



SMPTE SLAVE DRIVER

**HIGH-FIDELITY SMPTE SYNCHRONIZER  
FOR DIGIDESIGN PRO TOOLS™  
PROMASTER 20™ AND SOUND TOOLS II™**

**USER'S GUIDE**

**digidesign**

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## Radio and Television Interference

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

If necessary, consult an experienced radio/television technician for additional suggestions. The following booklet prepared by the Federal Communications Commission may also be helpful: "How to Identify and Resolve Radio-TV Interference Problems" The booklet is available from the U.S. Government Printing Office, Washington, DC 20402 Stock No. 004-000-00345-4

**Important Note:** This equipment includes a shielded data cable for connection between the SMPTE Slave Driver and Digidesign Audio Interface. This shielded cable or an equivalent must be used to insure compliance with FCC limits on RF emissions. Digidesign also advises the use of shielded cables for any analog or digital connections to this equipment.

Changes or modifications not expressly approved by Digidesign could void the user's authority to operate the SMPTE Slave Driver.

## Important Safety Instructions!

**Warning:** When using electric products, basic precautions should always be followed, including the following:

- Read all instructions before using this product.
- Do not use this product near water (for example, a bathtub, sink, etc.) or if the unit is wet.
- The product should be located away from all sources of heat, such as radiators, heat registers or other devices that produce heat.
- The product should be connected only to the correct power supply as indicated on the product.
- The power cord should be unplugged when the product is not in use for an extended period of time.
- Do not attempt to service the product. Refer all servicing to a qualified technician.

Any attempt to service the product will expose you to a risk of electric shock, and will void the manufacturer's warranty.

## Digidesign's Update and Support Policy

As a new SMPTE Slave Driver owner, the first action you should take is to send in your registration card. You must be a registered owner if you want to receive telephone support, program updates, or new product information. Once you are a registered owner, program updates will be made available to you for a minimal charge.

Digidesign is serious about customer support, and is strongly committed to a continuing relationship with you after your purchase. As a registered SMPTE Slave Driver owner, you can contact Digidesign directly with any questions or problems. A SMPTE Slave Driver Technical Support person will be standing by to help you during business hours (Monday to Friday, 9:30 to 5:30 PST). For customer service, call (415) 688-0600.

Digidesign is made up of people who are very interested in audio and the recording process as a whole. Become one of our registered owners and participate in the creative process.

# Contents

<b>Introduction .....</b>	<b>5</b>
<b>Installing the SMPTE Slave Driver .....</b>	<b>5</b>
<b>Operating Modes .....</b>	<b>5</b>
<b>Front Panel .....</b>	<b>6</b>
<b>Rear Panel .....</b>	<b>9</b>
<b>SMPTE Slave Driver Setup Software .....</b>	<b>10</b>
<b>The Update Command .....</b>	<b>10</b>
<b>The Setup Command.....</b>	<b>10</b>
<b>The Preferences Command.....</b>	<b>12</b>
<b>Testing the SMPTE Slave Driver .....</b>	<b>13</b>
<b>Striping a Tape with the SMPTE Slave Driver .....</b>	<b>14</b>
<b>Resolving your Digidesign System to SMPTE .....</b>	<b>14</b>
<b>Some Advice About Synchronization .....</b>	<b>15</b>
<b>About Pull Up and Pull Down Sample Rates .....</b>	<b>16</b>
<b>Technical Specifications .....</b>	<b>17</b>

## Introduction

The Digidesign SMPTE Slave Driver™ is a hardware device designed to provide high-fidelity, direct hardware synchronization of Digidesign's Pro Tools™, Sound Tools II™, or ProMaster 20™ digital recording & editing systems to external Longitudinal SMPTE Time code (LTC).

When used with any of the above systems, the SMPTE Slave Driver allows you to achieve high-fidelity LTC synchronization with any digital or analog audio or video tape recorder. This makes the SMPTE Slave Driver an excellent complement to your Digidesign recording & editing system for synchronization applications such as overdubbing, machine-to-machine lock, and track bouncing—as well as music scoring or other non-Vertical Interval Time Code video applications.

