Model F30
Time Code
Generator/Reader/Character Inserter
User's Guide

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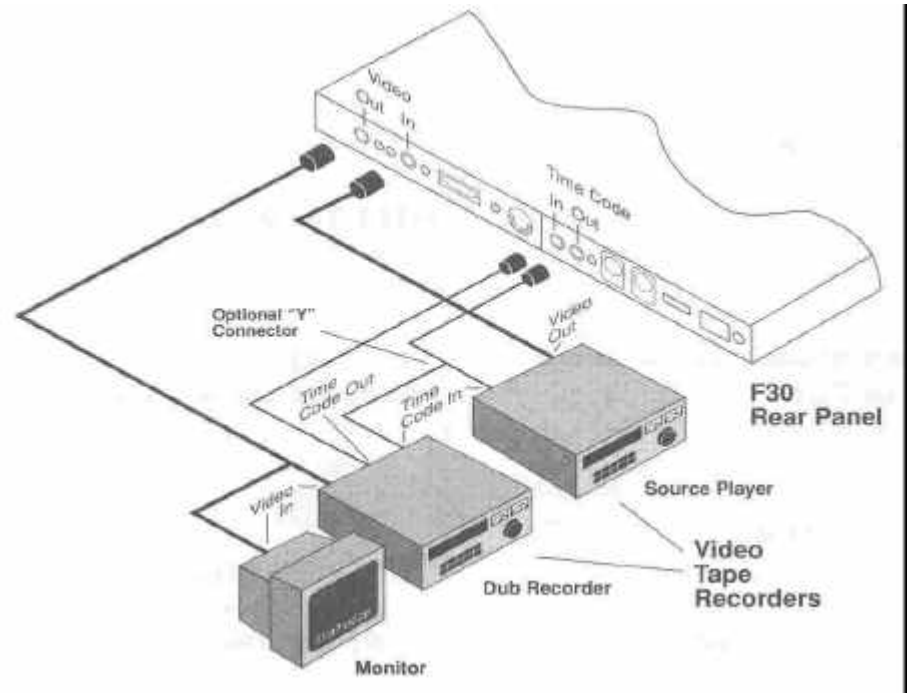
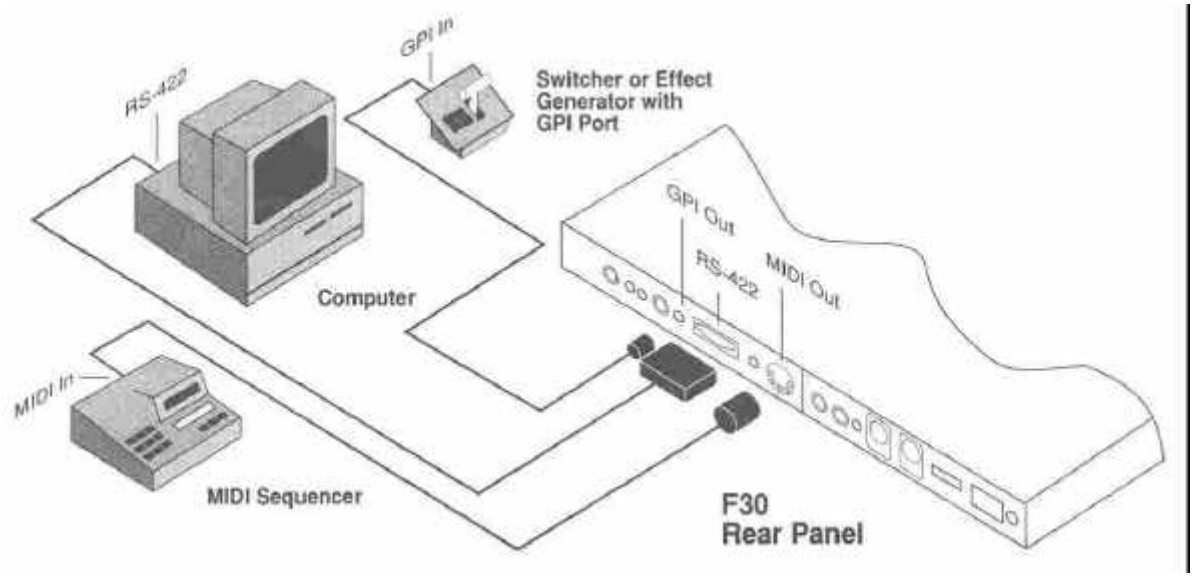
HOOK-UP

1. Basic installation to record time code on a source tape, to read time code and to record "window dub" copies.



2. Additional connections for computer control of F30, control of MIDI sequencer and control of GPI device.



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.

- **SMPTE** - on when the F30 is working with 30-frame SMPTE (Society of Motion Picture and Television Engineers) time code.

- **EBU** - on when the F30 is working with 25-frame EBU (European Broadcast Union) time code.

  When both **SMPTE** and **EBU** are off, the F30 is working with 24-frame SMPTE time code.

- **On/Off switch** - we hope you can figure this one out. The F30 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 F30 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*.

When you press **Window,** the indicator light at the center of the Arrow Keys comes on. Now **Up** and **Right** change the size of the character display (or "window"). **Left** and **Down** turn parts of the window off and on (hours, minutes, seconds, and frames). See *Instructions for* Use under *Character Inserter*.

- **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 F30 is reading time code over five times play speed.

- **Drop** - the indicator light is on when the F30 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 F30'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 F30 is generating or reading. If the F30 is generating or reading user bits conforming to the ISO eight-bit character set, the *Display* will be blank, and the user bits will be visible only on the video character display. See *Instructions for* Use under Preset.

- **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 F30's time code output. When in **Read, Jam Sync,** or **Regen,** this button freezes the F30's front panel *Display,* but the window and time code output continue.

CONTROLS

REAR PANEL

(1) **Video Out** - when the F30 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 F30 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 F30's video character display. See *Adjusting Character and Background Contrast* under *Instructions For Use Character Inserter*.

(3) **Impedance Switch** - sets the F30's video input to high impedance (>10K ohms) or 75 ohm termination. The switch only takes effect when the F30's power switch is ON.

(4) **Video In** - the F30 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) **GPI (General Purpose Interface) Out** - acts as a “contact closure" when the F30 reaches a specified time code address. You can trigger a character generator, switcher, or any device activated by a GPI input. Use the RS422 Port to specify the time code address for the GPI output.

(6) **RS-422 Serial Port** - an input / output port that allows a computer or edit controller to communicate with and control the F30. See *Appendix* C: *F30 RS-422 Serial Protocol / Command Summary.*

(7) **Field Reference Input:**

SMPTE time code - The F30 will generate time code identifying the NTSC four-field sequence when a color frame reference signal is present at this connector and you have Preset the F30 to perform color framing. The color frame reference signal should be a TTL level square wave that is high for Frame A and low for Frame B. This signal is provided on most sync generators and one-inch video tape recorders.

EBU time code - the F30 will generate time code identifying the PAL eight field sequence when a field reference signal is present at this connector and you have Preset the F30 to perform color framing. The field reference signal should be TTL level and either 1) a low pulse at the beginning of field 1, or 2) a square wave that is low for fields 1 - 4 and high for fields 5 - 8. This signal is provided on most sync generators and one-inch video tape recorders.

NOTE: if the *F30 is* not set to *perform* color *framing through Preset, or if the field reference signal is not present, the F30 will automatically* generate *EBU* time code *in* sync *with* the *PAL* four *field sequence.*

(8) **MIDI Time Code Out** - the F30 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.

(9/11) **Time Code In/Out** - connect to the appropriate connectors on your recorder. You may use both outputs simultaneously, but connect to only ONE of the two time code inputs. The RCA type connectors (9) are for high impedance, unbalanced signals and the XLR type connectors (11) are for low impedance, balanced signals.

(10) **Time Code Output Level** - the F30'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 F30, as well as any other time code devices you have, can read this code.

INSTRUCTIONS FOR USE

READER

1) Verify the connections according to *Hook Up, page 3.*

2) Press the F30's **Read** button.

3) Play your source tape.

The F30 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* and *Appendix C: RS-422 Protocol / Command* Summary for further information about these features while reading time code.

If you are not certain which frame rate you are trying to read (30 frame, 25 frame, or 24 frame), press Regen while playing the time code source. The F30 will automatically configure itself to read correctly. You may then press Read again to take advantage of the F30's bi-directional, multi speed-reading capability.

Indicators and Controls Read

- **Video Lock** is inactive when the F30 is reading time code. The indicator will remain off.

