F22

SMPTE Time Code Generator/Reader/Character Inserter User's Guide

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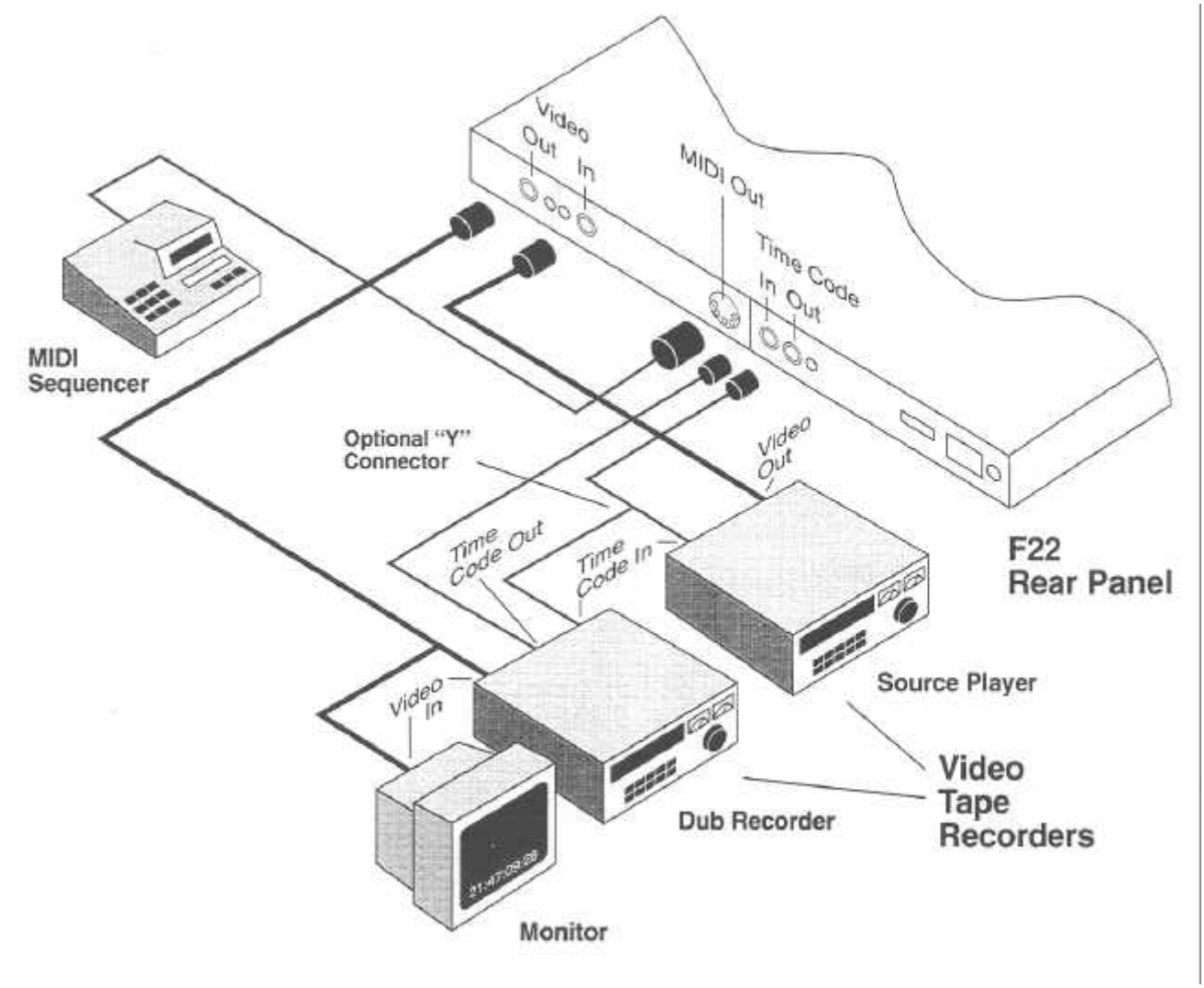
HOOK UP

To record time code on a source tape, to read time code and to record “window dub” copies.



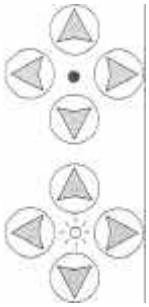
FRONT PANEL

The following indicators and controls always behave as described here. For explanations of the other indicators and controls, see the *Reader,* Generator, Preset, *and Character Inserter* sections of this guide.

- **On/Off** switch - we hope you can figure this one out. The F22 will retain its presets and mode settings when the power is off.

- **Read, Gen, Preset, Regen, Jam Sync** - these buttons activate the indicated function. See the appropriate heading under *Instructions* for Use for a full explanation.

- **MIDI TC** - switches the MIDI time code output on and off. When the indicator lamp is on, the F22 is generating MIDI time code.



- **Arrow Keys** - When Preset is off and the indicator light is off these buttons control the position of the time code "window" (the video character inserter's display) on the screen.

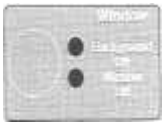
  When you press **Preset, the Arrow Keys select and set** the time code and user bit digits. See *Instructions* for Use under *Preset* on page 8.

  When you press **Window,** the indicator light at the center of the Arrow Keys comes on. Now **Up** changes the size of the character display (or "window"). See *Instructions* for Use under *Character Inserter* on page 7.