## Installing the SMPTE Slave Driver

Carefully unpack the SMPTE Slave Driver. Next, complete the enclosed registration card and return it to Digidesign immediately. It is important that you do this in order to be eligible for technical support and product updates. To install the SMPTE Slave Driver:

- Mount the SMPTE Slave Driver in your rack.
- Connect the AC power cord.
- Connect a serial cable to the Mac Port on the rear of the SMPTE Slave Driver. Connect the other end of the serial cable to the appropriate serial port on your Macintosh. If you usually send MIDI Time Code (MTC) to your Macintosh through the modem port, connect it to the modem port. If you typically use the printer port, connect the serial cable to the printer port. You will also need to select the proper settings in the MIDI Setup dialog of your software application (Pro Tools or Sound Designer II) to assign the proper port.
- Set the System Exclusive Source switch on the rear of the SMPTE Slave Driver to Mac Port.
- Connect the Slave Clock Output connector to the Slave Clock Input connector of your Digidesign Audio Interface with a short length of 75 ohm coaxial cable.
- Connect the SMPTE Input connector to the time code track of the tape machine you wish to use as a reference.

Depending on your particular setup, you may wish to these connections *before* you mount the SMPTE Slave Driver in your rack.

## Operating Modes

The SMPTE Slave Driver has two basic operating modes: *Resolve Mode* and *Generate Mode*.

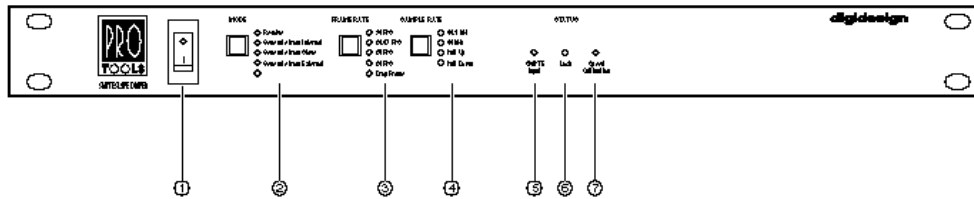
In *Resolve Mode*, the SMPTE Slave Driver accepts longitudinal time code on its *SMPTE In* connector, then generates Pro Tools Slave Clock and MIDI Time code (MTC) using the LTC as a reference timebase. The Slave Clock is generated in such a way as to make the total output *pulse* count related to the incoming LTC *frame* count. In this way the SMPTE Slave Driver implements a true position servo.

Should a time code dropout be detected, the Slave Clock and the MTC outputs will begin to “freewheel” at the last known LTC velocity, then resynchronize with the incoming LTC when it becomes valid again. A reshaped version of the incoming LTC is available at the *SMPTE Output* connector on the rear of the SMPTE Slave Driver.

In *Generate Mode*, the SMPTE Slave Driver produces Slave Clock and MTC independently, using its own internal crystal, an externally received Slave Clock, or an externally received 1-times or 256-times Sample Rate clock as its timebase reference. In *Generate Mode*, incoming LTC is ignored.

The SMPTE Slave Driver's operating Mode, Frame Rate, and output Sample Rate can be selected with the front panel controls or with the *SMPTE Slave Driver Setup* software.

# Front Panel



The SMPTE Slave Driver's front panel controls can be set manually from the front panel, or from the Macintosh with the *SMPTE Slave Driver Setup* software, which is included with your system. The SMPTE Slave Driver's front panel controls and indicators are described as follows, from left to right:

## 1. Power Switch

This switch applies power to the SMPTE Slave Driver. The "I" position on. The "O" position is off.

## 2. Mode Button

This button selects one of four possible operation modes. The current operation mode is indicated by an LED.

### Resolve

This LED indicates that the SMPTE Slave Driver is in *Resolve Mode*. When in *Resolve Mode*, the SMPTE Slave Driver resolves to the incoming LTC frame rate. The *Resolve* LED blinks slowly in the absence LTC to show that no actual resolving is taking place. Once the resolver has acquired the incoming LTC, the LED glows steadily. Should a dropout cause the SMPTE Slave Driver to begin freewheeling, the *Resolve* LED will flicker until freewheeling has ended.

### Generate from Internal

This LED indicates that the SMPTE Slave Driver is in *Generate Mode*, and is referenced to its own internal crystal oscillator. In this mode, LTC and MTC are generated with the internal crystal oscillator as a timebase.

### Generate from Slave

This LED indicates that the SMPTE Slave Driver is in *Generate Mode*, and is referenced to the Slave Clock input. LTC and MTC are generated with the Slave Clock input as a timebase. This mode allows you to connect a Digidesign Video Slave Driver™ to create a video-referenced LTC/MTC generator. If there is no Slave Clock signal present, this LED will blink, and the *Generate from Internal* LED will light, indicating that the output time code is still referenced to the internal crystal oscillator.

