

SYNC I/O Guide

Version 1.0

For Pro Tools 5.3.1

Digidesign

2001 Junipero Serra Boulevard
Daly City, CA 94014-3886 USA
tel: 650-731-6300
fax: 650-731-6399

Technical Support (USA)

tel: 650-731-6100
fax: 650-731-6384

Product Information (USA)

tel: 650-731-6102
tel: 800-333-2137

International Offices

Visit the Digidesign Web site
for contact information

Web Site

www.digidesign.com



digidesign

Copyright

This guide is copyrighted ©2002 by Digidesign, a division of Avid Technology, Inc. (hereafter "Digidesign"), with all rights reserved. Under copyright laws, this guide may not be duplicated in whole or in part without the written consent of Digidesign.

DIGIDESIGN, AVID and PRO TOOLS are trademarks or registered trademarks of Digidesign and/or Avid Technology, Inc. All other trademarks are the property of their respective owners.

All features and specifications subject to change without notice.

PN 910609328-00 REV B 06/02

Communications & Safety Regulation Information

Compliance Statement

The model SYNC I/O complies with the following standards regulating interference and EMC:

- FCC Part 15 Class A
- EN55103 – 1, environment E4
- EN55103 – 2, environment E4
- AS/NZS 3548 Class A
- CISPR 22 Class A

Radio and Television Interference

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

Communications Statement

This equipment has been tested to comply with the limits for a Class A digital device. Changes or modifications to this product not authorized by Digidesign, Inc., could void the Certification and negate your authority to operate the product. This product was tested for CISPR compliance under conditions that included the use of peripheral devices and shielded cables and connectors between system components. Digidesign recommends the use of shielded cables and connectors between system components to reduce the possibility of causing interference to radios, television sets, and other electronic devices.

Safety Statement

This equipment has been tested to comply with USA and Canadian safety certification in accordance with the specifications of UL Standards; UL6500 and Canadian CSA standard; CSA C22.2 No.1-M90. Digidesign Inc., has been authorized to apply the appropriate UL & CUL mark on its compliant equipment.

Important Safety Instructions

When using electric or electronic equipment, basic precautions should always be followed, including the following:

- Read all instructions before using this equipment.
- To avoid the risk of shock, keep this equipment away from rain water, and other moisture. Do not use this equipment if it is wet.
- The equipment should only be connected to the correct rating power supply as indicated on the product.
- Do not attempt to service the equipment. There are no user-serviceable parts inside. Please refer all servicing to authorized Digidesign personnel.
- Any attempt to service the equipment will expose you to a risk of electric shock, and will void the manufacturer's warranty.
- The product should be connected only to the correct power supply as indicated on the product.

contents

Chapter 1. Introduction	1
System Requirements	2
SYNC I/O Features	4
Compatibility Information	4
About This Guide	5
Chapter 2. Installation and Getting Started	7
Hardware Connections	7
9-Pin for MachineControl	11
Synchronization and Time Code Connections to Machines, Decks, and Other Devices	12
Software Installation	14
Getting Started with Pro Tools HD and SYNC I/O	14
MachineControl Configuration	18
Software Configuration for SYNC I/O Setup Software	19
Getting Started with Pro Tools 24 MIX and Pro Tools 24	19
Updating SYNC I/O Firmware	20
Troubleshooting	21
Chapter 3. SYNC I/O Hardware and Software Overview	23
SYNC I/O Front Panel	23
SYNC I/O Back Panel	26
SYNC I/O Setup Software	28

Chapter 4. Using Sync I/O 31

 SYNC I/O Controls in Pro Tools, SYNC I/O Setup and the Front Panel 32

 Using the Front Panel Generator/Parameter Switches 33

 Clock References and Options 35

 Positional Reference and Options 41

 Generating & Regenerating Time Code 45

 Generating a Window Burn 51

Chapter 5. Additional Operational Information 55

 Front Panel Generator/Parameter Controls 55

 Using Fader Start 60

 Calibrating the SYNC I/O Oscillator 61

 Restoring Factory Settings 62

 Managing and Selecting Video Inputs 63

Appendix A. Additional Synchronization Information 65

 Video and VITC Signals 65

 LTC Signals 66

 Auto-Switch LTC/VITC 66

 Digital Clock Signal Types 67

 Bi-Phase/Tach 68

 Pilot Tone 69

Appendix B. Technical Specifications 71

Appendix C. Wiring Diagrams Pin Assignments 79

- LTC 79
- BiPhase/GPI/Pilot 80
- Bi-phase/Tach OptoCoupler Input 81
- GPI Relay Outputs 82
- GPI (TTL)/MTC Outputs 83
- GPI (opto) Inputs 84
- Connector Pin Assignments 85
- SYNC I/O Serial Cable Pin Assignments 87
- Bi-phase/Tach/GPI/Pilot Port Interfacing Notes 87

Index 89

chapter 1

Introduction

Welcome to the Digidesign SYNC I/O, a multi-purpose synchronization peripheral for Pro Tools|HD™ systems. The SYNC I/O supports all Pro Tools|HD sample rates, and synchronizes to all major time code and clock reference standards used in audio, video, film, and multimedia production.

SYNC I/O is designed especially for Pro Tools|HD systems, but it can also be utilized as a stand-alone synchronization device. When used with Pro Tools, most SYNC I/O features can be controlled from within the Pro Tools application. In addition, a utility application (SYNC I/O Setup™) is provided which gives software access to all SYNC I/O parameters remotely, with or without Pro Tools. Even without a computer, SYNC I/O can be configured manually using its front panel switches and displays.

SYNC I/O with Pro Tools

With Pro Tools|HD, SYNC I/O provides highly accurate lock to time code through the DigiSerial Port connection to the HD Core card. Most SYNC I/O settings are available directly from within Pro Tools.

When the SYNC I/O is used with Pro Tools|24 MIX or Pro Tools|24, it supports all features of (and emulates on-screen) the Digidesign USD (Universal Slave Driver).

Stand-alone Mode

SYNC I/O can be used as a stand-alone synchronization converter, time code generator, clock generator and time code character generator. Throughout this guide, the term “stand-alone” refers to systems utilizing SYNC I/O but *not* using Pro Tools. SYNC I/O is connected to time code and clock signals as needed, and configured from the front panel. Optionally, SYNC I/O Setup software can be run from a supported Macintosh or Windows computer for software remote control of all SYNC I/O parameters.

SYNC I/O Setup Software

The SYNC I/O Setup software is a remote control application for SYNC I/O. SYNC I/O Setup can be used with or without Pro Tools on any supported Macintosh or Windows computer. A Macintosh serial port is required. SYNC I/O Setup is not supported through the DigiSerial port. SYNC I/O Setup can also be installed and run from a Windows computer with the appropriate cable (see “SYNC I/O Setup” on page 2 for more information).

System Requirements

Pro Tools|HD

Macintosh

- A Digidesign-qualified Power Macintosh computer
- A Pro Tools|HD system
- Pro Tools software version 5.3.1

Windows

- A Digidesign-qualified Windows computer
- A Pro Tools|HD system
- Pro Tools software version 5.3.1

Pro Tools|24 MIX and Pro Tools|24

The SYNC I/O can be used with Pro Tools|24 MIX and Pro Tools|24 systems. When used with these systems, the SYNC I/O emulates the Digidesign Universal Slave Driver (USD). Only features supported by Pro Tools|24 MIX, Pro Tools|24, and the USD will be available.

Macintosh

- A Digidesign-qualified Power Macintosh computer
- A Pro Tools|24 MIX, or Pro Tools|24 system
- Pro Tools software version 5.1.3 or later

Windows

- A Digidesign-qualified Windows computer
- A Pro Tools|24 MIX, or Pro Tools|24 system
- Pro Tools software version 5.3.1

SYNC I/O Setup

(Macintosh and Windows)

The optional SYNC I/O Setup application requires a serial connection from SYNC I/O to your computer. SYNC I/O Setup is not available through the DigiSerial port.

SYNC I/O Setup provides stand-alone software control of SYNC I/O, and firmware updating capabilities. SYNC I/O Setup can be used with or without Pro Tools for complete control of all SYNC I/O features.

Macintosh

- A Power Macintosh computer running Macintosh OS 9 or later (OS X is not supported at this time)
- 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 “Serial Port Requirements” on page 3 for details.

Windows

- A Pentium-I, 90 MHz computer, running either Windows 98SE, Windows Me, Windows NT4, or Windows 2000
- An available COM port. See “Serial Port Requirements” on page 3 for details.
- A custom Serial-to-COM cable. See “SYNC I/O Serial Cable Pin Assignments” on page 87 for wiring information.

Serial Port Requirements

Pro Tools|HD Systems

◆ SYNC I/O requires a Host Serial port on the system's HD Core card.

Pro Tools|24 MIX and Pro Tools|24 Systems

◆ SYNC I/O requires a DigiSerial Port on the system's MIX Core or d24 "Core" card. (If using an expanded Pro Tools|24 system that includes a MIX Farm card, use the DigiSerial Port on the MIX Farm card.)

SYNC I/O Stand-alone, without Pro Tools

If you are not using Pro Tools, but are using SYNC I/O in stand-alone mode, you can use the front panel controls, or SYNC I/O Setup. SYNC I/O Setup provides total control of all SYNC I/O parameters.

Not all parameters and options can be configured using the front panel only. The following SYNC I/O parameters are available only through SYNC I/O Setup, or Pro Tools:

- ◆ Variable Speed Override (VSO)
- ◆ Window burn parameters. While you can turn the Window burn on or off from the front panel, you cannot configure its display parameters without Pro Tools or SYNC I/O Setup.

 See "SYNC I/O Controls in Pro Tools, SYNC I/O Setup and the Front Panel" on page 32 for more information.

Serial Port Requirements for Using the SYNC I/O Setup Application

(Macintosh and Windows)

In order to use SYNC I/O Setup, you must have the following:

Macintosh A serial port (modem or printer, or equivalent serial port adaptor) is required for the SYNC I/O Setup application on Macintosh.

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.
- gPort Serial Adaptor, made by Griffin Technology.
- USB Twin Serial Adaptor, model USA-28x, made by Keyspan.

Windows A COM port connection is required for the SYNC I/O Setup application on Windows. SYNC I/O Setup does not work if SYNC I/O is connected to a DigiSerial port.

SYNC I/O Cables

SYNC I/O Serial Cable A Host Serial cable is included to connect SYNC I/O to a the DigiSerial Port on a Pro Tools|HD Core, MIX Core, or d24 card, or MIX Farm when one is present in an expanded Pro Tools|24 system. This cable is a standard Macintosh serial cable.

Windows SYNC I/O Setup on Windows requires a non-standard 8-pin to 9-pin cable to connect SYNC I/O to a COM port on any supported Windows computer. Wiring instructions for making the required cable can be found in Appendix C, "Wiring Diagrams Pin Assignments."

SYNC I/O Features

SYNC I/O supports all Pro Tools|HD sample rates, including 88.2, 96, 176.4, and 192 kHz. SYNC I/O provides the following synchronization features.

Supported Positional Reference Sources

- LTC
- VITC
- Bi-phase/Tach
- Internal Time Code Generator
- Serial Time Code

Supported Clock Reference Sources

- Loop Sync
- Reference Video
- Composite Video Input
- Word Clock
- AES/EBU Null
- Pilot Tone
- 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)
- Two 9-pin Sony P-2 machine protocol ports, for MachineControl™-enabled systems.

Other Features

- Front panel controls and a large LED display of time code and parameters
- Integrated control of SYNC I/O from Pro Tools
- Time Code Character Generator
- Remote 9-Pin Deck Emulation mode
- Fader start, provided through GPI output, for remote transport control from select Pro Tools fader movement.
- SYNC I/O Setup software for Macintosh and Windows
- SYNC I/O firmware that can be updated at any time for future upgrades

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 <i>N</i> 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.

chapter 2

Installation and Getting Started

SYNC I/O installation includes the following steps:

Hardware Connecting power, serial, clock, and time code to and from SYNC I/O, Pro Tools, and your other studio equipment.

Software Checking Pro Tools software, and installing SYNC I/O Setup software.

For standalone SYNC I/O systems, hardware installation instructions begin with “Hardware Connections” on page 7. Optional software installation instructions for remote control through the SYNC I/O Setup software can be found in “Software Installation” on page 14.



Make sure Pro Tools is already installed and operating correctly before installing the SYNC I/O.

Once installed, Pro Tools needs to be configured for SYNC I/O. For instructions on how to set up Pro Tools for SYNC I/O, see “Getting Started with Pro Tools|HD and SYNC I/O” on page 14.

Hardware Connections

The following are the primary hardware connections required for SYNC I/O:

- AC Power
- Host Serial, to Pro Tools or computer
- Clock to Pro Tools audio interfaces
- 9-pin, to external machines (requires MachineControl™)
- Synchronization, including positional and clock references to and from machines, decks, and other devices

Pro Tools installations require all types of connections. Stand-alone operation requires power and synchronization connections, with serial connection optional (for remote control using SYNC I/O Setup software).

AC Power

The SYNC I/O AC connector accepts an IEC Standard AC Power Cable. SYNC I/O 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 SYNC I/O:

- Plug one end of a power cable into the SYNC I/O AC connector, and plug the other end into a wall outlet or other power source.

Serial Connections

Pro Tools systems require a serial connection between SYNC I/O and the Pro Tools|HD Core card. Stand-alone setups (or any installation utilizing SYNC I/O Setup software) require a serial connection between SYNC I/O and a standard serial port on the host CPU (modem or printer port on Macintosh, or a COM port on Windows computers).

About the SYNC I/O Serial Cable

Host Serial SYNC I/O includes a 4 meter (approximately 12 foot) standard Macintosh serial cable, to connect SYNC I/O to a DigiSerial Port on a Pro Tools|HD Core card.

