Universal Slave Driver

User's Guide

Version 5.0.1

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contents

Introduction

The Universal Slave Driver (USD) is a multipurpose synchronization device. It supports all major time code and clock reference standards used in audio, video, film, and multimedia production.

USD with Pro Tools

With Pro Tools MIX/MIXplus and Pro Tools 24 systems, the USD provides near-sample-accurate lock to time code through the DigiSerial Port connection.

Standalone Mode

The USD can also be used as a standalone synchronization converter, time code generator, clock generator and time code character generator. Throughout this guide, the term "standalone" refers to systems utilizing USD but *not* using Pro Tools.

USD Setup

USD Setup is a remote control application for the USD. USD Setup can be used with or without Pro Tools on any supported Macintosh or Windows computer.

System Requirements

Macintosh Pro Tools Systems

- Digidesign-qualified Macintosh computer
- 17-inch or larger color monitor
- A Pro Tools MIX/MIXplus or Pro Tools 24 system
  – or –
- A Pro Tools III system

✳ Serial port requirements vary depending on the type of Pro Tools system. See "USD Serial Port Requirements" on page 2 for details

Windows Pro Tools Systems

- Digidesign-qualified Windows NT computer
- A Pro Tool MIX/MIXplus or Pro Tools 24 system

USD Setup Macintosh and Windows

USD Setup provides standalone software control of the USD, and firmware updating capabilities. USD Setup can be used with or without Pro Tools for complete control of all USD features. In order to use USD Setup, you must have the following:

◆ An available serial or Com port (Macintosh and Windows, respectively)
USD Setup is not available when the USD is connected to a DigiSerial Port

Minimum Macintosh Requirements for USD Setup

◆ 68K and Power Macintosh computers require Mac OS version 7.5 or higher. Beige G3 Macintosh computers must run OS 8.5 or higher.
- At least 2 MB of available RAM
- Virtual Memory must be turned off in the Macintosh Memory Control Panel
- An available serial (modem or printer) port, or equivalent USB converter. See "USD Serial Port Requirements" on page 2 for details.

Minimum Windows Requirements for USD Setup

- Windows NT 4.0, or Windows 98
- A Pentium-I/90 MHz processor
- An available COM port. See "USD Serial Port Requirements" on page 2 for details.

USD Serial Port Requirements

Pro Tools MIX/MIXplus and Pro Tools 24 Systems

◆ The USD must be connected to the DigiSerial Port on the Digidesign MIX or d24 card (if multiple, use the card in the lowest slot).

USD with the G3 and G4

Under certain circumstances, for example when running the USD Setup utility application, the USD must be connected to a conventional serial port. Many MIDI devices, as well as Digidesign's MachineControl™ option, also require connection to a conventional serial port. Since Power Macintosh G3 and G4 computers do not contain a conventional serial port, where connection to a conventional Macintosh serial port (modem or printer port) is called for in this guide, you will need to utilize one of the following adaptors:

- Stealth Serial Port, made by GeeThree.com. This adaptor supports firmware updating of the USD.
- gPort Serial Adaptor, made by Griffin Technology. This adaptor supports firmware updating of the USD.
- USB Twin Serial Adaptor, model USA-28x, made by Keyspan. This adaptor does not support firmware updating of the USD.

Pro Tools III Systems

◆ The USD must be connected to the modem or printer port, or equivalent serial port adaptor

USD Setup

◆ USD Setup requires its own connection from the USD to your computer for remote control of the USD:

Macintosh A serial port (modem or printer, or equivalent serial port adapter) is required for USD Setup Macintosh.
USD Setup does not work if the USD is connected to a DigiSerial Port.

Windows A COM port connection is required for USD Setup Windows. USD Setup does not work if the USD is connected to a DigiSerial port.

USD Standalone, without Pro Tools

If you are not using Pro Tools but using the USD in standalone mode, no USD-to-CPU connection is required unless you need to do any of the following:

◆ Use the USD for Variable Speed Override (VSO)

◆ Configure Window burn parameters

◆ Control the USD with USD Setup

If you do not connect USD to a CPU, you will use the USD front panel to access and edit parameters. (See "Control Options" on page 27 for details.)

USD Standalone with Remote Control

For software remote control using the USD Setup application, see "USD Setup" on page 3.

USD Cables

USD Serial Cable •A USD Serial cable is included to connect the USD to a Macintosh- or Windows-based Pro Tools DigiSerial Port (Pro Tools MIX, MIXplus, or Pro Tools 24 systems). This cable can also be used to connect the USD to r a Macintosh serial port or equivalent serial port adaptor.

Windows USD Setup on Windows requires a standard 9-pin-to-25-pin modem cable to connect the USD to a COM port on any supported Windows computer. This cable is available from Digidesign through your Digidesign dealer, or from many computer supply stores.

Compatibility Information

Digidesign can only assure compatibility and provide support for devices it has tested and approved.

For a list of qualified computers, diskette drives, SCSI accelerators, serial port convertors and hard drives, refer to the latest Digidesign compatibility documents, available from Digidesign by fax or on the Digidesign Web site.

✳ For a list of Digidesign's contact information, see the title page of this guide.

About This Guide

This guide assumes you understand the basics of synchronization and time code, know how to operate devices that send or receive time code such as a video tape recorder, and how to connect your studio. Refer to the documentation for your studio hardware if necessary.

In addition, you should have an understanding of the time code requirements for your particular project.

Conventions Used in This Guide

Digidesign guides use the following conventions to indicate menu choices and key commands:

Convention	Action
File > Save Session	Choose Save Session from the File menu
Control+N	Hold down the Control key and press the N key
Option-click	Hold down the Option key and click the mouse button
Right-click (Windows)	Click with the right mouse button

The following symbols are used to highlight important information:

✽ *User Tips* are helpful hints for getting the most from your system.

✽ *Important Notices* include information that could affect your data or the performance of your system.

✽ *Cross References* point to related sections in other Digidesign guides.

USD Synchronization Support

Supported Positional Reference Sources

- LTC
- VITC
- Bi-Phase/Tach
- Internal Time Code Generator
- Serial Time Code (requires Digidesign's MachineControl option and Pro Tools software version 5.0 or higher, and a video reference signal)

Supported Clock Reference Sources

- Reference Video
- Composite Video Input
- Word Clock
- AES/EBU Null
- Pilot Tone
- Super Clock
- Internal Crystal
- Bi-phase/Tach
- LTC

Output and Generation

- Digidesign Super Clock (256x sample clock)
- Word Clock (1x sample clock);
- AES/EBU null clock (AES "digital black")
- VITC (if a video input is present)
- LTC
- MIDI Time Code (MTC)

Other Features

- Front panel controls and a large LED display of time code and parameters
- Integrated control of USD from Pro Tools
- Time Code Character Generator
- Fader start, provided through GPI output, for remote transport control from select Pro Tools fader movement.
- USD Setup software for Macintosh and Windows
- USD firmware that can be updated at any time for future upgrades

chapter 2

Installing the USD

For USD with Pro Tools, installation includes the following steps:

- Connect the USD to your Pro Tools system
- Connect your studio
- Install and configure USD software

Complete installation instructions are provided for each of these steps throughout this chapter.

For standalone USD systems, installation instructions begin with "Connecting AC Power" on page 10.

✱ Make sure Pro Tools is already installed and operating correctly before installing the USD.

Connecting USD to a Computer

Pro Tools systems require a USD-to-computer connection, as explained beginning in "Connecting USD to a Computer" on page 7.

For standalone USD systems (without Pro Tools), firmware updating and USD Setup require a connection to a Mac-

intosh serial port or Windows COM port. Firmware updating is explained in "Updating USD Firmware" on page 14.

In addition, USD Setup can be used for software remote control of all USD features. USD Setup requirements are listed in "Software Installation" on page 13.

About the USD Serial Cable

The USD includes a 4 meter (approximately 12 foot) cable, designed to connect the USD to a DigiSerial Port on a Macintosh or Windows Pro Tools MIX/MIXplus or Pro Tools 24 system, or to a Macintosh serial port (modem or printer).

For Windows NT systems, a standard 9-pin to 25-pin modem cable is required to connect the USD to a Windows COM port in order to use USD Setup. Contact your Digidesign dealer if you need to acquire one of these cables.

✱ If you choose to use a longer cable, be sure it supports hardware handshaking. A schematic for these cables can be found in *Appendix C: Wiring Diagrams Pin Assignments*.

Pro Tools MIX/MIXplus or Pro Tools 24 Systems

(Macintosh and Windows)

To connect the USD to a Macintosh or Windows Pro Tools MIX/MIXplus or Pro Tools 24 system:

1 Make sure the power is switched off for both the USD and the computer.

2 Connect one end of the cable to the USD port labelled Mac Serial (whether using a Macintosh or a Windows computer).

3 Connect the other end of the cable to the DigiSerial Port on your primary Pro Tools MIX or d24 card (the Core card).
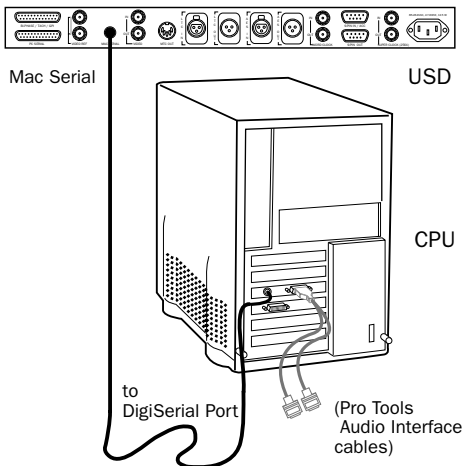
Connecting USD to a DigiSerial Port

4 Restore power to the USD, and restart your computer.

USB Blue and White G3/G4 Example

■ Connect the USD Mac Serial port to the DigiSerial port.

■ Connect MachineControl™ (optional) to a GeeThree, Griffin, or Keyspan serial port adaptor (see "USD Serial Port Requirements" on page 2).

If using MIDI, connect a MIDI interface or HUI to a GeeThree or Griffin serial port adaptor (see "USD Serial Port Requirements" on page 2).

DigiSerial Port General Info

Pro Tools MIX and d24 cards feature a DigiSerial Port. Though this port is identical in appearance to the serial ports on your CPU, it is designed to only be used for:

• the USD proprietary serial connection.
  – or –
• a serial-to-9-pin cable in combination with the MachineControl™ option for Pro Tools. This should only be connected to the DigiSerial Port when there is no USD present in the system.

▲ The DigiSerial Port should *not* be used for connecting MIDI Interfaces or any other serial device. Attempting to do so will adversely affect Pro Tools performance.

Rules for Using the DigiSerial Port for USD in Expanded Pro Tools Systems

◆ The active DigiSerial Port will be on the Digidesign MIX or d24 card connected to the primary Pro Tools audio interface.

◆ If your system is a Pro Tools MIXplus, connect your USD to the DigiSerial Port on the first Pro Tools 24 MIX card (the bus master card).

◆ If you have a combination of Pro Tools 24 MIX and Pro Tools d24 cards, use the DigiSerial Port on the first Pro Tools MIX card.

◆ If you have more than one d24 card, and are using only d24 cards (no MIX hardware), use the DigiSerial Port on the first d24 card in your system.

Pro Tools III Systems

Pro Tools III systems do not have a DigiSerial Port, so a Macintosh modem or printer port (or serial port adaptor) must be used for the USD serial connection. (See "USD Serial Port Requirements" on page 2.)

To connect a USD to Pro Tools III (no DigiSerial Port):

1 Make sure the power is switched off for both the USD and the computer.

2 Connect one end of the cable to the Mac Serial port of the USD.

3 Connect the other end of the cable to either the modem or printer port (or serial port adaptor) of your Macintosh.

4 Restore power to the USD, and restart your computer.

5 Connect the rest of your equipment to the USD as described in the following sections of this chapter.

6 Install USD Setup (see "Software Installation" on page 13).

USD Setup

USD Setup requires a serial connection from the USD to a Macintosh or Windows computer. (For compatibility information, see "System Requirements" on page 1.)

To connect the USD to a Macintosh computer without Pro Tools:

1 Make sure the power is switched off for both the USD and the computer.

2 Connect the USD *Mac Serial* port to the modem or printer port, or serial port adaptor, on your computer.

To connect the USD to a Windows computer without Pro Tools:

1 Make sure there is a COM port available and enabled (refer to your Windows NT documentation for information on enabling COM ports, if necessary).

2 Make sure the power is switched off for both the USD and the computer.

3 Connect the USD *PC Serial* port to an available COM port.

▲ USD Setup will not control USD through the DigiSerial port.

4 Restore power to the USD, and restart your computer.

5 Connect the rest of your equipment to the USD as described in the following sections of this chapter.

6 Install USD Setup (see "Software Installation" on page 13).

Standalone Mode

In standalone mode (when USD is not connected to Pro Tools), no computer or serial connection is required except for USD Setup and firmware updating. The USD Setup software (included) can be used to control the USD and to update its firmware, through a serial connection to a compatible Macintosh or Windows computer as explained in "USD Setup" on page 9.

Connecting USD to Pro Tools

The USD must be connected to Pro Tools as the clock master.

To connect the USD to a compatible Digidesign audio interface:

1 Connect the Super Clock Out of the USD to the Super Clock In (or Slave Clock In) of your master Digidesign audio interface.

to DigiSerial Port   Super Clock Out
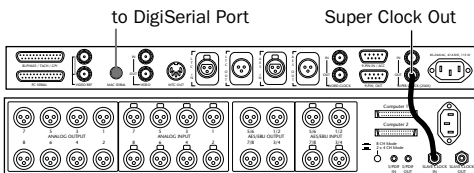
SuperClock (Slave Clock) connection from the USD to a single Pro Tools audio interface

2 If using more than one interface, connect the Slave Clock output of your primary interface to the Slave Clock input of the second interface, and so on for each additional Interface (but do not loop Slave Clock from the last interface back to USD).

to DigiSerial Port   Super Clock Out
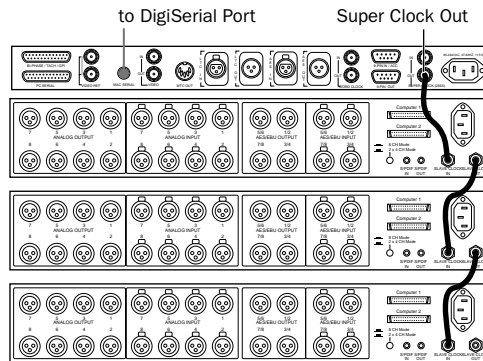
Super Clock (Slave Clock) "chain" connection from the USD to multiple 888 24 I/O Audio Interfaces

Connecting AC Power

The USD AC connector accepts an IEC Standard AC Power Cable. The USD is auto power-selecting (100V to 240V) and will automatically work with a standard modular cable to connect to AC power receptacles in any country.

To connect AC power to the USD:

■ Plug one end of a power cable into the USD AC connector, and plug the other end into a wall outlet or other power source.

Connecting Machines, Decks, and Other Devices

The following sections describe connections required for different applications.

Connecting a Video Source

For the USD to resolve to house sync:

■ Connect the house sync/black burst signal to the USD Video Ref In port.

This is a non-terminated loop-through connection. If the Video Ref Thru connector is not used, then you must terminate it using the supplied 75-ohm precision terminator resistor

For the USD to resolve directly to an incoming video signal:

■ Connect the video signal to the USD Video In port. This port is self-terminated inside the USD chassis.

Character Generator for Window Burn

The USD can also generate a Window burn while using the same video source signal as the video reference. The following is one example setup for a window burn.

To use the USD Time Code Character Generator to make a window burn:

1 Connect your video signal to the USD Video Ref In port.

2 Use another BNC cable to connect the USD Video Ref Thru port to the Video In port.

3 Connect the USD Video Out port to other video devices.

Connecting LTC

The USD provides LTC input and output connectors.

To Input LTC to the USD:

■ Connect the LTC signal from your machine, synchronizer or other source to the USD LTC In port.

To output LTC from the USD:

■ Connect the USD LTC Out to your external device(s).

Connecting Word Clock Devices

The USD has Word Clock input and output, and both can be used simultaneously.

To input Word Clock to the USD:

■ Connect the Word Clock signal from your DAT machine or other device to the USD Word Clock In.
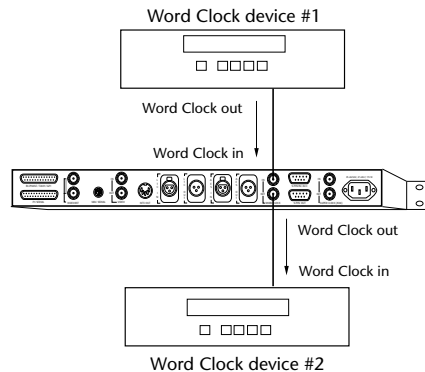
Connecting the USD to Word Clock devices

To supply Word Clock from the USD:

■ Connect the USD Word Clock Out to the device Word Clock input.

Keep in mind that Word Clock contains no positional information; if you want devices to play or record in sync, you'll still need to provide them with a positional reference.

☞ The USD can generate time code to provide positional reference to other devices. See "Generating and Regenerating Time Code" on page 44 for more information.

Connecting AES/EBU Devices

To use AES/EBU clock reference:

■ Connect the device's AES/EBU output to the USD's AES/EBU input.
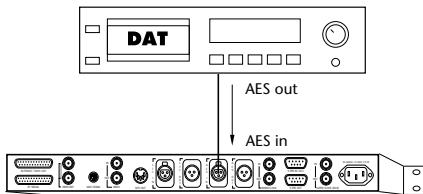
Connecting the USD to an AES/EBU device

To supply AES/EBU clock reference from the USD:

■ Connect the USD AES/ABU output to the AES/EBU input on a DAT machine or other digital device.

Connecting MIDI Devices

The USD MTC Out port provides MTC derived from conversion (from LTC, VITC and Bi-Phase) or MTC generation to synchronize MTC-compatible consoles, sequencers, lighting systems and other devices.

The MTC output from the MTC Out always matches the time code address displayed on the USD front panel.

OMS, Pro Tools, and the USD

When a CPU is connected to the USD Mac Serial port, Pro Tools does not need any additional connections to facilitate MTC sync or communication (it is handled through the proprietary Mac Serial-to-DigiSerial Port or modem/printer port connection). With Pro Tools 4.1 and earlier, a MIDI Interface and OMS were required for Pro Tools to recognize the USD as a "generic" synchronization device.