### Generate from External

This LED indicates that the SMPTE Slave Driver is in *Generate Mode*, and is referenced to the External Clock input. This mode allows the SMPTE Slave Driver to operate as a Word Clock-referenced LTC/MTC generator. LTC and MTC are generated with the External Clock input as a timebase. The External Clock is a TTL input at either 1-times or 256-times the audio sample rate indicated on the front panel. If there is no External Clock present, this LED will blink, and the *Generate from Internal* LED will light, indicating that the output time code is still referenced to the internal crystal oscillator.

### 3. Frame Rate Button

In *Resolve Mode*, this button allows you to select one of four possible frame rates. In *Generate Mode*, this button allows you to select one of six possible generator frame rate and format combinations. In *Resolve Mode*, the chosen frame rate is used to determine the number of audio samples per SMPTE frame. In *Generate Mode*, the frame rate and format combinations are used to specify the outgoing time code.

#### Frame Rate LEDs

In *Resolve mode* these LEDs alternately indicate the selected frame rate and the incoming LTC format. If the incoming LTC format matches the selected frame rate and format, the LEDs light steadily. If there is a discrepancy between the incoming LTC and the chosen setting, the LEDs will flash briefly from the steady currently selected display to the incoming format display. For example, if the SMPTE Slave Driver is set for 30 FPS with no Drop Frame, and 25 FPS LTC is received, the 30 FPS LED will be lit most of the time, while the 25 FPS LED will blink on briefly.

In *Generate Mode*, these LEDs show the frame rate and format of the LTC and MTC currently generated by the SMPTE Slave Driver.

#### 30 FPS LED

This LED indicates that the frame rate of the incoming or outgoing LTC is 30 frames per second.

#### 29.97 FPS LED

This LED indicates that the frame rate of the incoming or outgoing LTC is 29.97 frames per second.

#### 25 FPS LED

This LED indicates that the frame rate of the incoming or outgoing LTC is 25 frames per second.

#### 24 FPS LED

This LED indicates that the frame rate of the incoming or outgoing LTC is 24 frames per second.

#### Drop Frame LED

In *Resolve Mode*, the *Drop Frame LED* displays the state of the Drop Flag in the incoming LTC. In *Generate mode*, it indicates that the Drop Flag is set in the outgoing LTC and MTC.

### 4. Sample Rate Button

This button selects one of six possible output sample rates.

#### 44.1 kHz LED

This LED indicates that the frequency of the outgoing Slave Clock corresponds to a 44.1 kHz Sample Rate.

#### 48 kHz LED

This LED indicates that the frequency of the outgoing Slave Clock corresponds to a 48 kHz Sample Rate.

#### Pull Up LED

This LED indicates that the frequency of the outgoing Slave Clock corresponds to the indicated sample rate “pulled up” or multiplied by 1.001000000.

#### Pull Down LED

This LED indicates that the frequency of the outgoing Slave Clock corresponds to the indicated sample rate “pulled down” or multiplied by 0.999000999. The Pull Up and Pull Down sample rates are used in film and video applications.

### 5. SMPTE Input LED

When lit, this LED indicates that a signal is present at the *SMPTE In* connector.

## **6. Lock LED**

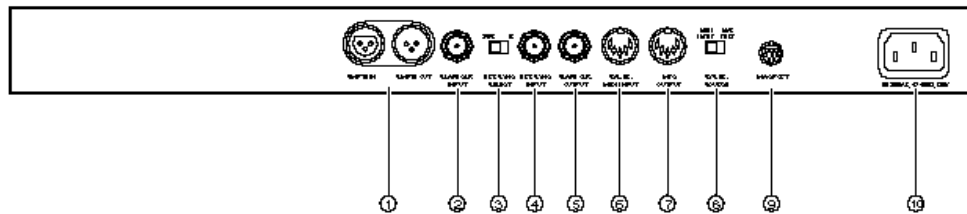
When lit, this LED indicates that the SMPTE Slave Driver has achieved “lock” with the incoming LTC in *Resolve Mode*. MTC output is muted when the SMPTE Slave Driver is out of lock, so the *Lock LED* also shows MTC activity.

## **7. Speed Calibration LED**

When lit, this LED indicates that the Output Slave Clock is at a frequency corresponding to the chosen Sample Rate  $\pm 250$  ppm. The LED flashes quickly if the Slave Clock is faster than the chosen rate, and slowly if the Slave Clock is slower than the chosen rate.