- **Display** - shows either time code or user bits. Time code is displayed as hours, minutes, seconds, and frames. The frames digits will turn off when the F22 is reading time code over five times play speed.

- **Drop** - The indicator light is on when the F22 is working with Drop Frame SMPTE time code. The button functions only when Preset is on. See *Instructions* for Use under *Preset.*

- **User Bits** - switches the F22's front panel display between time code and user bits. When the User Bits Indicator is on, the display shows the numeric user bits that the F22 is generating or reading.



- **Window** - this button changes the character display on the video screen Each press moves to the next of three possible choices:

  1) characters on, background on;
  2) characters on, background off;
  3) window off

  Once you have pressed **Window,** the arrow keys change other aspects of the character display. See *Instructions for* Use under *Character Inserter.*

- **Pause - In Gen,** this button pauses the F22's time code output. When in **Read, Jam Sync, or Regen, this** button freezes the F22's front panel *Pause* display, but the window and time code output continue.

CONTROLS

REAR PANEL

(1) **Video Out** - when the F22 is on, the character inserter's time code display is superimposed on the input video signal. See *Front Panel – Display / Preset Controls* for details on setting the display's size, position, and composition.

When the F22 is off, the input video signal bypasses the Impedance Switch and loops through to this output.

(2) **Character Contrast / Background Contrast** - these dials adjust the brightness of the F22's video character display. See *Adjusting Character and Background Contrast* under *Instructions For* Use *Character Inserter* on page 7.

(3) **Impedance Switch** - sets the F22's video input to high impedance (>10K ohms) or 75 ohm termination. The switch only takes effect when the F22's power switch is ON.

(4) **Video In** - the F22 uses this input for two purposes: 1) as a sync reference for generated time code and 2) as the signal on which the character inserter superimposes its time code display.

(5) **MIDI Time Code Out** - the F22 outputs the MIDI (Musical Instrument Digital Interface) equivalent of the current SMPTE time code address when the Gen, Jam Sync, or Regen indicator is on. Press the MIDI TC button on the front panel to turn this output on and off.

(6) **Time Code In/Out** - connect to the appropriate connectors on your recorder.

(7) **Time Code Output Level** - the F22's time code output level is adjusted to maximum amplitude when it leaves the factory. If you find this level too high for your equipment, use a small screwdriver to adjust it. Turn counter-clockwise to lower the output level. Always TEST a new output level: record a few minutes of time code, then play the tape back and verify that the F22, as well as any other time code devices you have, can read this code.

READER

1) Verify the connections according to *Hook Up,* page 2.

2) Press the F22's **Read** button.

3) Play your source tape.

The F22 will read and display time code forward and reverse, from 1/30 play speed to about fifteen (15) times play speed, subject to limitations in your recorder's playback circuitry. See *Character Inserter* for more information about this feature while reading time code.

Indicators and Controls – Read

- **Video Lock** is inactive when the F22 is reading time code. The indicator will remain off.

- The F22 does not output MIDI time code in Read. The MIDITC indicator remains off, and the MIDITC button has no effect. Use Jam Sync or Regenerate to translate SMPTE from an existing track to MIDI Time Code.

- **Drop Indicator** on when the F22 is reading Drop-Frame SMPTE time code.

- **Pause** freezes the current time code address on the front panel display. Note that in Read, **Pause** does not effect the Character Inserter. This feature is provided so that you may make logging notes without disturbing a window dub in progress.

GENERATOR

The following situations are the most common applications for the F22's generator:

- You have shot a source tape in the field or in the studio and wish to “post-dub” time code on one of the audio channels

- You are preparing an edit master for insert editing by pre-recording black on the video channel and time code on the address track (if available).

To Post-Dub Time Code:

Note: Many professional video recorders provide an "address track” specifically intended for time code. Be aware that most of these recorders do not provide for an audio dub on the address track. In other words, you *CAN NOT POST-DUB TIME CODE ON AN ADDRESS TRACK.*

1) Put the source tape in a recorder that is capable of an audio dub (the “source recorder") The source tape must have video recorded on it, and must have at least one audio channel free to record the time code.

2) Verify the connections according to *Hook Up.*

3) You may record a window dub on a different tape while you post dub time code on your source tape. To do so, connect the F22's **Video Out** to the Video In of the "dub recorder" as shown in *Hook Up.* Configure and position the window to your taste according to the instructions under Character Inserter on page 7.

4) Prepare the source recorder for audio dubbing on the unused audio channel.

S) Preset the hours, minutes, and seconds digits as you wish. See *Preset.*

6) Press Gen to start the time code.

7) Start the source recorder in audio dub mode, and adjust the audio record level. See *Facts You Should Know* for additional information on setting the audio level correctly.

8) Start the dub recorder in record mode.

9) You may **Pause** the time code output at any time. However, to achieve an uninterrupted time code recording, allow all machines to run Pause continuously until the source tape ends.

To Prepare an Edit Master:

1) Insert a blank tape into the source recorder.

2) Verify the connections according to Hook Up. Use your recorder's address track if available.

3) Be sure to route a black burst video signal from an appropriate source to both the source recorder and the F22's Video In.

4) Preset the hours, minutes, and seconds digits as you wish. Select the format you wish to use (SMPTE drop or non-drop frame). See *Preset.*

5) Press Gen to start the time code.

6) Start the source recorder in record mode, and adjust the audio record level. Review Facts You *Should Know* for further information.