If you need to supply MTC from the USD to another MTC-compatible device, connect the device as described below.

To connect an MTC-compatible device to receive MTC from USD:

■ Connect the USD MTC Out port to the appropriate MIDI input on the device using a standard MIDI cable.
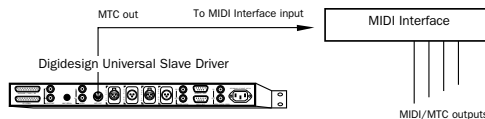
Connecting the USD MTC output to a MIDI Interface input

Pro Tools and MTC

Pro Tools does not receive MTC from the USD through its connection to the USD Mac Serial or PC Serial port (see "Connecting USD to a Computer" on page 7). The signal does not include standard MIDI time code, but is instead a high-quality, proprietary time code signal designed for Pro Tools. Therefore, a MIDI Interface is only required with Pro Tools version 4.1 or earlier.

Additional MIDI Requirements

Macintosh-based systems using Pro Tools version 4.1 or earlier will also need to define an OMS device for the USD so that it can provide MTC to other OMS-compatible devices. See "Configuring OMS" on page 15 for further instructions.

Software Installation

The following sections provide software installation instructions for different Pro Tools systems and standalone operation.

☞ The location and availability of all parameters is explained in "Control Options" on page 27.

Pro Tools MIX/MIXplus and Pro Tools 24 Systems

■ Check to make sure you have already installed the most recent USD options for your system, from your Pro Tools Installer CD-ROM or the Digidesign Web site.

Optionally, USD Setup can be installed to provide access to the complete set of USD parameters, and provide remote control of USD independent of Pro Tools.

Pro Tools III Systems

■ Check to make sure you have already installed the most recent Pro Tools and USD Setup software from your Pro Tools Installer CD-ROM.

Optionally, USD Setup can be installed to provide access to the complete set of USD parameters, and for remote control of USD independent of Pro Tools.

USD Setup

To install USD Setup:

1 Make sure the USD is connected to your computer as described in "Standalone Mode" on page 10.

2 Insert the disk containing the latest USD software, or navigate to its location if you downloaded the update.

3 Launch the installer and follow the on-screen instructions.

Standalone

No software is required for standalone mode except to update the USD firmware or to use USD Setup software. See "USD Setup" on page 13 for more information.

Firmware updates are made available by Digidesign to add capabilities to your USD. These updates can be downloaded from our Web site or obtained from your Digidesign dealer.

Getting Started

This section includes software configuration instructions applicable to Pro Tools/USD systems.
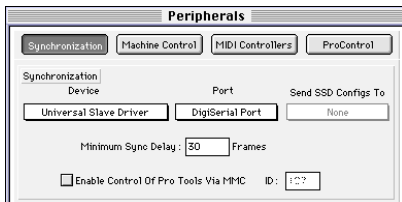
Software Configuration for Pro Tools and USD

Pro Tools provides USD initialization, configuration and firmware update controls.

To configure USD for Pro Tools MIX, MIXplus and Pro Tools 24 systems:

1 Start up your system beginning with hard drives, then the USD, then MIDI/other studio equipment and then the CPU.

2 Launch Pro Tools.

3 Choose Setups > Peripherals, and click Synchronization.

4 In the Synchronization Device pop-up, select Universal Slave Driver.

5 Select DigiSerial Port for the (Synchronization) Port.

Once USD is selected as the Synchronization device, the USD Enable controls at the bottom of the window become active.

Pro Tools Peripherals dialog, configured for the USD on DIgiSerial Port

Software Configuration for USD Setup

To configure USD Setup:

1 Make sure the USD is connected to your computer according to the instructions in "Connecting USD to a Computer" on page 7.

2 Launch USD Setup.

3 Choose Preferences > USD Setup Preferences.

4 If not already selected, choose the appropriate serial port for your USD-to-CPU connection.

5 Close the Preferences window.

Updating USD Firmware

The USD contains a flash EEPROM that allows you to update the firmware in your unit at any time. As Digidesign continues to create improvements for USD, you can update your unit without having to send it back to the factory or replace any chips.

Pro Tools and USD Setup can download up-to-date firmware to your USD.

▲ To acquire the latest firmware, please contact Digidesign Customer Service, or visit the Digidesign Web site.

Displaying the Current Firmware Version

To display the current USD firmware version number from Pro Tools:

■ See the display in the USD Setup section of the Peripherals > Synchronization window.

To display the current USD firmware version using the front panel:

■ Current firmware version is shown during power up in the time code LED display.

To display the current USD firmware version in USD Setup:

■ The current firmware version is shown in the USD Setup > Preferences window.

Updating Firmware

To update USD firmware from Pro Tools:

1 Choose Setups > Peripherals and click Synchronization.

2 Make sure you have already configured the Synchronization Device and Port options for USD.
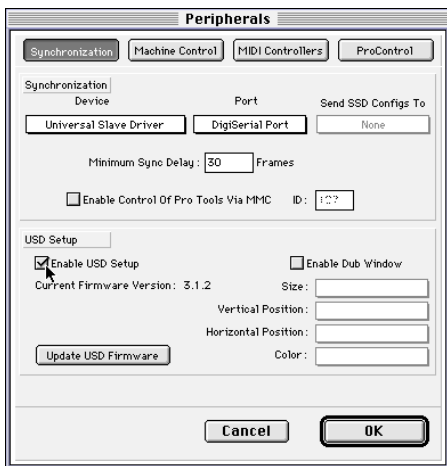
Pro Tools Peripherals window

3 Click Update USD Firmware. (If this option is not available, see "Software Configuration for Pro Tools and USD" on page 14.)

4 Follow the instructions on-screen to complete the update.

To update USD firmware using USD Setup:

1 Make sure the USD is connected to the computer as explained in "USD Setup" on page 9.

2 Choose Preferences > USD Preferences.

3 Click Update USD Firmware.

4 Follow the instructions on-screen to complete the update.

Configuring OMS

(Macintosh Only)

If you are *not* using the USD Mac Serial port to connect USD to a DigiSerial Port or CPU serial port, then you will need to define an OMS device for Pro Tools so that Pro Tools can receive MTC from the USD. This applies only to Pro Tools 4.1 and earlier.

An OMS device is not required for the USD to output MTC.

▲ OMS should not be configured for any USD-specific purposes whenever the USD Mac Serial port *is* connected to a DigiSerial Port or Macintosh serial port, Doing so would duplicate (and adversely affect) timing information between the USD and your computer already provided through the Mac Serial port.

This section assumes you have a basic working knowledge of OMS or FreeMIDI and their operating conventions, including connecting MIDI interfaces, creating documents, configuring drivers, and defining and connecting MIDI devices. If you need to review this information, refer to your OMS or FreeMIDI documentation.

OMS settings for the USD:

1 Create a new device for the USD.

2 Enable both Receives and Sends MIDI Time Code.

3 Deselect Receives/Sends MIDI Beat Clock, and Receive/Sends MIDI Machine Control.

4 Deselect all Receive Channels for the USD and click OK to close the New Device window.
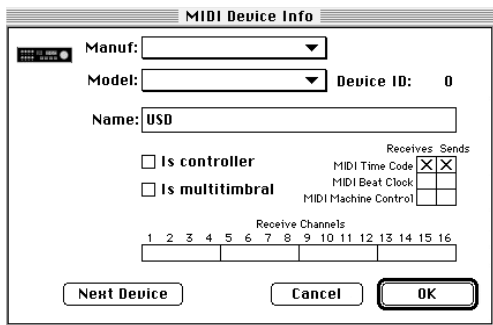
OMS definition for the USD

5 In the main OMS Setup window, connect the USD device to the appropriate MIDI interface.

6 Since the USD does not have a MIDI input port, OMS Setup does not require a software connection coming from the MIDI interface and going to the USD icon. Click the arrowhead of the line directed towards the USD icon to deactivate this connection.

7 If necessary, select the appropriate MIDI port for USD.

Troubleshooting

This section describes common synchronization problems and some possible solutions.

Status LEDs

The status LEDs (LOCKED and SPEED CAL) on the USD Front Panel may help you isolate potential problems. See "11. Status LEDs" on page 19 for details about these indicators and their meaning.

Use the Current TC field in Pro Tools Session Setup Window as a Reference

The Current TC field in the Session Setup Window indicates whether or not USD is receiving positional reference. If this field appears to be inactive when inputting time code to the USD, check your hardware device settings, serial connection to your computer, and your software settings.
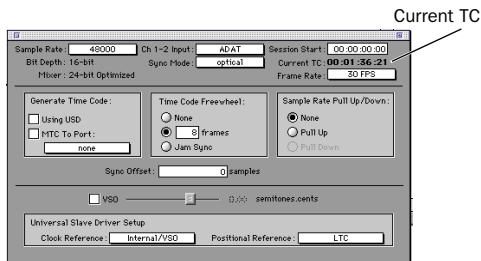
Current Time Code display

chapter 3

USD Hardware and Software Overview

USD Front Panel
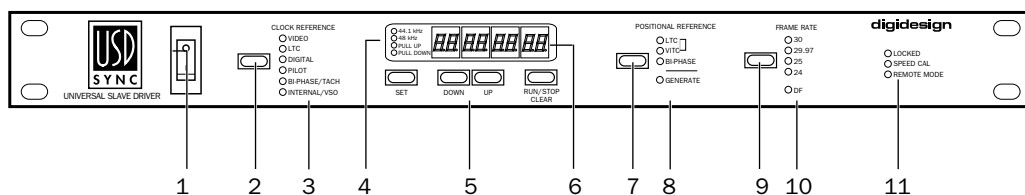
Figure 1. USD Front Panel

Controls and Displays

All USD local controls are on its front panel; the rear panel is reserved for connectors only. This section identifies each front panel switch and display.

For information on rear panel connectors and setup, see *Chapter 2: Installing the USD*.

1. AC Mains Power Switch

Down (|), USD power is *on*; Up (O), power is *off*.

2. Clock Reference Switch

Selects the USD clock reference, with green LEDs.

Clock References

> VIDEO
> LTC
> DIGITAL
> PILOT
> BI PHASE/TACH
> INTERNAL/VSO

3. Clock Reference LEDs

Green LEDs display the active clock reference, as selected with the Clock Reference Switch.

4. Sample Rate LEDs

Green LEDs show the current USD sample rate.

The table below shows how the four Sample Rate LEDs indicate the current USD sample rate.

USD LED Displays and Sample Rates

USD LEDs ON	Sample Rate
44.1 kHz	44.100 kHz
48 kHz	48 kHz
44.1 kHz and PULL UP	44.144kHz
44.1 kHz and PULL DOWN	44.056kHz
48 kHz and PULL UP	48.048 kHZ
48 kHz and PULL DOWN	47.952 kHz

PAL format and PULL UP/DOWN

The USD Pull Up and Pull Down features are not designed to perform conversions between 24 fps and 25 fps.

5. Set, Down, Up, Run/Stop+Clear Generator/Parameter Controls

These four momentary switches provide direct access to many USD functions, including time code generator settings, PAL/NTSC selection, sample rate and more.

The LED display shows the current mode, or currently selected parameter or setting.

6. LED Time Code Display

This 7-segment, multifunction LED is the USD time code and parameter display.

Time Code The current positional reference (internal or external), is displayed in hours:minutes:seconds:frames. Decimal points indicate additional time code information:

- Odd/even field distinction is indicated using a decimal point to the right of the frames display. A lit decimal point to the right of frames indicates an even-numbered field; no decimal point indicates odd-numbered.
- When the USD is in Auto Switch LTC/VITC mode, the decimal point to the right of "minutes" illuminates.

Parameters and Values When configuring the USD with the Set, Run/Stop and other parameter controls, the LED display shows parameter names, values, and other data.

☞ For a table identifying each LED abbreviation and function, see "Parameters" on page 55.

7. Positional Reference Switch

Selects the USD positional reference. Choices include:
   LTC
   VITC
   Auto Switch LTC/VITC
   BI PHASE
   GENERATE

8. Positional Reference LEDs

Yellow LEDs display the active positional reference.

In Auto Switch LTC/VITC mode, both the LTC and VITC LEDs light while the USD determines which source it will use. Either the LTC or the VITC LED will remain lit to indicate the chosen positional reference.

9. Frame Rate Switch

Selects the time code frame rate and format (drop-frame or non drop-frame). The active choice is displayed by the Frame Rate LEDs.

10. Frame Rate LEDs

Display the current USD frame rate.

Frame Rates 30, 29.97, 25, or 24 fps are indicated by four green LEDs

Drop/Non-drop Format is indicated by a single orange LED labelled DF (a lit DF LED indicates drop frame, unlit indicated non-drop frame).

11. Status LEDs

Show the current state of the USD in relation to clock references. Indicators include:

Locked This red LED lights solid when the USD is locked to the selected clock reference. LOCKED flashes if the selected clock reference source is missing or out of lockable frequency range.

Speed Cal (Speed Calibration) This yellow LED indicates when all output clocks are at a frequency that corresponds with the chosen sample rate. Speed Cal flashes when-

ever there is a mismatch between the chosen sample rate and the actual output sample rate.

For example, if the Clock Reference is set to LTC, and being fed by LTC from an analog tape that is running somewhat off-speed, this indicator will flash quickly (if too fast) or slowly (if too slow). The Speed Calibration LED will be lit steadily only if the output clock (remember, USD is generating an output clock from incoming LTC) is within ±0.025% (250 parts per million) of the chosen sample rate. If the speed is greater than +0.025%, the indicator will flash quickly; if the speed is less than –0.025%, the indicator will flash slowly.

Relatively new professional ATRs should be able to play back with a speed deviation of less than –0.025%. Some ATRs, even when calibrated properly, may not run accurately enough to allow the Speed Calibration to remain lit without flashing.

The Speed Calibration LED compares actual output sample rate to desired sample rate. This LED does *not* reflect the speed of motion of the chosen Positional Reference. However, it would bear a relationship to the Positional Reference if both Positional Reference and Clock Reference were set to LTC.

Remote Mode This green LED lights when the USD is set to Remote-Only /Front Panel Lockout Mode. For more information see the section "About Remote-Only Mode" on page 29.
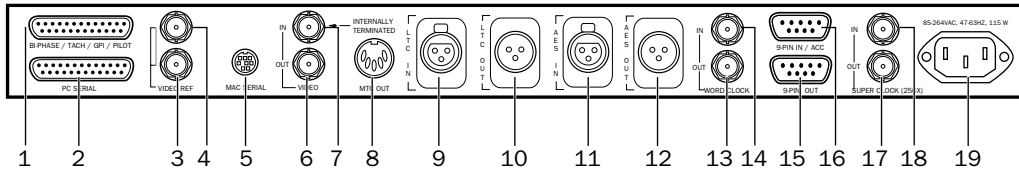
USD Rear Panel

Figure 2. USD Rear Panel

1. Bi-Phase/Tach/GPI/Pilot port

With a properly wired cable, this serves as accessory port inputs for Bi-Phase, Tach, and Pilot signals. This connector is also used for GPI input, output (including Fader Start), and thru signals.

Connector: Female DB-25

☞ Refer to *Appendix C: Wiring Diagrams Pin Assignments* for wiring information and other specifications for this port.

2. PC Serial port

A bidirectional (in/out) port is designed for use exclusively with a PC-compatible host computer.

Connector: Female DB-25

3. Video Reference In

Receives a signal from an NTSC/PAL video source, such as a black burst (house sync) generator or a standard video signal, for clock reference and window burn purposes. This jack is configured as an un-terminated loop-through. Therefore, you must either:

• Connect a 75-ohm terminator (included with the USD) to the unused loop-through connector (Video Reference Thru on the back panel)
  – or –
• Ensure that another, terminated, video device is fed from the loop-through connector.

Connector: Female BNC

4. Video Reference Thru

A parallel, unbuffered connection output for any video source connected to the Video Reference In port; allows black burst or other video reference to be passed to another device. Continues to output whatever signal is present at the Video Reference In port, regardless of whether or not the USD is powered up.

Connector: Female BNC

▲ If the USD is the last device in the video sync chain, a BNC Terminating Plug (supplied) must be attached to this connector.

5. Mac Serial Port

A bidirectional (in/out) port designed for use exclusively with the DigiSerial Port found on all Pro Tools MIX and d24 cards, or to a modem/printer port on a compatible Macintosh host computer.

Connector: Female mini DIN-8 (8-pin)

6. Video In

Receives a signal from an NTSC/PAL video source for clock or VITC positional reference input, or for generating a window burn. This connector is internally terminated at 75 ohms.

Connector: Female BNC

7. Video Out

If the Positional Reference is set to Generate and the Clock Reference is set to one of the two video inputs, this will output a copy of the video signal appearing at the Video Reference input. Under all other combinations of Positional and Clock Reference settings, this will output a copy of the video signal appearing at the Video In input.

In either case, this output might additionally carry VITC and/or Window Burn information if those features are enabled.

Connector: Female BNC

8. MTC Out

Outputs MIDI Time Code (MTC), only. No other MIDI data appears at this output. MTC output can be regenerated while the USD is locked to any supported positional reference and clock reference, or internally generated in Generate mode, in which case MTC output follows generator run/stop. Intended to supply MTC from the USD to external sequencers or other MIDI devices.

Connector: Female standard, DIN 5-pin

9. LTC In

Receives a Linear Time Code (LTC) source, balanced or unbalanced analog, for clock and positional reference. This port is often used to receive LTC from an audio track on an external deck or the address track of a VTR.

Connector: Female XLR-style 3-pin

(Pin 2 "+" or "hot," Pin 3 "–" or "cold")

10. LTC Out

Outputs linear time code, in balanced or unbalanced analog audio format.

Connector: Male XLR-style 3-pin

(Pin 2 "+" or "hot," Pin 3 "–" or "cold")

When the LTC Out port is connected in unbalanced mode, Pin 3 must be grounded. See *Appendix C: Wiring Diagrams Pin Assignments* for wiring details.

11. AES/EBU In

Receives an AES/EBU digital audio signal, for clock reference purposes only. The USD utilizes only the signal's clock information, not the audio information. If digital audio information is present at this input, it will be ignored and not passed through to the AES/EBU digital output connector.