# Rear Panel



## 1. SMPTE Input/Output Connectors

The *SMPTE Input* connector is an XLR female connector for balanced Longitudinal Time code (LTC) input at -20 to +20 dBu. Pin 1 is ground, Pin 2 is “hot”, Pin 3 is “neutral”. If an unbalanced connection is desired, Pin 3 should be grounded, and signal applied to Pin 2. The *SMPTE Output* connector is an XLR male connector for balanced Longitudinal Time code output at +3.8 dBu. Pin 1 is ground, Pin 2 is “hot”, Pin 3 is “neutral”. If an unbalanced connection is desired, Pin 3 should be left unconnected, and signal obtained from Pin 2.

## 2. Slave Clock Input Connector

The *Slave Clock* connector is a BNC connector for receiving a Slave Clock signal. This signal is used as a timebase reference when the SMPTE Slave Driver is in *Generate from Slave* mode.

## 3. External Sync Select Switch

The *External Sync Select* switch allows selection of clock rate for the *External Sync Input* connector. Selections are *1-times* and *256-times* the selected sample rate.

## 4. External Sync Input Connector

The *External Sync Input* connector is a BNC connector for receiving an External Clock signal. This signal is used as a timebase reference when the SMPTE Slave Driver is in *Generate from External* mode.

## 5. Slave Clock Output Connector

The *Slave Clock Output* connector is a BNC connector for output of a Slave Clock. This signal is used as a timebase reference for Pro Tools, Sound Tools II, and ProMaster 20.

## 6. System Exclusive Input Connector

The *System Exclusive Input* connector is a 5-pin DIN female MIDI input connector for receiving MIDI System-Exclusive messages. System-Exclusive messages are used for setup, generator control, and updating internal software.

## 7. MTC Output Connector

This connector is a 5-pin DIN female MIDI output connector for MIDI Time code

## 8. System Exclusive Source Switch

This switch allows you to select the source of MIDI System Exclusive messages. Your choices are *MIDI Input* (for 5-pin DIN connector) or *Mac Port* (for 8-pin mini-DIN connector).

## 9. Mac Port Connector

This is an 8-pin mini-DIN female connector for connecting the SMPTE Slave Driver to one of the Macintosh’s serial ports. The transmit clock is at 1 MHz.

## 10. AC Power Input

This connector accepts a modular AC power cable. Because the SMPTE Slave Driver is auto power selecting, it will work with a standard modular cable and connect to AC power receptacles in any country.

# SMPTE Slave Driver Setup Software

The *SMPTE Slave Driver Setup* software included with your system can be used to control the SMPTE Slave Driver from your computer. It allows you to control the front panel settings, set other internal preferences, and load new firmware updates into the SMPTE Slave Driver.

In order to use this software, your SMPTE Slave Driver must be turned on and its *Mac Port* connected with a serial cable to one of your computer's serial ports. The System *Exclusive Source* switch must be set to *Mac Port*.

To install SMPTE Slave Driver Setup:

- Copy the *SMPTE Slave Driver Setup* application to your hard disk.
- Make sure the SMPTE Slave Driver is connected to your Macintosh and turned on.
- Double click *SMPTE Slave Driver Setup* application to open it. After a moment, the program opens and a menu bar appears.

The SMPTE Slave Driver Setup software has a single menu, called *Options*, which contains three commands: *Update*, *Setup*, and *Preferences*. These commands are explained in the following sections.

## The Update Command

The *Update* command allows you to load new firmware into the SMPTE Slave Driver. Although the SMPTE Slave Driver shipped with the latest firmware already installed, Digidesign periodically updates firmware for certain products. When a new version of firmware is released, you can install the new version by sending it to the SMPTE Slave Driver via a MIDI System-Exclusive message.

To Update the SMPTE Slave Driver firmware:

- To put the SMPTE Slave Driver in *Update* mode, turn the unit off and then back on while holding down one of the front panel buttons. The *44.1kHz* and *Speed Calibration* LEDs will flash, indicating the SMPTE Slave Driver is ready to receive new firmware.
- Choose *Update...* from the *Options* menu. A dialog appears asking you to put the SMPTE Slave Driver in *Update* mode.
- Click *OK*. The software will send the new firmware via MIDI. When the firmware update is complete, the unit will go back to its normal operating mode.