7) Allow the recorder to run until the tape ends.

Indicators and Controls - Gen

- **Video Lock** is on when the F22's time code output is successfully synchronized with the signal at **Video In.**
- **MIDI** TC switches the MIDI time code output on and off. When the indicator is on, the F22 is generating MIDI time code
- **Pause** halts the F22's time code output.

CHARACTER INSERTER

The F22 contains a video character inserter which can superimpose a display of time code and user bits on a video signal. This display is known as a "window." Simply connect a video source to Video In on the F22's rear panel, and the window will be present on the signal at Video Out.

Positioning the Window

Use the **Arrow Keys** to position the window anywhere on the screen Note that the Arrow Keys perform several functions; they control window position only when Preset is NOT LIT and the indicator light is OFF.

If the indicator light is on, the **Arrow Keys** will not position the window. To turn off the indicator light, press **Read, Gen, Regen, Jam Sync, or Preset.** If one of these keys is lit, press that one in order not to disturb the function in progress.

Changing the Window Characteristics

Press the **Window button** to set the window's size and composition. The **Arrow Keys** now change the appearance of the window. To restore the **Arrow Keys** to their default function of moving the window, you must press **Read, Gen, Regen, Jam Sync** or **Preset** as described under ***Positioning*** the ***Window*** above.

Each press of the **Window** button selects the next of three possible formats: Background Off, Window Off, and the default format, characters with background.

The Up key varies the height of the window.

User Bits turns on and off the user bits portion of the window. The F22 will display eight numeric user bits directly below the time code on the screen. For more information on numeric user bits, see *User Bits* under *Preset.*

Adjusting Character and Background Contrast

The F22 leaves the factory with its character display adjusted for white characters on a black background To change the display contrast, use a small screwdriver (a flat blade works best) to adjust the Character Contrast / Background Contrast dials on the F22's rear panel. You may vary the display to your taste, from white on black to black on white.

Note that it is possible to adjust the display levels past nominal black and white levels, and thus distort the video signal at Video Out. If possible, use a waveform monitor or oscilloscope to make your adjustments. Otherwise, route color bars to Video In and set the window's black to a maximum of slightly lighter than the black bar, and the window's white to a maximum of slightly darker than the white bar.

Record a "Window Dub"

A “Window Dub" is a copy of another tape. The copy has time code numbers superimposed on the original image. This section describes how to make a window dub of a tape that already has time code recorded on it. To make a window dub while simultaneously recording time code on the original, see *To Post-Dub Time Code* under ***Generator.***

1) Verify the connections according to *Hook Up.*

2) Put the source tape in the "source player”.

3) Connect the F22's **Video Out** to the Video In of the dub recorder as shown in *Hook Up.* Configure and position the window to your taste according to the instructions above.

4) Press Read.

5) Start the source player in play mode.

6) Start the dub recorder in record mode.

PRESET

Preset configures the F22’s generator. The settings take effect in Gen, Jam Sync, and Regen.

Use Preset and the Arrow Keys to set a starting time code address and user bits. Use Preset and the Drop button to select the time code format (SMPTE drop frame or non-drop frame). See the explanationunder Indicators and Controls below.

You can set the hours, minutes, and seconds to any time code address from 00:00:00:00 to 3:59:59:00. The range of possible starting time code addresses is limited by SMPTE specification. For example, you could not set the F22 to 62 minutes or 78 seconds.

One common application of this feature is to set the hours digits to a different number for each tape in a program with multiple source tapes.

Indicators and Controls · Preset

To preset the F22, start by pressing **Preset.** The indicator will light up, and the indicators and controls will behave as described here.

Video Lock is inactive. The indicator is off.

Arrow Keys - The Left and Right buttons select a digit, which will flash both on the front panel display and on the character inserter's video display. The Up and Down buttons change the digit's value up or down. Holding a button down has the same effect as repeated pressing.

The **Display** shows either time code or user bits. See User *Bits* below.

Drop - Use this button to select drop frame or non-drop frame SMPTE time code.

The **Drop** indicator is on when the F22 is set to generate drop-frame time code.

User Bits switches the F22's displays between time code and user bits.

Note that once you have set the user bits, the F22 will generate those user bits until you explicitly change them through **Preset.** These user bits will appear in time code generated **in Gen and Jam Sync.**

Pause will put the F22 in a standby state when you switch from **Preset** to Gen.

JAM SYNC

In **Jam Sync** the F22 matches its output too incoming time code. The F22 generates as usual, and continuously monitors the **Time Code In** connector. When incoming time code starts or changes, the F22 synchronizes with it. When incoming timecode stops, the F22 continues generating.

The most common use for jam sync is to continue time code where it stops on a previous recording. Common situations are:

- You are shooting a source tape in the studio and wish to record time code as you go, making sure that the count remains continuous even when the recorders are stopped between takes.

- You wish to replace a section of time code that is missing, perhaps accidentally erased.

To Replace Sections of Time Code:

1) Verify the connections according to ***Hook Up.*** Note that both the **F22's** Time Code In and Time Code Out must be connected to the source recorder's appropriate Audio Out and Audio In.

2) Prepare the source recorder for an audio insert edit on the appropriate audio channel.

3) Confirm that the F22 is set to generate time code in the same format as the source time code, either drop frame or non-drop frame. See Preset.

