:	1.75" x 19 " Rack Mount, 10" deep	1.75" x 19 " Rack Mount, 10" deep	2.25" H x 7.1" W x 5.35" D, desktop
Time Code Input:	IRIG-B: 100 mVPP to 10 VPP	**ESE** (TC76-24Hr, TC89 or TC90)	SMPTE/EBU, 0 dB into 600Ω, balanced
Video Input:	Composite, 1 VPP, unterminated	Composite, 1 VPP, unterminated	N/A
Color Frame Input:	TTL or CMOS, field #1 negative pulse	TTL or CMOS, field #1 negative pulse	N/A
Time Code Output:	SMPTE, 0 dB into 600Ω, balanced	SMPTE, 0 dB into 600Ω, balanced	**ESE** -TC90 (ASCII-RS232C or RS422A)
Connectors:	BNC, XLR	BNC, XLR	XLR, BNC (XLR, DB-9)
Options:	DC, EBU, J, UL, 1PPS	EBU, J, UL	Black, J, P, TZ, UL

142 SIERRA ST., EL SEGUNDO, CA 90245 (310)322-2136 FAX (310)322-8127 www.ESE-WEB.com

ES-267 & ES-269
VERTICAL INTERVAL TIME CODE (VITC) CONVERTERS / GENERATORS

The **ES-267** and **ES-269** are VITC Converters / Generators that are able to accept video from either an NTSC or PAL source. The **ES-267** accepts SMPTE or EBU Longitudinal Time Code (LTC) and then inserts synchronized VITC into a composite video signal looped thru the unit. A rear-mounted female XLR connector receives the LTC code while two rear-mounted BNC connectors provide the video loop. Conversely, the **ES-269** accepts VITC and generates synchronized SMPTE or EBU LTC. The rear-mounted male XLR connector outputs the LTC code while two rear-mounted BNC connectors provide the video input loop. Additionally, the **ES-269** includes a +/- One Frame switch that allows compensation for different types of readers or recording situations. This switch allows LTC readers with a one frame delay to be synchronized to the output of the **ES-269**.

Each unit is housed in a black-anodized desk-top enclosure that measures 1.6" H x 7" W x 5" D and a 1¾" x 19" rack mount is optional.

Features

- User Selectable VITC Lines
- Several Options Available

- Accepts NTSC or PAL
- Converts Time & User Bits

- Reads SMPTE or EBU
- 75Ω Video Termination Switch

Specifications

Video Input:	1 VPP, 75Ω, BNC loop-thru; switchable termination
VITC Lines:	10 - 24
VITC Level:	80 IRE nominal; 50 IRE minimum
LTC Output:	XLR, 600W balanced, + 6 dbm
Enclosure:	Desk-Top
Dimensions:	1.6" H x 7" W x 5" D
Electrical:	117 VAC, 50/60 Hz
Power:	5W maximum
Options:	J, P, P2, UL

ESE & SMPTE PCI CARDS

The **PC-471PCI** is a "PC" card designed to plug into any computer with a vacant PCI slot. The unit continuously reads Time Code (selectable **ESE** TC76, TC89, TC90 and SMPTE Formats L, E, S) and updates the time of the PC. The card may be installed in a 32-bit slot or a 64-bit slot. Windows® compatible software is provided which synchronizes the PC clock. The software also allows selection of Time Code, Update Rate and Time Zone Offset.

Alternatively, if frames are required for your application, the **PC-456PCI** which receives SMPTE or EBU timecode is available. The included Windows® and Linux drivers provide access to the Time, User and Auxiliary Bits for use in editing or other timecode uses. The card reads in forward and reverse, 1/30 to 30x playspeed.
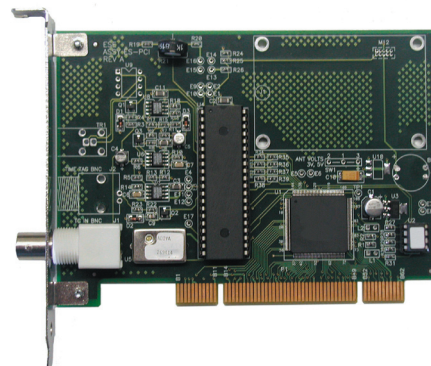
Specifications