- **Color Frame** is on when the F30 is reading time code, which identified the color frame sequence when the time code was originally recorded. Note that when the F30 is reading, this indicator does not verify that the time code on the tape maintains the correct color frame correspondence. For example, this indicator is meaningless when the F30 is reading time code from a heterodyne type video tape recorder (3/4 inch, 1/2 inch, or 8 mm).

- The F30 does not output MIDI time code in Read. The MIDI TC indicator remains off, and the MIDI TC button has no effect. Use Jam Sync or Regenerate to translate SMPTE or EBU from an existing track to MIDI Time Code.

- **Drop Indicator** - on when the F30 is reading Drop-Frame SMPTE time code.

- **Pause** freezes the current time code address on the *Display.* Note that in Read, **Pause** does not affect 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 F30'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 F30'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*.

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

5) 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 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 F30's Video In.

4) Preset the hours, minutes, and seconds digits as you wish. Select the format you wish to use (SMPTE drop/non-drop frame or EBU). *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 F30's time code output is successfully synchronized with the signal at Video In. In the case of EBU time code, the indicator is lit when the F30 is correctly locked to the PAL four-field sequence.

- **Color Frame indicator:**

  For SMPTE time code: on when the F30 is successfully setting the color frame flag in its output time code. The color frame flag will be set according to the four-field signal at the **Field Ref input** on the rear panel.

  For EBU time code: on when the F30 is successfully generating time code in the EBU eight-field sequence according to the **Field Ref** input on the rear panel.

- **SMPTE** is on when the F30 is preset to generate 30 frame SMPTE time code in either the Drop Frame or Non-Drop Frame format.

- **EBU** is on when the F30 is preset to generate 25 frame EBU time code.

When neither SMPTE nor EBU is lit, the F30 is preset to generate 24 frame SMPTE time code.

- **MIDI TC** switches the MIDI time code output on and off. When the indicator is on, the F30 is generating MIDI time code.

- **Pause** halts the F30's time code output.

CHARACTER INSERTER

The F30 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 F30'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, or Jam Sync** 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. **The Right** key varies the width.

- The **Left and Down** keys turn time code digits on and off. Press the **Left** key to select the hours, minutes, seconds, or frames digits, which will flash. One press of the down key will cause that portion of the window to go black, indicating that it will not appear when you return to normal operation. You may turn off any or all of the digits in this manner.

- **User Bits** turns on and off the user bits portion of the window. The F30 will display either eight numeric user bits or four character user bits directly below the time code on the screen. For more information on numeric and character user bits, see User *Bits* under *Preset.*

Adjusting Character and Background Contrast

The F30 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 F30'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.

To 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 F30'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 F30'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, non-drop frame, 24 frame, or EBU), and to activate or disable color framing. See the explanation under *Indicators and Controls* below.

You can set the hours, minutes, and seconds to any time code address from 00:00:00:00 to 23:59:59:00. The range of possible starting time code addresses is limited by SMPTE and EBU specifications. For example, you could not set the F30 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 F30, 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.

- **Color Frame** indicator comes on when you activate color framing by pressing Drop. See the explanation below.

- **SMPTE** is on when you select 30 frame SMPTE time code in either the Drop Frame or Non-Drop Frame format. Choose the format by pressing Drop.

- **EBU** is on when you select 25 frame EBU time code by pressing Drop.

  When neither SMPTE nor EBU is lit, you have selected 24 frame SMPTE time code.

- **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. If the display is blank and **User Bits** is on, the F30 is set to generate character user bits. *See User Bits below.*

- **Drop** - Use this button to select the time code format. Each successive press of the Drop button selects the next possible format, with or without color framing when appropriate.
  1) 30 frame SMPTE non-drop
  2) 30 frame SMPTE non-drop with color framing
  3) 30 frame SMPTE drop frame
  4) 30 frame SMPTE drop frame with color framing
  5) 25 frame EBU
  6) 25 frame EBU with 8-field color framing
  7) 24 frame SMPTE

Observe the **Display, the Drop** indicator, and the **Color Frame indicator** until you arrive at the combination you desire.

- **User Bits switches** the F30's displays between time code and user bits. To select user bits conforming to the ISO eight-bit character set, press and hold both the left and right arrow keys simultaneously. The front panel display is blank when character user bits are selected; in this case, observe the video character inserter's user bits display on a monitor while using the **Arrow Keys** to set the user bits.

  Note that the F30 will generate the same 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 F30 in a standby state when you switch from **Preset** to Gen.

JAM SYNC

- **In Jam Sync** the F30 matches its output to incoming time code. The F30 generates as usual, and continuously monitors the Time Code In connector. When incoming time code starts or changes, the F30 synchronizes with it. When incoming time code stops, the F30 continues generating.

  The F30 can transfer time information from one time code format to another through jam sync. See *Inter-format Conversion* on next page for a full discussion.

  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 F30'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 F30 is set to generate time code in the same format as the source time code. 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.

Inter-format Conversion

The F30 will generate time code in the format you have selected through **Preset,** regardless of the incoming time code's format. This feature is provided to convert time code from one format to another. It is possible to change user bits, to align non-color framed time code with the color frame sequence, or to convert between formats with different frame rates. During a conversion between formats with different frame rates (for example, 30 frame SMPTE Drop-frame and 25 frame EBU), the generated time code will not maintain a one to one correspondence with incoming time code, but hours, minutes, and seconds will correspond to within two frames.

Note that the F30's indicators and controls behave exactly as they do when the F30 is set to Gen. The displays and indicators describe the time code being generated, NOT the input time code.

1) Connect the time code source to the F30's **Time Code In.**

2) Connect the F30's **Time Code Out to the** dub recorder's Time Code In or Audio In, as appropriate.

3) Route the source video through the necessary standard converter to the dub recorder's Video In.

4) Connect the dub recorder's Video Out to the F30's **Video In.** This will synchronize the F30's generator with the video on the copy.

5) Select the format you desire, starting address and user bits through **Preset.**

6) Press J**am Sync.**

7) Record the copy.

REGENERATE

Regeneration restores the time code signal to the proper shape and properly synchronizes the time code output to reference video. The F30's output time code is the same as the input time code: the F30 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 F30's window. See *Character Inserter* 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 F30 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 F30 to generate, read, or jam sync time code in the same format.

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 F30's time code output is successfully synchronized with the signal at Video In. If the F30 is connected according to *Hook Up,* **Video Lock** indicates that output time code is correctly re-locked to the source tape's video.

- **Color Frame** on shows that the time code at **Time Code In** contains color frame information. This does not guarantee that the time code is aligned with the color frame sequence: the source time code may have been inaccurately recorded with respect to the color frame sequence, or the source video may not reproduce the color frame sequence at all (as in the case of 3/4 inch or 1/2 inch players).

- **Pause** freezes the current time code address on the front panel **Display.** In **Regen, Pause** does not affect the time code at **Time Code Out** or the 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 F30 can send time code directly to MIDI instruments, such as sequencers or computer-based cue-list programs, via MIDI Time Code.

The F30 can convert SMPTE or EBU time code into MIDI protocol. Simply press the MIDI TC button. While generating SMPTE or EBU time code, the F30 will continuously output the equivalent MIDI time code at the rear panel **MIDI Out** connector.

The F30 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 D, MID/ Specification.*

RS-422 SERIAL CONTROL

The F30 will operate under the control of a computer or edit controller through the **RS-422 Port** located on the rear panel. RS-422 serial commands will activate all of the F30's functions including address and user bit preset, control of the window (the F30's video character inserter display), start, and pause. A computer can receive time code information either continuously or on request.

For complete details see *Appendix* C, *F30 RS-422 Serial Protocol Command Summary.*

Devices which convert from computer industry standard RS-232 to video industry standard RS-422 are available from various vendors. Fast Forward does not provide these devices directly, but can provide a few sources on request.

GPI OUTPUT

The F30 provides a GPI (General Purpose interface) output on its rear panel. A GPI "trigger" is a common means of activating various video production devices, from character generators to switchers and special effects generators. By sending out a GPI trigger at a designated time code address, the F30 can precisely control the timing of an effect or edit.

To set the time code address for the GPI output, you must use the RS-422 Port. See *Appendix* C/ *F30 RS-422 Serial Protocol/Command Summary* for information on setting up a GPI trigger.

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 F30's time code output on a video recording, you must connect that video signal to the F30's Video In connector when generating to insure generated time code is correctly synchronized with video. If you are using the F30's Time Code output on an audio recording, you do not need to route any signal to the F30's Video in connector.

- *Time Code is a high level audio signal, and it 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 F30 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 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 F30 to a monitor.

7) Test the F30's ability to do window dubs.