4) Press **Jam Sync.**

5) Select your edit-in point at least one second before the problem section.

6) Preview the edit at least once to verify proper connections and levels.

7) Perform the edit.

REGENERATE

Regeneration restores the time code signal to the proper shape and properly synchronizes the time code output to reference video. The F22's output time code is the same as the input time code: the F22 automatically chooses the correct format (for example, drop or non-drop frame SMPTE), user bits are unchanged, and discontinuities in the input are duplicated.

Regeneration is necessary because an audio channel's playback head is slightly offset from its record head, which results in a phase shift of as much as half a field of video. This phase shift would compound if you were simply to re-record the time code.

NOTE: *Regeneration is* ***NOT NECESSARY*** *if you are using an address track. Address tracks are designed for the demands of time code recording and playback, and thus do not distort the time code signal's shape or cause a phase shift.*

The Regenerate function is primarily useful when you wish to duplicate a tape that has time code recorded on an audio channel.

1) Verify the connections according to *Hook* Up. If you do not wish to record visible time code on the copy (a "window dub"), be sure to turn off the F22's window. See Character Inserter for instructions.

2) Press **Regen.**

3) Play the source tape on the "source recorder" and record the duplicate on the "dub recorder".

4) See Facts You *Should Know* for additional information on setting the audio level correctly.

In **Regen,** the F22 automatically determines the format of the input time code. Thus, this function is useful to see what kind of time code is on a tape. Further, a few seconds in **Regen will** automatically configure the F22 to generate, read, or jam sync time code in the same format, either drop frame or non-drop frame.

Indicators and Controls - Regen

Except as noted below, all indicators and controls behave as described in *Generator* under *Indicators and Controls - Gen.*

Video Lock is on when the F22's time code output is successfully synchronized with the signal at Video in. If the F22 is connected according to Hook Up, Video Lock indicates that output time code is correctly re-locked to the source tape's video.

Pause freezes the current time code address on the front panel **Display.** In **Regen, Pause** does not effect the time code at **Time Code Out** or the Pause Character Inserter. This feature is provided so that you may make logging notes without disturbing a duplication in progress.

MIDI TIME CODE

MIDI stands for Musical Instrument Digital Interface. MIDI is a standardized protocol for communication among electronic musical instruments and their controllers. The F22 can send time code directly to MIDI instruments, such as sequencers or computer-based cue-list programs, via MIDI Time Code.

The F22 can convert SMPTE time code into MIDI protocol. Simply press the MIDI TC button. While generating SMPTE time code, the F22 will continuously output the equivalent MIDI time code at the rear panel **MIDI Out** connector.

The F22 outputs MIDI Time Code when it is set to **Gen, Regen, or Jam Sync. Regen is** the best choice to convert an existing time code track to MIDI time code.

For a thorough technical discussion of MIDI, see *Appendix B, MIDI Specifications.*

FACTS YOU SHOULD KNOW

Time Code is an audio signal. It must be recorded and played from an audio channel. An address track is an audio channel designed for time code.

Time Code is synchronized with the video signal, and the audio time code information corresponding to each frame number is exactly as long as one frame. If you intend to use the F22's time code output on a video recording, you must connect that video signal to the F22's Video In connector when generating to insure generated time code is correctly synchronized with video. If you are using the F22's Time Code output on an audio recording, you do not need to route any signal to the F22's Video In connector.

Time Code is a high level audio signal*, and if may bleed over onto adjacent, sound tracks if recorded at too high a level.* The goal is to record the Time Code at as high a level as possible without interfering with the other channels. Experiment until you arrive at a level that works consistently with your recorders, then stick with it. If your recorder has an address track, use it. Otherwise, use the audio track closest to the edge of the tape (channel 1 on 3/4 inch VCRs). Avoid using an automatic recording level.

The address track is a specialized audio channel designed to record and reproduce SMPTE time code. Not all VTRs are equipped with address tracks. Aside from the obvious benefit of freeing up both audio channels for production sound, the address track does a much better job than an audio channel of playing back Time Code at all search speeds. The address track has one serious limitation: you can record Time Code on it only when you are recording video at the same time. Thus, you cannot post-dub time code onto an address track.

TROUBLE SHOOTING TIME CODE SYSTEMS

To isolate problems, isolate equipment. If operation of the F22 is in question, remove the unit from your system and test it individually.

1) Unplug all inputs and outputs from the unit.

2) Connect the power plug. If possible, use a different circuit than the one on which you observed problems.

3) Generate time code and record it on an audio cassette deck and set the recording level to at least 0 dB. Use different patch cords than those you were using when you noticed the problem, and do not route through a patch bay or a distribution amplifier.

4) Play back the tape. Attempt to read, regenerate, and jam sync to the time code on the tape.

5) Run video from house black or a color bar generator to the unit. Again, use fresh cables, and avoid patch bays and distribution amplifiers.

6) Run video from the F22 to a monitor.

7) Test the F22's ability to do window dubs.

If your F22 does not pass these tests please contact your dealer, factory authorized representative, or the factory directly. Please be prepared with your unit's serial number, the dealer you purchased the unit from, and the approximate purchase date. Your satisfaction is our number one priority.

If this simple procedure convinces you that your unit is properly generating and reading time code, and you can insert a window dub on a known good video source, then refer to the following list of problems and solutions.