Connector: Female XLR-style 3-pin

(Pin 2 "+" or "hot," Pin 3 "–" or "cold")

12. AES/EBU Out

Outputs a silent (all bits OFF) AES/EBU audio signal whose sample rate exactly matches the USD Word Clock BNC output.

Connector: Male XLR-style 3-pin

(Pin 2 "+" or "hot," Pin 3 "–" or "cold")

13. Word Clock In

Receives (1x sample rate) Word Clock, for clock reference purposes only. Often used with external digital consoles and digital tape machines.

Connector: Female BNC

14. Word Clock Out

Outputs 1x sample rate Word Clock information, for clock reference purposes only. Can be generated internally.

Connector: Female BNC

15. 9-pin In/Acc

This port is not active.

16. 9-pin Out (9-pin Pass-through)

This port is not active.

17. Super Clock In

Receives Super Clock (256x sample rate) information. Used for 256x clock reference purposes only (also known as Slave Clock).

Connector: Female BNC

18. Super Clock Out

Outputs Super Clock (256x sample rate) information for Digidesign Audio Interfaces, for clock reference purposes only. Can be generated internally, or can be converted from an external clock reference. Also known as Slave Clock.

Connector: Female BNC

19. AC Power In

Receives AC mains power, 85 to 264 volts, 47 to 63 Hz (auto switching).

Connector: IEC Standard AC Power Cable

(3-conductor)

USD Setup Software

The following is an overview of the USD Setup application for Macintosh and Windows. System and installation requirements for USD Setup can be found in "Software Installation" on page 13.

Using Help

To activate Help:

■ From the Help menu choose the Show Help command, or click on the question mark button in the upper-right corner of the USD Setup window.

To deactivate Help:

■ From the Help menu, select the Hide Help command, or click on the question mark button in the upper-right corner of the USD Setup window.

Overview of USD Setup Controls

The following section identifies each control of USD Setup. Details on configuring parameters can be found in
Chapter 4: Using the USD.
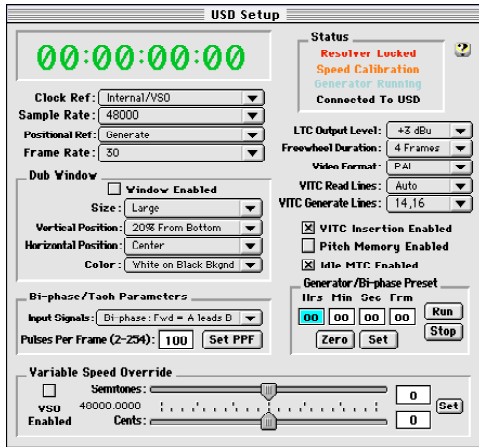
USD Setup

1. Time Code Window

The time code display mirrors the LED Time Code Display on the USD front panel, displaying (in hours:minutes:seconds:frames) the time code address of the current positional reference.

Display of Odd/Even Fields When the USD is reading odd-numbered fields, the separator changes from a normal colon (:) to a period (.); when it's reading even-numbered fields, the punctuation returns to a colon (:). Odd/even status is only available while reading VITC, and only when VITC is within a speed range from zero to about 50% of playback speed.

2. Clock Reference

Selects the USD clock reference, which include:
    Video (Video Reference Input)
    Video (Video Input)
    Linear Time Code (LTC),
    Digital (AES/EBU)
    Digital (Super Clock)
    Digital (Word Clock)
    Pilot Tone
    Bi-Phase/Tach
    Internal/VSO

3. Sample Rate

Selects the USD sample rate (or the Pro Tools session sample rate, if applicable).

4. Positional Reference

Selects the USD positional reference, which include:
    Linear Time Code (LTC)
    Vertical Interval Time Code (VITC)
    Auto Switch LTC/VITC
    Bi-Phase/Tach
    Generate

5. Frame Rate

Selects the frames-per-second (fps) rate of external (or internally generated) time code:
    30 fps
    30 fps drop-frame
    29.97 fps
    29.97 fps drop-frame
    25 fps
    24 fps

6. Status

Shows the current state of USD Setup software in relation to the USD and external devices.

Resolver Locked Lights when the USD is locked to the chosen external clock reference, or to its *Internal* clock reference.

Speed Calibration Lights when the USD system clock and all output clocks are at a frequency that corresponds with the chosen sample rate. Capable of indicating mismatch of pull-up, pull-down and frame rate.

☞ For details about Speed Calibration characteristics, see "11. Status LEDs" on page 19.

Generator Running Lights when the USD is regenerating time code at its video, LTC, and MTC outputs in sync with the incoming positional reference source. Also lit whenever the USD is generating time code internally.

Connected to USD Lights when USD Setup is the front-most window and is communicating with the USD.

Waiting for USD Lights when USD Setup is the frontmost window and is unable to communicate with the USD.

Port Relinquished Lights when USD Setup is not the frontmost window or is unable to allocate a serial port with which to communicate with the USD.

7. LTC Output Level

Adjusts the analog audio level of the USD LTC output, from –24 dBu to +9 dBu.

8. Freewheel Duration

Sets the period of time for which the USD will continue to supply positional reference data after an external source is interrupted or stopped. (Also referred to as Time Code Freewheel in Pro Tools.)

9. Video Format

Indicates the format (NTSC or PAL) for both the incoming and outgoing video signals.

NTSC is used in North and South America, Japan, and certain other parts of the world.

PAL is used in most of Europe, Asia, and Africa. Users of SECAM video (for France, Russia, and certain other parts of the world) should select PAL.

10. VITC Read Lines

Determines which line pair of incoming video signal is used for the VITC source.

When set to Auto, the USD will search for the first valid line pair automatically. Alternatively, this value can be set to specific VITC line pairs.

11. VITC Generate Lines

Determines the line pair of the outgoing video signal onto which the USD inserts VITC. Normally, this should be left at the default (and preferred) setting of 14/16.

12. VITC Insertion Enabled

When selected, VITC will be inserted into the outgoing video signal—assuming that a video signal is present at a USD video input, and that the USD is in a valid mode for

inserting VITC. The only invalid positional reference modes are VITC or Auto Switch LTC/VITC. The USD can't read VITC and generate new VITC at the same time.

13. Pitch Memory Enabled

When selected, the USD will remain at a *pitch* (sample rate) that corresponds to the last known incoming time code speed. When deselected, the USD will revert to the selected sample rate. This feature enables the USD to learn the time code form a specific source during successive lockups, so lock up times can be optimized.

If Pitch Memory is disabled and the selected external clock reference is not available, then the USD will revert to the nominal, selected internal sample rate setting.

14. Idle MTC Enabled

Controls MTC Output during idle (play stopped). When enabled, MTC is continuously output. When not enabled, MTC output is muted when playback is idle. See "MTC Output and Idle Muting" on page 51 for details.

15. Window Dub

Settings for the USD character generator/window dubbing features. (These controls are also available from within the Pro Tools Peripherals dialog.)

Complete Window Dub instructions are provided in the section "Generating a Window Burn" on page 51.

16. Bi-Phase/Tach Parameters

Used for specialized applications that involve film or other equipment that output Bi-Phase/Tach information. These parameters must be set to match the Bi-Phase or tach source to achieve lock. See "Positional Reference and Bi-Phase/Tach" on page 38 for more information.

17. Generator/Bi-Phase Preset

Serves two functions, as determined by the current USD mode:

Generate mode Sets the time code start time directly by clicking in the Hrs:Min:Sec:Frm fields and typing in a value. The Tab key will cycle though the fields.
   – or –

Bi-Phase/Tach Mode Zeros the time code counter, to allow the USD to generate time code in relation to the pulses of the incoming Bi-Phase/Tach information. Establishes a time code start point (first frame of a reel, for example).

18. Variable Speed Override (VSO)

Used to varispeed the rate of the USD internal crystal-referenced clock (±699 cents; a cent is one-hundredth of a semitone). VSO is available at any positional reference setting, but only when the clock reference is Internal/VSO.

chapter 4

Using the USD

Control Options

The USD can be controlled in three ways:

• from within Pro Tools

• using the front panel controls

• using USD Setup

Which methods you will use depends on the type of Pro Tools system being used, if any, and its serial connection between the USD and your system

Pro Tools MIX/MIXplus and Pro Tools 24 Systems

DigiSerial Port-equipped systems can use Pro Tools and the front panel to control USD. USD Setup can optionally be used for access to specific features described throughout this chapter.

Pro Tools III Systems

Pro Tools III and other systems without a DigiSerial Port connection can use Pro Tools and the front panel, or USD Setup software.

Standalone

Remote installations (no connections to a computer) will use the USD front panel switches and displays.

USD Standalone with Remote Control

For software remote control from a supported Macintosh or Windows computer, USD Setup provides access to all USD parameters.

For a listing of USD parameters supported in each method, see "USD Controls in Pro Tools, USD Setup, and Front Panel" on page 28.

USD Controls in Pro Tools, USD Setup, and Front Panel

USD Controls in Pro Tools, USD Setup, and the Front Panel

Parameters	Available from/in:		
	Pro Tools	Front Panel	USD Setup
Firmware Update	yes (Peripherals/Sync)	no	yes
Clock References	all (Session Setup)	all, except Video In versus Video Ref in	all
Positional References	all (Session Setup)	all	all
Sample Rates	all (Session Setup)	all	all
Frame Rates	all (Session Setup)	all	all
LTC Output level	no	yes	yes
Freewheel duration	yes (Session Setup)	yes	yes
Video Format (NTSC/PAL)	no	yes	yes
VITC Read Lines	no	yes	yes
VITC Generate Lines	no	yes	yes
VITC Insertion Enable	no	yes	yes
Pitch Memory	no	yes	yes
Window Dub	all (Peripherals/Sync)	on/off only	yes, all
Bi-Phase/Tach	no	yes	yes
Gen/Bi-Phase Preset	Generator, no Bi-Phase	yes	yes
GPI	yes	no	no
VSO	yes (Session Setup)	no	yes
Pull Up/Down	yes (Session Setup)	yes	yes
Idle MTC Enabled	no	yes	yes

About Remote-Only Mode

(USD Setup Only)

When the default Remote-Only Mode (Front Panel Lockout) is enabled in the USD Setup Preferences window, none of the USD front panel switches will be operational. The Remote Only LED will be lit.

To exit Remote-Only mode from the front panel:

■ Simultaneously press and hold down the Clock Reference, Positional Reference, and Frame Rate front panel switches.

This will disengage the USD from Remote-Only mode. This is useful when the host computer is not easily accessible to override Remote-Only Mode.

✻ Pro Tools USD controls always provide access to most USD parameters.

Using the Front Panel Generator/Parameter Switches

The Generator/Parameter Controls are labelled SET, DOWN, UP, and RUN/STOP/CLEAR. In addition to their primary generator functions, these switches provide front panel access to most USD parameters.

Features Not Accessible from the USD's Front Panel Controls

The front panel provides access to all USD features except the following (which can be controlled using Pro Tools or USD Setup):

• Remote-Only Mode/Front Panel Lockout
• Firmware update

• Changing Window Burn Size, Vertical Position, Horizontal Position, and Color
• GPI (General Purpose Interface) functions
• Choosing between Video In or Video Ref In connector for the Clock Reference source
• Variable Speed Offset (VSO)

For a listing of available parameters, refer to "USD Controls in Pro Tools, USD Setup, and the Front Panel" on page 28.
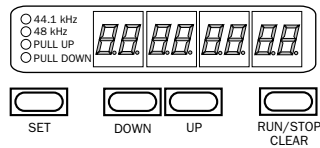
Generator/Parameter Switches

Set

The SET switch has three primary functions:

When time code is displayed Pressing Set once changes the Display from time code to parameter names.

When a parameter name is visible Pressing Set once will change the Display to show parameter *values*.

When a parameter value is visible Pressing Set once will set that parameter value, and will return the Display to time code.

Down and Up

These switches scroll through parameter names and values (whichever is currently displayed):

When a parameter name is visible Pushing the Down and Up switches scrolls through the parameter names (for example, from SET GEn to VIdEo SY).

When a parameter value is visible These switches scroll through the available parameter values.

When entering time code values Pressing these two switches simultaneously tabs through the hours:minutes:seconds:frames fields.

Run/Stop/Clear

This switch has two functions, depending upon the current mode:

While generating time code Pressing RUN/STOP starts or stops the time code generator when USD is in Generator Preset mode.

While time code is being displayed Clear resets the counter whenever time code is visible in the LED Time Code display.

Otherwise, the RUN/STOP+CLEAR switch serves as a Cancel button (Clear mode).

Edit Mode

To enter Parameter/Value Edit mode:

■ Push Set (when time code numbers are visible in the LED Time Code Display). One press will display the first parameter name, "Set Gen," (for the time code generator:)

SE7   6En

The (default) first page of Generator Parameter controls

Depending upon the last state of the USD, you may see a readout other than SE7 GEn.

To scroll parameter choices:

■ Press Up or Down as needed to scroll through available parameters. Holding the switch scrolls through the parameters.

To select a parameter to edit:

■ When the desired parameter is displayed, press Set. This will access that parameter's current setting.

To edit parameter values:

■ With parameter values displayed, press Up or Down to cycle through the available values.

Examples

Example 1: Using Set, Down and Up to adjust LTC Gain

As an example, the following steps explain using the USD front panel controls to change the Linear Time Code output level. LTC Gain is the example parameter, but the basic steps are similar for most parameters.

To select a parameter name and change its respective parameter values:

1 Time code numbers should be visible and not blinking in the LED Time Code Display. If you don't see them, press the Set switch until you do.

2 Press the Set switch. The LED Time Code Display will switch from showing time code numbers to a parameter name. The first name is Set Generator (SE7 6En), although you may see a different name, depending upon the USD's last settings.

3 Press the Down or Up switches until the LED Time Code Display shows LTC Gain (L7C 6AIn).

4 Press the Set switch again. The LED Time Code Display will now show the current parameter value for LTC Gain in dBu values.

5 Press the Down or Up switches to scroll through the available parameter options. Values will scroll (in 3 dBu steps). Hold down either Down or Up to fast-scroll.

6 When the desired parameter value is displayed, press the Set switch again.

With just a few exceptions these steps remain the same for all USD parameters.

☞ For a complete listing of all the front panel Generator/Parameter controls, see *Chapter 5: Additional Operational Information*.

Example 2: Standalone Sample Rate Configuration

The following is an example of abbreviated front panel instructions, this time showing how to set the USD sample rate.

To set the USD sample rate from the front panel:

1 Press Set, then scroll using the Up and Down switches to display SPL FrEc.

2 Press Set again, then use the Up and Down switches to scroll through available sample rates (shown in the LED display). See "4. Sample Rate LEDs" on page 18 for more information about USD sample rates and displays.

3 When the required rate is displayed, press Set to confirm it as the current USD sample rate.

Sync Setup

This section describes how to configure the USD for the specific requirements of your system or current project. Instructions are organized by task, and cover Pro Tools, front panel and USD Setup control procedures, as supported. (A complete list of control options for each method can be found in "USD Controls in Pro Tools, USD Setup, and Front Panel" on page 28.)

◆ For clock reference instructions, see "Clock References" on page 32.

◆ For Positional Reference instructions, see "Positional References" on page 38.

◆ To utilize Generate/Regenerate modes see "Generating and Regenerating Time Code" on page 44.

◆ For window burn instructions see "Generating a Window Burn" on page 51.

Frame Rate Settings

If using Pro Tools, the USD frame rate will follow the session frame rate setting in the Session Setup window.

The USD frame rate can be also set from the front panel.

To set the USD frame rate from the front panel:

■ Press the FRAME RATE switch to cycle through available frame rates. A lit DF LED indicates drop-frame.

Clock References

When used with an external clock reference, the USD functions as a resolver—so that Pro Tools and other devices can be synchronized, or resolved, to a common clock source.

Selecting a Clock Source

To choose a clock reference from Pro Tools:

■ Choose Display > Session Setup Window, then select a setting from the Clock Reference pop-up menu.
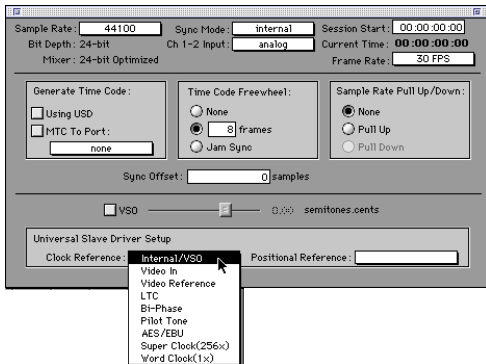
Configuring the USD Clock Reference from Pro Tools

To choose a clock reference using the front panel controls:

■ Push and release the Clock Reference switch to cycle the USD through its available clock references.

To choose a clock reference using USD Setup:

■ Select a setting from the Clock Reference pop-up menu.

Clock Reference Options

The following sections provide specialized instructions for each clock reference choice.

Video Clock Options

Depending upon how the USD is configured, this clock reference may be the *Video Ref In* or the *Video In* connector (for more details, see "Limitation When Using Front Panel Clock Reference Switch" on page 32).

For House Sync/Black Burst Use the USD Video Ref Input.

For Incoming Video Use the Video In connector.

Serial Time Code with MachineControl

MachineControl-equipped Pro Tools systems can utilize serial time code. When using MachineControl with serial time code as the positional reference, the USD must be locked to Video Ref. In this scenario, the USD is set to Generate mode to indicate that positional information is acquired by Pro Tools directly over the 9-pin cable, not through the USD. Consult the *MachineControl User's Guide* for complete serial time code information.

Limitation When Using Front Panel Clock Reference Switch

When you choose Video using the front-panel Clock Reference switch, the USD uses the signal at the Video Ref In connector. To choose the signal at the Video In connector as your clock reference, you must use USD Setup or Pro Tools.

If you have only a single video source, and since USD uses different video inputs depending on configuration, you may want to follow the wiring tip below to ensure that you have full functionality in all configurations:

To work with a single video source:

1 Connect the video signal to Video Ref In.

2 Run a short BNC jumper cable from the Video Ref Thru connector to the Video In connector.

3 Connect the Video Out signal to the video input of your "destination" VTR or video editing system.

The issue of which video connector is used also matters when choosing a positional reference. For instance, when the USD is in Generate mode and Video is the current clock reference, the time code reference for the generator is always from the Video Ref In connector.