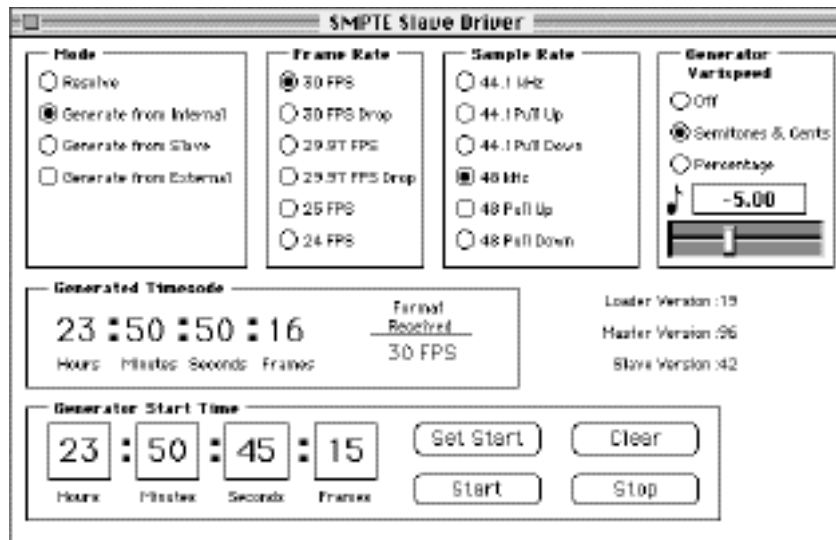
## The Setup Command

The *Setup* command is used to control the SMPTE Slave Driver front panel settings and its varispeed control. All of the SMPTE Slave Driver's front panel settings are represented in the *Setup Window*. The *Setup window* also displays incoming MIDI Time Code messages and allows you to set the start time for the SMPTE Slave Driver's internal time code generator.

In addition, this window displays the current versions of the SMPTE Slave Driver's firmware as well. These are indicated by the *Loader Version*, *Master Version*, and *Slave Version* numbers that appear in this window.

To use the *Setup window*, you must first make sure that the SMPTE Slave Driver is properly connected to the Macintosh with a serial cable. *Mac Port* must be selected as the *System Exclusive Source* on the rear of the SMPTE Slave Driver.

If the SMPTE Slave Driver is not properly connected to your computer you will not be able to use the *Setup* software. The SMPTE Slave Driver will not respond to the software if it is currently generating MIDI Time Code.



The Setup window

## Resolve Mode

When the SMPTE Slave Driver is in *Resolve* mode, the received time code will be displayed with its format under *Format Received*. This information is transmitted to the Mac via MIDI Time Code, so it cannot distinguish between 30 Frames Per Second and 29.97 Frames Per Second. So, even if the SMPTE Slave Driver is receiving time code at 29.97 FPS, the *Format Received* display will still show 30 FPS. When in *Resolve* mode, the generator start time and varispeed functions are disabled.

## Generate from Internal Mode

When the SMPTE Slave Driver is put into *Generate from Internal* mode, the *Generator Start Time* boxes and varispeed control are enabled. The start time can be set by typing in the appropriate hours, minutes, seconds, and frames, and then clicking the *Set Start* button. This will load the start time for the generator into the SMPTE Slave Driver.

The *Start* and *Stop* buttons in this window are used in order to actually start and stop the SMPTE Slave Driver's internal time code generator. The *Clear* button is used to reset the generator start time to zero, as well as reset the start time text display to 00:00:00:00. The *Received Timecode* display will then change to *Generated Timecode* and will display the SMPTE Slave Driver's MIDI Time Code output.

The varispeed control, which is enabled only in *Generate from Internal* mode, allows you to change the speed of the generated time signal by a controlled amount. There are two choices for varispeed: semitones/cents adjustment or percentage adjustment. The amount of varispeed can be adjusted by either moving the slider or by simply selecting the text with the mouse and typing in a new value.

When in *semitones/cents* adjustment, moving the slider will change the varispeed value in semitone increments. If you wish to adjust by cents (1/100 of a semitone) hold down the Control key before you drag the slider. Similarly, when you are in "percentage" adjustment, moving the slider will change the varispeed value in whole percent increments. Again, to adjust by 1/100 of a percent, hold down the Control key before you drag the slider. Switching between *semitones/cents* and *percentage* will cause the text display to re-calculate to display the new units.