PROBLEM	SOLUTIONS	NOTES
Time Code loses time.	Gen-lock input video and time code generator to a good external source.	If this solves your problem, it indicates bad sync information
Video level too low or looks bad.	Change impedance switch position.	
Can't move window, or window jumps.	Only push one of the arrow keys at a time. Press firmly.	
Time code is erratic or numbers freeze when reading.	Gen-lock video and the F22 to previously recorded vertical video source such as a color bar generator.	Irregular incoming sync, or Interval Time code disrupts time code generation erratically.
Difficulty reading time code.	Problems reading time code are generally caused by poor recording.	
	1) Turn off noise reduction on audio channel that time code is being recorded on. Don't use automatic level adjustment.	Time code is not normal audio program material, although it is recorded on an audio channel.
	2) Adjust output level of time code when recording.	Use appropriate tools to adjust output level control on rear panel.
No window dub when the window is turned on.	Try moving the window with the arrow keys.	Sometimes the window will be hidden in the over scan portion of the video.
Window dub causes flagging.	Adjust character and/or background contrast to shades of gray instead of dark black and bright white.	Extreme white or black will sometimes exceed the limits of a normal video signal.

TECHNICAL SPECIFICATIONS

Video Input: 1.0 Vp-p. 75 ohm or high impedance. BNC.

Video Output: Characters are keyed onto the input signal. Unity gain amplification. When the F22's power switch is off, the input signal loops through and bypasses termination. BNC.

Time Code Out: Adjustable from 0 to 4 V p-p into high impedance. When the F22's power switch is off, the input signal loops through either input to unbalanced outpUt. Unbalanced. RCA.

Time Code In: High impedance, unbalanced, RCA phono connector. Signal range from 500 mv to 8 V p-p.

Field Ref. Input: 5.0 V p-p. BNC.

MIDI **Time Code Out:** Industry standard, 5 pin, 180 degree, circular DIN.

Window Display: 4 character sizes. Contrast adjusts for white characters on black background to black characters on white background. Position fully adjustable from front panel. Can display time code or time code and user bits together. Front panel on/off.

Power Requirements: 110-120 Volts AC, 50-60 hz.

Dimensions: 19” W x 61/4" L X 1 ¾H. Standard single unit rack size.

LIMITED WARRANTY

The F22 is unconditionally guaranteed for thirty (30) days from the date of purchase The unit may be returned to the place of purchase for a complete refund during this period provided that it is still in new condition and complete with manual and original packing material. In addition, Fast Forward warrants the F22 against defects in material or workmanship as follows:

For a period of one (1) year from date of purchase, Fast Forward will repair or replace the defective item(s) at no charge at its facility in Irvine, California. Purchaser is responsible for all shipping charges to and from Irvine, California.

After one (1) year, repair becomes the responsibility of the purchaser.

The purchaser should retain his or her receipt as evidence of the date of purchase.

This warranty does not cover any damage due to accident, misuse, abuse, or negligence.

This warranty is valid only in the United States. Fast Forward shall not be liable for any incidental or consequential damages for breach of any express or implied warranty on this product. Any implied warranty is limited in duration to the duration of this warranty. Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

APPENDICES

APPENDIX A: SMPTE TIME CODE SPECIFICATIONS

ANSI/SMPTE 12M-1986
Revision and Redesignation of
ANSI V98.12M-1981

American National Standard for television—time and control code—video and audio tape for 525-line/60-field systems

Approved January 29, 1986 Sponsor: Society of Motion Picture and Television Engineers

1. Scope

1.1 The first part of this standard specifies a format and modulation method for a digital code to be recorded on a longitudinal track of video and audio magnetic tape recorders. The code is to be used for timing and control purposes.

1.2 The second part specifies the digital format to be inserted into the television signal vertical interval to be used for timing and control purposes in video magnetic tape recorders. This part also specifies the location of the code within the television baseband signal and its relationship to other components of the television signal and to the longitudinal track code described in the first part of this standard.

2. Referenced Standards

This standard is intended for use in conjunction with the following standards:

EIA Industrial Electronics Tentative Standard No. 1, Color Television Studio Picture Line Amplifier Output Drawing

International Standard ISO 646-1983, Information Processing — ISO 7-Bit Coded Character Set for Information Interchange

International Standard ISO 2022-1982, Information Processing — ISO 7-Bit and 8-Bit Coded Character Sets — Code Extension Techniques

3. Longitudinal Track Application

3.1 Modulation Method. The modulation method shall be such that a transition occurs at the beginning of every bit period. "One" is represented by a second transition one half a bit period from the start of the bit. "Zero" is represented when there is no transition within the bit period. (See Fig. 1.)

3.2 Code Format

3.2.1 Frame Make-up. Each television frame shall be identified by a unique and complete address. A frame consists of two television fields or 525 horizontal lines. The frames shall be numbered successively 0 through 29, except as noted in 5.2.2 (Drop Frame). If color frame identification in the code is required, the even units of frame numbers shall identify Frame A and odd units of frame numbers shall identify Frame B, as defined by EIA Tentative Standard No. 1.

3.2.2 Frame Address. Each address shall consist of 80 bits numbered 0 through 79.

3.2.2.1 Boundaries of Address. The address shall start at the clock edge before the first address bit (bit 0). The bits shall be evenly spaced throughout the address period, and shall occupy fully the address period which is one frame. Consequently, the bit rate shall be 80 times the frame rate in frames per second. (See 3.2.1 for definition of a television frame.)