For SYNC I/O Setup software on Macintosh, use the same standard serial cable.

For SYNC I/O Setup on Windows systems, a custom 8-pin to 9-pin cable is required to connect SYNC I/O to a Windows COM port.

 *If you choose to use a longer serial cable between Pro Tools and SYNC I/O, be sure it supports hardware handshaking. Wiring diagrams can be found in Appendix C, “Wiring Diagrams Pin Assignments.”*

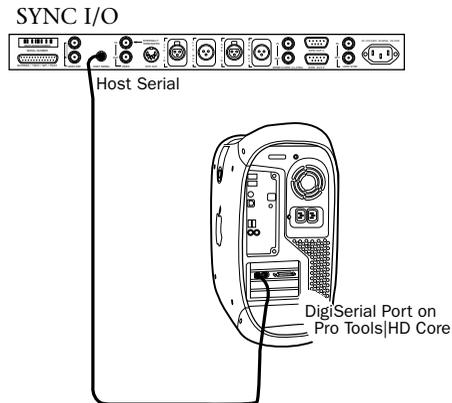
MachineControl and SYNC I/O

SYNC I/O provides two 9-pin pass-through ports which are designed for use with Digidesign’s MachineControl software. If you use MachineControl with your Pro Tools|HD system, see “9-Pin for MachineControl” on page 11 for important instructions.

Serial to Pro Tools

To connect SYNC I/O to a Pro Tools|HD system:

- 1 Make sure power is off on all equipment.
- 2 Connect one end of the Host Serial cable to the SYNC I/O Host Serial port.
- 3 Connect the other end to the DigiSerial port on your HD Core card. Do not use any other DigiSerial ports on other HD-series cards.

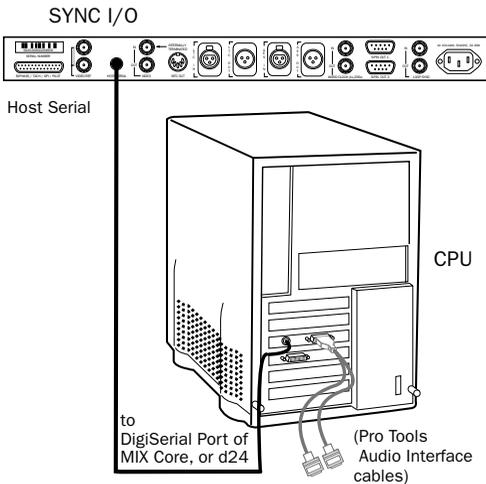


Host Serial connection, SYNC I/O to Pro Tools|HD

To connect SYNC I/O to a Pro Tools|24 MIX or Pro Tools|24 system:

- 1 Make sure all your equipment is powered off (including your computer, SYNC I/O, and all Pro Tools hardware).
- 2 Connect one end of the DigiSerial cable to the SYNC I/O Host Serial port (whether using a Macintosh or a Windows computer).

3 Connect the other end of the cable to the DigiSerial Port on your MIX Core or d24 card. (If using an expanded Pro Tools|24 system that includes a MIX Farm card, use the DigiSerial Port on the MIX Farm card. See your *Expanded Systems Guide* for more information.)



Connecting SYNC I/O to a DigiSerial Port

4 Connect the rest of your equipment to SYNC I/O as described in “Synchronization and Time Code Connections to Machines, Decks, and Other Devices” on page 12.

Serial Connections for SYNC I/O Setup

SYNC I/O Setup requires a serial connection from SYNC I/O to a Macintosh or Windows computer. (For compatibility information, see “System Requirements” on page 2.)

⚠ SYNC I/O Setup will not control SYNC I/O through the Host Serial port.

To connect SYNC I/O to a Macintosh computer for SYNC I/O Setup without Pro Tools:

- 1** Make sure the power is switched off for both SYNC I/O and the computer.
- 2** Connect the SYNC I/O Host Serial port to the modem or printer port, or serial port adaptor, of your computer.
- 3** Restore power to SYNC I/O, and restart your computer.
- 4** Connect the rest of your equipment to SYNC I/O as described in “Synchronization and Time Code Connections to Machines, Decks, and Other Devices” on page 12.

To connect SYNC I/O to a Windows computer for SYNC I/O Setup without Pro Tools:

- 1** Purchase or make the required 9-pin to 8-pin cable. For wiring details, see “SYNC I/O Serial Cable Pin Assignments” on page 87.
- 2** Make sure all equipment is powered off.
- 3** Connect the SYNC I/O Host Serial port to an available COM port on your computer.
- 4** Restore power to SYNC I/O, and restart your computer.
- 5** Connect the rest of your equipment to SYNC I/O as described in “Synchronization and Time Code Connections to Machines, Decks, and Other Devices” on page 12.

Clock for Pro Tools Audio Interfaces

SYNC I/O must be connected to Pro Tools audio interfaces in the Loop Sync chain.

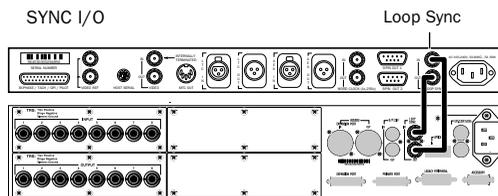
Connecting Loop Sync for Pro Tools|HD (Pro Tools|HD Macintosh Only)

SYNC I/O now supports Loop Sync, and can serve as Loop Sync Master. Loop Sync is a dedicated clock loop for synchronizing multiple HD-series interfaces. Loop Sync should only be used to connect multiple HD-series peripherals.

The following steps explain how to make Loop Sync connections between the SYNC I/O and Pro Tools|HD interfaces.

To connect SYNC I/O to Pro Tools|HD interface:

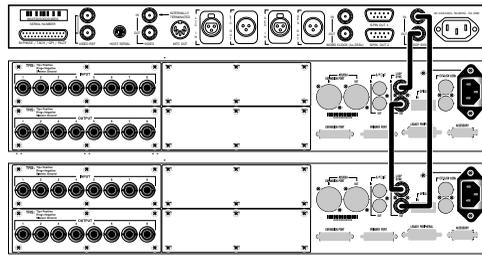
- 1 Connect the Loop Sync Out of the SYNC I/O to the Loop Sync In of your primary HD-series audio interface.
- 2 Connect the SYNC I/O Loop Sync In to the Loop Sync Out of your HD-series interface.



Pro Tools 96 I/O

Loop Sync connections between SYNC I/O and a 96 I/O

When using more than one HD-series audio interface, make SYNC I/O the first and last unit in the Loop Sync chain.

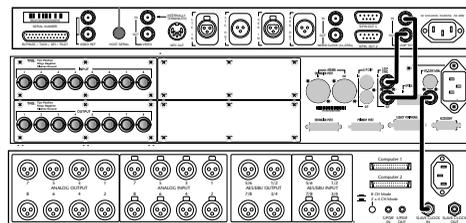


Loop Sync in an expanded Pro Tools|HD system

Using Legacy Audio Interfaces

To connect SYNC I/O to a Pro Tools|HD system that also has an 888|24, 882|20, 1622, or ADAT Bridge audio interface:

- 1 Connect SYNC I/O Loop Sync as described in the previous steps.
- 2 Connect a BNC cable from the Ext Clock Out of your primary HD-series interface to the Slave Clock In of your first legacy audio interface.



Clock for SYNC I/O, a 96 I/O, and an 888|24 I/O

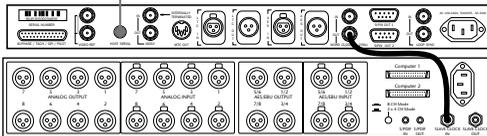
- 3 If using multiple legacy interfaces, daisy-chain their Slave Clock connections from the first interface Slave Clock Out to the next interface Slave Clock In, and so on.

 See the *Getting Started with HD Guide* for external clock configuration instructions.

Connecting Slave Clock for Pro Tools|24 MIX and Pro Tools|24

To connect SYNC I/O to a Pro Tools|24 MIX-series or Pro Tools|24-series audio interface:

- Using a BNC cable, connect the SYNC I/O Word Clock Out to the Slave Clock In of your primary audio interface.



Clock from SYNC I/O to an 888|24

When Pro Tools launches, the SYNC I/O Word Clock Out port will switch to 256x Slave Clock output. In stand-alone use, you can manually configure the SYNC I/O for 256x Base clock output using the front panel controls, or using SYNC I/O Setup software. See the *SYNC I/O Guide* for instructions.

About the DigiSerial Port

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 SYNC I/O Host Serial connection
- a USD Macintosh Serial connection
- a serial to 9-pin cable in combination with the MachineControl™ option for Pro Tools

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

Selecting a DigiSerial Port for SYNC I/O in Expanded Systems

Always connect the SYNC I/O serial cable to the DigiSerial Port on the card connected to the primary Pro Tools audio interface (your MIX Core, “Core” d24, or MIX Farm if using an expanded Pro Tools|24 system).

9-Pin for MachineControl

SYNC I/O provides two 9-pin machine ports, to support direct 9-pin connection for MachineControl-enabled Pro Tools systems. Both ports can be connected simultaneously. In this configuration, MachineControl and SYNC I/O provide all connections required for Serial modes, remote track arming, and other MachineControl features. See the *MachineControl Guide* for more information on all of its Pro Tools features.

To connect one or two machines for MachineControl Serial Control mode:

- Connect a 9-pin cable from either SYNC I/O 9-pin Out port to the 9-pin out of the machine. You can connect two machines, one to each port, and control either one of them at any time.

Remote 9-pin Deck Emulation Mode

In order to use MachineControl Remote 9-pin Deck Emulation mode, you must connect a serial-to-9pin cable to a standard Macintosh serial port or equivalent. For more information, see the *MachineControl Guide*.

Synchronization and Time Code Connections to Machines, Decks, and Other Devices

The following sections describe connections required for different applications.

Connecting a Video Source

This section describes connections required when utilizing video and house video reference.

For SYNC I/O to resolve to house sync:

- Connect the house video reference/black burst signal to the SYNC I/O Video Ref In port.

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

For SYNC I/O to resolve directly to an incoming video signal:

- 1 Connect the video signal to the SYNC I/O Video In port.
- 2 Terminate the SYNC I/O Video Out port, using the included BNC terminator.

Character Generator for Window Burn

SYNC I/O 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 SYNC I/O Time Code Character Generator to make a window burn:

- 1 Connect your video signal to the SYNC I/O Video Ref In port.

- 2 Use another BNC cable to connect the SYNC I/O Video Ref Thru port to the Video In port.

- 3 Connect the SYNC I/O Video Out port to other video devices.

Connecting LTC

SYNC I/O provides LTC input and output connectors.

To Input LTC to SYNC I/O:

- Connect the LTC signal from your machine, synchronizer or other source to the SYNC I/O LTC In port.

To output LTC from SYNC I/O:

- Connect the SYNC I/O LTC Out to your external device(s).

Connecting Word Clock Devices

SYNC I/O has Word Clock input and output, and both can be used simultaneously. Use Word Clock when you want SYNC I/O to lock to 1x clock from DAT machines, DA-88s, and similar digital devices.

Pro Tools|HD-series audio interfaces each provide their own Word Clock inputs, which provide additional clock options and flexibility. See your Pro Tools|HD documentation for more information.

To input Word Clock to SYNC I/O:

- Connect Word Clock from your master Word clock signal or device to the SYNC I/O Word Clock In.

To supply Word Clock from SYNC I/O:

- Connect the SYNC I/O Word Clock Out to the External Clock In of your HD audio interface; or, connect to the Word Clock input on any other compatible device.

Make sure the SYNC I/O Word Clock Out port is configured for the appropriate choice (1x, or 256x Slave Clock if using the SYNC I/O with Pro Tools|24 MIX or Pro Tools|24).

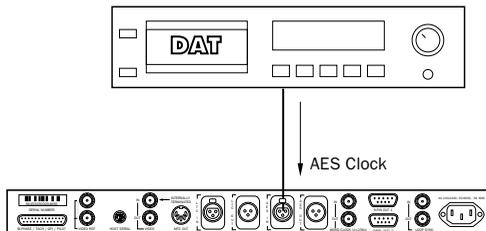
Keep in mind that Word Clock contains no positional information; if you want devices to play or record in sync, you'll still need to provide them with a positional reference.

 SYNC I/O can generate time code to provide positional reference to other devices. See "Generating & Regenerating Time Code" on page 45 for more information.

Connecting AES/EBU Devices

To use AES/EBU clock reference:

- Connect the device's AES/EBU output to the SYNC I/O's AES/EBU input.



Connecting SYNC I/O to an AES/EBU device

To supply AES/EBU clock reference from SYNC I/O:

- Connect the SYNC I/O AES/EBU output to the AES/EBU input on a DAT machine or other digital device. (AES/EBU clock does not support 176.4 kHz or 192 kHz sample rates.)

Connecting MIDI

The SYNC I/O MTC Out port supplies MIDI time code, 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 from the MTC Out always matches the time code address displayed on the SYNC I/O front panel. If you need to supply MTC from SYNC I/O to another MTC-compatible device, connect the device as described below.

To connect an MTC-compatible device to receive MTC from SYNC I/O:

- Connect the SYNC I/O MTC Out port to the appropriate MIDI input on the device using a standard MIDI cable.

Pro Tools and MTC

Pro Tools does not receive MTC from SYNC I/O through its connection to the SYNC I/O Host Serial port. 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 not required.

OMS, Pro Tools, and SYNC I/O (Macintosh Only)

When SYNC I/O is connected to the DigiSerial Port on an HD Core card, 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).

Software Installation

The following sections provide software installation instructions to install software required to use SYNC I/O with Pro Tools|HD, or with SYNC I/O Setup.