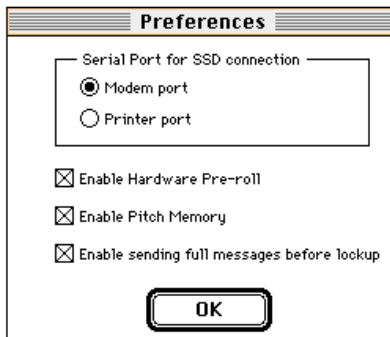
## Generate from Slave/Generate from External Modes

When the SMPTE Slave Driver is put into either of these modes, the varispeed control will be disabled and the generator start time edit boxes will be disabled. The *Generated Timecode* display will show the SMPTE Slave Driver's MIDI Time Code output and its frame per second format under *Format Received*. The generator start time boxes and buttons function as described in *Generate from Internal* mode.

# The Preferences Command

Choosing *Preferences* from the Options menu brings up the *Preferences* dialog. Here you can choose the serial port you wish to connect the SMPTE Slave Driver to. The default serial port connection is the modem port. If the printer port is currently in use (by AppleTalk, for example), it will not be available.

Other SMPTE Slave Driver preferences that you can set in this window are: *Enable HW Pre-roll*, *Enable Pitch Memory*, and *Enable sending full message before lock-up*. These preferences can be turned on and off. The default setting is *on*.



*The Preferences window*

## Pitch Memory

Pitch Memory is a feature that allows the SMPTE Slave Driver to remain at the last known pitch (i.e. incoming SMPTE speed) even when the tape is stopped. If your deck is varispeeding, this feature causes Pro Tools to stay “in tune” with the rest of the tracks when you are editing with the SMPTE source stopped. If you forget about your varispeed, however, you might not be able to lay your finished mix off to DAT because the varispeeded sample rate may be beyond the lock range of your DAT recorder. Turning off Pitch Memory causes the Slave Clock to return to the selected sample rate when the tape (SMPTE) is stopped.

*Full Message Defeat* controls whether or not an MTC “Full Message” will be sent on the last valid frame after the SMPTE has started. Its function is identical to the *FMSG* switch on the Opcode Studio 3. Some MIDI applications do not recognize MTC Full Messages.

*Hardware Preroll* refers to withholding MTC until the SMPTE Slave Driver servo has locked. This feature is essential for use with Pro Tools. Sequencer users who are not using the Slave Clock for anything (i.e. only using the SMPTE Slave Driver as an MTC converter) do not need to have the servo locked, so they can avoid the lock-up delay by disabling *Hardware Preroll*.

# Testing the SMPTE Slave Driver

After you have installed your SMPTE Slave Driver, and made the proper connections, use the following procedure to test and synchronize your system to an external source.

To synchronize to an external source:

- Load a tape with a known frame rate and format time code stripe. Leave the transport stopped. (For testing purposes, you may wish to use a time code generator.)
- Turn on the SMPTE Slave Driver and verify that the 30 FPS LED, and the 44.1 kHz LED are lit properly, and that the *Resolve* LED is flashing slowly.

These are the default settings of the SMPTE Slave Driver when you turn it on. The *Speed Calibration* LED will flash and then light steadily to show that the Slave Clock Output frequency has stabilized to the power-on default of 44.1kHz. The *Sync Source* LEDs on the Audio Interface should indicate *Slave*. The *SMPTE Input* LED should be off if your transport is stopped. The *Lock* and *Speed Calibration* LEDs may flicker and then go off.

- Press the *Frame Rate* button to select the appropriate frame rate and format for your tape.
- Press the *Sample Rate* button to select your session sample rate.
- Start your tape transport and verify that the *SMPTE Input* LED lights. If the *Frame Rate* LEDs do not flash, this means that your SMPTE Slave Driver settings correctly match those of your tape.
- Confirm that the *Lock* LED lights up when lock has been achieved.

It may take several seconds for the SMPTE Slave Driver to lock when you first turn it on. Subsequent lockups are much faster. If your transport speed is accurately calibrated, or if you are using a generator, the *Speed Calibration* LED will light. It may flicker during operation as the SMPTE Slave Driver's servo acts to maintain lock. Once the *Lock* LED lights up, MTC will be sent to the Mac.

- Stop your transport.
- Start your application program (Pro Tools or Sound Designer II) and verify that your frame rate and sample rate settings match those set on the SMPTE Slave Driver. The application must have software SMPTE chasing disabled so that the SMPTE Slave Driver can take over that task. If you are using Pro Tools, set the software to *Trigger Mode*. If you are using Sound Designer II, set *Continuous SMPTE Resync* to *OFF*.
- Set the SMPTE start time in the application (Pro Tools or Sound Designer II) to a value a few seconds ahead of where your tape transport is parked.
- Connect an audio track output of your tape deck to one of your Audio Interface's inputs.
- Set the appropriate track to *record* in Pro Tools or Sound Designer II. Start the tape transport and confirm that your software begins recording at the proper start time.
- Record several minutes of audio to disk. Next, stop and rewind the transport to the beginning of the recorded portion.
- Begin playback and confirm that the audio on disk stays in sync with the tape. Try adjusting the varispeed control of the deck to verify that your system follows the speed fluctuations and maintains position lock.