If your F30 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 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 known good external source.	If this solves your problem it indicates bad sync information on the tape.
Video level too low, 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 F30 to an external, known good video source such as a color bar generator.	Irregular incoming sync, or previously recorded Vertical 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 F30'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 F30's power switch is off, the input signal loops through either input to unbalanced output. Unbalanced, RCA. Balanced, XLR.

Time Code In: High impedance, unbalanced, RCA phono connector. Signal range from 500 mv to 8 V p-p. 600 ohm, balanced, XLR.

GPI Out: Open collector active low output. F30 can be set through RS422 port to issue a GPI trigger when any given time code address is read, generated, or regenerated.

RS-422: Industry standard communications protocol. D-subminiature 9 pin connector. ALL time code functions of F30 can be controlled. Also, continuous time code output possible. See *Appendix* C: *F30 RS-422 Serial Protocol* appendix for command descriptions.

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

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

Window Display: 16 character sizes. Contrast adjusts for white characters on black background to black characters on white background. Position fully adjustable from front panel. Can display any combination of User Bits, and time code Hours, Minutes, Seconds, and Frames. Front panel on/off.

Power Requirements: 110-120 Volts AC, 50-60 hz, or 220-240 AC, 5060 hz. Configured at factory, specify when ordering.

Dimensions: 1 9"W x 61/4"L X1 3/4"H. Standard single unit rack size.

LIMITED WARRANTY

12 – MONTH LIMITED WARRANTY
Fast Forward Video, Inc. warrants to the original purchaser that the product (Hardware and components) shall be free from defects in material and workmanship for a period of 1 year from the date of purchase, If a defect covered by this warranty occurs during this 1 year period, Fast Forward Video, Inc. will repair or replace the defective product or component, at its option, free of charge.

WARRANTY LIMITATIONS
THIS WARRANTY SHALL NOT APPLY IF THIS PRODUCT: (a) IS DAMAGED BY NEGLIGENCE, ACCIDENT, MISUSE, OR BY OTHER CAUSES UNRELATED TO DEFECTIVE MATERIALS OR WORKMANSHIP; OR (b) HAS HAD THE SERIAL NUMBER ALTERED, DEFACED, OR REMOVED.

ANY APPLICABLE IMPLIED WARRANTIES ARE HEREBY LIMITED IN DURATION TO THE WARRANTY PERIOD DESCRIBED ABOVE. IN NO EVENT SHALL FAST FORWARD VIDEO, INC. BE LIABLE FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES RESULTING FROM THE BREACH OF ANY IMPLIED OR EXPRESS WARRANTIES. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR EXCLUSION OF CONSEQUENTIAL OR INCIDENTAL DAMAGES, SO THE ABOVE LIMITATIONS 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.)