Pro Tools|HD Systems

To install software to use SYNC I/O with Pro Tools|HD:

- Make sure you have already installed the most current version of Pro Tools|HD software, and chosen the SYNC I/O custom options, from your Pro Tools Installer CD-ROM or the Digidesign Web site (www.Digidesign.com).

Each release of Pro Tools|HD software also includes SYNC I/O firmware and documentation.

 *Pro Tools|24 MIX and Pro Tools|24 systems should use their most current version of Pro Tools software.*

SYNC I/O Setup Software

When using SYNC I/O in stand-alone mode, the SYNC I/O Setup application is required in order to update firmware (as well as control all SYNC I/O parameters). Firmware updates are made available by Digidesign to add capabilities to your SYNC I/O. These updates can be downloaded from our Web site or obtained from your Digidesign dealer.

To install SYNC I/O Setup:

- 1 Make sure SYNC I/O is connected to a serial or COM port of your computer, as described in “Serial Connections for SYNC I/O Setup” on page 9.

- 2 Insert the disk containing the latest SYNC I/O software, or navigate to its location if you downloaded the update.

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

Getting Started with Pro Tools|HD and SYNC I/O

Pro Tools provides SYNC I/O initialization, configuration, and firmware update controls. These establish communication between Pro Tools and SYNC I/O.

This section describes how to configure Pro Tools for the SYNC I/O, how to check your configuration and firmware, and how to set session settings relevant to the SYNC I/O.

 *In Pro Tools 5.3.1 Macintosh, many synchronization controls have been moved to the Pro Tools Session Setup window.*

Loop Sync

SYNC I/O now supports Digidesign’s Loop Sync feature for connecting HD interfaces. SYNC I/O can be configured as the Clock Source (Loop Master), in order to provide Loop Sync master clock to the rest of your Pro Tools|HD hardware.

 *For system requirements and Loop Sync connection instructions, see Chapter 1, “Introduction.”*

Auto ID of SYNC I/O through Loop Sync

Pro Tools|HD automatically recognizes if a SYNC I/O is connected to the DigiSerial port when Pro Tools is launched. When SYNC I/O is recognized, Pro Tools automatically configures the Device and Port settings for SYNC I/O on the DigiSerial Port in the Peripherals > Synchronization dialog. Pro Tools also checks for recent firmware, and alerts you if you need to update the SYNC I/O. (See “Updating SYNC I/O Firmware with Pro Tools|HD” on page 20 for more information.)

To check SYNC I/O and Pro Tools communication:

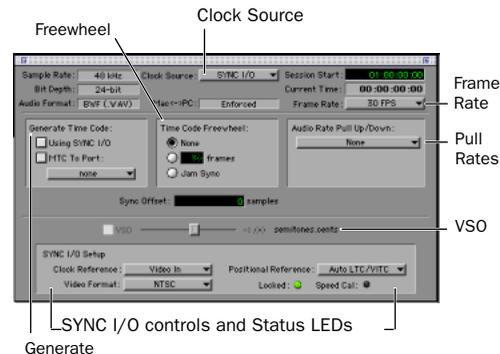
- 1 After installing Pro Tools and connecting the SYNC I/O as described, launch Pro Tools.
- 2 Choose Setup > Peripherals, and click the Synchronization tab. The SYNC I/O should be shown as the Device, with DigiSerial Port as the selected port.
- 3 If these are not shown, check all your connections, then try manually selecting SYNC I/O and DigiSerial Port from the Device and Port selectors. Once SYNC I/O is selected in this way, the SYNC I/O Setup controls become available in the lower part of the Peripherals window.
- 4 Click Enable SYNC I/O Setup. Pro Tools scans the DigiSerial port and checks SYNC I/O firmware. See “Updating SYNC I/O Firmware with Pro Tools|HD” on page 20 for more information.



SYNC I/O enabled in Peripherals > Synchronization

Configuring Sessions for SYNC I/O in Session Setup

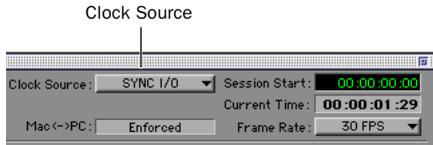
When connected through Loop Sync, and enabled in the Peripherals > Synchronization window, SYNC I/O settings become available in the Session Setup window.



Session Setup window, SYNC I/O controls

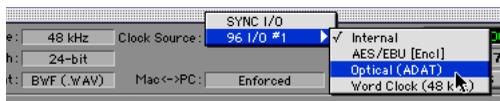
Clock Source

When connected and configured in the Loop Sync chain, SYNC I/O appears along with your HD-series audio interfaces in the Clock Source menu, located in the Session Setup window.



SYNC I/O selected as the current Clock Source in the Session Setup window

Clock Source can be any device in the Loop Sync chain. This lets you utilize any digital input source available on any HD peripheral, including the SYNC I/O, simply by selecting that device and source from the Clock Source menu.



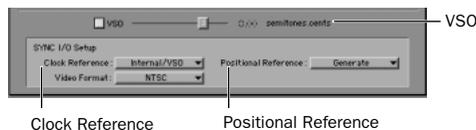
Selecting a 96 I/O option for Clock Source

Clock Reference

The selected Clock Source device determines your choices for clock reference.

When Clock Source is SYNC I/O

When the SYNC I/O is the Clock Source, it is the Loop Master. Clock and Positional Reference selectors become active in the SYNC I/O Setup area of the Session Setup window.



SYNC I/O Setup and VSO controls in the Session Setup window

SYNC I/O Clock Reference choices include Internal/VSO, Video In, Video Reference, LTC, Bi-Phase, Pilot, AES, and Word Clock. When the SYNC I/O is not the selected Clock Source device, the Clock Reference menu in the SYNC I/O Setup area switches to Loop Sync.

 For LTC clock reference, multiple choices are available from the LTC sub-menu. See “LTC and Clock Reference” on page 37 for more information.

To choose a SYNC I/O Clock Reference:

- Select a SYNC I/O clock choice from the Clock Reference menu

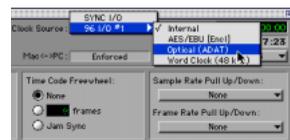


SYNC I/O Clock Reference menu

The Clock Source menu follows your selection of SYNC I/O for Clock reference, and automatically switches to SYNC I/O. (You can also choose the SYNC I/O as Clock Source first, then select a Clock Reference.)

To choose a different Loop Sync device as Clock Source:

- Choose a different Loop Sync device and Clock Source from the hierarchical Clock Source menu.



Clock Source menus in Session Setup

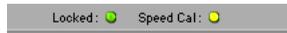
When Clock Source is HD I/O

When a 96 I/O, 192 I/O, or 192 Digital I/O is providing the Clock Source, it will be the Loop Master. Clock Source options are available directly from the Clock Source menu, based on the configuration of that interface in the Hardware Setup dialog. Choices can include AES, S/PDIF, Optical, or Word Clock.

 See the *Getting Started with HD Guide* for more information on audio interface configuration.

Locked and Speed Cal LEDs

The Locked and Speed Cal LEDs are provided in the SYNC I/O area of the Session Setup window. These LEDs display synchronization status of the SYNC I/O, to reflect the state of the same LEDs on the front panel.



Locked and Speed Cal LEDs

Locked The Locked LED stays lit when the SYNC I/O is locked to the selected clock reference. The Locked LED flashes if the selected clock reference source is missing or out of lockable frequency range.

Speed Cal Speed Cal is meant to be used as an indicator of the accuracy of the incoming clock reference. The Speed Cal LED flashes when the output sample rate is not at the expected (or target) rate. Speed Cal stays lit when the output frequency is within 200 ppm (0.02%) of the selected sample rate. If the output frequency is higher than expected, Speed Cal will blink quickly; if it's lower, it will blink slowly.

For example, if the session is 30 fps and LTC is the selected clock reference but the LTC is actually 29.97, the SYNC I/O will lock (the Locked LED will stay lit), but the Speed Cal LED will blink slowly.

Positional Reference

To select a positional reference:

- 1 Choose Window > Show Session Setup.
- 2 Choose a positional reference from the Positional Reference menu, located in the SYNC I/O Setup controls.

Sample Rate

The SYNC I/O sample rate is determined by the current Pro Tools session sample rate. In Stand-alone mode, SYNC I/O sample rate can be selected with SYNC I/O Setup software, or using the front panel switches. Current sample rate is indicated by the Sample Rate LEDs.

When used with a Pro Tools|HD system, SYNC I/O supports all available sample rates. Setting the session rate in Playback Engine or Hardware Setup dialogs also sets the SYNC I/O to that sample rate.

When using PostConform with the SYNC I/O, only 44.1 and 48 kHz sessions are supported.

Audio and Video Pull Up and Pull Down (Macintosh Only)

Pro Tools 5.3.1 provides new 4.167% pull up, and 4.0% pull down choices. When working with a Movie track containing video, a separate Video Pull-Down menu becomes available in the Session Setup window, allowing you to apply standard or non-standard pull factors to audio and video separately. This lets Pro Tools synchronize to most supported SMPTE frame rates and formats.

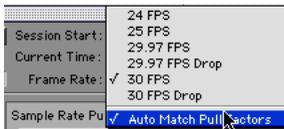
 See the *Pro Tools 5.3.1 Addendum* for more information.

Frame Rate

While using Pro Tools, SYNC I/O frame rate automatically follows the session frame rate setting. Session Frame Rate is set in the Session Setup window.

To set the session Frame Rate:

- Choose a rate from the Frame Rate selector in the Session Setup window.



Choosing a session Frame Rate (Auto Match Pull Factors shown enabled)

In Stand-alone mode, SYNC I/O frame rate can be set using the SYNC I/O Setup application, and from the front panel.

 *Pro Tools provides additional frame rate settings, including audio and video pull up and pull down, as well as Auto Match Pull Factors. See the Pro Tools 5.3.1 Addendum for more information.*

PAL/NTSC Video Format Setting

Choose PAL or NTSC format for the session using the Video Format selector in the Session Setup window. See “PAL/NTSC Video Format Setting” on page 18 for more information.

MachineControl Configuration

If using Digidesign MachineControl, do the following to establish basic communication.

 *See the MachineControl Guide for installation instructions and additional information.*

To configure MachineControl:

- 1 Choose Setup > Peripherals.
- 2 In the Synchronization window, make sure the SYNC I/O is the current Synchronization device, and DigiSerial is the selected port.
- 3 Click the MachineControl tab to open the MachineControl window.
- 4 Enable and configure options for 9-pin Serial or 9-pin Remote. SYNC I/O 9-Pin ports 1 and 2 are available for Serial mode on HD systems only. (Remote mode requires a standard serial or COM connection.)

Selecting Transport Master

The Pro Tools Transport window provides the Transport Master selector. This pop-up lets you select the device that will be controlled by the Pro Tools transport. Choices include Pro Tools and any other devices or modes you have enabled in the Synchronization or Machine Control tabs of the Peripherals dialog.



Transport master

Software Configuration for SYNC I/O Setup Software

To configure SYNC I/O Setup:

- 1 Make sure SYNC I/O is connected to your computer according to the instructions in “Serial Connections” on page 8.
- 2 Launch SYNC I/O Setup.
- 3 Choose Preferences > SYNC I/O Setup Preferences.
- 4 If not already selected, choose the appropriate serial port for your SYNC I/O-to-CPU connection.
- 5 Close the Preferences window.
SYNC I/O Setup should now show that it recognizes SYNC I/O in the information display area. If it does not, check your connections and port selection, and try again.

For more information on firmware updates and SYNC I/O Setup, see “Updating SYNC I/O Firmware” on page 20.

Getting Started with Pro Tools|24 MIX and Pro Tools|24

The SYNC I/O can be used with Pro Tools|24 MIX and Pro Tools|24 systems, as an alternative to the USD. When used with these system, the SYNC I/O emulates the USD.

For instructions on how to connect a SYNC I/O to your MIX system, see “Hardware Connections” on page 7.

To configure Pro Tools|24 MIX or Pro Tools|24 for a SYNC I/O:

- 1 Start up your system beginning with hard drives, then the SYNC I/O, then MIDI and other studio equipment, then the CPU. Turn on your speakers and monitoring system last.
- 2 Launch Pro Tools.
- 3 Choose Setups > Peripherals, and open the Synchronization tab.
- 4 Select Universal Slave Driver for the Synchronization Device.
- 5 Select DigiSerial Port for the Port.
- 6 Once the SYNC I/O is declared as a USD, click OK to close the Peripherals window.

Using the SYNC I/O with Pro Tools|24 MIX and Pro Tools|24:

When used with Pro Tools 5.1.3, the SYNC I/O choices are labelled as USD options. This is because the SYNC I/O is able to emulate the USD, providing all of its supported features (the SYNC I/O only supports sample rates and other features as supported by the USD with Pro Tools|24 MIX and Pro Tools|24).

To configure the SYNC I/O for your projects and sessions:

- 1 In the Session Setup window, select Clock and Positional References from their menus.
- 2 To generate time code from the SYNC I/O, enable Generate using USD.
- 3 Configure other settings as needed, selecting USD wherever appropriate.

Updating SYNC I/O Firmware

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

Pro Tools and SYNC I/O Setup can download up-to-date firmware to your SYNC I/O.

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

Pro Tools|HD When Pro Tools 5.3.1 is installed, new firmware for the SYNC I/O will automatically be installed in the SYNC I/O folder within the Digidesign folder. If there is no SYNC I/O folder in the Digidesign folder, the firmware will not be installed. To update your unit, launch Pro Tools and follow the instruction in the next section. You can also update firmware using the SYNC I/O Setup application.

Pro Tools|24 MIX and Pro Tools|24 Use the SYNC I/O Setup application to update SYNC I/O firmware. Updating SYNC I/O firmware through Pro Tools requires Pro Tools software version 5.3.1 or higher.