Signaling Protocol:	3.3V or 5 V	**Card Size:**	5.25" L x 3.75" H
Time Code Input:	**PC-471PCI** - ESE (TC76, TC89, TC90) or SMPTE (Formats L, E, S)	**OS Requirements:**	Windows® 98/NT/2000/XP
	PC-456PCI - SMPTE or EBU	**Connector:**	BNC
Drift Rate:	+/- 1 Second per month		

NTP TIME SERVERS

ESE's line of NTP (Network Time Protocol) Time Servers provides a simple method of putting accurate time information onto a network. NTP is arguably the most reliable method for sharing time information on a network (LAN , WAN or Internet, etc.). Each of these four NTP Time Servers offers a perfect solution for providing accurate and synchronized time throughout a network.

Features

- Create NTP From Most Any "Non-NTP" Master Clock
- NTP Primary Time Server **(ES-104E)**
- Several Options Available
- Platform Independent

- Simple Installation & Hands-Free Operation
- IPv6 10/100BaseT - NTP Data Port (RJ-45)
- Rugged Desktop Enclosure
- **ESE** Time Code Output

The **ES-104E** employs an internal GPS Receiver as its time reference. This provides the user a source of UTC (Universal Coordinated Time) from an NTP Primary (Stratum 1) Time Server. In contrast, **ES-289E**, **ES-299E** and **ES-911E/NTP** receive their time reference from external sources of time code. They are in essence time code translators, each receiving time code and "outputting" NTP.

Specifications

I/O Connection:	Network: IPv6 10/100BaseT Ethernet, RJ-45	**Drift**:	33ms/Day (if no GPS signal)
Outputs:	**ESE** Time Code™ TC89 or TC90, Drives 100 Slaves @ 4000', BNC	**Configuration**:	Web page or Telnet
GPS Receiver:	Internal 12-Channel (**ES-104E** only)	**Enclosure**:	Desk-Top, Black Anodized Aluminum
Antenna:	Indoor/Outdoor with 16' Cable (**ES-104E** only)	**Dimensions**:	1.6" H x 7" W x 5" D
Antenna Input:	L1, 1.57542 GHz, TNC (**ES-104E** only)	**Electrical**:	117 VAC, 50/60 Hz
Time Code Input:	**ES-289E**: **ESE** (TC-90), SMPTE or EBU Time Code with Date data, BNC	**Power**:	5W maximum
	ES-299E: IRIG (A,B or E), NASA 36, BNC	**Options**:	Ant (**ES-104E** Only), BBU, DC, J, P, P2, UL
	ES-911E/NTP: ASCII (RS-232C): NENA (format "1"), **ESE** ("A"), or NMEA 0183 (GPRMC), DB-9		
	ESE (TC-90) via BNC		

SMPTE/EBU TIME CODE
DISTRIBUTION AMPLIFIERS

The **ES-245** and **ES-246** are Quad 1 x 6 (or Single 1 x 24) Audio Distribution Amplifiers (DA). The units are also used to distribute and/or isolate SMPTE/EBU Time Code. Each unit consists of four sections that accept a single balanced or un-balanced input and creates six identical copies. Inputs and outputs are via rear mounted terminal blocks (XLR connectors are optionally available). The **ES-245** has a separate "Gain" control for each of the 24 outputs. This provides excellent signal isolation and allows each output to compensate for any length of cable up to 2000 feet. The **ES-246** has a separate "Gain" control for each of the four channels.

The **ES-217** is a single channel Audio Distribution Amplifier (1 x 4) that works equally well when SMPTE/EBU time code must be distributed or isolated. The unit is similar to the **ES-245** in that each of the four outputs have independent "Gain" controls providing excellent signal isolation and cable compensation. Inputs and outputs are via front mounted terminal blocks (XLR connectors are optionally available).

Features:

- Terminal Block Inputs/Outputs (Optional XLR Connectors)
- Accepts Balanced or Un-Balanced Audio
- Professional/Broadcast Quality
- Ruggedized Enclosures
- Simple Installation & Hands-Off Operation

The transformerless design accepts a balanced or unbalanced signal and provides exact copies of the original audio signal. If unbalanced outputs are desired, the number of outputs can be doubled. An input attenuator is also provided that is internally adjustable and may be used when using lower input levels.