However, if you select a positional reference other than Generate, then the signal at the Video In connector is used.

☞ For more video signal information, refer to "Video and VITC Signals" on page 67 in Appendix A.

Digital AES/EBU, Word Clock and Super Clock

To resolve Pro Tools/USD to external AES/EBU, Word Clock or Super Clock:

From Pro Tools

■ Select the appropriate digital clock reference from the Clock Reference pop-up in the Pro Tools Session Setup window.

Using the front panel controls

1 Press the front panel Clock Reference switch to select Digital as the clock reference.

2 Press Set.

3 Press Up or Down until Digital Reference (dI6 rEF) is displayed in the LED.

$$d \; I \; 6 \qquad r \; EF$$

4 Press Set again. The LED Time Code Display displays the current digital reference, which will be:

• AES/EBU (AES-E8U), or

• Super Clock (256 CLOC), or

• Word Clock (I CLOC)

5 Use the Down and Up switches to select the desired digital clock.

6 When the desired option is displayed, press Set.

Using USD Setup

■ Select the appropriate Digital clock reference option from the Clock Ref pop-up menu.

If the chosen clock reference source is unavailable, or the current configuration is not valid, the Locked LED on the far-right of the USD front panel will flash.

Additional Digital Clock Information

AES/EBU The USD AES In connector only recognizes and uses the clock portion of an incoming AES/EBU audio signal. All audio information will be ignored and will not be passed to the USD AES Out connector.

Word Clock (1x) Word Clock is a digital clock reference signal that runs at 1x sample rate, which is the same rate as the clock signal carried within an AES/EBU or S/PDIF data stream. However, devices that support Word Clock have separate, dedicated BNC-style Word Clock connectors that carry no audio information of their own. A wide variety of professional audio devices have Word Clock connectors, including digital mixing consoles, DASH-standard digital multitrack tape recorders and MDMs (modular, digital multitrack recorders).

When transferring digital audio to Pro Tools from a device that doesn't support Super Clock (256x), make sure to resolve the USD to Word Clock.

Super Clock (256x) Super Clock (or Slave Clock) is Digidesign's proprietary hi-speed clock that runs at 256x the sample rate. All Digidesign audio interfaces are equipped with Super Clock inputs and outputs because its 256x rate makes it less susceptible to jitter than Word Clock (1x).

In most situations, the USD should *supply* the master Super Clock signal to Digidesign audio interfaces. You should resolve the USD *to* Super Clock any time you are transferring digital audio from one Digidesign workstation to another.

☞ For additional digital clock signal information, see "Digital Clock Signal Types" on page 69.

LTC and Clock Reference

LTC can provide both positional and clock information as part of the time code signal. LTC cannot be read when the reference deck is stopped or playing back at slow speeds, or at fast wind speeds (roughly 10x playback speed).

To resolve the USD to Linear Time Code:

Using Pro Tools:

■ Choose Display > Session Setup and select LTC from the Clock Reference menu.

Using the front panel controls:

■ Using the Clock Reference switch, select LTC as the clock reference.

Using USD Setup:

■ Select Linear Time Code (LTC) from the USD Setup Clock Ref pop-up menu.

Additional LTC Information

LTC can be recorded, or striped, to an analog audio tape track to provide the source of both positional and clock reference (when routed back through the USD after striping). LTC can also be recorded onto and played back from a VTR audio, address or cue track.

If you are working with house sync in your facility and want to use LTC for positional reference (only), see "Positional Reference Options" on page 39.

☞ For further information on LTC signals, see "LTC Signals" on page 67.

Pilot Tone

The USD can resolve to an external Pilot Tone signal for clock reference, for synchronizing to (or transferring audio from) certain types of open-reel audio tape recorders. Pilot Tone is basically a 60 Hz (NTSC) or 50 Hz (PAL) sine wave tone. Pilot Tone is used on location film shoots to establish a common sync reference between a film or video camera with a portable 1/4" analog ATR. Pilot Tone contains no positional information; it provides only clock reference.

USD decides whether to use 60 Hz or 50 Hz as the pilot tone reference frequency according to the setting of the Video Format. When set to PAL, the pilot tone frequency is assumed to be 50 Hz. When set to NTSC, 60 Hz is assumed.

To resolve the USD to Pilot Tone:

From Pro Tools:

■ In the USD Setup area of the Pro Tools Session Setup window, click on the Clock Reference pop-up and choose Pilot Tone.

Using the front panel controls:

1 Connect your Pilot Tone reference source to the USD Bi-Phase/Tach/GPI/Pilot port.

2 Using the front panel Clock Reference switch, select Pilot.

Using USD Setup:

1 Connect your Pilot Tone reference source to the USD's Bi-Phase/Tach/GPI/Pilot port.

2 Select Pilot Tone under the USD Setup's Clock Ref pop-up menu.

If the Pilot Tone reference source is not valid for any reason (such as a poor connection or other signal transmission problem), the Locked LED on the far-right of the USD front panel will flash on and off.

Bi-Phase/Tach and Clock Reference

The USD is able to resolve to Bi-Phase/Tach information for use as a clock reference. Bi-Phase/Tach can synthesize positional reference, but you must provide a reference *start address* (see "Bi-Phase Position Trimming" on page 44 for other requirements).

To configure Bi-Phase/Tach for the USD clock reference:

Using USD Setup:

1 Select Bi-Phase/Tach under USD Setup's Clock Ref pop-up menu.

2 Select the appropriate Pulse Per Frame and Input Signals parameters, as described in "Bi-Phase/Tach Starting Frame" on page 42 and "Bi-Phase/Tach Signal" on page 43.

Typically, when you use Bi-Phase/Tach as the clock reference you will also be using it as the positional reference (see "Bi-Phase/Tach Positional Reference" on page 42.).

Using the front panel controls:

1 Using the front panel Clock Reference switch, select BI PHASE/TACH.

2 Select the appropriate Pulse Per Frame and Input Signals parameters, as described in "Bi-Phase/Tach Starting Frame" on page 42 and "Bi-Phase/Tach Signal" on page 43.

▲ If the Bi-Phase/Tach reference clock source is not valid for any reason (such as a poor connection or other signal transmission problem), the Locked LED on the far-right of the USD front panel will flash.

To select Bi-Phase/Tach as the positional reference from Pro Tools:

■ In the USD Setup area of Pro Tools Session Setup window, click on the Clock Reference pop-up and select Bi-Phase.

Additional Bi-Phase/Tach Information

Bi-Phase/Tach is used with mag machine,16-, 35- and 70mm projectors, flatbed editing systems and other types of motor-driven film equipment. Bi-Phase (sometimes called Quadrature Sync) and Tach information are similar, though they do differ.

Bi-Phase A Bi-Phase signal consists of two square waves, which are generated directly by a device's transport mechanism, and which are 90° out-of-phase with one another. As a Bi-Phase-generating device plays it outputs a steady stream of square waves that the USD can use as its clock reference, at nearly any speed including still/paused.

The USD uses the phase relationship between the two square waves to determine the device's direction (forward or reverse). However, this is relevant only when the USD is using the Bi-Phase signal as a positional reference.

Tach A Tach signal is a variation of Bi-Phase. With Tach's two signals, one is used only as the direction indicator, while the other is used as the velocity, or rate, indicator.The USD uses this rate signal when resolving to Tach as a clock reference.

There are several different standards for the number of pulses-per-frame for Bi-Phase or Tach devices. Using USD Setup's Pulse Per Frame setting, you can set the USD to operate from 2 to 254 pulses per frame to match the PPF rate of the external device's Bi-Phase/Tach encoder.

☞ For additional Bi-Phase/Tach signal information, see "Bi-Phase/Tach" on page 70 in Appendix A.

Internal Clock, Generating and Regenerating

The USD can use its own, crystal-referenced, internal clock as a master clock source. When USD Clock Reference is set to Internal:

• Word clock, Super clock, and AES/EBU digital clock outputs are simultaneously driven from the internal crystal reference.
  – and –
• If the Positional Reference is set to Generate, generated LTC, MTC, VITC count, and Window Dub outputs are resolved to the same internal crystal reference.

To resolve the USD to its internal clock:

From Pro Tools

■ In the USD Setup area of Pro Tools Session Setup window, select Internal from the Clock Reference selector.

Using the front panel controls

■ Use the front panel Clock Reference switch to select Internal.

Using USD Setup

■ Select Internal/VSO from the USD Setup Clock Ref pop-up menu.

Variable Speed Override (VSO)

You can varispeed the rate of the USD's crystal-referenced internal clock, to fine-tune the speed and subsequent pitch of Pro Tools and any device receiving its clock reference from the USD.

Maximum VSO range is ±699 cents (±6 semitones). VSO is available at any positional reference setting. VSO is not available from the front panel controls, but can be controlled directly from Pro Tools and USD Setup.

To varispeed the rate of the USD's internal clock:

Using Pro Tools

1 Choose Windows > Session Setup, and expand the Session Setup window to full view.

2 Click to enable VSO (an "X" indicates VSO is enabled).

3 Adjust the varispeed value using the on-screen slider.

Using USD Setup

1 In the USD Setup's Variable Speed Override section, check the VSO Enabled box. An "X" indicates that varispeeding is enabled.
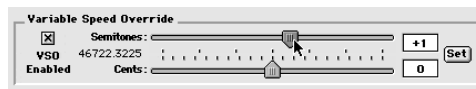
The Variable Speed Override section

2 Use the sliders to adjust the varispeed values in semitone or cent increments. The actual output word-clock frequency is shown near the sliders.

– or –

3 Enter the value in semitones and cents using the editable fields. If the varispeed value results in an output frequency (sample rate) that is below 35 kHz or above 50 kHz, the frequency display turns red, and the actual output frequency is limited to this value.

4 When finished, click the Set button to enable the changes.

Using Pitch Memory

Pitch Memory, when enabled, holds the output sample rate steady even when the Clock Reference has disappeared or gone out of lock range. If not enabled, the output sample rate will return to the nominal rate (for example, exactly 44.1 kHz) when the Clock Reference disappears or goes out of lock range.

With Pitch Memory enabled, Pro Tools continues to play and record at the resolved sample rate even if the Clock Reference source disappears. You might want to disable Pitch Memory while performing

analog recordings so as to have the recording made at the true nominal sample rate (for example, exactly 44.1 kHz.)

If Pitch Memory is disabled and the selected external clock reference is not available, then the USD will revert to the nominal, selected internal sample rate setting.

To configure Pitch Memory (Hold) from the front panel:

1 Using the Set, Down, and Up switches, select Pitch Hold (PICH HLd):

$$PICH\ HLd$$

2 Press the Set switch again. The LED Time Code Display will switch to display one of the two parameter values:

- On (On); or
- Off (OFF).

3 Use the Down and Up switches to switch between the parameter values.

Using USD Setup:

■ Click Pitch Memory Enabled.

When you have chosen your desired option, press Set. The LED Time Code Display will return to showing time code numbers. The USD will retain the setting, even when the unit is powered off and on again, until changed

Positional References

Positional Reference relates to the USD time code readers and generator, and to the Bi-Phase reader.

Whereas the clock connections and Clock Reference setting serve to keep your system's components all operating at exactly the same rate over time, the Positional Reference is the facility for working with a particular time address.

The Positional Reference setting serves to place the USD into a reading or generating mode. While in a reading mode, time addresses may be obtained from LTC, VITC, or Bi-Phase. While in the generate mode, the USD simultaneously generates LTC, VITC, and MTC.

Positional Reference and Bi-Phase/Tach

Time code and *positional referenc*e are not always directly synonymous. In this guide the terms are used interchangeably except while referring specifically to Bi-Phase/Tach, as noted in the following sections.

Selecting a Positional Reference

To select a positional reference from Pro Tools:

1 Open the Session Setup window.

2 Choose a reference setting from the Positional Reference pop-up menu.

To select a positional reference using the front panel:

■ Press the Clock Reference switch to cycle the USD through its available clock references.

To select a positional reference using USD Setup:

■ Choose a reference setting from the Positional Reference pop-up.

▲ Be sure to select the appropriate frame rates whenever you use LTC or VITC as your positional reference.

Positional Reference Options

The following sections provide additional information and configuration instructions for each available Positional Reference format.

Linear Time Code (LTC)

LTC is often striped onto an ATR or VTR audio track. Professional VTRs typically have an address or cue track, intended for LTC. If you are working with a standard audio tape, you'll almost certainly be working with LTC; if you're working with a videotape, you may be able to work with either LTC or VITC, or both.

LTC can also be generated as an interpolation of Absolute code. This is how time code DAT machines, DA-88, and many digital VTRs work. In any case, LTC is delivered to USD as a series of audio pulses, regardless of how it is stored or generated.

LTC can function simultaneously as a positional reference and a clock reference.

To use LTC as the USD's positional reference:

From Pro Tools:

■ In the USD Setup area of the Session Setup window, choose LTC from the Positional Ref pop.

Using the front panel controls:

■ Using the front panel Positional Reference switch, select LTC.

Using USD Setup:

■ Select Linear Time Code (LTC) under USD Setup's Positional Ref pop-up menu.

Ensure that you've selected the appropriate clock reference, sample rate, frame rate, and freewheel duration. Also make sure the LTC signal is routed properly to the USD LTC In connector.

Freewheel Duration

Freewheel duration (time code freewheel) configures USD for a maximum number of frames it should continue generating if time code drops out or is otherwise interrupted. Freewheel settings are ignored when USD is in Internal/Generate mode.

Example of Time Code Freewheel

In a 30 fps Pro Tools session, if Freewheel Duration/Time Code Freewheel is 28 frames, the USD will continue to generate until either the incoming time code signal is restored, or until 28 frames elapse, whichever occurs first.

To set freewheel duration from Pro Tools:

1 Choose Display > Session Setup.

2 In the Time Code Freewheel section, enter a number of frames for time code freewheel.

To set freewheel duration from the front panel:

1 Press Set, then use the Up or Down switches to show Freewheel Length (FrEE LEn) in the LED display.

2 Press Set again to access freewheel duration choices.

3 Use the Up and Down switches to scroll through available choices (lowest is "4 F4" or four frames, highest is "40 Fr" or 40 frames).

4 When the desired freewheel duration is displayed, press Set.

To set freewheel duration using USD Setup:

■ Choose the desired amount from the Freewheel Duration menu.

VITC and Positional Reference

VITC is a commonly used positional reference in professional audio post-production. Since VITC is time code information that is embedded as part of the video signal, VITC can be read when the VTR is paused or crawling slowly. When working with Pro Tools, this means that VITC can be used for Auto-Spotting regions to particular video frames.

VITC is less prone to tape drop outs, and in this sense, is inherently more reliable than LTC. VITC can be embedded into any video signal, including digital video signals (tape or nonlinear), without requiring an extra audio track to carry time code.

Tape Protection Mode and VITC

In order for VITC to be read when a videotape is paused, the picture must remain visible. However, to save wear-and-tear on video heads, after a few minutes of still/pause mode, many VTRs will automatically drop into stop mode—which means the tape will be disengaged from the video heads, and VITC can no longer be read off the tape. To continue reading VITC, you may need to reengage still/pause, or press play and re-shuttle the tape to the desired frame.

Clock Considerations for VITC

To avoid tape protection mode problems and ensure constant clock referencing, use the Video Ref In as your clock reference instead of Video In, whenever possible. When using Video Ref In (and house sync), if the video picture disappears the USD will remain resolved to the black burst signal at the Video Ref In connector.

To use VITC as the USD positional reference using Pro Tools:

1 Open the Session Setup window.

2 Use the Positional Reference pop-up menu to select VITC.

To use VITC as the USD positional reference using the front panel:

■ Use the front panel Positional Reference switch to select VITC.

To use VITC as the USD positional reference using USD Setup:

■ Choose Vertical Interval Time Code (VITC) from the Positional Ref pop-up menu.

Additional VITC-Related Settings

USD Settings Make sure to set the appropriate clock reference, sample rate, frame rate, and freewheel duration.

Connections and Sources Make sure that your VITC-striped video signal, if any, is routed to the USD Video In connector (not the Video Ref In connector). If you use a black burst signal as clock reference connect it to the Video Ref In connector.

You should consider using Video Ref as your Clock Reference (rather than Video In) when working with VITC because a black-burst signal at the Video Ref input will always be there, unlike the video signal at Video In, which may disappear if the videotape disengages.

Auto Switch LTC/VITC Positional Reference

In Auto Switch mode, the USD switches automatically between LTC and VITC depending upon which is delivering the best time code signal. This is indicated on the front panel by the LTC and VITC positional reference LEDs (both will be lit), and by a decimal point between the minutes and seconds. on the front panel time code display.

VITC cannot be read at high speeds (shuttle speeds, for example) while LTC can, and LTC cannot be read at slow speeds (while VITC can be read at slow speeds, and when parked). Auto Switch LTC/VITC provides the best of both LTC and VITC reading without having to manually switch settings.

To select Auto Switch LTC/VITC using Pro Tools:

1 Open the Session Setup window.

2 Choose Auto Switch (LTC/VITC) from the Positional Reference pop-up menu.

To select Auto Switch LTC/VITC using the front panel:

■ Press the Positional Reference switch to select Auto Switch LTC/VITC (indicated when both the LTC and VITC LEDs are simultaneously lit).

To select Auto Switch LTC/VITC using USD Setup:

■ Choose Auto Switch LTC/VITC from the Positional Ref pop-up menu.

Make sure to select the appropriate clock reference, sample rate, frame rate, and freewheel duration options.

Auto Switch LTC/VITC Requirements

• Make sure the LTC signal is routed properly to the USD's LTC In connector;

• Make sure the VITC-striped video signal is routed properly to the USD's Video In connector (not the Video Ref In connector);

- Make sure to have or stripe matching code on both your LTC and VITC tracks (and your on-screen video window burn, if any).
- Make sure to select Auto or the correct line pair for VITC Read.

☞ For additional information and examples of Auto Switch LTC/VITC, see "Auto-Switch LTC/VITC" on page 68 in Appendix A.

Serial Time Code

For MachineControl-equipped Pro Tools systems, serial time code can be selected for positional reference. This option is configured from the Pro Tools Peripherals > Synchronization window. Refer to the *MachineControl User's Guide* for configuration instructions and requirements.