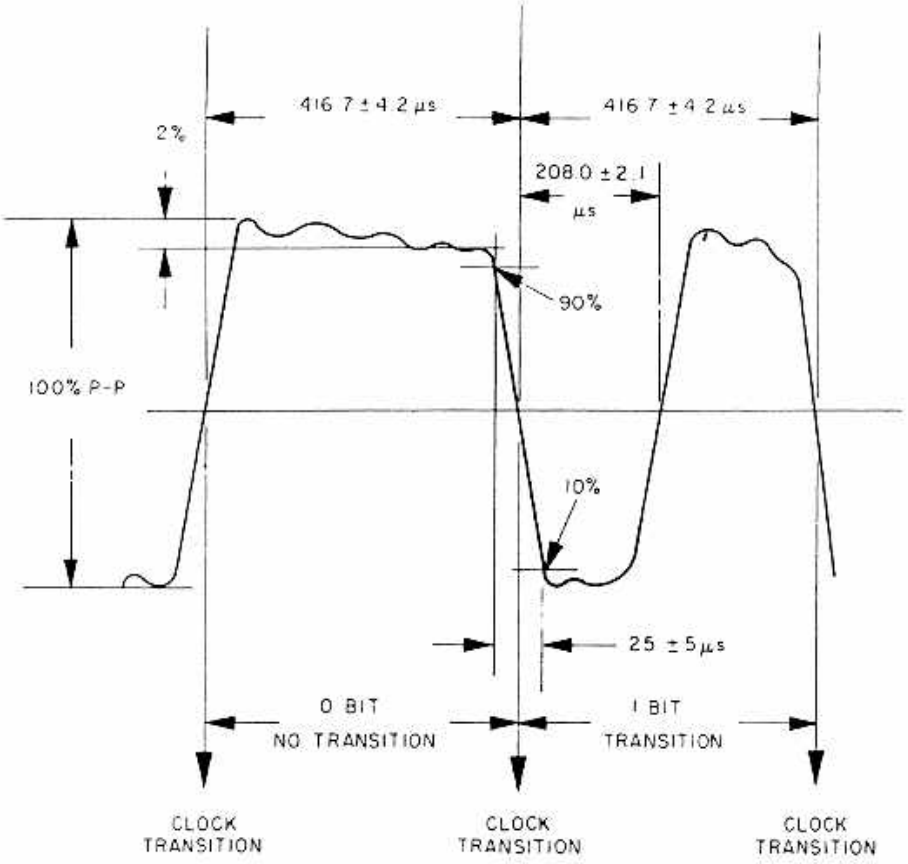


Fig. 1
Longitudinal Recorder Waveform

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

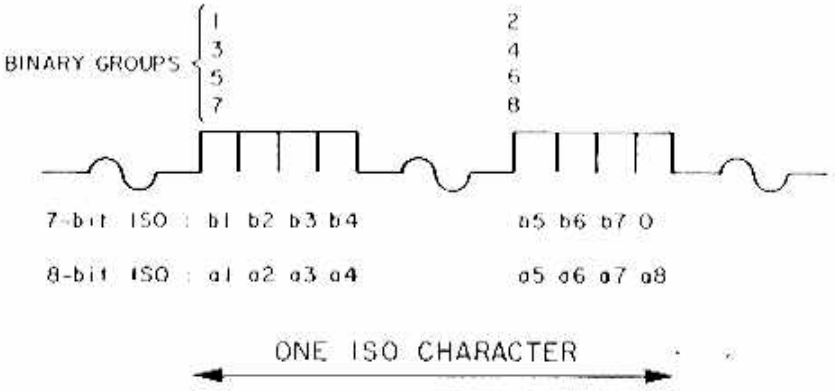


Fig. 2
Use of Binary Groups to Describe ISO Characters Coded with 7 or 8 Bits

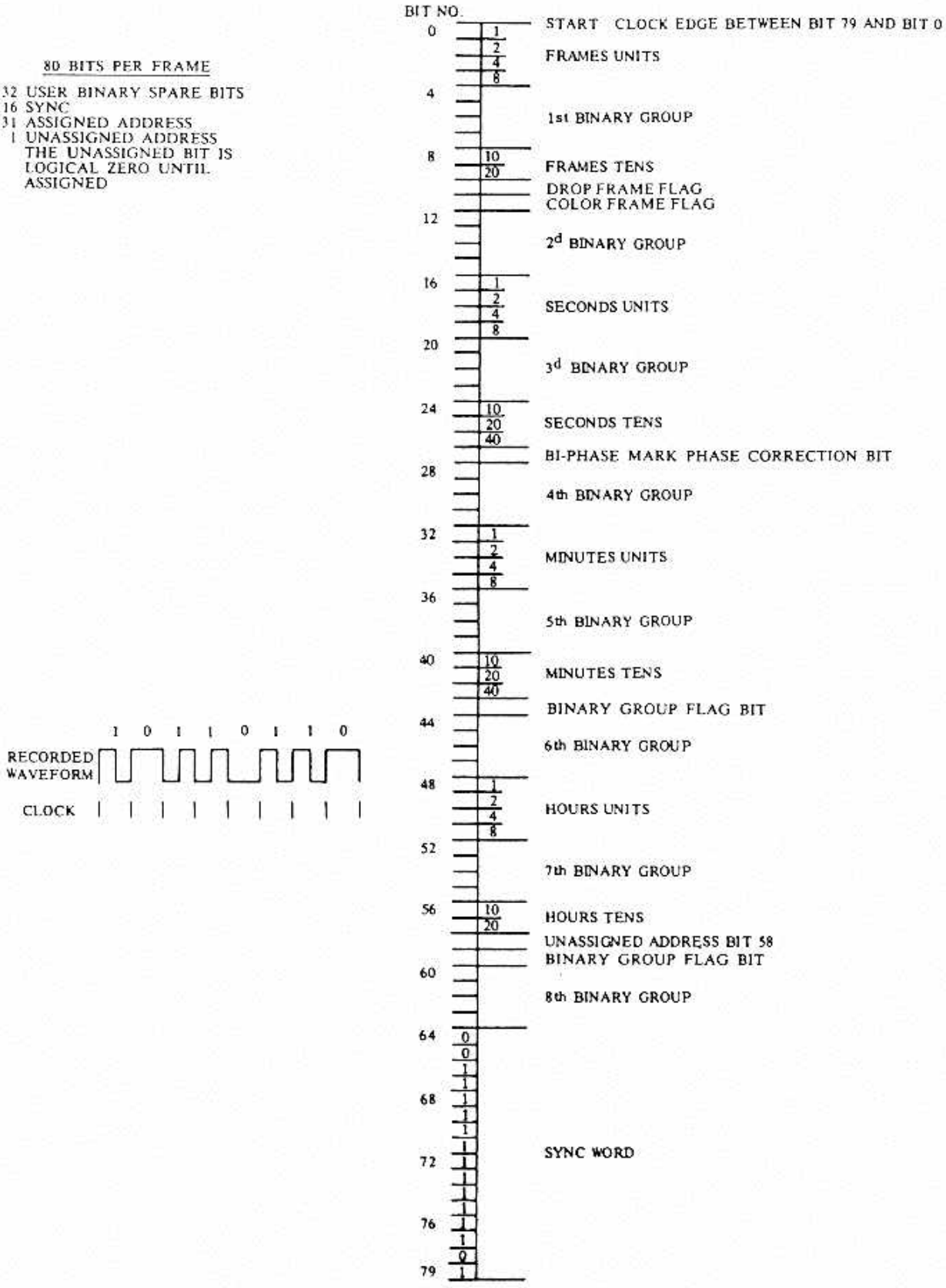


Fig. 3
Longitudinal Bit Assignment

APPENDIX B - EXCERPT - EBU TIME AND CONTROL CODES FOR TELEVISION TAPE RECORDINGS. 3RD EDITION, APRIL 1982

LONGITUDINAL TIME-AND-CONTROL CODE (LTC)

1. Scope

This part specifies the format and modulation method for a digital code recorded on a longitudinal track which is to be used for timing and control purposes on television tape machines and on the associated audio tape-machines, if any, for recordings made in accordance with the 625-line/50-field television systems defined in CCIR Report 624-2 [3]. The document also specifies the relationship of the longitudinal code signal to other associated signals before and after recording on the tape.

2. Modulation method and bit-rate

2.1. *Type of code*

The modulation method shall be such that a transition occurs at the beginning of every clock period. In the case of a "zero" there is no second transition within the clock period. In the case of a "one" there is a second transition in the middle of the clock period. This system, commonly known as *bi-phase mark*, is illustrated in *Fig. 1.*

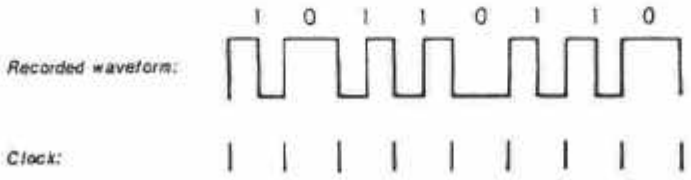


Fig. 1.– Modulation system "bi-phase mark".

2.2. *Bit-rate*

The bit-rate at nominal speed shall be 80 bits per picture, i.e. 2000 bit/s.

3. Code Format

3.1. Rate *of c*hange *of* the *code word*

Each television picture, comprising an odd-numbered field followed by an even-numbered field*. shall be identified by a complete code word.

3.2. Composition *of* the code word

Each code word shall consist of 80 bits, numbered from 0 to 79 inclusive.

3.3. bit assignment

The bits shall be assigned as shown in Fig. 2 and as described below:

0 - 3	Units of pictures
4 - 7	First binary group
8 - 9	Tens of pictures
10	Unassigned bit (see 5 4.6)
11	Colour lock flag bit (see 5 4.4)
12 - 15	Second binary group
16 - 19	Units of seconds
20 - 23	Third binary group
24 - 26	Tens of seconds
27	Binary group flag bit (see 5 4.3)
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 5 4.3)
44 - 47	Sixth binary group
48 - 51	Units of hours
52 - 55	Seventh binary group
56 - 57	Tens of hours
58	Unassigned bit (see 5 4.6)
59	Bi-phase mark phase correction bit (see 5 4.5)
60 - 63	Eighth binary group
64 - 79	Synchronizing word: 64 - 65: fixed zero 66 - 77: fixed one 78 : fixed zero 79 : fixed one

* Odd-numbered fields : fields 1, 3, 5, 7 } defined in CCIR Report 624-2 [3]
Even-numbered fields: fields 2, 4, 6, 8 } defined in CCIR Report 624-2 [3]

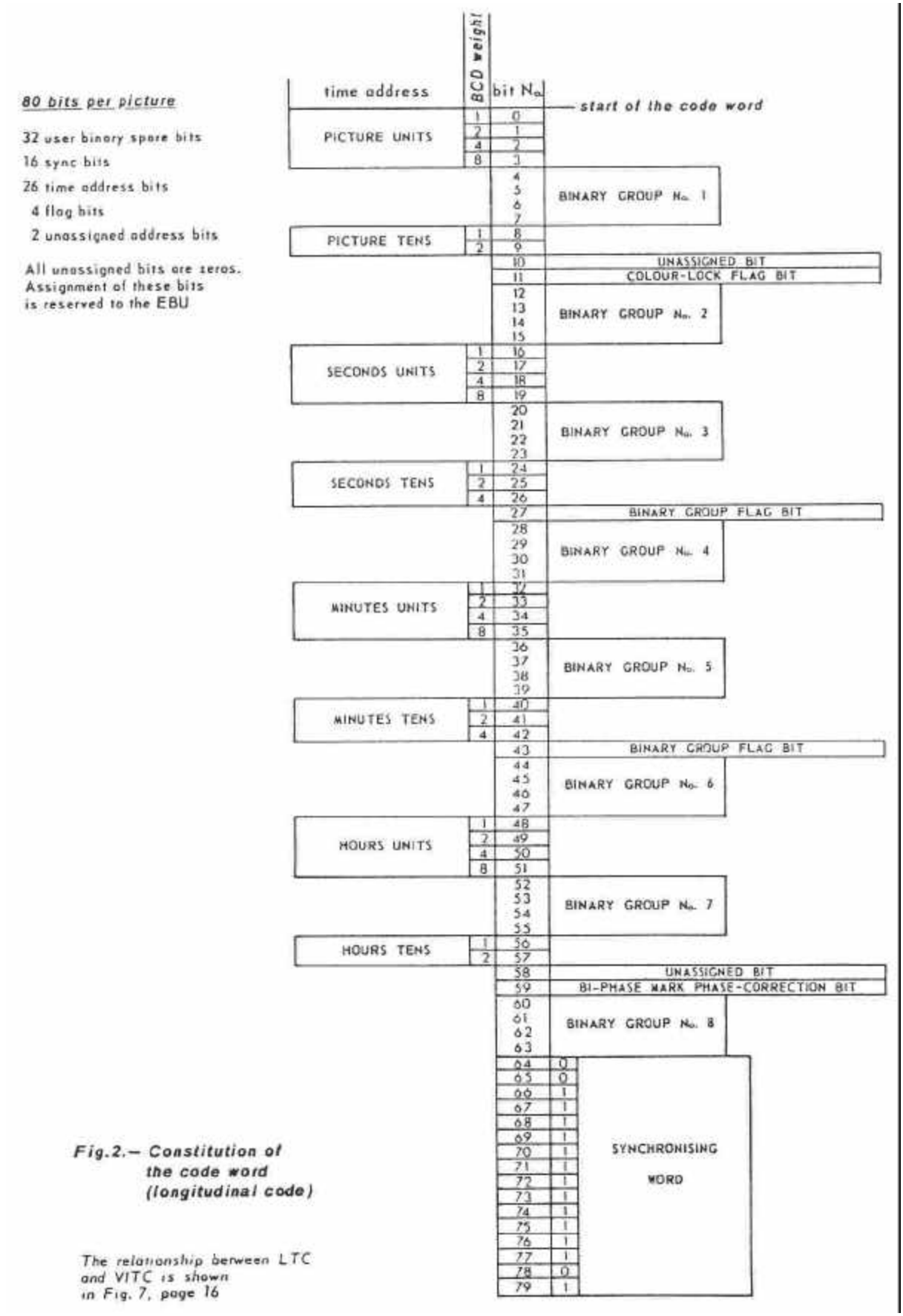


Fig.2.– Constitution of the code word (longitudinal code)

The relationship between LTC and VITC is shown in Fig. 7, page 16

4. Structure of the coded data

4.1.* *Structure of the time Label*

The basic structure of the time label is based upon the *binary Coded Decimal (SC'D)* system. In those cases where the count does not attain 9, only 2 or 3 bits are required, rather than 4 bits as is normal in the BCD code.