Updating SYNC I/O Firmware with Pro Tools|HD

When you launch Pro Tools|HD, it checks your SYNC I/O firmware and compares it to the most recent version (see “Auto ID of SYNC I/O through Loop Sync” on page 15 for more information). Pro Tools will compare firmware whenever you launch Pro Tools, or whenever SYNC I/O is enabled in the Peripherals > Synchronization dialog.

If Pro Tools determines that the SYNC I/O does not have the most current firmware, a dialog appears asking if you want to update it now.

- ◆ Click Update to update your unit. This automatically navigates to the firmware in the SYNC I/O folder and updates the SYNC I/O through the DigiSerial Port.

– or –

- ◆ Press Cancel to quit Pro Tools without updating.

If for any reason the firmware file cannot be located, Pro Tools will display a message indicating why (see “Firmware Messages” on page 20). If this happens, reinstall the Pro Tools software and repeat the firmware instructions.

▲ *Follow the on-screen instructions very closely, being careful to power cycle your unit at the correct times during the process, as instructed.*

Firmware Messages

The following messages may appear during firmware updating:

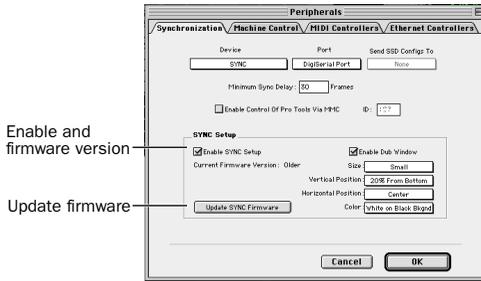
Firmware Not Found If no compatible firmware is found in the SYNC I/O Folder, a dialog appears instructing you to install SYNC I/O firmware. Use the Pro Tools installer CD, or use the latest version of SYNC I/O Setup.

SYNC I/O not on DigiSerial Port In order to update SYNC I/O firmware from Pro Tools, SYNC I/O must be connected to the DigiSerial Port. Otherwise, if the SYNC I/O is connected to the CPU’s serial port, you can update the firmware using SYNC I/O Setup.

Updating Firmware

To update SYNC I/O 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 SYNC I/O.



SYNC I/O setup and firmware controls

- 3 Click Update SYNC I/O Firmware.
- 4 Follow the instructions on-screen to complete the update.

SYNC I/O Setup Application and Firmware

If using the SYNC I/O with Pro Tools|24 MIX or Pro Tools|24, or if you are not using Pro Tools, use the most recent version of the SYNC I/O Setup application to install the latest version of firmware. SYNC I/O must be connected to a host computer serial port (SYNC I/O Setup is not supported through the DigiSerial Port.) The SYNC I/O firmware file will always be suffixed with “SYC.”

To update SYNC I/O firmware using SYNC I/O Setup:

- 1 Make sure SYNC I/O is connected to the computer as explained in “Serial Connections for SYNC I/O Setup” on page 9.
- 2 Choose Preferences > SYNC I/O Preferences.

- 3 Click Update SYNC I/O Firmware.

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

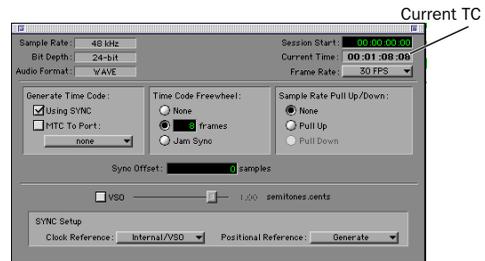
Troubleshooting

Status LEDs

The status LEDs (LOCKED and SPEED CAL) on the SYNC I/O front panel and in the Session Setup window may help you isolate potential problems.

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 SYNC I/O is receiving positional reference. If this field appears to be inactive when inputting time code to SYNC I/O, check your hardware device settings, serial connection to your computer, and your software settings.



Current Time Code display

Lost Communication

If Pro Tools loses communication with SYNC I/O, a dialog will appear asking you whether you want to switch to MTC (if available) or continue trying to locate SYNC I/O. If you see a “lost communication” dialog, check power, DigiSerial, and other connections.

If you switched ports in order to update firmware using SYNC I/O Setup, check to make sure you reconnected SYNC I/O to the Host Serial port on your HD Core card.

Pro Tools|HD may present a dialog, which provides options for re-establishing synchronization when communication with SYNC I/O stops:

Use MTC Click this button if the SYNC I/O is unavailable, to switch to any currently connected MIDI interface for MTC synchronization. This option requires a compatible device that supports MTC conversion, and that is already connected to your CPU and enabled.

Keep SYNC I/O Click this to leave the session configured for SYNC I/O, or to continue searching for the SYNC I/O to re-establish lost communication.

Synchronization Accuracy

If you are noticing drift or lack of accurate synchronization between your devices, check the following:

- ◆ If your system locks up in the wrong place, make sure you have set the correct frame rate and format (NTSC or PAL) on all your devices.
- ◆ If your system locks up in the correct location, but drifts, check your clock signals and settings.

chapter 3

SYNC I/O Hardware and Software Overview

SYNC I/O Front Panel

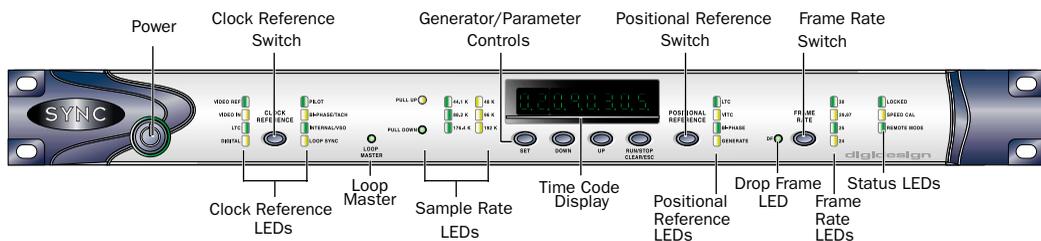


Figure 1. SYNC I/O Front Panel

Controls and Displays

All SYNC I/O local controls are on its front panel; the back panel is reserved for connectors only. This section identifies each front panel switch and display. For information on back panel connectors and setup, see Chapter 2, “Installation and Getting Started.”

AC Mains Power Switch

When in, SYNC I/O power is *on*; Out, power is *off*.

The LED ring around the power switch is orange while the SYNC I/O is powering up, or while firmware is being updated. When the SYNC I/O is ready for use after power cycling, or after updating firmware, the power switch LEDs light green.

Clock Reference Switch and LEDs

This switch selects the SYNC I/O clock reference, as indicated by the Clock Reference LEDs. Available clock reference inputs include Video Ref, Video In, LTC, Digital, Pilot, Bi-phase/Tach, Internal/VSO, and Loop Sync.

Loop Master Indicator

When lit, this LED indicates that the SYNC I/O is the current Pro Tools Loop Master device.

Sample Rate LEDs

These green or yellow LEDs show the current SYNC I/O sample rate. Pull Up and Pull Down are available for all sample rate settings, indicated by the appropriate PULL UP, or PULL DOWN LED. The table below shows the actual sample rates when pulled up or down by NTSC standard 0.1%.

LED Displays and SYNC I/O Sample Rates

Sample Rate LEDs	0.1% Pull Up	0.1% Pull Down	Actual Sample Rate
44.1 kHz	•		44.144 kHz
		•	44.056 kHz
48 kHz	•		48.048 kHz
		•	47.952 kHz
88.2 kHz	•		88.288 kHz
		•	88.112 kHz
96 kHz	•		96.096 kHz
		•	95.904 kHz
176.4 kHz	•		176.576 kHz
		•	176.224 kHz
192 kHz	•		192.192 kHz
		•	191.808 kHz

 *Pro Tools 5.3.1 and later support all the 0.1% rates listed above, as well as 4.167% pull up, and 4.0% pull down (4% rates are not available in 176.4 and 192 kHz sessions).*

Generator/Parameter Controls

These four momentary switches provide direct access to many SYNC I/O functions, including time code generator settings, PAL/NTSC selection, sample rate and more. The Time Code LED display shows the current mode, selected parameter, or setting.

Time Code Display

This 7-segment, multifunction LED is the SYNC I/O time code and parameter display.

Time Code The current positional reference (internal or external), is displayed in hours:minutes:seconds:frames. 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 an odd-numbered field. When SYNC I/O is in Auto Switch LTC/VITC mode, the decimal point to the right of “minutes” illuminates.

Parameters and Values When configuring SYNC I/O 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.*

Positional Reference Switch

This switch selects the positional reference source, as indicated by the Positional Reference LEDs. Choices include LTC, VITC, Auto Switch Bi-phase, and Generate.

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

Frame Rate Switch

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

Frame Rate LEDs and DF Indicator

These display the current SYNC I/O frame rate: 30, 29.97, 25, or 24 fps are indicated by four green LEDs. The DF LED indicates drop- or non-drop. DF (a lit DF LED indicates drop frame, unlit indicates non-drop frame).

Status LEDs

These LEDs show the current state of SYNC I/O in relation to clock references. Indicators include:

Locked This green LED lights solid when SYNC I/O 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 whenever there is a mismatch between the chosen sample rate and the actual output sample rate. Speed Cal 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 SYNC I/O is set to Remote-Only /Front Panel Lockout mode. While this LED is lit, the front panel switches will have no affect on the SYNC I/O. (Do not confuse Remote-only/Front Panel lockout with Remote 9-pin Deck Emulation mode.) For more information see the section “Overview of SYNC I/O Setup” on page 28.

SYNC I/O Back Panel

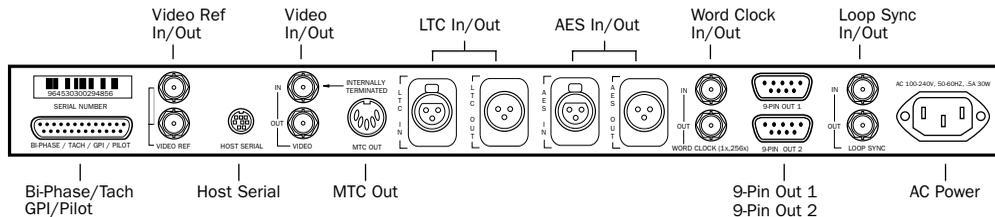


Figure 2. SYNC I/O Back Panel

Bi-Phase/Tach/GPI/Pilot

An accessory port for Bi-Phase, Tach, and Pilot signals (specific cables are required for different applications). This connector is also used for GPI input, output (including Fader Start), and thru signals. This port handles up to 12 volts Bi-phase.

 Refer to Appendix C, “Wiring Diagrams Pin Assignments” for wiring information and other specifications for this port.

Video Reference In/Out

Video Ref 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 SYNC I/O) to the Video Reference Out on the back panel, or
- Ensure that another, terminated, video device is fed from the loop-through connector.

Video Reference Out 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 an-

other device. Continues to output whatever signal is present at the Video Reference In port, regardless of whether or not SYNC I/O is powered up.

 **If SYNC I/O is the last device in the video sync chain, a BNC terminator (supplied) must be attached to this connector.**

Host Serial Port

A bidirectional (in/out) port to connect SYNC I/O to the DigiSerial Port on a Pro Tools|HD Core card. When not being used with Pro Tools|HD, the SYNC I/O Host Serial port can be connected to a standard serial port on a supported host computer, for SYNC I/O Setup

Video In/Out

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.

Video Out Output of the current Video In signal. 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. In either case, this output might additionally carry VITC and/or Window Burn information if those features are enabled.

MTC Out

Outputs MIDI Time Code (MTC), only. No other MIDI data appears at this output. MTC output can be regenerated while SYNC I/O 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. This port is intended to supply MTC from SYNC I/O to external sequencers or other MIDI devices.

LTC In/Out

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. Adjustable LTC servo gain is available in Pro Tools and from the front panel.

LTC Out Outputs linear time code, in balanced or unbalanced analog audio format. See Appendix C, “Wiring Diagrams Pin Assignments” for wiring details. LTC output gain is also adjustable from the front panel and from the SYNC I/O Setup software.

AES/EBU In/Out

AES In Receives an AES/EBU digital audio signal, for clock reference purposes only. SYNC I/O 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.

AES/EBU Out Outputs a silent (all bits OFF) AES/EBU audio signal whose sample rate exactly matches SYNC I/O Word Clock BNC output.

Word Clock In/Out

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

Word Clock Out Outputs 1x sample rate Word Clock information, or 256x Slave Clock, to provide clock to HD-series audio interfaces, Legacy peripherals, and other Word clock-capable devices. This port is configured from the front panel, or using SYNC I/O Setup, by adjusting the SYNC I/O Base Clock setting.

9-pin Out 1 and 2

For Digidesign MachineControl-enabled systems, these two ports connect directly to external 9-pin transport devices. See the *MachineControl Guide* for more information.

Loop Sync In/Out

Loop Sync is the clock signal used to synchronize Pro Tools|HD-series audio interfaces.

Loop Sync In Receives Loop Sync from any HD-series audio interface.

Loop Sync Out Provides Loop Sync. This port connects to the primary HD-series audio interface.

AC Power In

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

SYNC I/O Setup Software

The following is an overview of SYNC I/O Setup. System and installation requirements for SYNC I/O Setup can be found in “Software Installation” on page 14.

Using Help

To activate Help:

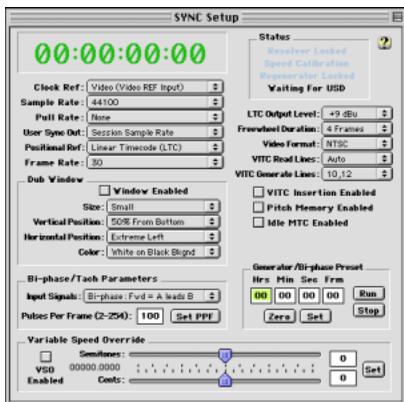
- Choose Help > Show Help, or click on the question mark button in the upper-right corner of the SYNC I/O Setup window.