Bi-Phase/Tach Positional Reference

Strictly speaking, Bi-Phase/Tach signals are clock reference signals, and do not contain positional information of their own. However, they do contain enough information for the USD to calculate positional information.

To calculate positional reference from Bi-Phase/Tach requires that the USD be given a starting frame address, and a specific pulses-per-frame value. Each of these related settings are explained in the following sections.

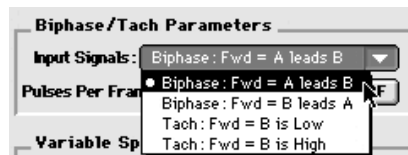### To use Bi-Phase/Tach for positional reference, from Pro Tools:

■ Select Bi-Phase from the Positional Reference menu, located in the Session Setup window.

To use Bi-Phase/Tach for positional reference, from the front panel:

■ Using the front panel Positional Reference switch, select Bi-Phase/Tach.

To use Bi-Phase/Tach for positional reference, from USD Setup:

1 Select Bi-Phase/Tach under USD Setup's Positional Ref pop-up menu.

2 Set the starting frame as described in "Bi-Phase/Tach Starting Frame" on page 42.

3 Set other Input Signals options, as appropriate.

Selecting Bi-Phase/Tach input signals

Bi-Phase/Tach Starting Frame

In order to use the Bi-Phase/Tach signal as a positional reference, the USD also needs to know the time code address for a particular frame of film. This positional relationship is established by parking the film device at a particular frame and setting the USD to the equivalent time code value using the Bi-Phase/Tach Starting Frame parameter.

▲ Bi-Phase start frame can not be set from within Pro Tools.

To set the starting frame for Bi-Phase/Tach from the front panel:

1 Select Set Gen (SE7 6En), using the Set, Down, and Up switches.

2 Press the Set switch again to display time code numbers; one of the time code fields (hours:minutes:seconds:frames) will be flashing.

3 Press the Down or Up switch to scroll through the current parameter.

4 To set a time code setting and advance to the next field, press and release the Down and Up switches simultaneously.

5 Repeat until you have finished setting the USD to the desired generator start time.

6 When you are done, press the Set switch again. The LED Time Code Display will stop flashing, and will show the start time you have just set.

To set Bi-Phase/Tach start frame using USD Setup:

1 In the Generator/Bi-Phase Preset section, type in the time code value of the starting frame, in hours:minutes:seconds:frames.
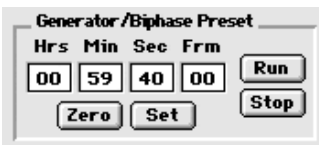
Setting the Generator/Bi-Phase Preset

2 When you have entered the proper starting frame, click Set.

Bi-Phase/Tach Signal

To define the direction for a Bi-Phase/Tach input signal using the front panel:

1 Using the Set, Down, and Up switches, select Bi-Phase/Tach Input Signal (bIPH 5I6):

2 Press the Set switch. The LED Time Code Display will switch to display one of the four parameter values:

A LEAd b Bi-Phase: FWD = A leads B — Here, when the A square wave is ahead of the B square wave, the direction of the Bi-Phase signal is understood to be "Forward."

b LEAd A Bi-Phase: FWD = B leads A — Here, when the B square wave is ahead of the A square wave, the direction of the Bi-Phase signal is understood to be "Forward."

r–n–d LO Tach: FWD = B is Low. Here, when the B signal is in a "low" state, the rate and direction ("r–n–d") of the Tach signal is understood to be "Forward."

r–n–d HI Tach: FWD = B is High. Here, when the B signal is in a "high" state, the rate and direction ("r–n–d") of the Tach signal is understood to be "Forward."

3 Use the Down and Up switches to switch between the parameter values.

4 When you have chosen your desired option, press Set.

Bi-Phase/Tach Pulses-per-frame (PPF)

There are several different standards for the number of pulses-per-frame output by Bi-Phase or Tach devices. Using USD Setup's Pulse Per Frame setting, you can set the USD to operate from 2 to 254 pulses per frame. The setting should match the PPF rate of the external device's Bi-Phase/Tach encoder.

To set the pulses per frame value for a Bi-Phase/Tach signal using the front panel:

1 Using the Set, Down, and Up switches, select Bi-Phase/Tach Pulses Per Frame (bIPH PPF):

2 Press the Set switch again. The LED Time Code Display will switch to display the current PPF value.

3 Use the Down and Up switches to scroll through the parameter values (range is from 2 to 255 pulses per frame). Holding either switch will scrolls at a faster speed.

4 When you have chosen your desired option, press Set.

Bi-Phase Position Trimming

While using bi-phase as your positional reference, you can trim the Bi-Phase-to-time code translation at any time. Each press of the Up switch will advance the time address one frame. Each press of the Down switch will retard the time address by one frame. Remember how many presses you've accumulated so that you can go back and trim the starting address you previously programmed in.

Generating and Regenerating Time Code

The USD generates LTC, VITC, and MTC simultaneously, obtaining time addresses from a variety of sources:

• When the Positional Reference is set to Generate, the USD generates LTC, VITC, and MTC from an internal time address clock. This is referred to as Generator Preset mode.

• When the Positional Reference is LTC, VITC, or Bi-Phase, the USD generates LTC, VITC, and MTC based on the time address of one of those sources. This is sometimes called *re-generation* or *translation*. For the USD, this is referred to as Read/Regeneration mode.

☞ For information about using serial time code with Pro Tools, refer to the *MachineControl User's Guide*.

Read/Regeneration Mode

In this mode, the USD regenerates time code based upon external positional reference information (LTC or VITC time code, or a Bi-Phase/Tach signal). Subject to certain conditions, three types of time code (LTC, VITC, and MTC) are simultaneously regenerated from the selected positional reference.

Requirements for Read/Regeneration of LTC, VITC and MTC

LTC The external positional reference must be moving at normal, 1x forward speed (±8%).

VITC The positional reference must be LTC or Bi-Phase/Tach, at any readable speed, forward or reverse, or when the positional reference is set to Generate. The USD will not regenerate VITC if the positional reference is VITC.

MTC In order for the USD to regenerate continuous MTC, the external positional reference must be moving at normal, 1x forward speed (±8%). Outside of this speed range and direction, MTC is generated in bursts every 200 milliseconds. This allows MTC-slaved devices to read VITC or Bi-Phase properly in either direction, and at speeds down to zero. The USD begins re-generating MTC as soon as it again detects a valid positional reference signal.

✳ To optionally mute idle time MTC output, see "MTC Output and Idle Muting" on page 51.

If the positional reference is LTC or VITC, USD will regenerate time code addresses that match the incoming time code addresses. If the positional reference is a Bi-Phase/Tach signal, the USD will generate time code addresses starting at the Bi-Phase preset start time. (See "Bi-Phase/Tach Starting Frame" on page 42 for more information.)

Generator Preset Mode

In this mode, the USD generates time code internally from a start time based upon the Generator Preset Time. Using either USD Setup or the front panel controls, you can start, stop, resume, and reset time code generation.

When generating time code in Generator Preset Mode, the USD time code generator is resolved (locked) to one of three possible sources, based upon the following Generator Reference rule.

Generator Reference Rule

◆ If the Clock Reference is set to Internal, LTC, Pilot Tone, Bi-Phase/Tach, Digital (AES/EBU), Digital (Super Clock), or Digital (Word Clock), then the time code generator will lock to the selected clock reference.
  – or –

◆ If the Clock Reference is set to one of the two video inputs (Video Ref In or Video In), then the time code generator will reference the Video Ref In connector.

24 fps and Frame Rate Restrictions

24 FPS cannot be used as the USD time code format when the Positional Reference is set to Generate and the Clock Reference is either one of the two video inputs.

Furthermore, under these same conditions, if the video format is set to NTSC, only 29.97 FPS and 29.97 DF FPS may be chosen as the time code format, and, if the video format is set to PAL, only 25 FPS may be chosen as the time code format.

These restrictions are removed when not in Generate mode.

Pro Tools Systems

Pro Tools provides controls for virtually all USD generator controls. Instructions for basic SMPTE or MTC generating can be found in the *Pro Tools Reference Guide*. Special instructions for any situations are included in the following sections.

✳ See "Control Options" on page 27 for details on the USD control access.

Generator Start Time

To set the generator start frame from Pro Tools:

■ Configure the Session Setup window as appropriate for your system and the current project. Refer to the *Pro Tools Reference Guide* for specific instructions.

To set the generator start frame from the front panel:

1 Select Set Gen (SE7 6En), using the Set, Down, and Up switches.

2 Press the Set switch again. One of the time code fields displayed will be flashing.

3 To lower or raise the currently flashing parameter press the Down or Up switch. Hold down either switch to scroll down/up.

4 To set a time code setting and advance to the next field, press and release the Down and Up switches simultaneously.

5 Repeat until you have finished setting the USD to the desired generator start time.

When you are done, press the Set switch again. The USD will retain the setting, even when the unit is powered off and on again, until it is changed.

LTC Generation/Regeneration

Regenerating LTC

The USD will regenerate LTC whenever the external positional reference is moving at normal, 1x forward speed (±10%).

Make sure LTC is correctly routed as explained in *Chapter 2: Installing the USD*. In addition, be sure to check and adjust the level of the USD LTC output signal, if necessary. See "Example 1: Using Set, Down and Up to adjust LTC Gain" on page 30 for instructions. If necessary, adjust the input level for the destination device.

To regenerate LTC using Pro Tools:

■ In the Session Setup window, select any external positional reference (except Generate).

To regenerate LTC using the front panel:

■ Using the USD Positional Reference switch, select the desired external positional reference (do not select Generate).

The USD regenerates LTC as soon as it receives a valid positional reference signal.

To regenerate LTC using USD Setup:

■ Select the desired external positional reference from the Positional Reference popup (any choice except Generate).

Generating LTC

In Generator Preset mode, the USD can generate LTC using either an external or internal clock reference. This allows the USD to function as a complete standalone time code generator.

Make sure LTC is correctly routed and that all your other gear is properly configured before you begin. See "Example 1: Using Set, Down and Up to adjust LTC Gain" on page 30 for USD LTC instructions. If necessary, adjust the input level for the destination device.

To generate LTC using Pro Tools:

1 In the Session Setup window, choose Generate from the Positional Reference pop-up menu.

2 Activate "Online Mode" in Pro Tools

3 Start Pro Tools recording or playback. Pro Tools commands the USD to begin generating LTC with time addresses synchronized to the session timeline.

To generate LTC using the front panel controls:

1 Using the USD's Positional Reference switch, select Generate.

2 Configure the desired time code start in hours:minutes:seconds:frames using the Set, Up and Down switches. See "Generator Start Time" on page 46 for instructions.

3 To begin generating, press and release the Run/Stop+Clear switch.

To generate LTC using USD Setup:

1 In USD Setup's Positional Ref pop-up menu, select Generate.

2 In USD Setup's Generator/Bi-Phase Preset window, type in the desired time code start time, in Hrs:Min:Sec:Frm. To reset, click Zero.

3 To begin generating, click Run.

4 When you have finished generating the desired length of LTC, click Stop.

VITC Generation/Regeneration

When you use the USD to regenerate or generate VITC, you'll be inserting VITC into an existing video signal. The input is derived according to the following rule.

VITC Video Source Rule

Since USD has two video inputs (Video In and Video Ref In), the following rule describes which of these two signals VITC is applied to.

• If the Positional Reference is set to Generate *and* the Clock Reference is set to either of the two video inputs, then VITC will be applied to the video signal at the Video Ref In connector and fed to the Video Out connector.

• Under all other combinations of Positional Reference and Clock Reference, VITC will be applied to the video signal at the Video In connector and fed to the Video Out connector.

In addition, the USD will not insert new VITC while reading VITC from an external source. This is a safety feature to prevent the loss of existing VITC in the video

stream. Thus, VITC is never inserted when the Positional Reference is set to VITC or Auto Switch LTC/VITC.

Example Video Input Configuration

One common situation is transferring video from a source VTR (or a nonlinear video editing system) to a destination VTR (or a nonlinear video editing system). The video source signal is connected to one of the USD's video input connectors according to the VITC Video Source rule.

The USD Video Out signal is connected to the destination device. The USD is then able to stripe the second VTR's videotape with VITC. (At the same time, you might also want to insert a window burn, as described in "Window Burn Display Options" on page 53.)

▲ Unlike LTC, the USD can regenerate VITC with both forward and reverse time code addresses.

To prevent destruction of the original VITC code, the USD will not re-apply (regenerate) VITC onto the same video stream from which it is reading VITC.

LTC If you want to use LTC as a positional source, do not select Auto Switch LTC/VITC.

External In order for the USD to regenerate VITC based on an external positional reference, you'll need to select both a clock reference and a positional reference.

To regenerate VITC based on an external positional reference from the front panel:

1 Connect the video source to the USD Video Ref connector and loop to the USD Video Input connector.

2 Select VITC Insertion (VI7C In5), using the Set, Down, and Up switches.

3 Press the Set switch again. The LED Time Code Display displays one of the two parameter values (On or OFF).

4 Use the Down and Up switches to switch between the parameter values.

5 Press Set to select VITC Insertion.

6 Make sure you have selected the appropriate format (NTSC or PAL, depending on your project). For instructions, see "Video Format/System" on page 60.

7 Use Set, Up and Down to access the VITC Generate Lines (6En LInE) parameter. Press the Set switch again. The default line pair is14/16, which is also the SMPTE-recommended setting.

8 Use the Down and Up switches to scroll through the parameter values and select a new VITC line pair, if necessary. When you have chosen your desired line pair, press Set. The LED Time Code Display will return to showing time code numbers.

9 Select valid clock and positional references.

The USD will now regenerate VITC and insert it onto the video signal (as soon as it receives a valid positional reference signal).

To regenerate VITC based on an external positional reference using USD Setup:

1 Ensure that the USD is connected in-line with a video source and video destination.

2 Ensure that VITC Insertion Enabled is checked in the USD Setup window, and that you have selected the appropriate format (NTSC or PAL).

3 Use the VITC Generate Lines menu to configure the line pair, if necessary.

4 Select the appropriate clock reference, using USD Setup's Clock Reference menu.

5 Select either LTC or Bi-Phase/Tach from the USD Setup Positional Reference pop-up window:

The USD will now regenerate VITC and insert it onto the video signal (as soon as it receives a valid clock reference signal and positional reference signal).

Internal VITC Generation

The USD can also generate VITC internally, using its integral time code generating feature. In this mode (Positional Reference switch = Generate) you can use either an external clock reference, or the USD's internal crystal as a clock reference with a variable start time.

When generating VITC internally, if the insertion is not timed based upon an *upstream* video reference you may encounter repeated or skipped VITC frames. Be sure to check "VITC Timing Rule" on page 50 and "VITC Video Source Rule" on page 47.

To generate VITC internally using the front panel controls:

1 Ensure that the USD is connected in-line with a video source and video destination.

2 Select VITC Insertion (VI7C In5), using the Set, Down, and Up switches. For detailed instructions, see "VITC Insertion" on page 56.

3 Use the Down and Up switches to display VITC Insertion on/off.

4 When on is selected, press Set.

5 Select VITC Generate Lines (6En LInE), using the Set, Down, and Up switches.

6 Press the Set switch again. The default line pair is 14/16, which is also the SMPTE-recommended setting.

7 Use the Down and Up switches to scroll through the parameter values. When the desired line pair value is displayed, press Set.

8 Using the Positional Reference switch, select Generate.

9 Set the time code start time. See "Generator Start Time" on page 46 for instructions.

10 Arm the destination VTR to record video, so that VITC can be inserted into the video signal, and be recorded on the destination videotape.

11 Make sure that your chosen clock reference is actually present and running, then press the USD Run switch.

The time code addresses will begin to increment.

To pause or stop VITC from the front panel:

■ Press and release the Run/Stop/Clear switch when you want to pause or stop the generating process.

To generate VITC Internally using USD Setup:

1 Ensure that the USD is connected in-line with a video source and video destination.

2 Ensure that VITC Insertion Enabled is selected in the USD Setup window, and that you have selected the appropriate format (NTSC or PAL).

3 If necessary, select onto which line pair you'll be generating VITC using the VITC Generate Lines pop-up menu.

4 Select the appropriate clock reference, using USD Setup's Clock Ref selector.

5 From the Positional Ref selector, select Generate.

6 In the Generator/Bi-Phase Preset window, type in the desired time code start time, in Hrs:Min:Sec:Frm. To reset to 00:00:00:00, click Zero.

7 Click Set. Typically, at this point you would arm the destination VTR to record video, so that VITC can be inserted into the video signal, and be recorded on the destination videotape. Make sure that your chosen clock reference is actually present and running, and that it is synchronized with the incoming video signal

8 Click Run to start. The time code addresses will begin to increment.

9 Click Stop when you want to pause or stop the generating process.

✳ Regardless of whether you are generating or regenerating, an active video signal will need to be present at one of the USD's video inputs. If in doubt, always check if the machine is paused, stopped or unlaced.

VITC Timing Rule

The following rule is in effect whenever you are generating or regenerating VITC.

◆ Inserted VITC should be monotonic, regardless of whether it is being regenerated or generated.

By *monotonic*, we mean that the VITC should be smoothly ascending or descending, with no repeated or skipped frame addresses. In order to achieve monotonicity, the external positional reference (while regenerating) or the clock source (in Generator Preset Mode) must be synchronous with the video signal onto which the VITC is being inserted.

Example of VITC Timing Rule

As an example, if you are using LTC as a positional reference from a 3/4-inch U-Matic VTR, then that VTR should be referenced to the same video signal that you are applying to the USD. As another example, in Generator Preset Mode (Positional Reference = Generate), a clock reference of Internal is not a good choice, simply because the USD's internal crystal runs asynchronously with respect to the supplied video signal, and thus repeated or skipped frame addresses are sure to eventually occur.

MTC Generation/Regeneration

MTC (MIDI Time Code) is a serial digital signal. In many ways, you can think of it as an inaudible type of LTC, that can be used by various MIDI devices.

MTC is available from the USD MTC Out connector, which is a standard DIN-style 5-pin female MIDI connector.

To use MTC, you'll need to connect MTC Out to a MIDI In connector of a device that can recognize and use MTC. Typically, this would be a console, sequencer, synthesizer or sampler keyboard, a drum machine or other device.