ES-245 and **ES-246** are housed in single height rack mount enclosures. The **ES-217** is mounted in a powder coated, die-cast aluminum box.

SPECIFICATIONS

	ES-245	ES-246	ES-217
Electrical:	117 VAC, 50/60 Hz, 5 Watts	117 VAC, 50/60 Hz, 5 Watts	117 VAC, 50/60 Hz, 3 Watts
Mechanical:	1.75" x 19" Rack Mount, 5" Deep	1.75" x 19" Rack Mount, 5" Deep	4.7" H x 3.7" W x 2.2" D
Input:	Balanced or Un-Balanced; 2kΩ (input attenuator at maximum) 25kΩ (input attenuator at minimum)	Balanced or Un-Balanced; 600Ω or 100kΩ, Switchable; +21 dBm Maximum Input Level	Balanced or Un-Balanced; 2kΩ (input attenuator at maximum) 25kΩ (input attenuator at minimum)
Gain:	+20 dB Maximum	+20 dB Maximum	+18 dB Maximum
Output:	600Ω, Balanced or Un-Balanced; +26 dBm Maximum	600Ω, Balanced or Un-Balanced; +23 dBm Maximum	600Ω, Balanced or Un-Balanced; +21 dBm Maximum
Options:	Black, J, MT, UL, XLR	Black, BNC, J, MT, UL, XLR	BNC, J, UL, XLR

3G/HD/SD SDI VIDEO
DISTRIBUTION AMPLIFIERS

The **ESE** product line of 3G/HD/SD SDI Distribution Amplifiers offers multiple configurations for various applications. These units feature high-performance & low-cost and are able to distribute 3Gb/s, 1.5Gb/s & 270Mb/s data rates. They automatically detect the data rate and then re-clock and equalize the signal. These Distribution Amplifiers can equalize 400m @ 270Mb/s, 200m @ 1.5Gb/s and 140m @ 3Gb/s. Each of the units are DVB-ASI compliant at 270Mb/s. When the units are in Reclock mode, they automatically lock to and reclock the DVB-ASI signal. Additionally, most of the units provide a non-reclocked loop output.

Features:

- Automatic Input Rate Detection
- Reclocking & Equalization
- Rate Indicators
- 270Mb/s, 1.5Gb/s, 3Gb/s
- Reclocking Bypass Switch
- DVB/ASI Compliant @ 270Mb/s

DV-201
1 x 4

(optional rackmount available)

DV-207
1 x 4

DV-228
1 x 8

DV-222
Dual 1 x 4

DV-208
1 x 12

DV-212
1 x 12

DV-242
Quad 1 x 2

SPECIFICATIONS

POWER: 110 – 120 VAC, 50 – 60 Hz, 5 Watts maximum (DV-201, DV-207)
85 – 264 VAC, 47 – 63 Hz, 15 W maximum (DV-208, DV-212, DV-222, DV-228, DV-242)

MECHANICAL: Desktop Enclosure 1.6" H x 7" W x 5" D (DV-201)
Die Cast Box 4.7" H x 3.7" W x 2.2" D (DV-207, DV-228)
Die Cast Box 4.7" H x 7.4" W x 2.2" D (DV-208, DV-222)
Rackmount Enclosure 1.75" H x 19" W x 4.8" D (DV-212, DV-242)

VIDEO STANDARDS: SMPTE 259M-C, SMPTE 292M and SMPTE 424M compliant

VIDEO INPUT: 1 BNC (DV-201, DV-207, DV-208, DV-212, DV-228)
1 BNC, per channel (DV-222, DV-242)

LOOP THROUGH: 1 BNC (DV-207, DV-208, DV-212, DV-228)
1 BNC, per channel (DV-222)

CABLE EQUALIZATION: 2.97Gb/s: 140m @ 0.3UI (Belden 1694A cable)
1.485 Gb/s: 200m @ 0.3UI (Belden 1694A cable)
270 Mb/s: 400m (Belden 1694A cable)

VIDEO OUTPUTS: 2 BNCs, per channel (DV-242)
4 BNCs (DV-201, DV-207)
4 BNCs, per channel (DV-222)
8 BNCs (DV-228)
12 BNCs (DV-208, DV-212)