To deactivate Help:

- Choose Help > Hide Help, or click the question mark button again.

Overview of SYNC I/O Setup

The following section identifies SYNC I/O Setup controls and displays.



SYNC I/O Setup

Time Code Window

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

When SYNC I/O 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.

Clock Reference

Selects SYNC I/O clock reference.

Sample Rate

Selects SYNC I/O sample rate (or the Pro Tools session sample rate, if applicable).

Pull Rate

Enables Pull Up or Pull Down for the current sample rate.

User Sync Out

Configures the base clock of the External Clock Output for 1x (session sample rate) or 256x (for Slave Clock devices only).

Word Clock Out

Configures the SYNC I/O Word Clock Output between 256x (Super Clock) and the current session rate (1x at 44.1 kHz, or 1x at 48 kHz). Only Legacy audio interface require 256x Super Clock.

Positional Reference

Selects SYNC I/O positional reference.

Frame Rate

Selects the frames-per-second (fps) rate of external (or internally generated) time code.

Status

Shows the current state of SYNC I/O Setup software in relation to SYNC I/O and external devices, as follows:

Resolver Locked Lights when SYNC I/O is locked to the chosen external clock reference, or to its *Internal* clock reference.

Speed Calibration Lights when SYNC I/O 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 “Status LEDs” on page 25.

Generator Running Lights when SYNC I/O is regenerating time code at its video, LTC, and MTC outputs locked with the incoming positional reference source. Also lit whenever SYNC I/O is generating time code internally.

Connected to SYNC I/O Lights when SYNC I/O Setup is the front-most window and is communicating with SYNC I/O.

Waiting for SYNC I/O Lights when SYNC I/O Setup is the front-most window and is unable to communicate with SYNC I/O.

Port Relinquished Lights when SYNC I/O Setup is not the front-most window or is unable to allocate a serial port with which to communicate with SYNC I/O.

LTC Output Level

Adjusts the analog audio level of the SYNC I/O LTC output, from -24 dBu to +9 dBu.

Freewheel Duration

Sets the period of time for which SYNC I/O 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).

Video Format

Selects 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.

VITC Read Lines

Determines which line pair of incoming video signal is used for the VITC source. When set to Auto, SYNC I/O will search for the first valid line pair automatically. Alternatively, this value can be set to specific VITC line pairs.

VITC Generate Lines

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

VITC Insertion Enabled

When selected, VITC will be inserted into the outgoing video signal—assuming that a video signal is present at a SYNC I/O video input, and that SYNC I/O is in a valid mode for inserting VITC. The only invalid positional reference modes are VITC or Auto Switch LTC/VITC. SYNC I/O can't read VITC and generate new VITC at the same time.

Pitch Memory Enabled

When selected, SYNC I/O will remain at a *pitch* (sample rate) that corresponds to the last known incoming time code speed. When deselected, SYNC I/O will revert to the selected sample rate. If Pitch Memory is disabled and the selected external clock reference is not available, then SYNC I/O will revert to the nominal, selected internal sample rate setting.

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 Idle Mute” on page 59 for details.

Window Dub

Settings for SYNC I/O 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.

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.

Generator/Bi-Phase Preset

Serves two functions, as determined by the current SYNC I/O 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 through the fields.

Bi-Phase/Tach Mode Zeros the time code counter, to allow SYNC I/O 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).

Variable Speed Override (VSO)

Used to varispeed the rate of SYNC I/O 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 Sync I/O

SYNC I/O settings can be controlled in three ways:

- from Pro Tools
- using the front panel controls
- using SYNC I/O Setup

Pro Tools Most SYNC I/O controls are available within Pro Tools and from the front panel.

Stand-alone Remote installations (stand-alone) use the SYNC I/O front panel switches and displays.

SYNC I/O Setup Optional software remote control from a supported Macintosh or Windows computer, SYNC I/O Setup provides access to all SYNC I/O parameters.

For a listing of SYNC I/O parameters supported in each method, see “SYNC I/O Controls in Pro Tools, SYNC I/O Setup and the Front Panel” on page 32.

About SYNC I/O Setup Remote-Only Mode

When the default Remote-Only Mode (Front Panel Lockout) is enabled in the SYNC I/O Setup Preferences window, none of the SYNC I/O 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 SYNC I/O from Remote-Only mode. This is useful when the host computer is not easily accessible to override Remote-Only Mode.



Pro Tools SYNC I/O controls always provide access to most SYNC I/O parameters.

SYNC I/O Controls in Pro Tools, SYNC I/O Setup and the Front Panel

SYNC I/O Controls in Pro Tools, SYNC I/O Setup, and the Front Panel

Parameters	Available from/in:		
	Pro Tools	Front Panel	SYNC I/O Setup
Firmware Update	yes (Peripherals/Sync)	no	yes
Clock References	all (Session Setup)	all	all
Positional References	all (Session Setup)	all	all
Sample Rates	all	all	all
Pull Rates	yes	yes	yes
Base Clock (External Clock Out)	no	yes	yes
Frame Rates	all (Session Setup)	all	all
LTC Output level	no	yes	yes
LTC Servo gain	no	yes	no
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
Idle MTC Enabled	no	yes	yes
USD Emulation mode	no	yes	n/a

Using the Front Panel Generator/Parameter Switches

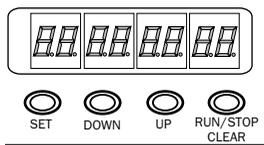
The Generator/Parameter Controls are labelled SET, DOWN, UP, and RUN/STOP/CLEAR. In addition to their primary generator functions, these switches provide front panel access to most SYNC I/O parameters.

Features Not Accessible from the SYNC I/O Front Panel Controls

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

- Remote-Only Mode/Front Panel Lockout
- Firmware update
- Changing Window Burn Size, Vertical Position, Horizontal Position, and Color
- GPI (General Purpose Interface) functions
- Variable Speed Offset (VSO)

For a listing of available parameters, refer to Table on page 32.



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 SYNC I/O 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:)

SE 7 6En

The (default) first page of Generator Parameter controls

A different parameter may be displayed, depending on any previous adjusting of Generator/Parameter controls.

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.

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

As an example, the following steps explain using the SYNC I/O 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 parameters for editing:

- 1** Press Set until the LED Time Code Display shows a parameter name. The first name is Set Generator (SE7 6En), although you may see a different name, depending upon the SYNC I/O last settings.
- 2** Press the Down or Up switches until the LED Time Code Display shows LTC Gain (L7C 6AIn).
- 3** Press the Set switch again. The LED Time Code Display will now show the current parameter value for LTC Gain in dBu values.
- 4** 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.
- 5** When the desired parameter value is displayed, press the Set switch again.

With just a few exceptions these steps remain the same for all SYNC I/O parameters.

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

Clock References and Options

The following sections provide specialized instructions for each clock reference choice. For basic instructions to choose the clock or positional reference, set frame rate, or set SYNC I/O sample rate, see Chapter 2, “Installation and Getting Started.”

Video Clock Options

SYNC I/O provides two video inputs, *Video Ref In* and *Video In*, which are each selectable for clock reference. See “Video and Clock Reference” on page 35).

For House Video Reference (Black Burst) Use the SYNC I/O 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 through either of the SYNC I/O 9-pin ports. When using MachineControl with serial time code as the positional reference, SYNC I/O must be locked to Video Ref. In this scenario, SYNC I/O is set to Generate mode to indicate that positional information is acquired by Pro Tools directly over the 9-pin cable, not through SYNC I/O. Consult the *MachineControl User's Guide* for complete serial time code information.

 *MachineControl also provides Remote mode, but this mode is not supported through either of the SYNC I/O 9-pin ports. See Appendix D, “MachineControl and SYNC I/O” for more information.*

Video and Clock Reference

If you have only a single video source, and since SYNC I/O 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 SYNC I/O 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 65 in Appendix A.*

Digital Clock

To resolve Pro Tools/SYNC I/O to external AES/EBU, Word Clock or SuperClock:

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.
- 4 Press Set again. The LED Time Code Display displays the current digital reference, which will be:
 - AES/EBU (AES-E8U), or
 - Word Clock (I CLOC)
- 5 Use Down and Up to select the desired digital clock.
- 6 When the desired option is shown, press Set.

Using SYNC I/O 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 SYNC I/O front panel will flash.

Additional Digital Clock Information

AES/EBU The SYNC I/O 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 SYNC I/O AES Out connector.

Word Clock Word Clock is a digital clock reference signal that runs at 1x sample rate (44.1, 48, 88.2, 96, 176.4, or 192 kHz). Pro Tools|HD-series audio interfaces have dedicated BNC-style Word Clock connectors. 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).

Slave Clock (256x)

Slave Clock (or Super Clock) is a Digidesign proprietary hi-speed clock used by legacy Digidesign audio interfaces that run at 256x the sample rate. Slave Clock is utilized when using Digidesign Pro Tools 888|24, 882|20, 1622, and ADAT Bridge audio interfaces. When using legacy peripherals with SYNC I/O and Pro Tools|HD, your master HD audio interface (96 I/O or 192 I/O) should supply Slave Clock to the first legacy device through its External Clock Out connector, configured for 256x Slave Clock (see “Base Clock” on page 56 for more information).

Pro Tools|HD-series audio interfaces are always connected using Loop Sync (see “Clock for Pro Tools Audio Interfaces” on page 10 for more information).

 For additional digital clock signal information, see “Digital Clock Signal Types” on page 67.

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).

While resolving to LTC clock, the SYNC I/O now provides five options to optimize your system for different types of tasks. This lets you choose between quickest response (for when fast lock-up time is critical), or highest sound quality (during critical laybacks, for example).

The Session Setup window provides a sub-menu for LTC Clock Reference choices. The five choices provide different servo gain settings to reduce the effects of jitter when locking to linear time code. In Stand-alone mode, these settings are also available from the front panel.



Clock Reference > LTC menus in Session Setup

To choose an LTC setting:

- Choose a setting from the hierarchical LTC Clock Reference menu: Choices include:

LTC 0 (fastest) Allows the quickest resolving to incoming LTC, but with greater jitter. This is the default setting, and should be used when fast lock ups are critical.

LTC 1 Provides a next to fastest setting.

LTC 2 (average) Offers a compromise of lock up time and jitter quality.

LTC 3 Provides a next to slowest setting.

LTC 4 (smoothest) Offers the lowest jitter from LTC resolve, but can take six to ten seconds to achieve full resolve. This setting is most appropriate when loading critical audio from an analog master, where reducing or eliminating jitter is more important than lock speed. Be sure to allow adequate pre-roll before punching in.

Using the front panel controls:

- 1 Using the Set, Down, and Up switches, select LTC Servo Gain (SERVo Gn).
- 2 Use the Up and Down switches to select a gain setting.
- 3 Using the Clock Reference switch, select LTC as the clock reference.

Using SYNC I/O Setup:

- Select Linear Time Code (LTC) from the SYNC I/O Setup Clock Ref pop-up menu.

 *SYNC I/O provides adjustable LTC servo gain. See "Servo Gain" on page 58.*

Additional LTC Information

LTC can provide positional and clock reference. LTC can be recorded onto and played back from an analog track, or a VTR audio, address or cue track.

 *For further information on LTC signals, see "LTC Signals" on page 66.*

Pilot Tone

SYNC I/O 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.

SYNC I/O 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 SYNC I/O to Pilot Tone:

From Pro Tools:

- In the SYNC I/O 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 SYNC I/O Bi-Phase/Tach/GPI/Pilot port.
- 2 Using the front panel Clock Reference switch, select Pilot.

Using SYNC I/O Setup:

- 1 Connect your Pilot Tone reference source to the SYNC I/O Bi-Phase/Tach/GPI/Pilot port.
- 2 Select Pilot Tone under the SYNC I/O Setup's Clock Ref pop-up menu.

 For additional Pilot Tone information, see "Pilot Tone" on page 69 in Appendix A.

Bi-Phase/Tach and Clock Reference

SYNC I/O 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 45 for other requirements).

To configure Bi-Phase/Tach for SYNC I/O clock reference:

Using SYNC I/O Setup:

- 1 Select Bi-Phase/Tach under SYNC I/O 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 44 and "Bi-Phase/Tach Signal" on page 44.

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 43.).

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 44 and "Bi-Phase/Tach Signal" on page 44.

 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 SYNC I/O front panel will flash. SYNC I/O accepts up to 12 volts at the Bi-Phase input.

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

- In the SYNC I/O Setup area of Pro Tools Session Setup window, click on the Clock Reference pop-up and select Bi-Phase.

 For additional Bi-Phase/Tach signal information, see “Bi-Phase/Tach” on page 68 in Appendix A.

Internal Clock, Generating and Regenerating

SYNC I/O can use its own, crystal-referenced, internal clock as a master clock source. When SYNC I/O Clock Reference is set to Internal:

- Word 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 the same internal crystal reference.

To resolve SYNC I/O to its internal clock:

From Pro Tools

- In the SYNC I/O 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 SYNC I/O Setup

- Select Internal/VSO from the SYNC I/O Setup Clock Ref pop-up menu.

Variable Speed Override (VSO)

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

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 SYNC I/O Setup.

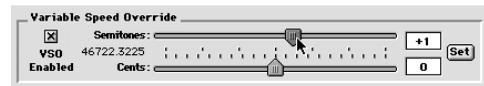
To varispeed the rate of SYNC I/O’s internal clock:

Using Pro Tools

- 1 Choose Windows > Session Setup, and expand the Session Setup window to full view.
- 2 Click to enable VSO.
- 3 Adjust the varispeed value using the on screen slider.