MTC Output and Idle Muting

MTC is normally output whenever LTC is output. Whenever LTC output stops, USD will continue to output MTC in bursts of one frame every 200 milliseconds. This allows any connected MIDI-reading device to be continuously updated as to the position of VITC or Bi-Phase (either of which might be operating at slow or still speeds). Thus, you can still use a connected MIDI device for Auto-Spotting from VITC or Bi-Phase.

Optionally, this constant output can be set to mute when time code (LTC) is idle.

To mute idle-time MTC output from the front panel:

1 Use the front panel Set, Up and Down switches to display Idle MTC (IdLE 7C).

2 Press Set to display the current state (On or Off).

3 Press Up or Down to toggle Idle MTC to the Off setting.

4 Press Set again to exit and return USD to its previous state.

To mute idle-time MTC output using USD Setup:

1 Launch USD Setup.

2 Deselect the Idle MTC Enabled option.

Idle MTC controls in USD Setup

Generating a Window Burn

The USD offers time code character generation (also known as window burn or dubbing). This superimposes onto a video signal a small area called a window dub (or window burn, or time code window) that displays time code in hours:minutes:seconds:frames.

Video image with window burn

A window dub can be very helpful for any-one involved in audio-for-picture, since it gives you an instant, visual cue as to where you are in time.

When working with Pro Tools, for in-stance, you can use a window dub to help locate a particular video frame that has been cued by the director for a particular sound effect. Or, if you're using Pro Tools and you want to spot a region to the same video frame at which you've paused your videotape, you can enter the time code reading you see in the window dub into the Auto Spot dialog. (This is especially useful if your only time code reference from the tape is LTC, as Auto-Spot requires VITC.)

The USD's character generator obtains its time code address from the chosen Posi-tional Reference.

Window Dub Requirements

Existing Video Signal The USD can only burn a window dub onto an existing video signal. This means that at least one video "source" signal (from a VTR, nonlinear ed-iting system, or other video device) must be present at one of the USD's video input connectors (Video In or Video Ref In). When generating a window dub, the two VITC Timing and VITC Video Source Rules apply.

USD Output The signal from the USD's Video Out connector must be routed to a video "destination" (such as another VTR or nonlinear editing system).

To burn a window dub onto a video signal from Pro Tools:

1 Choose Setups > Peripherals and display the Synchronization page.

2 Assuming USD is enabled already, the Window Dub controls should be available.
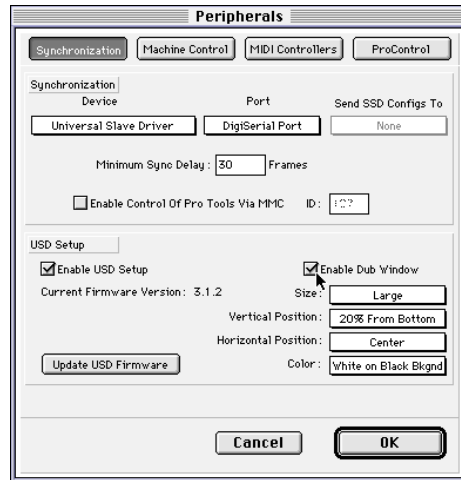
Configuring USD Window Dub from Pro Tools.

3 Click Enable Dub Window.

4 Configure the Window burn appearance settings: Size, Vertical Position, Horizontal Position, and Color. (See "Window Burn Display Options" on page 53 for details.)

5 After configuring the dub window set-tings, click OK to close the Peripherals win-dow.

To configure Window Dub using USD Setup:

1 In the Dub Window section of USD Setup, select Window Enabled.

2 Specify the appearance of the window dub with the pop-up menus for Vertical Po-sition, Horizontal Position, and Color. (See "Window Burn Display Options" on page 53 for details.)

3 Ensure that all the proper video connections have been made, and that you've selected the correct positional reference.

After you have completed these steps, you'll burn a window dub—with time code addresses based upon the selected positional reference—onto any video signal that's passing through the USD.

To turn off window dubbing:

■ Deselect Window Enabled.

To enable window dub using the front panel controls:

1 Using the Set, Down, and Up switches, select Burn Enabled (burn EnA).

2 Press the Set switch again. The LED Time Code Display will switch to display the current On or Off setting for Window Burn.

3 Use the Down and Up switches to switch between the parameter values.

4 When you have chosen your desired option, press Set.

The time code character generator can now burn time code addresses based upon the selected positional reference, onto any video signal that's passing through the USD.

If you need to change the appearance of the window dub—in terms of size, vertical position, horizontal position, and color— you'll need to use Pro Tools or USD Setup. These parameters cannot be adjusted from the USD's front panel controls.

Window Burn Display Options

If you need to change the appearance of the window dub—in terms of size, vertical position, horizontal position, and color— you'll need to use Pro Tools or USD Setup. These parameters cannot be adjusted from the USD's front panel controls.

Size Sets the relative size of the window dub. The choices are Small or Large. The default setting is Large.

Vertical Position Sets the vertical position of the window dub, relative to the bottom of the video picture. The choices range from 10% From Bottom to 50% From Bottom, in 10% increments. The default setting is 20% From Bottom.

▲ "10% from Bottom" vertical position is outside the standard "safe title" area, which means it may not be visible on some video monitors.

Horizontal Position Sets the window dub's relative horizontal position within the video picture. The choices include Extreme Left, Left, Center, Right and Extreme Right. The default setting is Center.

▲ The "Extreme" horizontal positions are outside the standard "safe title" area, which means they may not be visible on some video monitors.

Color Sets the color of the time code numbers in the window dub, and the color of the window dub's background. The choices include White on Black Bkgnd; Black on White Bkgnd; White on Video Bkgnd; or Black on Video Bkgnd. (Video Bkgnd means that the window dub's background is transparent, so that the time code num-

bers are displayed directly on top of the video signal, without a contrasting background box.) The default setting is White on Black Bkgnd.

☞ Default Window Burn settings are listed in "Restoring Factory Settings" on page 65.

chapter 5

Additional Operational Information

Front Panel Generator/Parameter Controls

This section details the parameter features available from the multi-function SET, UP, DOWN and RUN/STOP, CLEAR switches. (Referred to as Set, Up, Down and Run).

Generator start, stop and related functions of the Set, Up, Down and Run switches are explained in "Generating and Regenerating Time Code" on page 44.

Parameters

The USD 7-segment LEDs are not able to show all upper and lower case characters properly, and in some cases use numerals to represent letters (such as "5" to represent "S" or "s"). The following table identifies each of these abbreviations.

To select USD front panel parameters:

1 Press Set.

2 Use the Up and Down switches to scroll through available parameters, described below.

Detailed instructions for the multi-function Generator/Parameter switches can be found in the section "Using the Front Panel Generator/Parameter Switches" on page 29.

USD LED display of abbreviated parameter names

USD LED	Parameter
SE7 6En	Set Generator Start Time
dl6 rEF	Digital Reference
SPL FrEC	Sample Freq (Rate)
VI7C InS	VITC Insertion
rdr LInE	(VITC) Reader Line
6En LInE	(VITC) Generate Line
burn EnA	Window Burn On/Off
FrEE LEn	Freewheel Duration
L7C 6AIn	LTC Output gain
PICH HLd	Pitch Hold On/Off
bIPH PPF	Bi-Phase Pulse-per-frame
bIPH SI6	Bi-Phase Signal Configuration
VIdEO SY	Video System/Format (NTSC/PAL)
IdLE 7C	Idle MTC On/Off

Set Generator Start Time

See the section "Generator Start Time" on page 46 for configuration instructions.

$$SE7 \quad GEn$$

Digital Clock Reference

The USD can use one of three possible digital clock references—AES/EBU, Super Clock (256x), or Word Clock (1x).

See the section "Digital AES/EBU, Word Clock and Super Clock" on page 33 for complete configuration instructions.

$$dIG \quad rEF$$

Sample Rate/Frequency

Selecting this parameter name lets you choose the USD's sample rate.

$$SPL \quad FrEC$$

The table below shows USD Sample Rate indication with the four Sample Rate LEDs:

USD LED displays and Sample Rates

USD LEDs ON	Sample Rate
44.1 kHz	44.100 kHz
48 kHz	48 kHz
44.1 kHz and PULL UP	44.144kHz
44.1 kHz and PULL DOWN	44.056kHz
48 kHz and PULL UP	48.048 kHZ
48 kHz and PULL DOWN	47.952 kHz

PAL format and Pull Up/Down

The USD Pull Up and Pull Down features are not designed to perform conversion between 24 fps and 25 fps.

VITC Insertion

When selected, VITC will be inserted onto the outgoing video signal—assuming that a video signal is present at one of the USD video inputs, and that the USD is in a valid mode for inserting VITC.

$$VI7C \quad InS$$

To configure the USD to insert VITC using the front panel:

1 Select VITC Insertion (VI7C InS) using the Set, Down, and Up switches.

2 Press the Set switch again. The LED Time Code Display will switch to display On or Off.

3 Use the Down and Up switches to switch between the parameter values.

4 When you have chosen your desired option, press Set.

You may also need to select the line pairs that you will generate VITC on, using the VITC Generate Lines parameter (6En LInE).

VITC Read Lines

This setting determines which line pair of incoming video is used for the VITC source.

$$rdr\ LInE$$

To choose the VITC read lines:

1 Select VITC Read Lines (rdr LInE), using the Set, Down, and Up switches.

2 Press the Set switch again. The LED Time Code Display will switch to display one of the parameter values:

- Auto (ALL-LInE)—where the USD will search all lines and select the first valid line pair automatically
  – or –
- one of the following:
  10/12
  11/13
  12/14
  13/15
  14/16
  15/17
  16/18
  17/19
  18/20
  19/21
  20/22

3 Use the Down and Up switches to scroll through the parameter values.

4 When you have chosen your desired option, press Set.

VITC Generate Lines

This setting determines the line pair of the video signal at the Video Out connector onto which the USD inserts VITC. Normally, this should be left at the default setting of 14/16.

$$6En\ LInE$$

To choose the VITC generate lines:

1 Select VITC Generate Lines (6En LInE), using the Set, Down, and Up switches.

2 Press the Set switch again. The LED Time Code Display will switch to display one of the parameter values:

10/12
11/13
12/14
13/15
14/16 (SMPTE recommended setting)
15/17
16/18
17/19
18/20
19/21
20/22

3 Use the Down and Up switches to scroll through the parameter values.

4 When you have chosen your desired option, press Set. The LED Time Code Display will return to showing time code numbers. The USD will retain the setting, even when the unit is powered off and on again, until it is changed.

Window Dub/Burn

By enabling this setting, you can superimpose a window dub onto an incoming video signal.

$burn \ EnA$

The front panel lets you enable window dub but not adjust any window options.

To enable or disable the USD's window dub from the front panel:

1 Select Burn Enabled (burn EnA), using the Set, Down, and Up switch.

2 Press the Set switch again.

3 Use the Down and Up switches to toggle between on/off.

4 When you have chosen your desired option, press Set. The LED display will return to showing time code numbers. The USD will retain the setting, even when the unit is powered off and on again, until it is changed. See "Generating a Window Burn" on page 51 for Pro Tools and USD Setup window dub instructions.

Default Window Dub Settings

The USD time code character generator defaults to the following display settings.

Parameter	Default
Size	Large
Vertical Position	20% from bottom
Horizontal Position	Center
Color	White numerals on a black background.

Freewheel Length/Duration

Freewheel Length sets the period of time for which the USD will continue to regenerate time code when incoming time code is interrupted.

$FrEE \ LEn$

See "Freewheel Duration" on page 39 for an explanation of this feature. The following describes the choices list in the front panel.

To set the freewheel duration:

1 Select Freewheel Length (FrEE LEn), using the Set, Down, and Up switches.

2 Press the Set switch again. The LED Time Code Display will switch to display one of the parameter values:

   4 Fr
   8 Fr
   12 Fr
   16 Fr
   20 Fr
   24 Fr
   28 Fr
   32 Fr
   36 Fr
   40 Fr

3 Use the Down and Up switches to switch between the parameter values.

4 When you have chosen your desired option, press Set.

LTC Output Level/Gain

Adjusts the audio level of the USD's LTC output, from –24 dBu to +9 dBu.

L7C 6A In

See "Example 1: Using Set, Down and Up to adjust LTC Gain" on page 30 for step-by-step LTC gain instructions.

To set the LTC output level:

1 Select LTC Gain (L7C 6AIn), using the Set, Down, and Up switches.

2 Press the Set switch again. The LED Time Code Display will switch to display one of the parameter values (shown in USD LED as "dbu," referring to actual dBu levels):

> 9 dbu
> 6 dbu
> 3 dbu
> 0 dbu
> –3 dbu
> –6 dbu
> –9 dbu
> –12 dbu
> –15 dbu
> –18 dbu
> –21 dbu
> –24 dbu

3 Use the Down and Up switches to switch between the parameter values.

4 When you have chosen your desired option, press Set. The LED Time Code Display will return to showing time code numbers. The USD will retain the setting, even when the unit is powered off and on again, until changed.

Pitch Memory/Hold

Pitch Memory is useful when resolving USD to off-speed, free-running LTC. When Pitch Memory is enabled, the USD will remain at a pitch (sample rate) that corresponds to the last known clock reference speed. Without Pitch Memory/Hold, USD reverts to the selected sample rate.

PICH HLd

✽ Turn off Pitch Memory if you want to digitally transfer to another device and to ensure the receiving device gets the correct sample rate. Also, turn pitch memory off if you are doing an analog transfer to Pro Tools and want to ensure that the recording is made at the exact sample rate set by the session set up window.

To enable or disable the USD's pitch memory feature:

1 Select Pitch Hold (PICH HLd), using the Set, Down, and Up switches.

2 Press the Set switch again. The LED Time Code Display will switch to display one of the two parameter values:

> On (On)
> Off (OFF).

3 Use the Down and Up switches to switch between the parameter values.

4 When you have chosen your desired option, press Set. The LED Time Code Display will return to showing time code numbers. The USD will retain the setting, even when the unit is powered off and on again, until it is changed.

Bi-Phase/Tach Pulses Per Frame

This selection is used for specialized applications that involve film or other equipment that output Bi-Phase/Tach information. The parameter values set the number of Bi-Phase/Tach pulses per frame of time code.

```
b 1 PH   P PF
```

To set the pulses per frame value for a Bi-Phase/Tach signal:

1 Select Bi-Phase/Tach Pulses Per Frame (bIPH PPF), using the Set, Down, and Up switches.

2 Press the Set switch again. The LED Time Code Display will switch to display the current parameter values, from 2 to 255 pulses per frame. The readout will look something like this:

0002

3 Use the Down and Up switches to scroll through the parameter values. Pressing and releasing the switches will change the value by just one pulse per frame. Pressing and holding the switches will scroll at a faster speed.

4 When you have chosen your desired option, press Set. The LED display will return to showing time code numbers. The USD will retain the setting, even when the unit is powered off and on again, until it is changed.

Bi-Phase/Tach Input Signal

This selection is also used for specialized applications that involve film or other equipment that output Bi-Phase/Tach in-formation. Here, the parameter values will be used to define the *direction* of the Bi-Phase/Tach signal.

```
b 1 PH   5 16
```

For complete instructions, see "Bi-Phase/Tach Signal" on page 43.

Video Format/System

Selects the format (NTSC or PAL) for both the incoming and outgoing video signals.

```
U 1 dE o   5 4
```

NTSC The standard for North and South America, Japan, and certain other parts of the world

PAL Used in most of Europe, Asia, and Africa. Users of SECAM video (for France, Russia, and certain other parts of the world) should select PAL.

▲ Please be sure you have selected the correct format! The USD will not warn you if you have chosen the wrong one.

To select the desired video system:

1 Select Video System (VIdEo SY), using the Set, Down, and Up switches.

2 Press the Set switch again. The LED Time Code Display will switch to display one of the two parameter values:
  • NTSC (n75C)r
  • PAL (PAL)

3 Use the Down and Up switches to switch between the parameter values.

4 When you have chosen your desired option, press Set.

The LED Time Code Display will return to showing time code numbers. The USD will retain the setting, even when the unit is powered off and on again, until it is changed.

MTC Idle Mute

MTC is output constantly whenever the USD is generating time code. Optionally, this constant output can be set to mute when time code (LTC) is idle.

IdLE 7C

To mute idle-time MTC output from the front panel:

1 Use the front panel Set, Up and Down switches to display Idle MTC (IdLE 7C).

2 Press Set to display the current state (On or Off).

3 Press Up or Down to turn Idle MTC off.

4 Press Set again to exit and return USD to its previous state.

For USD Setup instructions for Idle MTC, see "MTC Output and Idle Muting" on page 51.

Managing and Selecting Video Inputs

The USD has two independent video inputs, referred to as "Video In" and "Video Ref" on USD's rear panel. These let you use one of the video inputs as a Clock Reference (the resolver sample clock master reference) and use the other input for working with VITC time code and the character generator (window dub).

Don't worry if you have just a single video source. The USD provides a very simple method for connecting your single video source to both of the video inputs. See "Using Video Inputs with VITC and the Character Generator" on page 62.

In a typical video setup, you will supply a reference video signal (black burst or color bars) to your VCR and to the USD Video Ref input. You will then connect the VCR's video output to the USD Video In input. Finally, the USD Video Out will be fed to your picture monitor and/or another VCR.

Using Video Inputs as Clock Reference

The USD lets you choose either of its video inputs as the Clock Reference for generating system clocks. There is no performance advantage to choosing one input over the other. Pro Tools and USD Setup allow you to freely select either input.

If you plan to control your USD only from its front panel, then there is a flexibility advantage in using the Video Ref input as your Clock Reference. This is because there's no way to select the Video In connector as the Clock Reference when using the front panel controls. When you use the

front panel Clock Reference switch to select VIDEO as the Clock Reference, it's referring to the Video Ref connector, and never to the Video In connector.

To avoid the chance of this limitation getting in your way, we suggest that you connect your reference video feed (from a black burst or colorbar generator) to the Video Ref input, and use this input as your Clock Reference whenever you want sample clocks locked to video.

Using Video Inputs with VITC and the Character Generator

Unlike selecting a video input to use for Clock Reference, you don't have freedom to arbitrarily choose which input to use for VITC and character generator functions.

The rule defining which video input is used for VITC and character generator functions is simple, and is explained in the following sections and in Figure 3.