# Striping a Tape with the SMPTE Slave Driver

Now that you are familiar with the SMPTE Slave Driver Setup software, you will learn how to stripe tape with the SMPTE Slave Driver, and how to resolve your system with the SMPTE Slave Driver.

To stripe a tape with the SMPTE Slave Driver:

- Verify that the SMPTE Slave Driver's SMPTE Output is connected to an input of your tape deck.
- Set the SMPTE Slave Driver mode to Generate from Internal (If you are using a Video Slave Driver, set the mode to Generate from Slave.) (If you are using a digital multi-track, set the mode to Generate from External.)
- In the SMPTE Slave Driver Setup application, choose Setup from the Options menu.
- Set the appropriate Frame and Sample Rates for your Session.
- In the Generator Start Time boxes, enter the desired SMPTE start time.
- Click Set Start. This sends the Start Time to the SMPTE Slave Driver.
- Hit record on your tape deck to begin recording.
- In the SMPTE Slave Driver Setup application's Setup window, click Start. SMPTE Slave Driver begins generating SMPTE. To stop striping tape, click Stop.

# Resolving your Digidesign System to SMPTE

To synchronize recording of your system to SMPTE:

- Make sure that the SMPTE output of your tape deck is connected to the SMPTE Input of the SMPTE Slave Driver.
- Set the SMPTE Slave Driver to Resolve mode.
- Set the SMPTE Slave Driver to the appropriate Frame and Sample Rate.
- In your software application (Pro Tools or Sound Designer II) set your SMPTE Start Time (and in Sound Designer II, a SMPTE Stop Time).
- Put the application online and enable Record.
- Start the tape deck.
- When the time code reaches the SMPTE address defined in Pro Tools or Sound Designer II, recording will begin.

To synchronize playback of your system to SMPTE:

- Make sure that the SMPTE output of your tape deck is connected to the SMPTE Input of the SMPTE Slave Driver.
- Set the SMPTE Slave Driver to Resolve mode.
- Set the SMPTE Slave Driver to the appropriate Frame and Sample Rate.
- In your software application (Pro Tools or Sound Designer II) set your SMPTE start time.
- Start the tape deck.
- When the time code reaches the SMPTE address defined in Pro Tools or Sound Designer II, playback will begin.

# Some Advice About Synchronization

The task of synchronizing a digital audio workstation to an external timebase can be a complex one. In order to ensure proper synchronization between Pro Tools and the outside world, it is necessary that you understand the underlying theory.

There are three basic requirements to keep in mind when synchronizing a workstation. The first is that the SMPTE start time of your audio be set correctly. If the audio on disk begins playback correctly at the beginning of the tape, the start time is correct. If the start time is wrong, the audio will be forever out of sync.

The second important requirement is that the digital audio clock frequency must be correct, so that once the audio has begun to play correctly, it will stay in sync and not drift. If your clock frequency is incorrect, the disk audio will slip out of sync with the tape audio. The longer you play the tape, the farther out of sync the disk audio will be.

The third requirement is that the number of audio samples per SMPTE frame (the sample per frame ratio) be correctly set in the application. This is necessary in order for the application to correctly calculate which sample to begin playback on if the transport is fast-forwarded into the middle of a session.

If your playback stays in sync when you begin playback from the beginning of a region, but gets out of sync when you fast forward into the region, your samples-per-frame ratio is probably being calculated incorrectly. This becomes more pronounced the farther you fast-forward.

The sample per frame ratio is set when you choose the sample rate and frame rate in your application. If the sample and frame rate combination you are using is not available in your application, you can work around this by specifying a sample and frame rate combination that results in the same sample-per-frame ratio.

As an example, imagine that you are using a sample rate of 44.056 kHz (44.1 kHz pull-down) and a frame rate of 29.97 FPS. The samples-per-frame ratio is 1470.000. If your application does not support that sample rate, you can select a sample rate of 44.1 kHz with a frame rate of 30 FPS. This yields the same samples-per-frame ratio of 1470.00. Given an arbitrary SMPTE offset into the session, the application will calculate the correct starting address, even though both the sample rate and frame rate are set "wrong".