4.2.* *Assignment of the time bits*

Pictures		
Units	Bits	0 - 3 : four-bit BCD arranged 1, 2, 4, 8 count 0 to 9.
Tens	Bits	8 - 9 : two-bit BCD arranged 1, 2 count 0 to 2.
Seconds		
Units	Bits	16 - 19 : four-bit BCD arranged 1, 2, 4, 8 count 0 to 9.
Tens	Bits	24 - 26 : three-bit BCD arranged 1, 2, 4
Minutes		
Units	Bits	32 - 35 : four-bic BCD arranged 1, 2, 4, 8 count 0 to 9.
Tens	Bits	40 - 42 : thr-e-bit BCD arranged 1, 2, 4 count 0 to 5.
Hours		
Units	Bits	48 - 51 : four-bit BCD arranged 1, 2, 4, 8 count 0 to 9.
Tens	Bits	56 - 57 : two-bit BCD arranged 1, 2 count 0 to 2.

(The 24-hour clock system is used.)

4.3.* *Use of binary groups*

The binary groups are intended for the storage of supplementary data by the users. The thirty-two bits within the eight binary groups may be assigned in any way without restrictions if the character set used for the data insertion is not specified and the binary group flag bits Nos. 27 and 43 both are zero.

If an eight-bit character set conforming to I50 646 [4] and ISO 2022 [5] is signaled by the binary group flag bits Nos. 27 and 43, the characters should be inserted in accordance with ***Fig. 3.*** The information carried by the user bits is not subjected to any regulation.

* These points are identical in both the longitudinal and vertical-interval time-codes, with the exception of the bits numbers, which are different in the two codes.

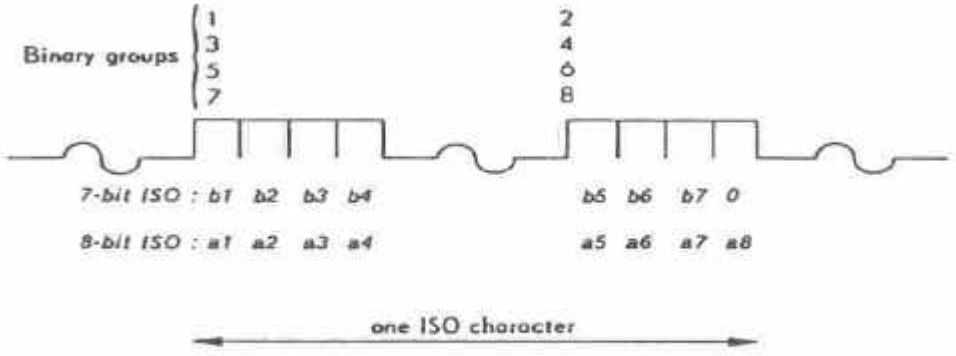


Fig. 3.— Use of binary groups of the time-and-control code to describe the ISO characters coded with 7 or 8 bits

At present, the following truth-table applies:

	Bit 27	Bit 63
Character set not specified	0	0
Eight-bit character set conforming to IS0 646 and IS0 2022	1	0
Unassigned	0	1
Unassigned	1	1

The unassigned states of the truth-table cannot be used and their assignment is reserved to the EBU. If it becomes clear that no use is to be expected for them, it is possible that bit No. 43 can again become unassigned and thus available for other applications, while still retaining bit No 27 to signal the presence of eight-bit ISO characters.

It should be noted that, in each time code word, some user bits will be decoded before bits Nos. 27 and b3 are encountered. The data in these earlier user-bit locations must not be lost.

Note. - The International Standard ISO 646 [4] defines two 7-bit Latin character code tables:

a) The basic code cable with control and alpha-numerical characters including punctuation marks can free positions for national use and some positions with more than one graphic symbol;

b) The international reference version (referred to as IRV), where the national positions are filled and a choice is made where more than one graphic symbol is shown in the basic code table.

The International Standard ISO 2022 t51 gives code extension techniques from the 7-bit code of ISO 646 to 8-bit codes, based on the use of the "escape' command of the basic code table of ISO 646. With character-combinations following the “escape” command access is given to a library of centrally registered character sets. This library consists of national character sets like the American ASCII although versions for special (e.g. broadcast) applications may also be included and registered. This central registration is done by the French national standardization office AFNOR.

6.4. Colour-Lock flag bit*

The colour-lock flag bit No. 11 shall be set to "1" when the time-code is locked to the associated PAL colour signal in accordance with the eight-field sequence, and when the video signal has the "preferred sub carrier-to-line-sync phase" (see § 5.1).

4.5. B*i-phase mark phase-correction bit*

The purpose of the phase-correction bit it to compensate for phase reversals in the bi-phase mark modulation that could occur when code inserts are performed. Such compensation may be required when code inserts modify the content of any of bits 0 to 63, bit 59 excluded.

In order that the magnetization transient between bit-cell 79 of one word and bit-cell 0 of the next shall always be in the same direction, bit 59 will be put in a state where every 80-bit word will contain an even number of logic zeros.

This requirement results in the following truth table for bit 59:

Number of logic zeros in bits 0 to 63 (59 exclusive):	Bit 59
Odd	1
Even	0

In drawing up this specification, the use of time-code write/read systems that have equal polarity relations between input/output voltage and the tape magnetization is assumed.

This specification should not be understood as a requirement for time-code insert capability in television tape-machines in situations where tapes have to be interchanged, until further notice from the EBU.

4. 6.* *Unassigned bits*

Bits 10 and 58 are reserved for future assignment and shall be zeros until specified by the EBU.

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* These points are identical in both the longitudinal and vertical-interval time-codes, with the exception of the bits numbers which are different in the two codes.

5. Relationship between the code and the television signals prior to recording

5.1.* Definitions relevant to the present section

The numbering of PAL or SECAM television fields in the respective 4-field sequence is described in CCIR Report 624-2 [3].

The definition of field 1 in the eight-field sequence of the PAL signal is described in CCIR Report 624-2 [3] and in A*ppendix* 1.

The stability conditions to be met by PAL video source equipment when sophisticated editing is required in post-production are detailed in Appendix 2.

To permit the sophisticated editing of PAL tapes, the video line-sync-to-burst phase on replay must be held within a certain tolerance. Recommendations on the tolerance required may be found in Appendix 3.

5.2. Association of code words and television pictures

In generating the code, each code word is associated with one particular television picture, with which it coincides in time. This relationship must be maintained throughout the whole post-production process.

The EBU Statement describing how this relationship can be maintained is reproduced in Appendix 4.

5.3. Timing of the code word

The code word shall start at the beginning of the clock period of the first bit (bit No. O). The bits shall be evenly spaced, subject to the tolerances specified in Section 6, in such a way that the code word duration shall coincide with the period of one television picture.

The start of the code word shall occur within the period of the sequence of field-synchronizing pulses [3], at the beginning of the picture with which the code word is associated (Fig. 4).

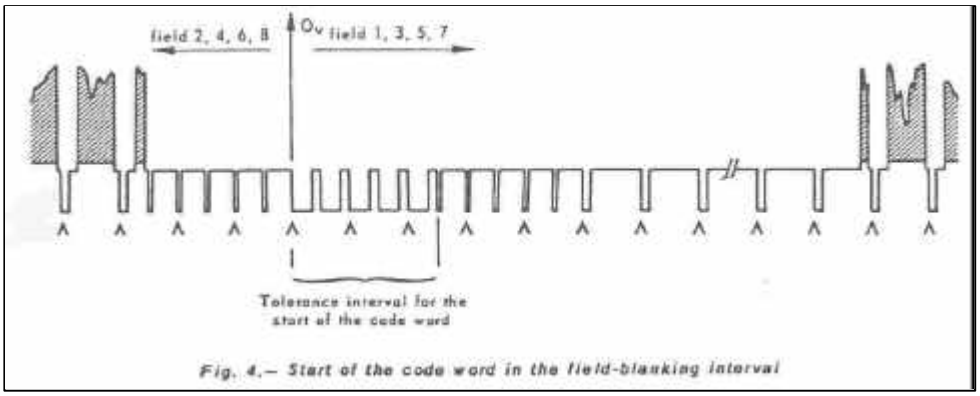


Fig. 4.— Start of the code word in the field-blanking interval

* This point is identical in both the longitudinal and vertical-interval time-codes.

*5.4. * Relationship between the time address and the associated colour television signal*

During electronic editing of colour signals recorded on television tape machines, it is important that:

a) in the case of editing in SECAM or simple editing in PAL, the correct four-field sequence be maintained in the edited master**;

b) in the case of sophisticated editing operations on PAL signals, the correct eight-field sequence also be maintained in the edited master, and that the "in-phase" or "out-of-phase" position of a slave tape** can be controlled.