◆ If the Clock Reference is one of the two video inputs, *and* the Positional Reference is Generate, then VITC and character generator functions are applied to the video arriving at the Video Ref input connector. This helps you avoid re-patching video cables whenever you want to stripe a videotape with your reference black burst or color bars, along with internally generated time addresses for VITC (and/or LTC, and/or CG dub window). In Figure 3, this scenario is identical to "Route A."
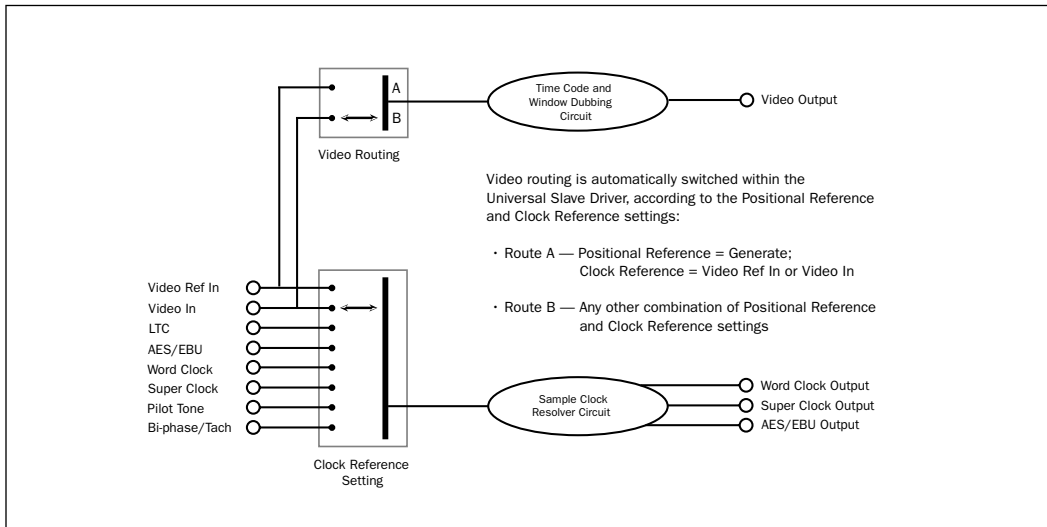
Figure 3. Video Input Flow diagram

The clock reference (labelled Sample Clock Resolver Circuit in Figure 3 on page 62) is selectable at all times. You can decide which input signal to use to generate the digital clock signal.

However, when the clock reference is set to Video, the positional (time code) reference circuitry (labelled Time Code and Window Dub Circuit in the illustration) is not switchable. This is because the positional (time code) reference circuitry is always used to derive time code, whether the USD is reading incoming time code or generating new time code. Even in Generate mode, the USD needs to use this circuitry to detect the frame edge of the video, in order to generate time code.

Using Fader Start

The USD provides six GPI outputs in total, two TTL-level and four relays. Together, this combination of outputs makes it possible for the USD to provide Fader Start capability.

☞ Utilization of Fader Start has specific wiring requirements. See "GPI Relay Wiring for Fader-Start" on page 88.

Fader Start allows faders in Pro Tools to trigger external devices to play and stop.

To implement Fader Start, Pro Tools maps the first two visible auxiliary input channels in a session to GPI Relay outputs 0 and 1 (first being left-to-right in the Mix window, top-to-bottom in the Edit window).

Example Fader Start Application

In a typical scenario, the Fader Start feature controls playback of a CD player. The CD player outputs are routed into a Pro Tools stereo Aux Input. As the Aux channel fader is moved above -120 dB, playback of the CD player is automatically triggered. Likewise, as the fader is moved below -120 dB, playback is automatically stopped.

✽ To rearrange tracks, drag the Track Name plate left or right in the Mix window, or up or down in the Edit window. Refer to your *Pro Tools Reference Guide* if you need additional information.

To configure Pro Tools tracks for Fader Start Play and Stop:

1 Use the New Track dialog to create two new auxiliary input tracks. If you already have aux tracks, you will use the first and second (top-most in the Edit window, left-most in the Mix window).

2 When the first visible aux input in a Pro Tools session is above -120 dB, GPI Relay output 3 (Fader Start #1) will be enabled; otherwise, it will be disabled.

Similarly, when the second visible aux input in a Pro Tools session is above -120 dB, GPI Relay output #4 (Fader Start #2) will be enabled; otherwise, it will be disabled.

If you rearrange channel strips in the Pro Tools Mix or Edit windows, the two GPI outputs will update dynamically to reflect the current state. The Fader Start channel must be in a Show Track state (not hidden).

Refer to "GPI Relay Wiring for Fader-Start" on page 88 for additional GPI information.

Calibrating the USD Oscillator

The USD provides a feature for calibrating the frequency of the on-board crystal oscillator. This allows USD to be used as an extremely accurate frequency reference while in Internal/VSO mode.

With normal usage, the USD should never require recalibrating. Each unit is factory calibrated to within +/- 5 ppm (parts per million).

You may want to recalibrate the USD in the following situations:

• If greater than 5 ppm accuracy is required

• If the unit needs to be matched to a unique (nonstandard) frequency

• To precisely compensate for component aging

• To restore the original factory setting

✻ Oscillator recalibration does not occur during firmware updating or when resetting the USD to factory defaults (see "Restoring Factory Settings" on page 65).

Oscillator Resolution and Stability

The USD calibration units are in 1/64th of a sample period. What this means is that the USD can theoretically be calibrated to about 1/3 of a ppm. The unit will maintain calibration across a wide range in temperature. Long-term drift should be less than 1 ppm per year due to aging of the crystal. To put this in perspective, most digital audio products are accurate to within 20 to 50 ppm and drift with temperature. The

USD's accuracy is possible because it contains a low-jitter, high-stability temperature controlled crystal oscillator.

Warm Up USD Before Recalibrating

Before you begin the calibration procedure, power on the USD and allow it to warm up for at least five minutes. The temperature of the room (or chassis) isn't critical during the calibration procedure. However, if you need better than 3 ppm accuracy, it is recommended that you allow the USD to warm up for at least 30 minutes and that the chassis be at normal operating temperature.

To restore the USD's oscillator calibration to its factory setting:

1 Press Set, then press Up until Video System (VIdEo SY) is displayed in the LED readout.

2 With the LED Time Code Display showing VIdEo SY, press and hold the Up switch. While you continue to hold that switch, press the Clock Reference switch momentarily, and then release both switches. The LED Time Code Display will read:

3 Press the Set switch again. The LED Time Code Display will switch to display the current parameter value, which shows a sample rate frequency deviation from –0999 to 0999.

4 Take note of the Oscillator Calibration value printed on the factory sticker, on the USD bottom panel.

5 Use the Down and Up switches to scroll through the parameter values. Pressing and releasing the switches will change the value by just one incremental value. Pressing and holding the switches will scroll at a faster speed.

6 When you reach a value that matches the sticker's value, stop scrolling and press Set. The LED Time Code Display will return to showing time code numbers. Your USD is now properly calibrated.

The next time you press Set, the LED Time Code Display will again show O5C CAL. If you then press the Down switch, you'll disengage the Oscillator Calibration parameter name. To change the setting once again, you'll need to repeat steps 1 through 6.

Restoring Factory Settings

The USD can be reset to its default factory settings. See "USD Defaults" on page 65 for default values.

To reset all parameters to default settings:

1 Switch off power to the USD and wait at least 10 seconds.

2 Hold down the Up and Down front panel switches and switch on power to the USD—do not release the Up and Down switches until the display reads FAC-CFG.

▲ Resetting factory settings does not reset the USD oscillator. See "Calibrating the USD Oscillator" on page 64 for information.

USD Defaults

Parameter Name	Default
Set Generator Start Time	00:00:00:00
Digital Reference	AES-EBU
Sample Freq (Rate)	44.1 kHz
VITC Insertion	On
(VITC) Reader Line	All
(VITC) Generate Line	14 - 16
Window Burn On/Off	On (Enabled)
Freewheel Duration	8 frames
LTC Output gain	3 dBu
Pitch Hold	Off
Bi-Phase Pulse-per-frame	0100
Bi-Phase Signal	A Lead B
Video System/Format (NTSC/PAL)	NTSC
Idle MTC Enabled	On
Window Burn options:	Enabled
	Size: Large
	Vertical Position: 20% from Bottom
	Horizontal Position: Center
	Color: White on Black background
Variable Speed Offset (VSO)	Off

Additional Synchronization Information

Video and VITC Signals

Black Burst and House Sync

A black burst signal is essentially a "position-less" video signal. As with any "shared" video signal, you'll want to ensure that your video feed comes from a properly buffered and distributed source, such as a video distribution amplifier, or the video reference/black burst output of another device in the house sync chain.

Resolving to video instead of house/black

There are several reasons why you would resolve the USD to a video signal rather than house sync.

When House Sync is Unavailable Resolve to a video signal whenever you are synchronizing Pro Tools (or other device) to video, and you either:

• do not have a black burst generator
  – or –

• your setup includes equipment that lacks house sync/black burst input and synchronization capability (including consumer grade VCR, or some entry-level PC-based editing systems).

Simple Setups In a modest setting with one or two VTRs, Pro Tools and the USD, using the video signal as the clock reference is often satisfactory. In these situations, proper sync can be achieved using the video signal as clock reference.

Why VITC is Unavailable for Clock Reference

VITC itself does not provide clock information directly as part of its time code information, only positional information. However, since VITC is always embedded into a video signal, that video signal can be used as a clock reference by selecting Video Input as the clock reference (or Video Ref In if your facility has house sync).

LTC Signals

Because it's an analog audio signal, LTC can sometimes be susceptible to either tape dropouts (tape shedding), or to level mismatches between the LTC source and the LTC input. The USD's freewheeling feature allows you to compensate for brief time code dropouts. However, if you have serious dropouts, you may not be able to sustain accurate synchronization.

If you plan to use LTC as a Clock Reference (whether or not you are also using it as a Positional Reference), you will need to ensure that your LTC is recorded at as high a level as possible without distortion, and that there are no dropouts longer than 1/80th of a frame.

The USD reads LTC most reliably when fed with a LTC signal of at least -12 dBu (and preferably 0 dBu to +3 dBu.)

Working with Analog Machines

It is good practice on a 24-track analog tape machine to record time code on Track 24 at a reference level of -10 dBu (or lower), with Track 23 left blank as a "guard" track. This practice avoids crosstalk "bleed" that can occur between the time code track and otherwise adjacent audio tracks. Time code (which is a mid-frequency alternating pitch square wave) is very sensitive to crosstalk from adjacent tracks, and conversely you don't want audible time code leaking onto your audio tracks.

If your ATR is under the control of a synchronizer, you must make sure that the synchronizer and USD are both locked to the same reference source (such as, typically, from a video black burst generator.)

Auto-Switch LTC/VITC

Auto-Switch LTC/VITC lets USD automatically select between these two (time code) sources.

LTC and VITC both provide useful and unique capabilities. For instance, it is impossible to read LTC off a paused videotape. Consequently, using only LTC, there's no way you can use Pro Tools to perform Auto-Spotting of regions when the tape is paused. However, VITC continues to be read as long as the picture remains visible, so it *can* be used as a positional reference when the VTR is paused. On the other hand, VITC cannot be read at fast winding speeds (except by broadcast-quality VTRs); LTC can be read at fast winding speeds, as long as its signal remains within the high-end frequency response of the ATR or VTR.

Examples of Auto-Switch LTC/VITC

◆ The USD will switch to LTC for positional reference during hi-speed searching and cueing, for example, or whenever the tape speed is too high to read VITC.

◆ The USD will switch to VITC if LTC stops or is unavailable. This will include, for example, if a tape is paused or parked.

◆ If both LTC and VITC are available, the USD chooses which one to use based on the speed of playback. The switch-over point is approximately 75% of full 1x playback speed. Above 75% playback speed, LTC is favored; below 75% speed, VITC is favored.

If a dropout occurs, the USD waits until the freewheel duration has expired before attempting to switch over to the opposite source. If neither source is available, the USD will stop reading time code.

Digital Clock Signal Types

A reference clock signal is part of any digital recording system. It is required because whenever digital audio information is mixed together or passed between devices, the playback samples must be aligned with the recording samples. In some cases (such as with AES/EBU or S/PDIF digital interfaces), the clock signal is embedded in the data stream itself. In other cases, such as SDIF, the clock signal is carried as an entirely separate signal from the digital audio sample data.

The USD is able to resolve to three different types of digital audio clock information: AES/EBU, Word Clock, and Super Clock (256x Slave Clock).

Word Clock

Many professional digital audio products—including open-reel multitrack tape recorders, digital mixing consoles, and the Tascam DA-88 modular digital multitrack—have Word Clock (1x sample rate) connectors.

Word Clock allows the DA-88 (and other Word Clock-compatible devices) to send or receive external clock information which controls the sample rate, which in turn (where applicable) controls the play and record speed.

Using just Word Clock, it is possible to create a "chain" of digital devices in your studio by picking one source as the Word Clock master, and configuring other sources as Word Clock slaves.

AES/EBU

Some professional digital audio products use AES/EBU "null clock" (which is an AES/EBU data stream that contains only clock information only and no audio information) as a system clock reference source. These systems rely upon a single AES/EBU master clock source that is distributed throughout a digital audio facility, in much the same way that house sync is distributed throughout a video facility. If you are connecting the USD to such a system, you will want to use the USD AES/EBU input as the clock reference connection, so that all system components are referenced to the same time base.

In some cases (such as using the USD as a standalone clock resolver or time code generator without a digital audio workstation), you may wish to use an audio DAT machine (or other similar device) as a source of AES/EBU null clock, and resolve your system to this reference source. In this case, the audio sample data in the AES/EBU data stream is stripped off, and only the clock information is used.

Super Clock

Super Clock (or Slave Clock) is Digidesign's proprietary hi-speed Word Clock that runs at 256x the sample rate. It is required by Digidesign Pro Tools systems to synchronize audio interfaces (up to the limits of each system) to a single, highly-accurate

clock from USD. Pro Tools audio interfaces must always be connected to this separate Super Clock signal chain.

Bi-Phase/Tach

Strictly speaking, Bi-Phase/Tach signals are clock reference signals, and do not contain positional information of their own. However, they do contain enough information for the USD to calculate positional information.

Bi-Phase/Tach signals use two square waves to generate pulses that can function as a clock reference. The two square waves are 90° out-of-phase, in a pattern that resembles this:
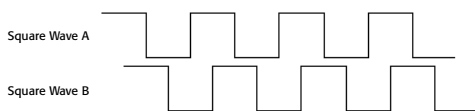
With a Bi-Phase signal, the USD can deduce the direction (forward or reverse) of the signal based upon which wave is read "high" relative to the other. For instance, with some film equipment, when the device is running forward, it will generate a Bi-Phase signal where the "A" wave leads the "B" wave—that is, where the A wave peaks before the B wave peaks. When the device is in reverse, the B wave will lead the A wave.

However, some film equipment works in the opposite manner, which is why the USD's Input Signals option lets you make the appropriate selection (Fwd = A leads B, or Fwd = B leads A).

Calculating the direction of a Tach signal is slightly different. As you may recall, Tach also uses two signals. The "A" signal is a square wave that provides clock information; the "B" signal is in a steady state (high or low) that indicates the direction. Unfortunately, not all Tach-generating equipment uses the B signal in the same way. Fortunately, the USD's Input Signals options allows you to choose the appropriate method (Tach: Fwd = B is Low, or Tach: Fwd = B is High).

This explains how the USD can use a Bi-Phase/Tach signal to deduce the direction, and how it also uses the signal as a clock reference—as long as USD is told the starting frame of the first clock signal.

Pilot Tone

The USD can resolve to an external Pilot Tone signal for synchronizing to (or transferring audio from) certain types of open-reel audio tape recorders.

In general, Pilot Tone is a sine wave reference signal running at the "line frequency" or "mains frequency," meaning the same frequency transmitted by the AC line voltage from the local power utility.

Pilot Tone is used on location film shoots to establish a common sync reference between a film or video camera with a portable 1/4" analog ATR (such as those made by Nagra or Stellavox). On location, Pilot Tone is derived by clock referencing the camera to the local AC line frequency (which is 60Hz or 50Hz depending on the country of origin), and this same frequency

is then used to clock-reference the ATR. The result is that both the camera and the ATR will run at the same speed.

You can think of Pilot Tone as a kind of inexpensive and readily available "house sync" for location production. Increasingly, it's being replaced by time code, since new-generation film cameras as well as many portable DAT recorders are time code-capable.