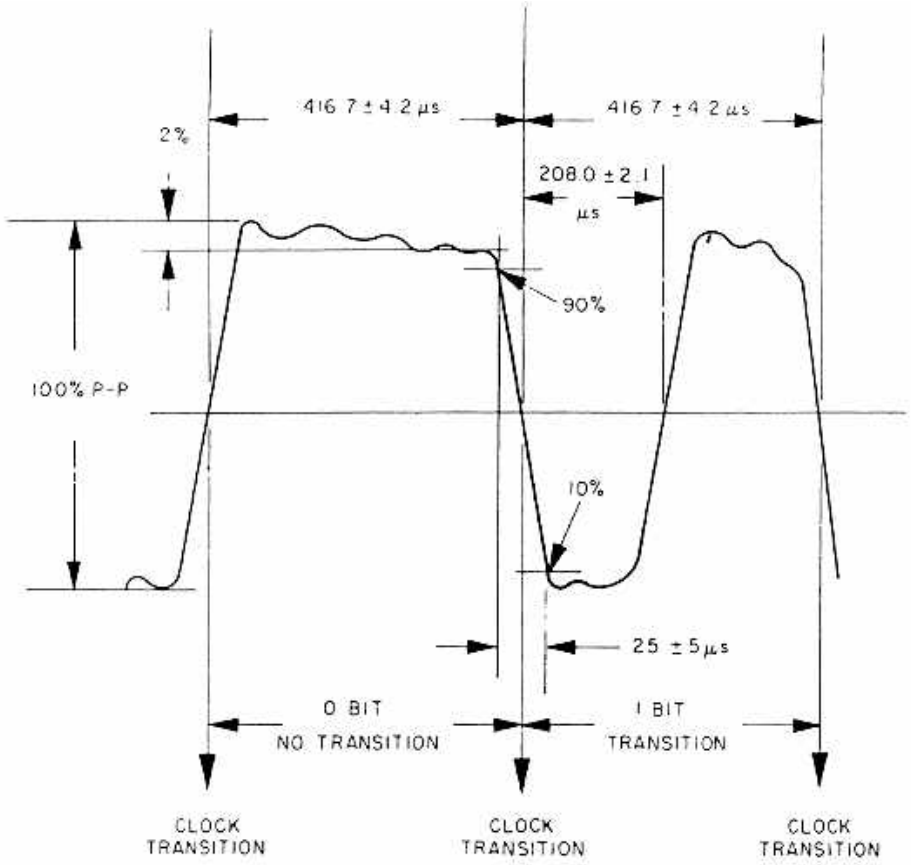


Fig. 1
Longitudinal Recorder Waveform

3.2.2.2 Start of Address. The start of the address shall occur at the beginning of line 5 in fields I and III, as defined in EIA Tentative Standard No. 1. The tolerance shall be ±1 line.

3.3 Longitudinal Recorder Input Waveform Characteristics (See Fig. 1.)

3.3.1 Rise Time. The rise and fall times of the clock and "one" transitions of the code pulse train shall be 25 ± 5 microseconds, measured between the 10 and 90 percent amplitude points on the waveform.

3.3.2 Amplitude Distortion. Amplitude distortion, such as overshoot, undershoot, and tilt, shall be limited to 2 percent of the peak-to-peak amplitude of the code waveform.

3.3.3 Time of Transitions. The time between clock transitions shall not vary more than 1 percent of the average clock period measured over at least one frame. The "one" transition shall occur halfway between two clock transitions within 0.5 percent of one clock period. Measurements of these timings shall be made at half-amplitude points on the waveform.

3.4 Use of Binary Groups. The binary groups are intended for storage of data by the users, and the 32 bits within the 8 groups may be assigned in any manner without restriction if the character set used for the data insertion is not specified and the binary group flag bits 43 and 59 are both zero.

If an 8-bit character set is used, the binary group flag bits 43 and 59 shall be set according to the following truth table:

	Bit 43	Bit 59
Character set not specified	0	0
Eight-bit character set	1	0
Unassigned	0	1
Unassigned	1	1

Unassigned states of the truth table cannot be used and their assignment is reserved to the SMPTE.

3.4.1 If an 8-bit character set conforming to ISO 646-1983 and ISO 2022-1982 is signalled by the binary group flag bits 43 and 59, the characters should be inserted in accordance with Fig. 2. Information carried by the user-bits is not specified.

3.5 Assigned and Unassigned Address Bits. Six bits are reserved within the address groups, 4 for identifying operational modes, 1 for bi-phase correction, and 1 unassigned bit reserved for future assignment and defined as zero until further specified by the SMPTE.

Bit 10 — Drop Frame Flag. If certain numbers are being dropped to resolve the difference between real time and color time, as defined in 5.2.2, a "1" shall be recorded.

Bit 11 — Color Frame Flag. If color frame identification has been intentionally applied, as defined in 3.2.1, a "1" shall be recorded.

Bit 27 — "Bi-phase Mark" Phase Correction. This bit shall be put in a state so that every 80-bit word will contain an even number of logical zeros. This requirement results in the following truth table for Bit 27:

Number of Logical Zeros in Bits 0 to 63 (27 exclusive):	Bit 27
Odd	1
Even	0

Bits 43 and 59 — Binary Group Flag Bits. These two bits shall be set in accordance with the truth table as specified in 3.4.