Using SYNC I/O Setup

- 1 In the SYNC I/O 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 –

Enter the value in semitones and cents using the editable fields. Varispeed range changes with sample rate, as shown in the following table.

Effective VSO rates

Sample Rate (kHz)	Rate Type	Min (kHz)	Max (kHz)
44.1	1x	40000	50500
48			
88.2	2x	80000	101000
96			
176.4	4x	160000	202000
192			

SYNC I/O will only output rates within the limits of the current sample rate. If a varispeed value results in an output frequency (sample rate) that is below or above the limits for the current sample rate, the frequency display turns red.

3 When finished, click Set.

Using Pitch Memory

Pitch Memory 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. If Pitch Memory is disabled and the selected external clock reference is not available, SYNC I/O will revert to the nominal, selected internal sample rate setting.

To configure Pitch Memory from the front panel:

- 1** Using Set, Down, and Up, select Pitch Hold (PICH Hld).
- 2** Press Set again. The LED Time Code Display shows On or Off.
- 3** Use Down and Up to switch between the parameter values.

Using SYNC I/O 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. SYNC I/O will retain the setting, even when the unit is powered off and on again, until changed

Positional Reference and Options

The following sections provide additional information 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 SYNC I/O 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 SYNC I/O's positional reference:

From Pro Tools:

- In the SYNC I/O 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 SYNC I/O Setup:

- Select Linear Time Code (LTC) under SYNC I/O 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 SYNC I/O LTC In connector.

Freewheel Duration

Freewheel duration (time code freewheel) configures SYNC I/O for a maximum number of frames it should continue generating if time code drops out or is otherwise interrupted. Freewheel settings are ignored when SYNC I/O 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, SYNC I/O 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 SYNC I/O 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 SYNC I/O will remain resolved to the black burst signal at the Video Ref In connector.

To use VITC as SYNC I/O 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 SYNC I/O positional reference using the front panel:

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

To use VITC as SYNC I/O positional reference using SYNC I/O Setup:

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

Additional VITC-Related Settings

SYNC I/O Settings Make sure to set the appropriate clock reference, sample rate, frame rate, and freewheel duration.

Connections and Sources Make sure that your VITC-stripped video signal, if any, is routed to SYNC I/O 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, SYNC I/O 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 SYNC I/O 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 SYNC I/O LTC In connector;
- Make sure the VITC-striped video signal is routed properly to the SYNC I/O 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 66 in Appendix A.

Serial Time Code

SYNC I/O provides two 9-pin ports, to be used with MachineControl-enabled systems to remotely control, or follow, external 9-pin transports through the use of serial time code.

For MachineControl-equipped Pro Tools systems, serial time code from either 9-pin port can be used for positional reference. This option is configured from the Pro Tools Peripherals > Machine Control window. For details on using serial time code with SYNC I/O, see the MachineControl Guide.

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 SYNC I/O to calculate positional information.

To calculate positional reference from Bi-Phase/Tach requires that SYNC I/O 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:

Using Pro Tools:

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

Using the front panel controls:

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

Using SYNC I/O Setup:

- 1 Select Bi-Phase/Tach under SYNC I/O Setup's Positional Ref pop-up menu.
- 2 Set the starting frame as described in "Bi-Phase/Tach Starting Frame" on page 44.
- 3 Set other Input Signals options, as appropriate.

Bi-Phase/Tach Starting Frame

In order to use the Bi-Phase/Tach signal as a positional reference, SYNC I/O 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 SYNC I/O to the equivalent time code value using the Bi-Phase/Tach Starting Frame parameter.

 *Bi-Phase start frame cannot be set from within Pro Tools. Use Sync Setup or the front panel.*

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 SYNC I/O 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 SYNC I/O Setup:

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

- 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 controls:

- 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 SYNC I/O Setup’s Pulse Per Frame setting, you can set SYNC I/O 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 scroll 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 & Regenerating Time Code

SYNC I/O generates LTC, VITC, and MTC simultaneously, obtaining time addresses from a variety of sources:

- When the Positional Reference is set to Generate, SYNC I/O 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, SYNC I/O generates LTC, VITC, and MTC based on the time address of one of those sources. This is sometimes called re-generation” or “translation”. For SYNC I/O, this is referred to as Read/Regeneration mode.

 *Time code generated by the SYNC I/O does not follow session Pull Up and Pull Down settings.*

Read/Regeneration Mode

In this mode, SYNC I/O 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 ($\pm 8\%$).

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. SYNC I/O will not regenerate VITC if the positional reference is VITC.

MTC In order for SYNC I/O to regenerate continuous MTC, the external positional reference must be moving at normal, 1x forward speed ($\pm 8\%$). 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. SYNC I/O begins regenerating 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, SYNC I/O will regenerate time code addresses that match the incoming time code addresses. If the positional reference is a Bi-Phase/Tach signal, SYNC I/O will generate time code addresses starting at the Bi-Phase preset start time. (See “Bi-Phase/Tach Starting Frame” on page 44 for more information.)

Generator Preset Mode

In this mode, SYNC I/O generates time code internally from a start time based upon the Generator Preset Time. Using either SYNC I/O 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 SYNC I/O 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), 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 SYNC I/O 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.

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 Set again. One of the time code fields displayed will be flashing.
- 3** To lower or raise the currently flashing parameter press Down or Up. Hold down either switch to scroll down/up.
- 4** To set a time code setting and advance to the next field, press and release Down and Up simultaneously.
- 5** Repeat until you have finished setting SYNC I/O to the desired generator start time.

When you are done, press Set again. SYNC I/O will retain the setting, even when the unit is powered off and on again, until it is changed.

LTC Generation/Regeneration

Regenerating LTC

SYNC I/O will regenerate LTC whenever the external positional reference is moving at normal, 1x forward speed ($\pm 10\%$).

Make sure LTC is correctly routed as explained in Chapter 2, “Installation and Getting Started”. If you need to adjust the level of the SYNC I/O LTC output signal, see “Example: Using Set, Down and Up to adjust LTC Gain” on page 34 for instructions. You can also adjust the SYNC I/O LTC servo gain, as described in “Servo Gain” on page 58.

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 SYNC I/O Positional Reference switch, select the desired external positional reference (do not select Generate).

To regenerate LTC using SYNC I/O Setup:

- Select the desired external positional reference from the Positional Reference pop-up (any choice except Generate).

SYNC I/O regenerates LTC as soon as it receives a valid positional reference signal.

Generating LTC

In Generator Preset mode, SYNC I/O can generate LTC using either an external or internal clock reference. Make sure LTC is correctly routed and that all your other gear is properly configured before you begin. See “Example: Using Set, Down and Up to adjust LTC Gain” on page 34 for SYNC I/O 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** Put Pro Tools online.
- 3** Start Pro Tools recording or playback. Pro Tools commands SYNC I/O to begin generating LTC with time addresses synchronized to the session time line.

To generate LTC using the front panel controls:

- 1** Using the SYNC I/O 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/StopClear switch.

To generate LTC using SYNC I/O Setup:

- 1 Select Generate in the Positional Ref pop-up menu.
- 2 In the Generator/Bi-Phase Preset window (time fields), 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 SYNC I/O 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 SYNC I/O 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, SYNC I/O 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 SYNC I/O's video input connectors according to the VITC Video Source rule.

The SYNC I/O Video Out signal is connected to the destination device. SYNC I/O 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, SYNC I/O can regenerate VITC with both forward and reverse time code addresses.*

To prevent destruction of the original VITC code, SYNC I/O 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 SYNC I/O 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 SYNC I/O Video Ref connector and loop to the SYNC I/O Video Input connector.
- 2 Select VITC Insertion (VITC 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 59.

7 Use Set, Up and Down to access the VITC Generate Lines (6En LInE) parameter. Press the Set switch again. The default line pair is 14/16, 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.

SYNC I/O 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 SYNC I/O Setup:

1 Ensure that SYNC I/O is connected in-line with a video source and video destination.

2 Ensure that VITC Insertion Enabled is checked in the SYNC I/O 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.

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

SYNC I/O 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

SYNC I/O 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 SYNC I/O 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 65 and “VITC Video Source Rule” on page 48.

To generate VITC internally using the front panel controls:

1 Ensure that SYNC I/O 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 SYNC I/O 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 SYNC I/O Setup:

- 1 Ensure that SYNC I/O is connected in-line with a video source and video destination.
- 2 Ensure that VITC Insertion Enabled is selected in the SYNC I/O 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 SYNC I/O 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 SYNC I/O video inputs. If in doubt, always check if the machine is paused, stopped or unlaced.*

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 SYNC I/O 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, SYNC I/O 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 SYNC I/O to its previous state.

To mute idle-time MTC output using SYNC I/O Setup:

- 1 Launch SYNC I/O Setup.
- 2 Deselect the Idle MTC Enabled option.

Generating a Window Burn

SYNC I/O 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 anyone 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 instance, 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.)

SYNC I/O's character generator obtains its time code address from the chosen Positional Reference.

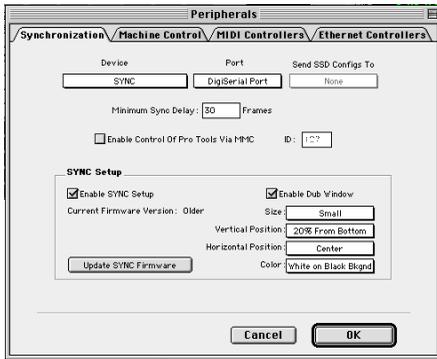
Window Dub Requirements

Existing Video Signal SYNC I/O can only burn a window dub onto an existing video signal. This means that at least one video “source” signal (from a VTR, nonlinear editing system, or other video device) must be present at one of the SYNC I/O video input connectors (Video In or Video Ref In). When generating a window dub, the VITC Timing Rule applies (see “VITC Timing Rule” on page 65).

SYNC I/O Output The signal from the SYNC I/O 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 SYNC I/O is enabled already, the Window Dub controls should be available.



Configuring SYNC I/O Window Dub from Pro Tools.

- 3 Click Enable Dub Window.
- 4 Configure any of the following Window burn appearance settings: Size, Vertical Position, Horizontal Position, and Color.

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

- 5 After configuring the dub window settings, click OK to close the Peripherals window.

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.

Based upon the selected positional reference, the time code character generator can now burn time code addresses onto any video signal that's passing through SYNC I/O.

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 SYNC I/O Setup. These parameters cannot be adjusted from the SYNC I/O front panel controls.

 *Default Window Burn settings are listed in "Restoring Factory Settings" on page 62.*

To configure Window Dub using SYNC I/O Setup:

- 1 In the Dub Window section of SYNC I/O Setup, select Window Enabled.
- 2 Specify the appearance of the window dub with the pop-up menus for Vertical Position, Horizontal Position, and Color.

- 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 SYNC I/O.

To turn off window dubbing:

- Deselect Window Enabled.

chapter 5

Additional Operational Information

Front Panel Generator/Parameter Controls

This section details the parameters available from the multi-function SET, UP, DOWN and RUN/STOP, CLEAR switches. (Referred to as Set, Up, Down and Run). Detailed instructions for the multi-function Generator/Parameter switches can be found in the section “Using the Front Panel Generator/Parameter Switches” on page 33.

Parameters

SYNC I/O parameters are selected and edited using the four Generator/Parameter switches.

To select SYNC I/O front panel parameters:

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

The 7-segment LEDs in the Generator/Parameter Display abbreviate some parameter names using numerals to represent letters (such as “5” to represent “S” or “s”). The following table identifies each of these abbreviations.

Front Panel Parameters

SYNC I/O LED display of abbreviated parameter names

LED	Parameter
SE7 6En	Set Generator Start Time
dl6 rEF	Digital Reference
SPL FrEC	Sample Freq (Rate)
PuLL r7E 1	Pull Up/Down 0.1%
PuLL r7E4	Pull Up 4.167%, Down 4.0%
bASE CLOC	External Clock Out
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 6Aln	LTC Output gain
SErVo Gn	LTC Servo gain
PICH HLd	Pitch Hold On/Off
bIPH PPF	Bi-Phase Pulse-per-frame
bIPH SI6	Bi-Phase Signal Configuration
VIdEO SY	Video Format (NTSC/PAL)
IdLE 7C	Idle MTC On/Off
USD CPA7	USD Compatibility On/Off

Set Generator Start Time

Lets you set a start time for the SYNC I/O time code generator.

SE 7 6En

See “Generator Start Time” on page 46.

Digital Clock Reference

SYNC I/O can use AES/EBU or Word Clock (1x) for digital clock reference.

d16 rEF

See “Digital Clock” on page 36.

Sample Rate

Selects the SYNC I/O sample rate.

SPL FrEE

See “Sample Rate” on page 17.

Pull Rate

Two Pull Rate settings enable 0.1%, and 4%, Pull Up or Pull Down for the current sample rate.

PULL r7E

Pull Rate1 Lets you enable 0.1% pull up or down.

Pull Rate4 Lets you enable 4.167% pull up, or 4.0% pull down, when available.

Base Clock

Configures the Word Clock Out port. Choices are Session (1x the base session sample rate), or 256x (for Slave Clock devices).

BASE CLOC

 *The base sample rate is 44.1 kHz when session sample rate is 44.1, 88.2, or 176.4 kHz, or 48 kHz when session sample rate is 48, 96, or 192 kHz.*

VITC Insertion

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

VI7C InS

To configure SYNC I/O to insert VITC using the front panel:

- 1 Select VITC Insertion (VI7C InS) using the Set, Down, and Up switches.
- 2 Press Set again. The Time Code Display shows On or Off.
- 3 Use Down an Up to toggle the choices.
- 4 Press Set when the desired choice is shown.