OPTIONS: DC, J, P, P2, UL (DV-201)
DC, J, UL (DV-207)
DC, UL (DV-208, DV-212, DV-222, DV-228)
DC, Loop, UL (DV-242)

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DV-319 & DV-321
HD/SD SYNC GENERATOR &
GENLOCKABLE HD/SD SYNC GENERATOR

The **DV-319** and **DV-321** are HD/SD Sync Generators. Two SD sync outputs, four HD sync outputs, an AES11 output and a Word Clock output are provided. The four HD tri-level sync outputs may be set to one of eighteen different formats. The AES-11 output may be switched between silent and tone modes. All outputs are in sync and accessible on rear panel BNC connectors. Front panel dip switches allow the user to configure the various outputs. Additionally, the **DV-321** provides a genlock input that accepts tri-level or bi-level signals.

Each unit is housed in a black-anodized desk-top enclosure. Optional single (Option 'P') or dual (Option 'P2') 19" rack mount are available.

Features:

- 4 HD Sync Outputs
- 2 SD Color Black/Color Bar Outputs
- 18 HD Formats
- AES-11 Output
- Wordclock Output (48KHz)
- SD/HD Genlock Input (DV-321)
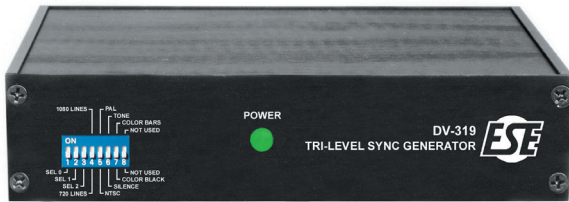
DV-321 Rear

Specifications

POWER: 110 – 120 VAC, 50 – 60 Hz, 5 Watts maximum
MECHANICAL: Desktop Enclosure 1.6" H x 7" W x 5" D
SD SYNC OUTPUTS: Color black or color bars; 2 BNCs
HD SYNC OUTPUTS: Tri-level; 4 BNCs
AES11 OUTPUT: Silence or tone (1kHz)
Impedance: 75Ω
Single ended, 1 Vpp into 75Ω, 1 BNC
WORD CLOCK OUTPUT: 48 kHz, 0 – 5 V, 1 BNC
DV-319 FORMATS: 525i60, 625i50, 720p23.98, 720p24, 720p25, 720p29.97, 720p30, 720p50, 720p59.94, 720p60, 1080i50, 1080i59.94, 1080i60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080psf23.98, 1080psf24
DV-321 GENLOCK INPUT: Autodetects 15 different reference input signals, see Formats, 1 BNC
DV-321 FORMATS: 525i60, 625i50, 720p23.98*, 720p24*, 720p25*, 720p29.97*, 720p30*, 720p50, 720p59.94, 720p60, 1080i50, 1080i59.94, 1080i60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080psf23.98, 1080psf24
* indicates unsupported input genlock reference format
OPTIONS: DC, J, P, P2, UL, XLR

OPTIONS

Options listed below are available only on certain products and descriptions are relative to products described in this brochure. Refer to product "Specifications" or the *Price Schedule* for option availability. Features neither listed as a Standard Feature nor available as an Option may be available on a "Custom" basis. Please consult the **ESE** Factory with your specific need.