Bit 58 — Unassigned Address. "0" until assigned by the SMPTE.

The bits shall be assigned as shown in Fig. 3 and described below:

0-3	Units of frames
4-7	First binary group
8-9	Tens of frames
10	Drop frame flag (see 3.5)
11	Color frame flag (see 3.5)
12-15	Second binary group
16-19	Units of seconds
20-23	Third binary group
24-26	Tens of seconds
27	Bi-phase mark phase correction bit (see 3.5)
28-31	Fourth binary group
32-35	Units of minutes
36-39	Fifth binary group
40-42	Tens of minutes
43	Binary group flag bit (see 3.4)
44-47	Sixth binary group
48-51	Units of hours
52-55	Seventh binary group
56-57	Tens of hours
58	Unassigned address bit (0 until assigned by the SMPTE)
59	Binary group flag bit (see 3.4)
60-63	Eighth binary group
64-79	Synchronizing word
	64-65 Fixed zero
	66-77 Fixed one
	78 Fixed zero
	79 Fixed one

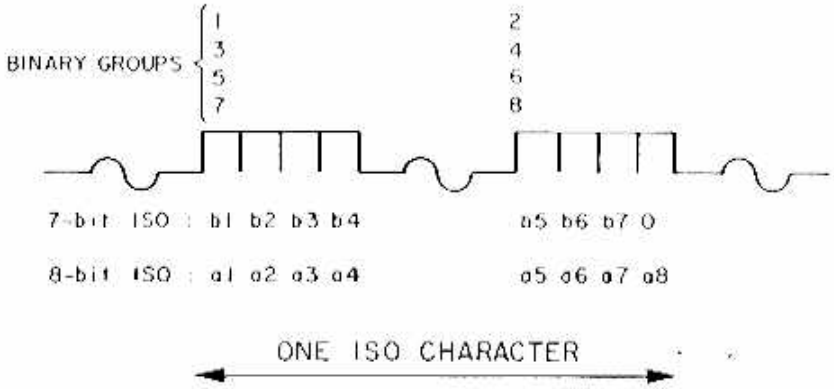
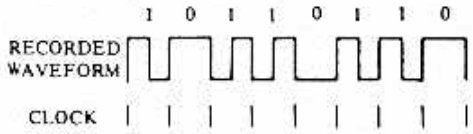


Fig. 2
Use of Binary Groups to Describe ISO Characters Coded with 7 or 8 Bits

80 BITS PER FRAME

32 USER BINARY SPARE BITS
16 SYNC
31 ASSIGNED ADDRESS
1 UNASSIGNED ADDRESS
THE UNASSIGNED BIT IS LOGICAL ZERO UNTIL ASSIGNED