# About Pull Up and Pull Down Sample Rates

*Pull Up* and *Pull Down* are terms used to refer to the deliberate “miscalibration” of the audio sample rate clock (the audio pitch) in order to compensate for a speed change elsewhere in the production chain. The usual situation in which these rates are encountered is when film footage (at 24 FPS) is transferred to color videotape (at 29.97 FPS).

If we had a film clip that lasted 1000 seconds, we would have 24,000 film frames (pictures). If we wanted to transfer that film to 1000 seconds worth of color videotape, we would have to “fit” our 24,000 film frames into 29,970.02997 video frames. Because we can’t have a fraction of a picture, the best we can do is to repeat a film frame occasionally to makeup the difference in the frame counts. Even if we do that, what happens to the remaining fraction of a picture (the 0.02997 part) left over? It is clear that this scheme won’t work.

The answer is to NOT convert to the color video rate of 29.97 FPS, but to use the old black and white frame rate of 30 FPS. We now would have to put our 24,000 frames into 30,000 video frames, which can be done simply by repeating every fourth film frame. The film frames would then go 1, 2, 3, 4, 4, 5, 6, 7, 8, 8, 9, etc. Now we have a picture-for-picture transfer, but it must be played back at 30 FPS if it is to be at the same speed as the original film.

No video deck plays at 30 FPS; they play at 29.97 FPS. So what happens if we play our tape on a normal video deck? The picture runs slightly slow. The amount that it is slow is exactly 1000 divided by 1001 (99.9000999 %) of actual play speed. Now, what about the audio? It is now running slow, too. The pitch is flat. If we were to record and edit this audio at 44.1 kHz, for instance, and transfer the final edit to DAT, when the DAT to film transfer is done at 44.1 kHz, the resulting audio would be slower than the picture.

There is a solution to this situation using “pull down”. Record and edit the audio at a “pull down” rate of 44.056 kHz (44.1 kHz times the ratio of 1000 to 1001). The DAT transfer then represents samples recorded at this “slow” rate. When the DAT is played at the normal 44.1 kHz sample rate, the pitch is automatically “pulled up” to the original film pitch.

The SMPTE Slave Driver gives you the capability of doing both a deliberate “pull up” and a “pull down” so that even a misprinted transfer can be used. You should always check with both the supplier and the receiver of your audio material to find out exactly what sample rate you should use.



# Technical Specifications

LTC Input:	Balanced XLR female connector -20 to +22 dBu level 200 k differential input impedance
LTC Output:	Balanced XLR male connector 2.5 V p-p balanced (+3.8 dBu RMS) <100 ohms output impedance
Slave Clock Output:	256 times Sample Rate HCTTL level 75 ohm BNC connector
Slave Clock Input:	256 times Sample Rate HCTTL level 75 ohm BNC connector
External Clock Input:	1 or 256 times Sample Rate rear panel switch selectable HCTTL level 75 ohm BNC connector
MIDI MTC Output:	5-pin DIN connector MIDI current loop
Mac MTC Output:	8-pin mini DIN connector RS-422 levels, 1 MHz clock rate
SYS-EX Input:	Mac: 8-pin mini DIN connector, RS-422 levels MIDI: 5-pin DIN connector, MIDI current loop, reverse polarity protected rear panel switch selectable Mac / MIDI
Input/Output Sample Rates:	44.1 kHz, 48 kHz, 44.056 kHz, 47.952 kHz (pull-down), 44.144 kHz, 48.048 kHz (pull-up)
Input/Output LTC	30 FPS Non-Drop 30 FPS Drop 29.97 FPS Non-Drop 29.97 FPS Drop 25 FPS 24 FPS
Varispeed range:	Nominal rate $\pm 10\%$
SMPTE Input Indication:	LED lights when LTC is applied to LTC input connector
Lock Indication:	LED lights when total position error is less than $\pm 5$ LTC cells ( $\pm 0.0625$ frames)
Speed Calibration Indication:	LED lights steadily when Slave Clock Output frequency is equal to 256 times the nominal Sample Rate (as indicated on the front panel) $\pm 250$ ppm. Slow flash for underspeed, fast flash for overspeed.
AC Input:	90 to 260 VAC, 47 to 63 Hz, 43 Watts MAX
Dimensions:	1 rack-unit, 19" W x 10.5" D x 1.7" H
Weight:	4.1 lbs.