Condition b) does not apply to SECAM signals.

These sequences can be preserved with the aid of the time-and-control code, provided that there exists a fixed relationship between the time addresses of the code and the sequence of television fields.

Therefore, it has been agreed that, when necessary, the on-tape relationship between the time address-numbers of the EBU time-and-control code and the associated eight fields of the PAL video signal, shall be as follows:

If bit No. 0 is A, bit No. 16 is B, bit No. 1 is C,
bit No. 8 is D, bit No. 17 is E, bit No. *24 is F,*

in order to fulfill condition a) above the code generator shall be locked to the associated video signal in such a way that:

a) $A \oplus B$ { "1" for fields 1 and 2 (and fields 5 and 6) constituting odd pictures
"0" for fields 3 and 4 (and fields 7 and 8) constituting even pictures,

where $\oplus$ = logical "exclusive or".

(For the numbering of fields, see CCIR Report 624-2 [3] and *Appendix 1).*

When it is also desired to fulfill condition b), in addition to condition a), the code generator shall, additionally, be locked to the associated PAL video signal in such a way that:

b) $(A + B) \oplus C \oplus D \oplus E \oplus F =$ { "1" for fields 1 to 4
"0" for fields 5 to 8.

When the time-code is displayed in decimal numbers, S and P designating the numbers of seconds and pictures respectively, condition a) is expressed as:

a) $S + P$ is { odd for fields 1 and 2 and fields 5 and 6
even for fields 3 and 4 and fields 7 and 8

and condition b) is expressed as:

b) the remainder on dividing S + P by *4 is*
0 for fields 7 and 8 2 for fields 3 and 4
1 for fields I and 2 3 for fields 5 and 6

- This point is identical in both the longitudinal and vertical-interval time-codes, with the exception of the bits numbers, which are different in the two codes.

***Edited master*: the videotape on the recording television tape-machine in an edit installation. *Slave tape: t*he videotape *on a* play-back t*elevision* tape-machine in an edit installation.

6. Waveform of the time-and-control code signal

Although time code signals serve for the transmission of data, it is more advantageous, in studio practice, if such signals can be handled as ordinary audio signals. The characteristic described hereafter takes into account this prerequisite*, as well as permitting unambiguous data recovery. This waveform is referred to as the "EBU Standardized characteristic of the time-and-control code signal", and the output of time code generators shall conform to it *(Fig. 5).*

Rise and fall time 50^{+15}_{-10} ìs is measured between the 10% and 90% amplitude points of the waveform

Shape of transition: similar co the edge of a sine squared pulse

Maximum overshoot,
undershoot, tilt: 5% of peak-to-peak amplitude

Clock period: 5oo ìs (nominal)

Maximum timing error
of any clock period: + 2.5 ìs

Maximum timing error
of "one" transition : + 2.5 ìs

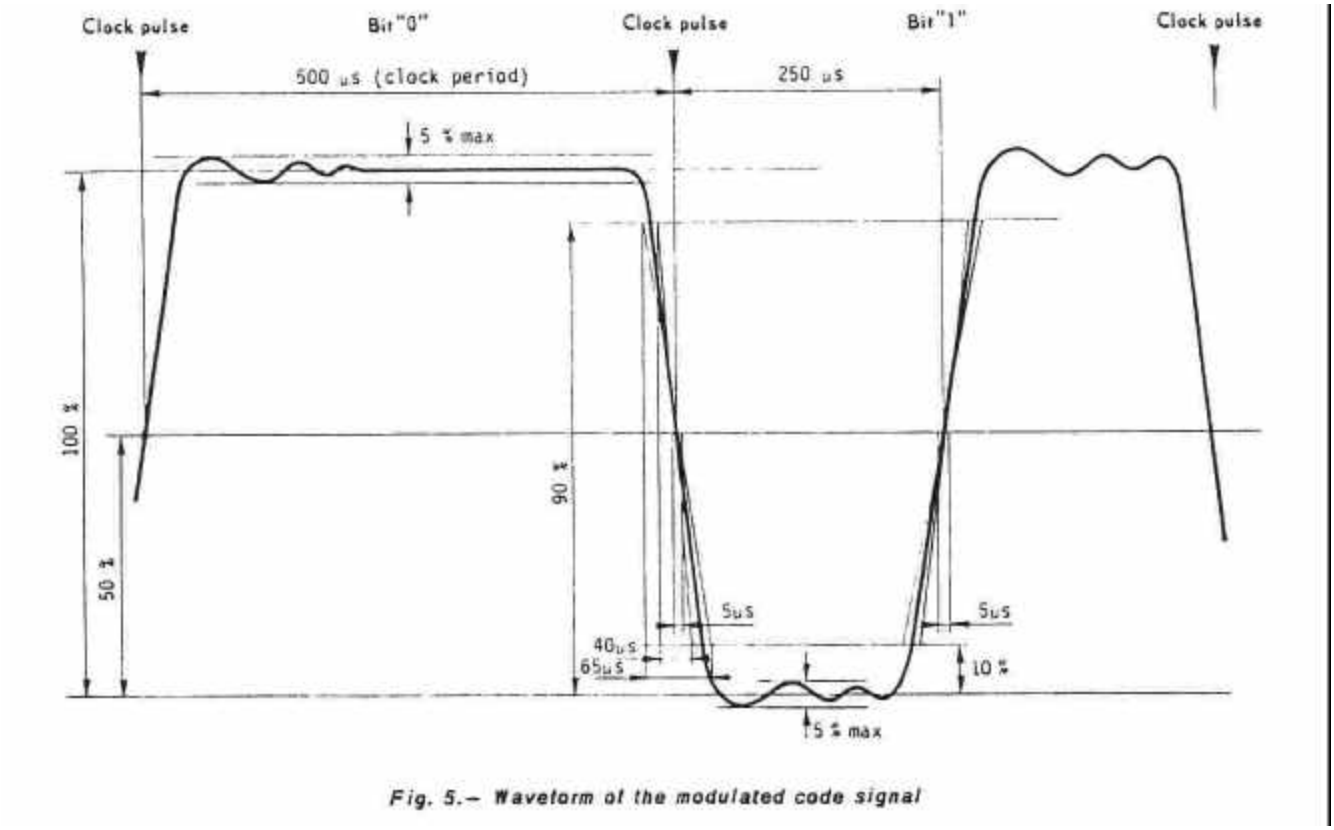


Fig. 5.– Waveform of the modulated code signal

The preferred specifications for the outputs of time code generators are described in the EBU Statement reproduced in *Appendix* 5.

* The signal described here has harmonics at least 40 dB down at 15 kHz.

APPENDIX C ~ F30 RS-422 SERIAL PROTOCOL

PROTOCOL—8 DATA BITS, ODD PARITY, 1 STOP BIT

COMMAND	FORMAT TO F30 (+ CHECKSUM)			F30 RESPONSE FORMAT (+ CHECKSUM)		
	CMD1	CMD2	DATA	BYTE1	BYTE2	DATA
READ	40H	80H	—	10H	01H	—
GEN	40H	81H	—	10H	01H	—
REGEN	40h	82H	—	10H	01u	—
JAM SYNC	40H	83H	—	10H	01H	—
MIDI ON	40H	84H	—	10H	01H	—
MIDI OFF	40H	90H	—	10H	01H	—
MODE CHANGE	41H	85H	1 Byte	10H	01H	
PAUSE	40H	0EH	—	10H	01H	—
UNPAUSE	40h	0EH	—	10H	01H	—
PRESET	44H	04H	4 Bytes	10H	01h (If Valid)	
				10H	13H (If Invalid)	—
RTN PRESETS/UB	61H	OAH	1 Byte	74H	08H (User Bits)	4 Bytes
				78H	08H (Time Code & UB)	8 Bytes
				74H	05H (Time Code)	4 Bytes
SET USER BITS	44H	05H	4 Bytes	10H	01H	
RTN CURRENT TC	61H	0CH	1 Byte	74H	04H	4 Bytes
RTN TC EACH FRAME	60H	70H	—	74H	04H	4 Bytes/frame
STOP TC EACH FRAME	60H	71H	—	10H	01H	—
WINDOW/BKGND ON/OFF	41u	86H	1 Byte	10H	01H	
CHANGE CHAR SIZE	41H	87H	1 Byte	10H	01H	
CHANGE WINDOW POS	42H	88H	2 Bytes	10H	01H	
FORMAT WINDOW	41H	8AH	1 Byte	10H	01H	
RETURN F30 ID	00H	11H	—	12H	11H	2 Bytes
COMPARE TC (GPI)	64H	71H	4 Bytes	74H	84H	4 Bytes
COMPARE TC OFF	60H	77H	—	10H	01H	—
HIGH SPEED MODE	-	-	—	10H	80H	—
ERROR/BAD CMD	-	-	—	11H	12H	—
RETURN MODE/STATUS	60H	72H	—	72H	80H	2 Bytes

CHECKSUM NOTE: A checksum follows each command packet (CMD 1, CMD2, Data). The checksum is the sum of CMD 1, CMD2 and Data, truncated to the low byte. For example, to preset the F30 to 1 hr., 30 min., 30 sec. send:

	44H	Preset command
	04H	
high nibble	01 H	frames (ignored)
tens digit	30H	seconds
low nibble	30H	minutes
units digit	01 H	hours
	AAH	sum of the above values, truncated to low byte.