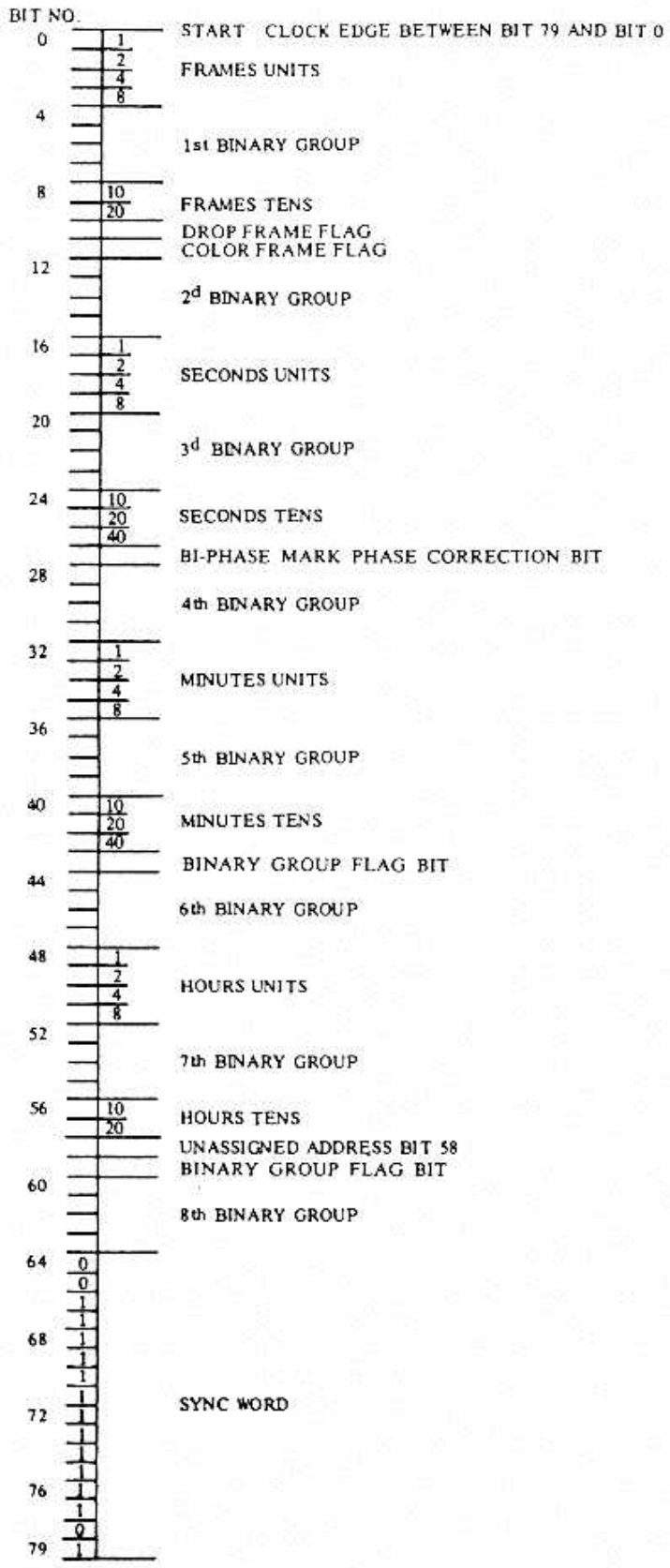


Fig. 3
Longitudinal Bit Assignment

A4

APPENDIX B - MIDI TIME CODE SPECIFICATIONS

MIDI PROTOCOL

The hardware MIDI interface operates at 31.25 (+/- 1%) Kbaud, asynchronous, with a start bit, 8 data bits (D0 to D7), and a stop bit. This makes a total of 10 bits for a period of 320 microseconds per serial byte. The start bit is a logical 0 (current on) and the stop bit is a logical 1 (current off). Bytes are sent LSB first.

Circuit: 5 mA current loop type. Logical 0 is current ON. One output shall drive one and only one input. To avoid ground loops, and subsequent data errors, the transmitter circuitry and receiver circuitry are internally separated by an opto-isolator (a light emitting diode and a photo sensor which share a single, sealed package). The receiver must require less than 5 mA to turn on. Rise and fall times should be less than 2 microseconds.

MIDI TIME CODE

For device synchronization, MIDI Time Code uses two basic types of messages, described as Quarter Frame and Full. There is also a third, optional message for encoding SMPTE user bits.

Quarter Frame Messages (2 bytes):

F1 <message>

F1 = System Common status byte
<message> = 0nnn dddd

nnn = Message Type:
0 = Frame count LS nibble
1 = Frame count MS nibble
2 = Seconds count LS nibble
3 = Seconds count MS nibble
4 = Minutes count LS nibble
5 = Minutes count MS nibble
6 = Hours count LS nibble
7 = Hours count MS nibble and SMPTE Type

dddd = 4 bits of binary data for this Message Type

After both the MS nibble and the LS nibble of the above counts are assembled, their bit fields are assigned as follows:

FRAME COUNT: xxx yyyyy

xxx	Undefined and reserved for future use. Transmitter must set these bits to 0 and receiver should ignore!
yyyyy	Frame count (0-29)

SECONDS COUNT: xx yyyyyy

xx	Undefined and reserved for future use. Transmitter must set these bits to 0 and receiver should ignore!
yyyyyy	Seconds Count (0-59)

MINUTES COUNT: xx yyyyyy

xx	Undefined and reserved for future use. Transmitter must set these bits to 0 and receiver should ignore!
yyyyyy	Minutes Count (0-59)

HOURS COUNT: x yy zzzzz

x	Undefined and reserved for future use. Transmitter must set this bit to 0 and receiver should ignore!
yy	Time Code Type: 0 = 24 Frames/Second 1 = 25 Frames/Second 2 = 30 Frames/Second (Drop-Frame) 3 = 30 Frames/Second (Non-Drop)
zzzzz	Hours Count (0-23)

Full Message - (10 bytes)

F0 7F <channel> 01 <sub-ID 2> hr mn sc fr F7

F0 7F = Real Time Universal System Exclusive Header
<channel> = 7F (message intended for entire system)
01 = <sub-ID 1>, 'MIDI Time Code'
<sub-ID 2> = 01, Full Time Code Message
hr = hours and type: 0 yy zzzzz
yy = type:
00 = 24 Frames/Second
01 = 25 Frames/Second
10 = 30 Frames/Second (drop frame)
11 = 30 Frames/Second (non-drop frame)
zzzzz = Hours (00->23)
mn = Minutes (00->59)
sc = Seconds (00->59)
fr = Frames (00->29)
F7 = EOX

Time is considered to be "running" upon receipt of the first Quarter Frame message after a Full Message.

User Bits Message - (15 bytes)

F0 7F <chan> 01 <sub-ID 2> u1 u2 u3 u4 u5 u6 u7 u8 u9 F7

F0 7F = Real Time Universal System Exclusive Header
<chan> = 7F (message intended for entire system)
01 = <sub-ID 1>, MIDI Time Code
<sub-id 2> = 02, User Bits Message
u1 = 0000aaaa
u2 = 0000bbbb
u3 = 0000cccc
u4 = 0000dddd
u5 = 0000eeee
u6 = 0000ffff
u7 = 0000gggg
u8 = 0000hhhh
u9 = 000000ii
F7 = EOX

These nibble fields decode in an 8-bit format: aaaabbbb ccccdddd eeeeffff ggggghhh ii. It forms 4 8-bit characters, and a 2 bit Format Code. u1 through u8 correspond to SMPTE Binary Groups 1 through 8. u9 are the two Binary Group Flag Bits, as defined by SMPTE.

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*Further details and implementation information regarding MIDI Time Code can be found in the **MIDI 1.0 Detailed Specification**, available from the International MIDI Association, 5316 W. 57th St., Los Angeles, CA 90056; tel: 213/649-6434.*