Option	Description
Amber	**Amber Display**: Replaces standard colored LEDs with Amber LEDs.
Ant	**GPS Antenna**: High Performance GPS Antenna for harsh RF Environments.
BBU	**Battery Back-Up:** An internal Gel-Cell battery is provided for maintaining the unit's microprocessor for up to a 4-hour power outage.
Black	**Black Anodized Front Panel**: Available on most rack mount units.
Blue	**Blue Display**: Replaces standard colored LEDs with Blue LEDs.
CW	**Ceiling / Wall Mount Bracket**: A ceiling/wall mount bracket is supplied allowing mounting to a ceiling or wall. The viewing angle can be adjusted if desired.
D	**Remote Control:** A switchplate is connected to the unit via a 6 foot cable (longer length available) and remote connector.
DC	**DC Operation:** Requires the unit to be powered from a DC source exclusively, typically +10 to +40 VDC.
EBU	**EBU Output:** The normal SMPTE output is replaced with an EBU (European Broadcast Union) output.
ESE	**ESE Time Code:** An **ESE** Time Code output(TC-90) allows **ESE** slaves to be driven.
Green	**Green Display**: Replaces standard colored LEDs with Green LEDs.
HR	**Programmable Relay Closures:** A contact closure occurs each hour and 1/2 hour (1/2 hour can be defeated).
IRIG(5100)	**IRIG-B Time Code Input:** Allows the unit to synchronize with a source of IRIG-B.
J	**220 VAC/50 Hz Operation:** The unit is configured to operate from 220 VAC line voltage. 117 VAC 50/60 Hz is standard.
K	**Precision Frequency Outputs:** 10 MHz and 1 KHz outputs are provided.
Light	**Lighted Dial:** Only on the LX-5100 Series Analog Clocks. The dial of the clock can be illuminated. A brightness control is included.
L2	**Two Additional Video Input/Output Sets:** Available on most Video Inserters.
L4	**Four Additional Video Input/Output Sets**: Available on most Video Inserters.
MT	**Multi-Turn Potentiometer:** Available only on the ES-246. Precision multi-turn potentiometers replace standard gain control.
N	**Reverse Count at Zero:** The count direction changes to up, indicating the elapsed time since zero was reached.
NTP	**NTP Server:** Allows for synchronization of computer networks. **NTP-C**, NTP Client Display will synchronize with an NTP Server.

Option	Description
NTP6	**NTP Server**: Provides an NTP Server. Allows for synchronization of computer networks and LAN control. IPv6 Compatible. **NTP6-C**, NTP Client Display will synchronize with an NTP Server. IPv6 Compatible.
OCXO	**OCXO:** Provides an Oven Controlled Crystal Oscillator.
P	**19" Rack Mount:** The unit is equipped with rack-ears for 19" panel mounting.
P2	**Dual Rack Mount:** Allows specific units to be mounted side-by-side.
PAL	**PAL Operation:** The unit is configured to operate with PAL instead of NTSC (standard or at no charge on many units).
PoE	**Power over Ethernet:** Provides the ability to pass electrical power over Ethernet.
Q	**Console Mount:** The unit is housed in an enclosure 8" deep, front panel is 3.5" x 9", 1/8" clear anodized aluminum.
R	**Remote Control Connector:** Allows access to controls via a rear-mounted connector.
Red	**Red Display**: Replaces standard colored LEDs with Red LEDs.
RS	**RS-232C Output:** Computer Interface allows the time code data to be shared with a computer. RS-422A may be specified.
SV	**S-VHS Connectors**: S-VHS connectors are provided and the unit becomes S-VHS compatible.
Text-Net	**Text Insertion**: Text Insertion of up to 3 lines and up to 30 characters per line via Ethernet input & USB input.
Text-USB	**Text Insertion**: Text Insertion of up to 3 lines and up to 30 characters per line via USB input.
TZ	**Time Zone Offset:** Internal DIP switch allows the hours (and half-hour) to be offset to any time zone.
UL	**"UL" Approved Power Supply:** A Wall Mount "UL" Approved power supply is provided.
XLR	**XLR Connectors:** The rear mounted terminal block is replaced with XLR connectors (the chassis is 3 1/2" high)
Z	**Relay Closure and Stop at Zero:** A reed relay closure occurs and the unit stops when the timer completes a countdown to zero (00:00.0). Relay contacts are rated at 10 Watts maximum resistive load, 500 ma switching current.
1pps	**1 PPS Output:** Provides a one pulse per second output synchronized to the time code output.
6-Digit	**6-Digit Display**: A 6-digit (Hr, Min, Sec) front panel mounted display (.56" LED) is included.
9-Digit	**9-Digit Display**: A 9-digit (Days, Hr, Min, Sec) front panel mounted display (.56" LED) is included.
10ηs	**10ηs Accuracy**: The accuracy of the unit is improved to 10ηs.

FIVE YEAR WARRANTY

All products described in this brochure are warranted free of mechanical and electrical defects, and will be replaced or repaired without charge if found defective under normal operating conditions when used as intended. Assembled products must be returned for adjustment within five years (Airborne and Ground Mobile products One Year) of purchase. Before returning goods, please write or call for shipping instructions.

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