TERMINOLOGY NOTE: Where appropriate the data is referred to in the following manner. When more than one byte of data is returned or sent, byte 1 is always the first byte of data, byte 2 the second, etc. Within a byte the Most Significant Bit, (MSB) is the bit furthest to the left (10000000 B) and the Least Significant Bit, (LSB) is the bit furthers to the right (00000001 B). The MSB is bit 7, and the LSB is bit 0. An X in a binary word indicates that the value of that particular bit does not matter, i.e. “Don't care.” H indicates hexadecimal, B indicates binary and data not otherwise notated is decimal.

COMMAND DESCRIPTIONS

CHANGE CHAR SIZE (41H 87H 1 Byte): Command changes the vertical and horizontal sizes of the window dub characters. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted.

1 data byte:

Bit 0,1 = Character Height, (00, 01,10,11)
Bit 2,3 = Character Width, (00, 01,10,11)
All other bits = x (Don't care).

CHANGE WINDOW POSITION (42H 88H 2 Bytes): Command changes the location where the upper left corner of the window begins on the screen. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR/BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted. Send 2 data bytes:

Byte 1 = Vertical position.
Byte 2 = Horizontal position.

The screen is divided into a 64 by 64 grid, where 64,64 is the upper left corner, and 0,0 is the lower right corner. Values should be greater then 2, and less then 64 to be considered valid. If values are outside valid range the F30 will return an ERROR/BAD CMD, (11H 12H).

COMPARE TC (GPI) (64H 71H 4 Bytes): Sends a complete time code address to the F30 and tells the F30 to toggle the GPI port when that time code address is READ, GENerated, REGENerated, or JAM SYNCed. F30 returns HIGH SPEED MODE, (30H 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted. Send 4 data bytes:

Byte 1 = Frames. Byte 2 = Seconds. Byte 3 = Minutes. Byte 4 = Hours.

The COMPARE TC (GPI) is frame accurate in the read mode only when the time code is being read at play speed, plus or minus 2 frames per second, or slower. At higher speeds the COMPARE TC (CPI) is accurate only to the nearest second. Use the RETURN CURRENT TC while VTR is shuttling to locate approximate position of event, then slow VTR to play speed and use COMPARE TC (GPI) to improve accuracy.

COMPARE TC OFF (60H 77H 4 Bytes): **Turns of the** COMPARE TC (GPI) mode. **F30 returns** HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted. Keeps the F30 from issuing spurious GPI toggles.

ERROR/BAD CMD (- - -): This command is issued by the F30 when it has received data which it can not parse as an acceptable command. This can occur when the command is wrong, or the accompanying data is improperly formatted or incomplete. Generally receiving this command will indicate that the previous command sent to the F30 should be verified and re-sent. ERROR BAD CMD has precedence over the HIGH SPEED MODE command.

The F30 returns l Byte of data indicating probable source of error:

Byte 1
- 04H = Checksum error
- 40H = Parity error
- 10H = 0verrun (Hardware)
- 20H = Framing error
- 02H = 0verrun (Software)
- 22H = Software
- 01H = Unidentified command

FORMAT WINDOW (41H 8AH 1 Byte): This command toggles on and off individual sections of the time code being inserted in the window dub. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted. The time code frames, seconds, minutes, and hours can all individually be added or removed from the display. Additionally, the user bits can be added or removed from the display.

1 data byte:

- Bit 0 = Toggles the Frames on and off, (1 on, 0 off).
- Bit 1 = Toggles the Seconds on and off, (1 on, 0 off).
- Bit 2 = Toggles the Minutes on and off, (1 on, 0 off).
- Bit 3 = Toggles the Hours on and off, (1 on, 0 off).
- Bit 4,5 = Format User Bits display, (00 = NUB, 01 = CUB, 2&3 = Reserved for future use.)
- Bit 6 = Toggles the User Bits on and off, (1 on, 0 off).
- Bit 7 = Toggles the LED between User Bits and Time Code, (1 UB on, 0 UB off).

GEN (40H 81H —): Switches F30 into generate mode. F30 returns acknowledgement, (10H 01H), if command is correctly interpreted, or ERROR/BAD CMD, (11H 12H), if otherwise.

HIGH SPEED MODE (- - -): A command the F30 replies with to indicate when it is in high speed mode and you have sent it a non-parsable command. The F30 only enters the HIGH SPEED MODE when READing time code above play speed. While in the high speed mode the F30 only parses for a subset of the entire command list. These HIGH SPEED MODE parsable commands include:

READ
GEN
REGEN
JAM SYNC
PAUSE
UNPAUSE
RETURN CURRENT TC

All other commands will elicit a HIGH SPEED MODE response.

JAMSYNC (40H 83H —): Switches F30 into jam sync mode. F30 returns acknowledgement, (10H 01H), if command is correctly interpreted, or ERROR/BAD CMD, (11H 12H), if otherwise.

MIDI OFF (40H 90H —): Turns MIDI output off. Not a toggle switch like the MIDI button. F30 returns HICH SPEED MODE, (10 H 80 H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H O1H) if command is correctly interpreted.

MIDI ON (40H 84H —): Turns MIDI output on. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted or acknowledgement, (1OH O1H), if command is correctly interpreted. The MIDI Time Code output is automatically disabled when the F30 is not in RECEN, JAM SYNC, or GENERATE mode.

MODE CHANGE (41H 85H 1 Byte): Sets the F30's frame rate. F30 returns HIGH SPEED MODE, (1OH 80H), if currently reading at high speed, ERROR/BAD CMD, (11H 12H), if command is not interpreted or acknowledgement, (1OH O1H) if command is correctly interpreted. Send 1 data byte:

Byte 1
0XXXXX00 B = SMPTE non-drop,
1XXXXX00 B = SMPTE drop,
0XXXXX01 B = EBU,
0XXXXX11 B = Reserved for future use.
01XXXX10 B = film (24 frame rate)

The frame rate set with the MODE CHANGE will be ignored if the F30 is in REGEN mode, where it automatically sets the frame rate equal to the input frame rate.

PAUSE (40H 0EH —): Pauses F30. Effect determined by mode F30 is in when it is paused. F30 returns acknowledgement, (10H 01H), if command is correctly interpreted, or ERROR BAD CMD, (11H 12H), if command is not interpreted. When the F30 is in READ, REGEN, or JAM SYNC, PAUSE freezes the LED display only. If the F30 is in GENerate mode the LED display, the Window, and the actual generation of time code are all PAUSEd. If the F30 is in PRESET mode when PAUSEd the pause is set, so that it will take place immediately when the F30 is switched out of the PRESET mode. This will not occur if all control of the F30 is done through the RS-422 port, as the PRESET is essentially instantaneous. If PAUSE is on, and modes are changed, the PAUSE will take whatever effect is appropriate for the new mode; (i.e., if the F30 is reading, is then paused, and finally switched into GENerate mode it will be paused on whatever time code and user bits were preset, but no time code generation will occur until the unit is UNPAUSEd).

PRESET (44H 04H 4 Bytes): Presets the F30's time code generator. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted. Send 4 data bytes:

Byte 1 = Frames,
Byte 2 = Seconds,
Byte 3 = Minutes,
Byte 4 = Hours.

If the data indicates a time code address outside of SMPTE specifications for valid time code, (greater then 23 hours, 59 minutes, 59 seconds, and 29 frames) the F30 will return a 10H 13H to indicate bad input values. In this case the F30 will revert to preset values saved in its EEPROM.

READ (40H 80H —): Switches F30 into read mode. Same effect as READ button. F30 returns acknowledgement, (10H 01H), if command is correctly interpreted, or ERROR/BAD CMD, (11H 12H), if otherwise.