VITC Read Lines

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

rdr L l nE

To choose the VITC read lines:

- 1 Select VITC Read Lines (rdr LInE), using the Set, Down, and Up switches.
- 2 Press Set switch. The Time Code Display will show one of the parameter values:
 - Auto (ALL-LInE)—where SYNC I/O will search all lines and select the first valid line pair automatically
 - the currently selected read lines, if different.
- 3 Use Down and Up to scroll parameters.
- 4 Press Set when the desired read line is shown.

VITC Generate Lines

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

6En L l nE

To choose the VITC generate lines:

- 1 Select VITC Generate Lines (6En LInE), using the Set, Down, and Up switches.
- 2 Press Set again. The LED Time Code Display displays the current lines.
- 3 Use Down and Up to scroll parameters.
- 4 When you have chosen your desired option, press Set. SYNC I/O 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 SYNC I/O window dub from the front panel:

- 1 Select Burn Enabled (burn EnA), using the Set, Down, and Up switch.
- 2 Press Set again.
- 3 Use Down and Up to toggle between on/off.
- 4 When you have chosen your desired option, press Set. SYNC I/O 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 SYNC I/O Setup window dub instructions. See “SYNC I/O Defaults” on page 62 for default display settings.

Freewheel Length/Duration

Freewheel Length sets the period of time for which SYNC I/O will continue to regenerate time code when incoming time code is interrupted.

FrEE L En

See “Freewheel Duration” on page 41 for an explanation of this feature.

To set the freewheel duration:

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

- 2 Press Set again. The LED Time Code Display displays the current setting, in frames.
- 3 Use Down and Up to scroll parameters.
- 4 Press Set when the desired value is shown.

LTC Output Level/Gain

Adjusts the audio level of the SYNC I/O LTC output, from -24 dBu to +9 dBu.

LTC GA In

See “Example: Using Set, Down and Up to adjust LTC Gain” on page 34 for step-by-step LTC gain instructions.

To set the LTC output level:

- 1 Select LTC Gain (LTC 6AIn), using the Set, Down, and Up switches.
- 2 Press the Set switch again. The LED Time Code Display shows the current setting, in dBu.
- 3 Use the Down and Up switches to switch between the parameter values.
- 4 When you have chosen your desired option, press Set.

Servo Gain

This setting provides a user selectable LTC input gain offset. Selectable from the front panel only, this parameter can significantly lessen or remove jitter on word clock while resolving to LTC (though it can slightly increase lockup time).

SERVO Gn

To set the LTC servo gain:

- 1 Select Servo Gain (SERVO Gn) using the Set, Down, and Up switches.
- 2 Press Set again. The LED Time Code Display shows the current setting (-001 is the default).
- 3 Use the Down and Up switches to display another parameter value. Servo gain provides four gain settings.
- 4 When you have chosen the desired option, press Set.

Pitch Memory/Hold

Pitch Memory is useful when resolving SYNC I/O to off-speed, free-running LTC. When Pitch Memory is enabled, SYNC I/O will remain at a pitch (sample rate) that corresponds to the last known clock reference speed.

P I C H H L D

 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 SYNC I/O pitch memory feature:

- 1 Select Pitch Hold (PICH HLD), using the Set, Down, and Up switches.
- 2 Press Set again. The LED Time Code Display will display the current setting (on or off).
- 3 Use Down and Up to scroll parameters.

4 When you have chosen your desired option, press Set. SYNC I/O retains the setting, even when powered off, until it is changed.

Bi-Phase/Tach Pulses Per Frame

Bi-Phase/Tach involve several settings, including pulse per frame. This sets the number of Bi-Phase/Tach pulses per frame of time code.



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 Set again. The LED Time Code Display shows the current parameter values, in pulses per frame. The readout will look similar to this:
0002
- 3 Use Down Up to scroll parameters. Pressing and releasing the switches will change the value by just one pulse per frame. Pressing and holding the switches scrolls at a faster speed.
- 4 When you have chosen your desired option, press Set. SYNC I/O will retain the setting, even when the unit is powered off and on again, until it is changed.

Bi-Phase/Tach Input Signal

In addition to other Bi-Phase/Tach parameters, the Input Signal defines the *direction* of the Bi-Phase/Tach signal.



For complete instructions, see “Bi-Phase/Tach Signal” on page 44.

Video Format/System

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



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 other parts of the world) should select PAL.

▲ Please be sure you have selected the correct format! SYNC I/O 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 Set again. The LED Time Code Display will show one of the following:
 - NTSC (n75C)
 - PAL (PAL)
- 3 Use Down and Up to toggle parameters.
- 4 When you have chosen your desired option, press Set.

SYNC I/O 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 SYNC I/O is generating time code. Optionally, this output can be muted 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 turn Idle MTC off.
- 4 Press Set again to exit and return SYNC I/O to its previous state.

For SYNC I/O Setup instructions for Idle MTC, see “MTC Output and Idle Muting” on page 51.

USD Compatibility Mode

This setting lets you turn USD emulation on and off, to support older Pro Tools systems and other audio systems.

Using Fader Start

SYNC I/O provides six GPI outputs in total, two TTL-level and four relays. Together, this combination of outputs makes it possible for SYNC I/O 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 left or right in the Mix window, or up or down in the Edit window. See the Pro Tools Reference Guide for more 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). See “GPI Relay Wiring for Fader-Start” on page 88 for additional GPI information.

Calibrating the SYNC I/O Oscillator

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

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

You may want to recalibrate SYNC I/O 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 – and –
- To restore the original factory setting

 *Oscillator recalibration does not occur during firmware updating or when resetting SYNC I/O to factory defaults (see “Restoring Factory Settings” on page 62).*

Oscillator Resolution and Stability

SYNC I/O calibration units are in 1/64th of a sample period. What this means is that SYNC I/O 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. SYNC I/O's accuracy is possible because it contains a low-jitter, high-stability temperature controlled crystal oscillator.

Warm Up SYNC I/O Before Recalibrating

Before you begin the calibration procedure, power on SYNC I/O 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 SYNC I/O to warm up for at least 30 minutes and that the chassis be at normal operating temperature.

The original Oscillator Calibration value is printed on the factory sticker, on the SYNC I/O bottom panel.

To restore the SYNC I/O 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:

OSC CAL

- 3** Press Set again. The LED Time Code Display shows 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 SYNC I/O bottom panel.
- 5** Use the Down and Up switches to scroll through the parameter values.

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 SYNC I/O 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

SYNC I/O can be reset to its default factory settings.

To reset all parameters to default settings:

- 1** Switch off power to SYNC I/O and wait at least 10 seconds.
- 2** Hold down the Up and Down front panel switches and turn on power to SYNC I/O — do not release the Up and Down switches until the display reads FAC-CFG.

⚠ *Resetting factory settings does not reset the SYNC I/O oscillator. See “Calibrating the SYNC I/O Oscillator” on page 61 for information.*

Factory Default Settings

The following table lists the default settings of each parameter.

SYNC I/O 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
Pull Rates	Off
Base Clock	Session (1x Word)
(VITC) Reader Line	All
(VITC) Generate Line	14 - 16
Window Burn On/Off	On (Enabled)
Freewheel Duration	8 frames
LTC Output gain	3 dBu
Servo gain	-001
Pitch Hold	Off
Bi-Phase Pulse-per-frame	0100
Bi-Phase Signal	A Lead B
Video System/Format	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

Managing and Selecting Video Inputs

SYNC I/O has two independent video inputs, referred to as “Video In” and “Video Ref” on the SYNC I/O 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. SYNC I/O 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 63.

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

Using Video Inputs with VITC and the Character Generator

Unlike selecting a video input to use for Clock Reference, input selection for VITC and character generator functions follows a simple rule. This rule is explained in the following sections and in Figure 3 on page 64.

Video Ref 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 on page 64, this scenario is identical to “Route A.”

Video In For all other combinations of Clock Reference and Positional Reference, VITC and character generator functions are applied to the video signal arriving at the Video In connector. In this way, SYNC I/O can read VITC from your videotape, or add VITC with or without character generation (window burn) while dubbing to a second VCR. In Figure 3 on page 64, this scenario is identical to “Route B.”

To understand why these rules exist, let's examine how the circuitry works within SYNC I/O (see Figure 3):

The clock reference (labelled Sample Clock Resolver Circuit in Figure 3 on page 64) 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 SYNC I/O is reading incoming time code or generating new time code. Even in Generate mode, SYNC I/O needs to use this circuitry to detect the frame edge of the video in order to generate time code.

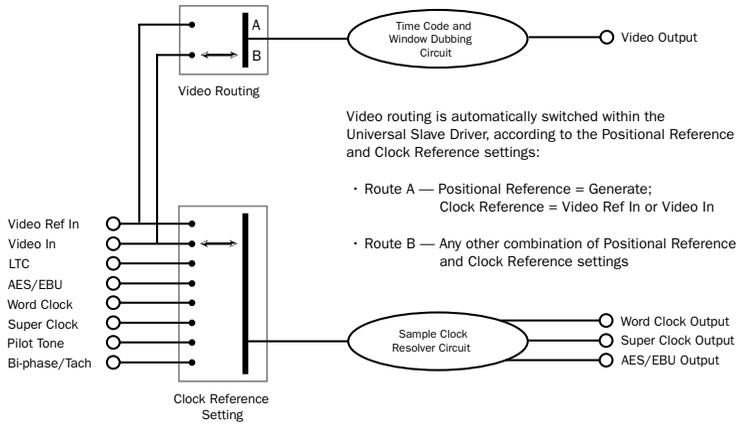


Figure 3. Video Input Flow diagram, USD

Additional Synchronization Information

Video and VITC Signals

Black Burst and House Video Reference

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 house video reference/black burst output of another device in the chain.

Resolving to video instead of house video reference (black burst)

There are several reasons why you would resolve SYNC I/O to a video signal rather than house sync.

When House Video Reference 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 video reference /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 SYNC I/O, 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 a house video reference).

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*, it is meant 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 SYNC I/O. As another example, in Generator Preset Mode (Positional Reference = Generate), a clock reference of Internal is not a good choice, simply because the SYNC I/O internal crystal runs asynchronously with respect to the supplied video signal, and thus repeated or skipped frame addresses are sure to eventually occur.

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 SYNC I/O 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.

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

LTC Servo Gain

You can adjust the servo gain of the SYNC I/O LTC input using the front panel controls. See "Servo Gain" on page 58 for more information.

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 SYNC I/O 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 SYNC I/O 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

- ◆ SYNC I/O 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.
- ◆ SYNC I/O 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, SYNC I/O 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, SYNC I/O waits until the freewheel duration has expired before attempting to switch over to the opposite source. If neither source is available, SYNC I/O 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.

SYNC I/O is able to resolve to AES/EBU and Word Clock.

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 SYNC I/O to such a system, you will want to use the SYNC I/O AES/EBU input as the clock reference connection, so that all system components are referenced to the same time base. (Note that AES/EBU does not support 176.4 kHz and 192 kHz sample rates.)

In some cases (such as using SYNC I/O as a stand-alone 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.

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.

Bi-Phase/Tach

Bi-Phase and Tach are 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 SYNC I/O can use as its clock reference, at nearly any speed including still/paused.

SYNC I/O uses the phase relationship between the two square waves to determine the device’s direction (forward or reverse). However, this is relevant only when SYNC I/O 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. SYNC I/O 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 SYNC I/O Setup’s Pulse Per Frame setting, you can set SYNC I/O to match the PPF rate of the external device’s Bi-Phase/Tach encoder.

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 SYNC I/O 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:

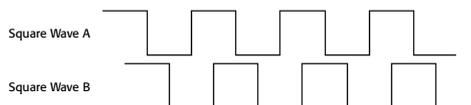


Illustration of Bi-Phase/Tach signals

With a Bi-Phase signal, SYNC I/O 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 SYNC I/O 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 SYNC I/O Input Signals options allows you to choose the appropriate method (Tach: Fwd = B is Low, or Tach: Fwd = B is High).

This explains how SYNC I/O 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 SYNC I/O is told the starting frame of the first clock signal.

Pilot Tone

SYNC I/O 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 Specifications

General

Nominal Sample Rates	44056 Hz (Pull Down)	
	44100 Hz	
	44144 Hz (Pull Up)	
	47952 Hz (Pull Down)	
	48000 Hz	
	48048 Hz (Pull Up)	
	88200 Hz (Up/Down)	
	96000 Hz (Up/Down)	
	176400 Hz (Up/Down)	
	192000 Hz (Up/Down)	
Frame Rates	30 fps	
	30 fps drop-frame	
	29.97 fps	
	29.97 fps drop-frame	
	25 fps	
	24 fps	
Variable Speed Override	±699 cents (±58.25%)	Actual range varies with sample rate

General

Resolver Lock Time	LTC:	750 msec
	Video:	1.5 sec
	Word Clock:	750 msec
	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)	
Vibration Resistance	5 mm displacement, 10 to 55 Hz, each axis	
Shock	5 G max	

General

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, CD EN 55022A, CE EN 60950, CE EN 55081:1, 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

Rear Panel Connectors

Connector	Specifications	
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 (minimum):	100 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
Video (Main) Out	Level:	1V p-p
	Source Impedance:	75 ohms
Video (Ref) In	Format:	NTSC or PAL composite video

Rear Panel Connectors

Connector	Specifications	
	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)
	Connector:	BNC Female
Loop Sync In	Level	0 to .5 V (low), 2.0 to 6.0 V (high)
	Connector	BNC Female

Rear Panel Connectors

Connector	Specifications	
Loop Sync 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 12V, 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
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

Rear Panel Connectors

Connector	Specifications	
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 Kilobaud
	Connector:	5-pin DIN female
	Cable Length:	50 feet (15 meters) max
Host Serial	Format:	Apple Macintosh-compatible serial printer port
	Connector:	8-pin mini DIN female
	Cable Length:	50 feet (15 meters) max

Rear Panel Connectors

Connector	Specifications	
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

appendix c

Wiring Diagrams Pin Assignments

LTC

The SYNC I/O 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.