Please note that Pilot Tone contains no positional information; it is simply a clock reference. Most 1/4-inch machines have a center track for time code or pilot.

appendix b

Technical Specs

General

Nominal Sample Rates	44056 Hz (Pull Down)	
	44100 Hz	
	44144 Hz (Pull Up)	
	47952 Hz (Pull Down)	
	48000 Hz	
	48048 Hz (Pull Up)	
Frame Rates	30 fps (frames per second)	
	30 fps drop-frame	
	29.97 fps	
	29.97 fps drop-frame	
	25 fps	
	24 fps	
Variable Speed Override	±699 cents (±58.25%)	Limited to absolute sample rate limits of 35.0 kHz and 50.0 kHz

General

Resolver Lock Time	LTC:	750 msec
	Video:	1.5 sec
	Word Clock:	750 msec
	Super Clock:	1.5 s (1.0 s typical)
	AES/EBU:	750 msec
	Bi-phase:	1.0 sec
	Pilot:	1.1 sec (60 Hz), 1.3 sec (50 Hz)
Frequency Reference	Stability:	±5 ppm from 50 to 131 degrees F (10 to 55 degrees C)
	Aging:	±2 ppm/year typical
Burn-in Window	Position:	5 horizontal and vertical positions
	Size:	Large and small text
	Color:	Black or white text on white or black background or keyed
Dimensions	Height:	1RU/1.75" (4.45 cm)
	Width:	19.0" (48.26 cm)
	Depth:	10.5" (26.67 cm)
Weight	5.0 lbs (2.27 kg)	

General

Vibration Resistance	5 mm displacement, 10 to 55 Hz, each axis	
Shock	5 G max	
Operating Temperature	32 to 131 degrees F (0 to 55 degrees C)	
Storage Temperature	-40 to 176 degrees F (-40 to 80 degrees C)	
Relative Humidity	0 to 95%, non-condensing	
Power Requirements	Voltage:	85 to 264 VAC
	Frequency:	47 to 63 Hz autoswitching
	Wattage:	9.5 W typical, 30 W maximum
	Connector:	3-pin, AC and ground (IEC 950:320;3.2.4)
Agency Compliance	Meets FCC Part 15 Class A limits, CE EN 55022A, CE EN 60950, CE EN 55082:1, UL 1419 and CSA 22.2	

Rear Panel Connectors

Connector	Specifications	
LTC In	Format:	SMPTE/EBU 80-bit longitudinal, drop frame/non-drop frame
	Connector:	3-pin XLR female per IEC 268-12
	Speed Range:	1/30 to 80X play speed, forward or backward
	Level:	-24 dBu to +9 dBu, differential (pin 2 hot)
	Impedance:	200K ohms
LTC Out	Format:	SMPTE/EBU 80-bit longitudinal, drop frame/non-drop frame
	Connector:	3-pin XLR male per IEC 268-12
	Speed Range:	±10% of play speed
	Level:	-24 dBu thru +9 dBu RMS, differential (pin 2 hot)
	Level Default:	0 dBu RMS, 1.52V p-p ±10mV
	Output Impedance:	5K ohms
	Load Impedance (min):	600 ohms
	Rise/Fall Time:	42us ± 1us measured between 10% and 90% p-p
	S/N Ratio:	-60 dB RMS at 0 dBu level
Video (Main) In	Format	NTSC or PAL composite video
	Level:	1V p-p
	Termination:	75 ohms

Rear Panel Connectors

Connector	Specifications	
Video (Main) Out	Level:	1V p-p
	Source Impedance:	75 ohms
Video (Ref) In	Format:	NTSC or PAL composite video
	Level:	1V p-p
	Termination:	100K ohms
Video (Ref) Out	Level:	1V p-p
	Termination:	100K ohms
	Description:	Passive loop-thru of Video Ref in
AES Clock In	Level:	5 V p-p at 110 ohms (pin 2 hot)
	Connector:	3-pin XLR female per IEC 268-12
AES Clock Out	Level:	5 V p-p at 110 ohms (pin 2 hot)
	Connector:	3-pin XLR male per IEC 268-12
Word Clock In	Level:	0 to .5 V (low), 2.0 to 6.0 V (high)
	Connector:	BNC Female
Word Clock Out	Level:	TTL (3.3 V typical)

Rear Panel Connectors

Connector	Specifications	
	Connector:	BNC Female
Super Clock In	Level:	0 to .5 V (low), 2.0 to 6.0 V (high)
	Connector:	BNC Female
Super Clock Out	Level:	TTL (3.3 V typical)
	Connector:	BNC Female
Bi-phase/Tach/	Connector:	25-pin D-subminiature female (DB25)
GPI/Pilot		
Bi-phase/Tach In	Frequency Range:	0 to 76.8 KHz
	Level:	4.5 to 5.5 V, opto-isolated
	Current:	10 mA max
	Polarity (bi-phase):	Both inputs are software programmable
	Polarity (tach):	"Direction" polarity is software programmable
	Modulo Range:	2 thru 254
Pilot In	Level:	100 mV to 5.5 V p-p, differential
	Frequency Range:	50/60 Hz nominal
	Impedance:	200K ohms

Rear Panel Connectors

Connector	Specifications	
GPI In	Description:	Four opto-isolator inputs/returns
	Level:	4.5 to 5.5 V
	Current:	10 mA max
	Frequency:	Frame-rate max
	Latency:	Half frame max
GPI Out (TTL)	Description:	Two TTL-level outputs
	Level:	TTL (3.3 V typical)
	Current:	15 mA
	Frequency:	Frame-rate max
	Latency:	Half-frame max
GPI (Relay)	Description:	Four pairs of SPST contacts, normally open
	Load (while switching):	.5 A max at 200 VDC
	Load (continuous):	1.5 A max at 200 VDC
	Operate/Release Time:	1 ms
	Repetition Rate:	Frame-rate max
	Latency:	Half frame max
MIDI Time Code (MTC) Out	Current Rating:	15 mA current loop
	Rate:	31.25 Kbaud
	Connector:	5-pin DIN female

Rear Panel Connectors

Connector	Specifications	
	Cable Length:	50 feet (15 meters) max
Mac Serial	Format:	Apple Macintosh-compatible serial printer port
	Connector:	8-pin mini DIN female
	Cable Length:	50 feet (15 meters) max
PC Serial	Format:	PC-compatible RS-232 serial port
	Connector:	25-pin D-subminiature female (DB25)
	Cable Length:	50 feet (15 meters) max
VITC In	Format	SMPTE 90-bit, drop frame/non-drop frame
	Line Range:	10 to 40 (all-line mode), 10 to 22 (single-line mode)
VITC Out	Format:	SMPTE 90-bit, drop frame/non-drop frame
	Line Range:	Two lines, 10 to 20

Wiring Diagrams Pin Assignments

LTC

The USD's LTC In and LTC Out connectors are balanced XLRs with Pin 2 wired "+" or "hot," Pin 3 wired "–" or "cold," and Pin 1 wired to ground (shield). Depending on whether you are connecting a balanced or unbalanced signal to these connectors, different wiring configurations are recommended for optimum signal integrity, especially for long cable runs.

If you are connecting a balanced signal to the USD's LTC In or LTC Out connectors:

• Pin 1 and ground should be connected at the input only (not at the output). This will prevent ground loops between the shield and the Pin 1 conductor.

If you are connecting an unbalanced signal to the USD's LTC In or LTC Out connectors:

• Connect only Pin 2 to the "+" signal;

• Connect both Pins 1 and 3 to ground at all inputs and outputs.

Refer to the following illustration for the correct wiring diagrams.
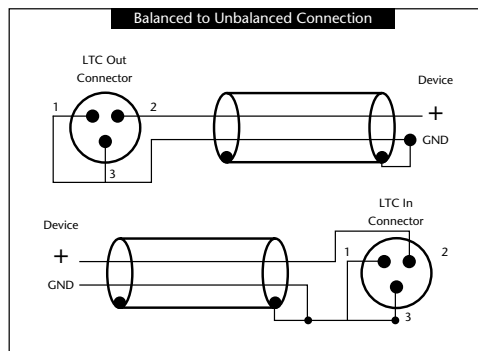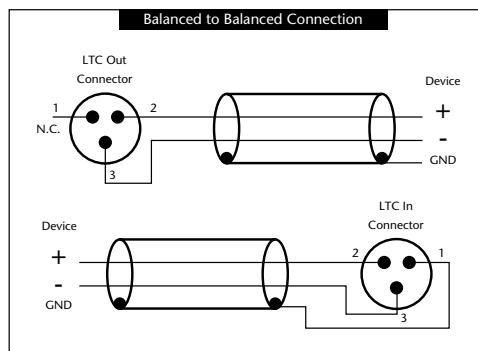
Wiring diagrams for the USD's LTC In and LTC Out connectors

BiPhase/GPI/Pilot
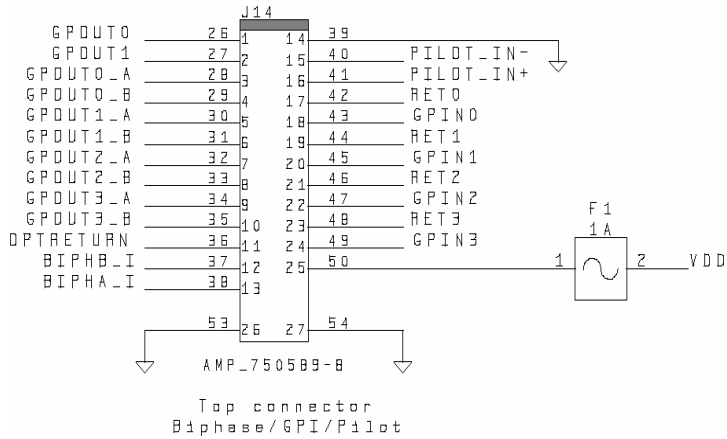
Bi-Phase/GPI/Pilot

Bi-phase/Tach Inputs
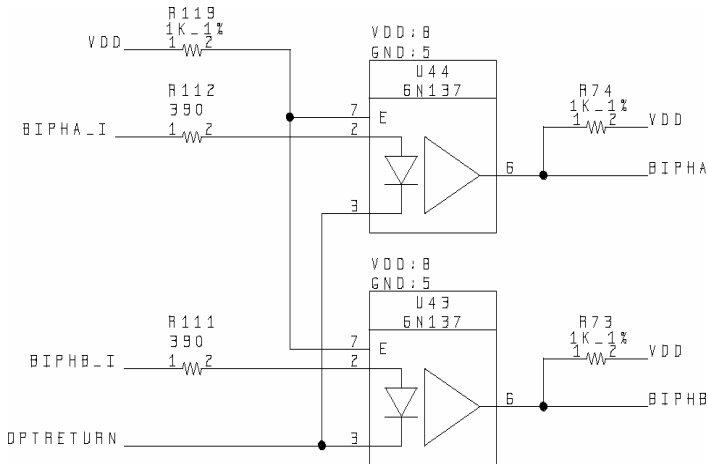
Bi-phase/Tach

GPI Relay Outputs
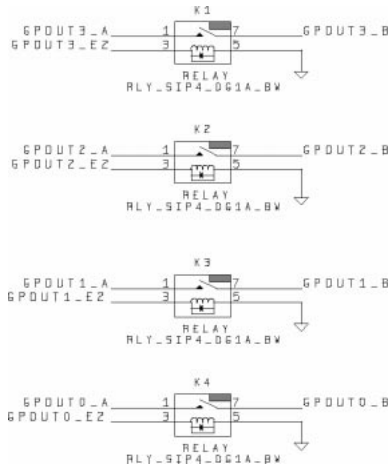
GPI Relay Output

GPI (TTL)/MTC Outputs
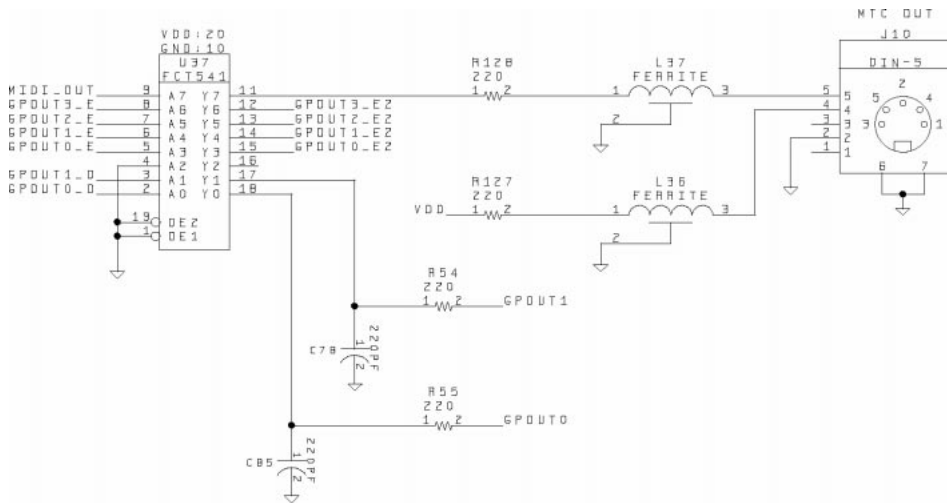
GPI TTL/MTC Output

GPI (opto) Inputs
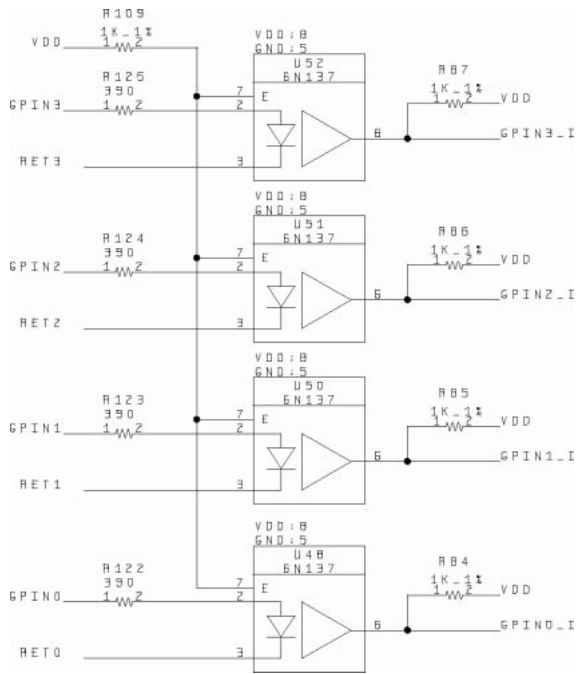
TPI (opto) Input

Connector Pin Assignments

Connector Pin Assignments

Mac Serial Port			
Pin #	Name	Description	Mac Connection
1	NC	No connection	Pin 2 (HSKiB)
2	RTS_IN	Request To Send (input to USD)	Pin 1 (HSKoB)
3	RX_OUT	Transmitted data (output from USD)	Pin 5 input (RXDB-)
4	GND	Chassis ground	Ground
5	TX_IN	Received data (input to USD)	Pin 3 output (TXDB-)
6	GND	Chassis ground	Pin 8 input (RXDB+)
7	CTS_OUT	Clear To Send (output from USD)	Pin 7 input (GPiB)
8	NC	No connection	Pin 6 (TXDB+)
Shell	GND	Chassis ground	Ground

Connector Pin Assignments

PC Serial Port			
Pin #	**Name**	**Description**	
1	GND	Connected to chassis ground	
2	TX_IN	Received data (input to USD)	
3	RX_OUT	Transmitted data (output from USD)	
4	RTS_IN	Request To Send (input to USD)	
5	CTS_OUT	Clear To Send (output from USD)	
6	NC	No Connection	
7	GND	Connected to chassis ground	
8-25	NC	No Connection	
Shell	GND	Connected to chassis ground	
Bi-phase/Tach/GPI/Pilot Port (Accessory Port)			
Pin #	**Name**	**Description**	
1	GPOUT0	GPI TTL-level output 0	
2	GPOUT1	GPI TTL-level output 1	
3	GPOUT0_A	GPI Relay 0, contact A	
4	GPOUT0_B	GPI Relay 0, contact B	
5	GPOUT1_A	GPI Relay 1, contact A	
6	GPOUT1_B	GPI Relay 1, contact B	
7	GPOUT2_A	GPI Relay 2, contact A	
8	GPOUT2_B	GPI Relay 2, contact B	
9	GPOUT3_A	GPI Relay 3, contact A	
10	GPOUT3_B	GPI Relay 3, contact B	
11	OPTRETURN	Return from Bi-phase/Tach opto-isolators	
12	BIPHB_I	Input to Bi-phase/Tach opto-isolator B	
13	BIPHA_I	Input to Bi-phase/Tach opto-isolator A	
14	GND	Chassis ground	

Connector Pin Assignments

15	PILOT_IN-	Pilot tone input, negative	
16	PILOT_IN+	Pilot tone input, positive	
17	RET0	Return from GPI opto-isolator "0"	
18	GPIN0	Input to GPI opto-isolator "0"	
19	RET1	Return from GPI opto-isolator "1"	
20	GPIN1	Input to GPI opto-isolator "1"	
21	RET2	Return from GPI opto-isolator "2"	
22	GPIN2	Input to GPI opto-isolator "2"	
23	RET3	Return from GPI opto-isolator "3"	
24	GPIN3	Input to GPI opto-isolator "3"	
25	VDD	+5V DC, fuse protected (see notes below)	
Shell	GND	Connected to chassis ground	

USD Serial Cable Pin Assignments

Mini DIN 8-pin Male to Mini DIN 8-pin Male	
1	2
2	1
3	5
4	4
5	3
6	8
7	7
8	6

Bi-phase/Tach/GPI/Pilot Port Interfacing Notes

◆ The six opto-isolators are 6N137 devices. Each port input passes through a 390 ohm series resistor to the cathode. Each port return comes directly from the anode. The bi-phase/tach inputs share the same return.

◆ The two TTL-level GPI outputs are driven by a 74FCT541. Each output passes through a 220 ohm series resistor.

◆ The fuse is thermally activated. The current rating varies between 1.0 A at 60°C and 1.5 A at 20°C. The time to trip varies with temperature and current. The typical time to trip at 1.5 A is 5 minutes. Time to trip at 8 A is 5 seconds. After tripping, the fuse will return to its low-resistance state when the current is reduced sufficiently.

◆ For Tach, the "rate" input is "BIPHA_I" and the "direction" input is "BIPHB_I." The polarity of "BIPHB_I" is software programmable and defaults to "low" for "forward."

◆ For Bi-phase, the default polarity relationship between A and B is software programmable. The default setting for "forward" is "A leads B." This means that the rising edge of A (0˚ phase) must precede the rising edge of B (90˚ phase).

◆ For highest signal quality, use a 25-pin cable with individually shielded conductors.

GPI Relay Wiring for Fader-Start

The Universal Slave Driver provides a total of four Relay-level GPI outputs on pins 3/4, 3-10 of the DB25 connector (see the circuit diagram GPI (TTL)/MTC Outputs).

The GPI Relay outputs are intended to drive Relay loads only.

GPI Triggers

GPI output signals information:
    0 (relay) = Play
    1 (relay) = Record Ready
    2 (relay) = fader start #1
    3 (relay) = fader start #2
    4 (TTL) = Stop
    5 (TTL) = Record

Logical GPI numbers 0 through 3 are associated with GPI relay outputs 0 through 3 (pins 3 through 10). GPI numbers 4 and 5 are associated with GPI TTL outputs 0 and 1 (pins 1 and 2).

GPI TTL WIring

The circuit can drive approximately 2 mA through a load of 1.6K and maintain a logic high level of 3.3V. In an application where the equipment being controlled has more demanding power requirements, an external buffer or relay circuit mst be used. This would typically be constructed as part of a custom electrical interface.

Each GPI TTL output is fully short-circuit protected via a 220-ohm series resistor.

Before attempting to wire any type of custom interface, always check the electrical specifications provided by the equipment manufacturer, including voltage levels, current, loading and polarity. Incorrect wiring may damage your equipment, your USD or cause personal injury.

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