REGEN (40H 82H —): Switches F30 into regenerate mode. F30 returns acknowledgement, (10H 01H), if command is correctly interpreted, or ERROR BAD CMD, (11H 12H), if otherwise.

RETURN CURRENT TC (61H 0CH 1 Byte): Queries F30 for current time code being read, generated, regenerated, preset, or jam synced. F30 returns ERROR BAD CMD, (11H 12H), if command is not interpreted, or response and 4 data bytes:

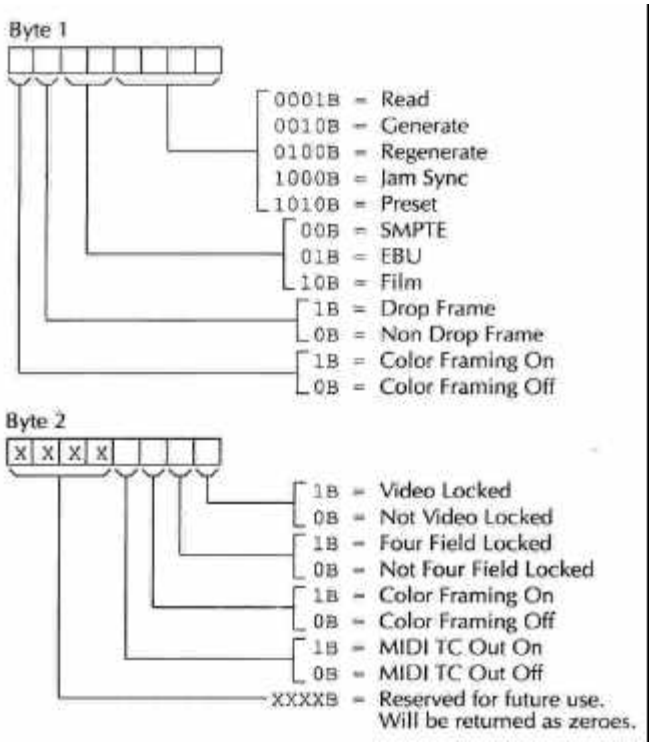
Byte 1 = Frames.
Byte 2 = Seconds.
Byte 3 = Minutes.
Byte 4 = Hours.

RETURN F30 ID (00H 11H 1 Byte): Queries F30 for identification code. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted.

Can be used to uniquely identify the F30 when other RS-422 devices are present. RETURN F30 ID allows verification of hardware and communications set up, and is a good test command. Returns 2 bytes:

Byte 1 = 30 (Fast Forward Video Equipment Model Number)
Byte 2 = 30 (Firmware Revision Number)

RETURN MODE/STATUS (60H 72H —): Queries the F30 for two bytes of data which will indicate the operating mode, the current settings of time code frame rate, and front panel indicator status. Can be used to verify that the MODE CHANGE command was received and correctly interpreted, and also to determine what kind of time code the F30 is processing. Receive two data bytes:



RETURN PRESETS/UB (61H 0AH 1 Byte): Queries F30 for current preset values, either of time code, user bits, or both. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR/BAD CMD, (11H 12H), if command is not interpreted, or appropriate response and data bytes if command is correctly interpreted.

Input data byte to the F30 indicates which value(s) are being requested:

XXX1XXX0 B = User Bit Presets.
XXX0XXX1 B = Time Code Presets.
XXX1XXX1 B = Time Code and User Bit Presets.

F30 responds indicating what data is being returned, and then returns 4 data bytes for User bit presets or Time Code presets, and 8 data bytes to return both.:

Response:

74H 08H = User Bit Presets,
78H 08H = Time Code and User Bit Presets.
74H 09H =Time Code Presets.

NOTE: There are two *separate formats for user bit data, indicated by a two-bit status indicator in the actual time code bit stream (see the SMPTE appendix). The two formats are Numeric User Bits, (NUB) consisting of 4 bytes, or 8 nibbles, representing 8 numbers, and Alphanumeric, or Character User Bits, (CUB), consisting of 4 bytes, representing 4 full character set characters. The F30 uses the standard ASCII character set for interpreting CUBs If you would rather encode CUBs in another character set simply read and write them in the numeric format, and utilize the data appropriately.*

For each of the three response formats:

Numeric User Bits;

Byte 1 = 2 Nibbles, numbers l & 2.
Byte 2 = 2 Nibbles, numbers 3 & 4.
Byte 3 = 2 Nibbles, numbers 5 & 6.
Byte 4 = 2 Nibbles, numbers 7 & 8.

Character User Bits;

Byte 1 = Alphanumeric 1, (ASCII).
Byte 2 = Alphanumeric 2, (ASCII).
Byte 3 = Alphanumeric 3, (ASCII).
Byte 4 = Alphanumeric 4, (ASCII).

Time Code Presets;

Byte 1 = Frames.
Byte 2 = Seconds.
Byte 3 = Minutes.
Byte 4 = Hours.

When Time Code and User Bit Presets are requested together, the 4 bytes of Time Code will be returned before the 4 bytes of User Bits.

RETURN TC EACH FRAME (60H 70H —): Puts the F30 in a mode where it will continually return the four bytes of data for the time code generated each frame. F30 returns HIGH SPEED MODE, (1OH 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or response and then 4 data bytes per frame:

Byte l = Frames.
Byte 2 = Seconds
Byte 3 = Minutes.
Byte 4 = Hours.

SET USER BITS (44H 05H 4 Bytes): Presets the F30's user bits.F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted. Requires 4 bytes of data, in one of two formats:

Character User Bits;

Byte 1 = Alphanumeric 1, (ASCII).
Byte 2 = Alphanumeric 2, (ASCII).
Byte 3 = Alphanumeric 3, (ASCII).
Byte 4 = Alphanumeric 4, (ASCII).

Numeric User Bits;

Byte 1 = 2 Nibbles, numbers 1 & 2.
Byte 2 = 2 Nibbles, numbers 3 & 4.
Byte 3 = 2 Nibbles, numbers 5 & 6.
Byte 4 = 2 Nibbles, numbers 7 & 8.

STOP TC EACH FRAME (60H 71H —): Turns off the RETURN TC EACH FRAME mode. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR/BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted.

UNPAUSE (40H 0FH —): Un-Pauses F30. F30 returns acknowledgement, (10H 01H), if command is correctly interpreted, or ERROR BAD CMD, (11H 12H), if command is not interpreted.

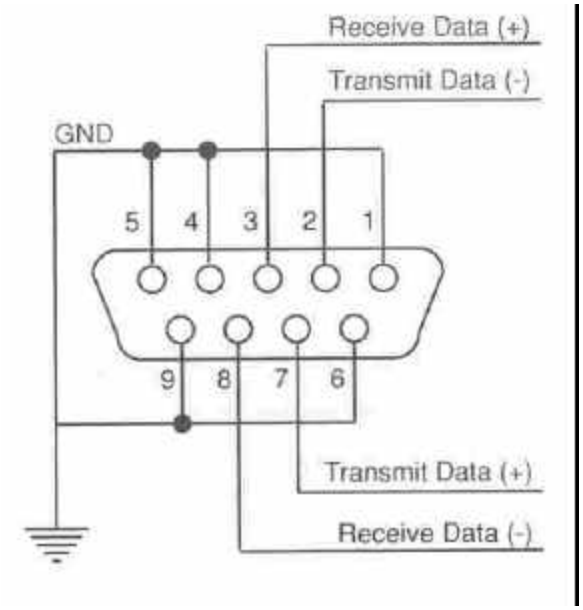
WINDOW/BCKGND ON/OFF (41H 86H 1 Byte): Toggles the window dub on the video passed through the F30 on and off. Also contains a bit used to toggle the background of the window on and off. F30 returns HIGH SPEED MODE, (10H 80H), if currently reading at high speed, ERROR/BAD CMD, (11H 12H), if command is not interpreted, or acknowledgement, (10H 01H) if command is correctly interpreted.

The background can be toggled on and off while the whole window is turned off, but no visible effect will be seen until the window is turned on.

1 data byte;

Bit 0 = Window On/Off toggle. High to turn window on.
Bit l = Background On/Off toggle. High to turn window on.

RS-422 SERIAL PORT DIAGRAM



APPENDIX D 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-lD 2> hr mn sc fr F7

F0 7F = Real Time Universal System Exclusive Header
<channel> = 7F (message intended for entire system)
01 = <sub-lD 1>, 'MIDI Time Code'
<sub-lD 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->S9)
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-lD 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-lD l>, 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 cacadddd eeeeffff gggghhhh ii. It forms 4 8-bit characters, and a 2 bit Format Code. u1 through u8 correspond to SMPTE Binary Groups l through 8. u9 are the two Binary Group Flag Bits, as defined by SMPTE.

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