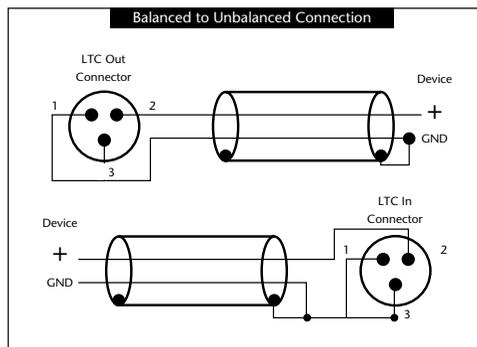
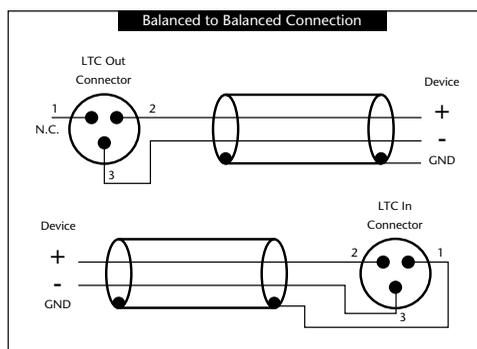
If you are connecting a balanced signal to the SYNC I/O LTC In or LTC Out connectors:

- 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 SYNC I/O LTC In or LTC Out connectors:

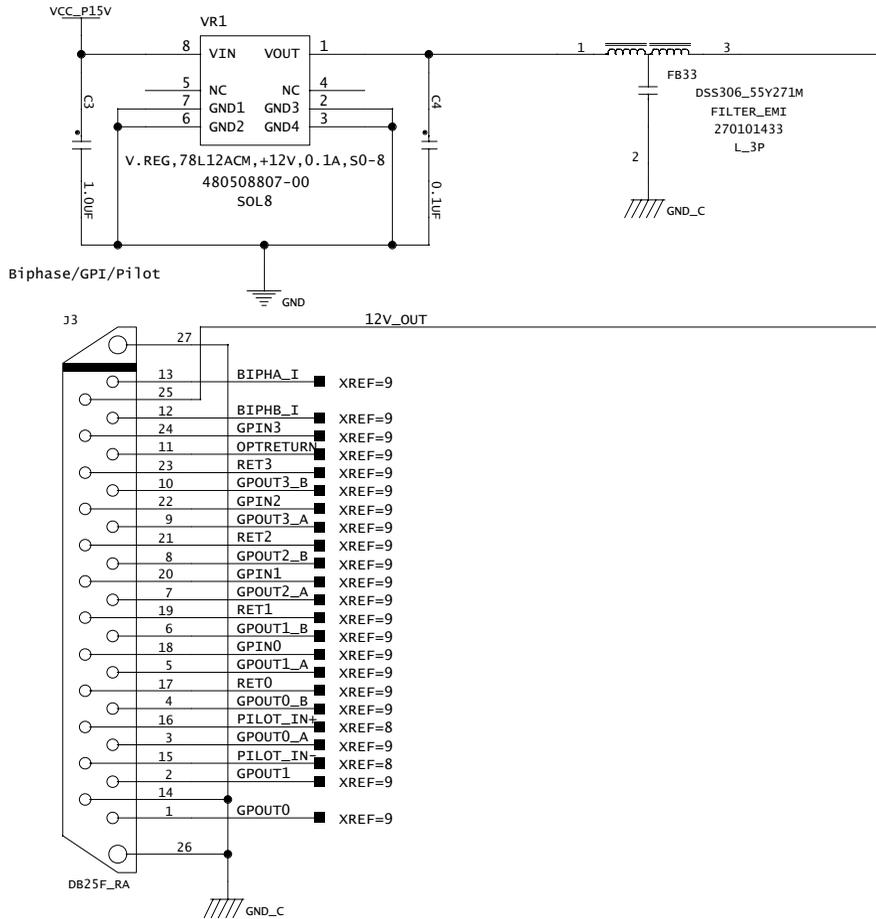
- Connect only Pin 2 to the “+” signal;
- Connect Pin 1 to ground at all inputs and outputs.

Refer to the following illustration for the correct wiring diagrams.



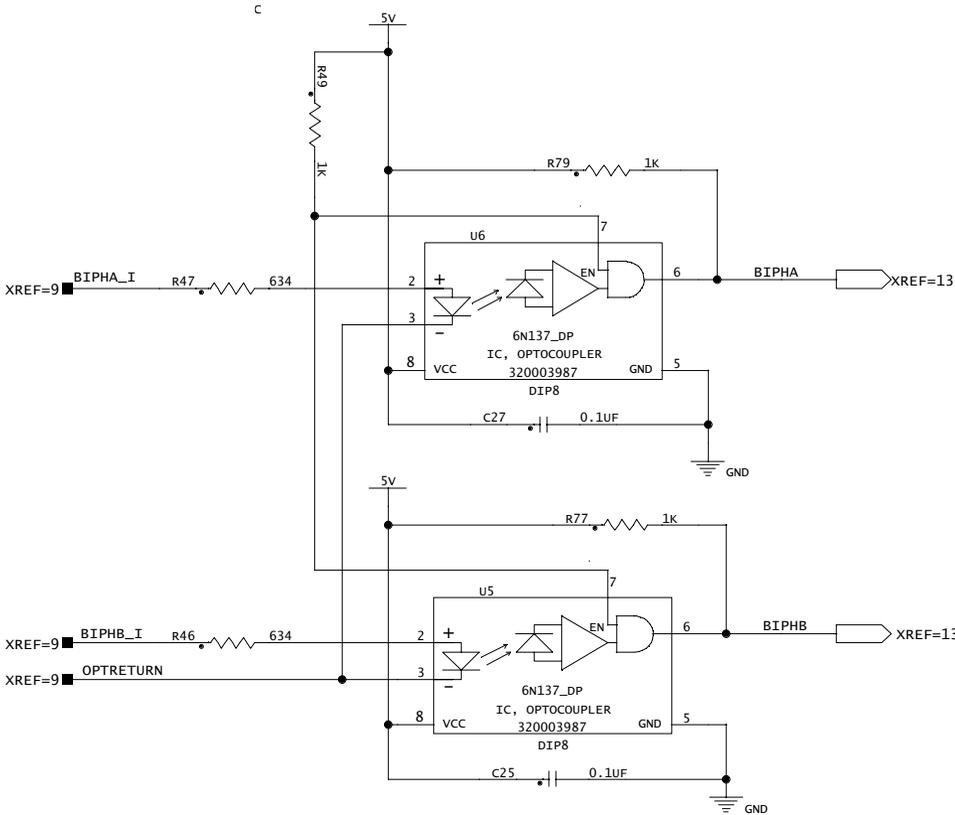
Wiring diagrams for the SYNC I/O LTC In and LTC Out connectors

BiPhase/GPI/Pilot



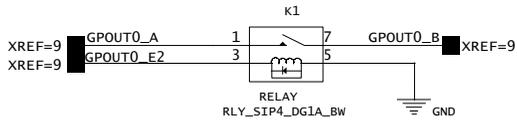
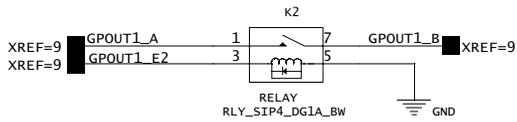
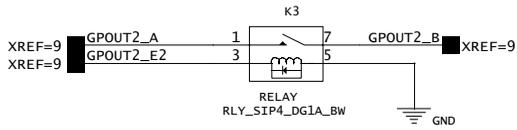
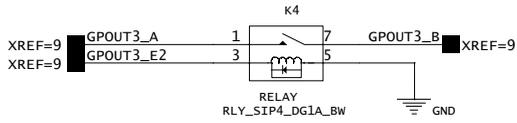
Bi-Phase/GPI/Pilot

Bi-phase/Tach OptoCoupler Input



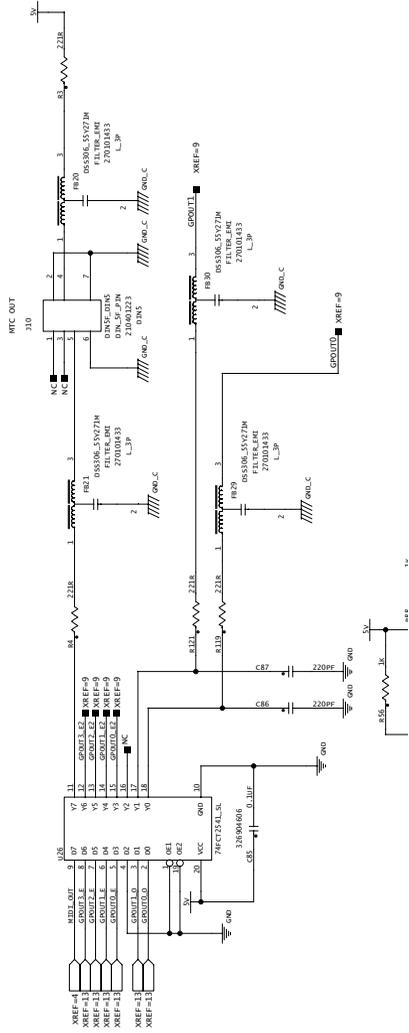
Bi-phase/Tach

GPI Relay Outputs



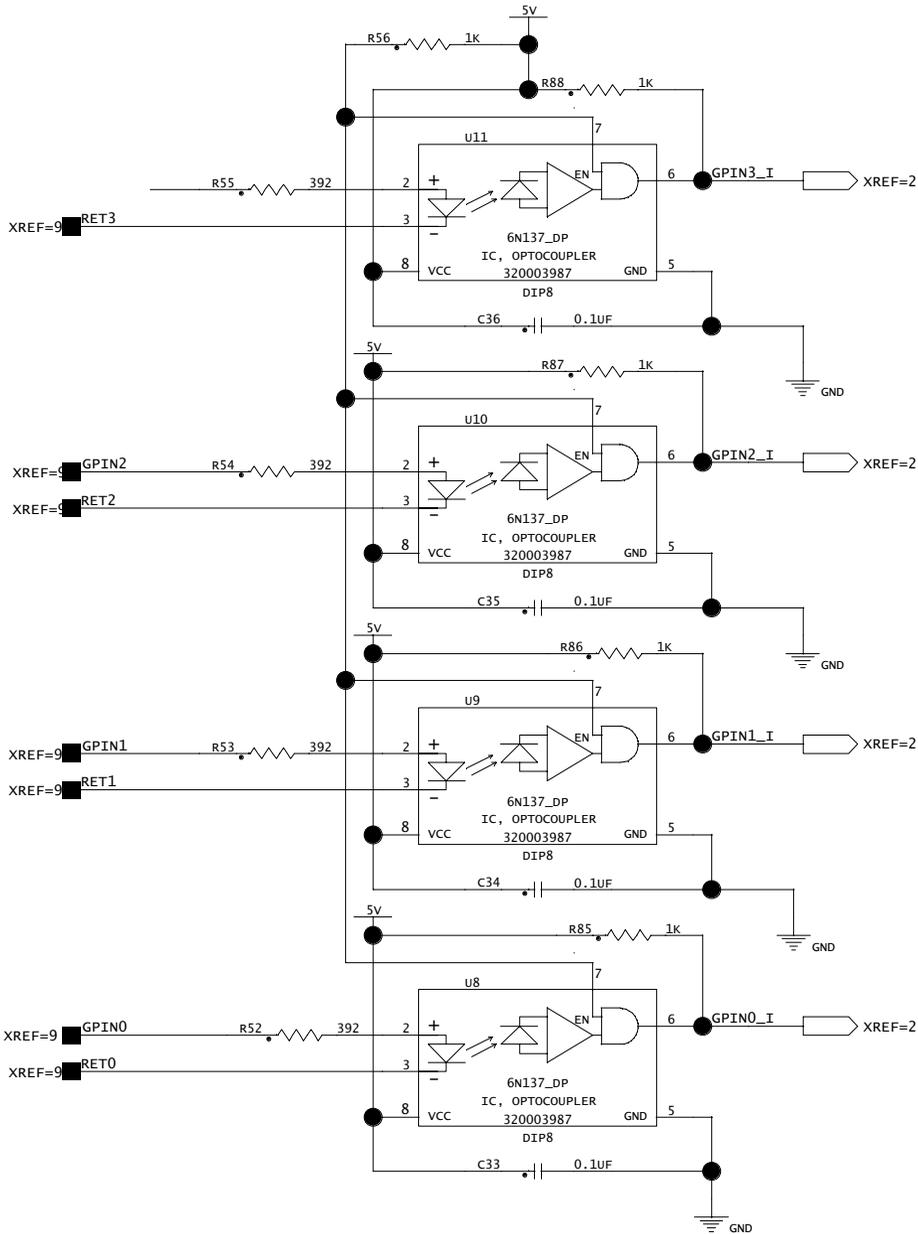
GPI Relay Output

GPI (TTL)/MTC Outputs



GPI TTL/MTC Output

GPI (opto) Inputs



GPI (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
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	

Connector Pin Assignments

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	
15	PILOT_IN-	Pilot tone input, negative	
16	PILOT_IN+	Pilot tone input, positive	
17	RET0	Return from GPI opto-isolator "0"	
18	GPINO	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	+12V DC	
Shell	GND	Connected to chassis ground	

SYNC I/O Serial Cable Pin Assignments

(Macintosh)

The following table shows the pin assignments for DigiSerial Macintosh.

DigiSerial for Macintosh

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

(Windows)

The following table shows the pin assignments needed for a SYNC I/O-to-COM cable, to support SYNC I/O Setup on a Windows computer.

Host Serial for Windows

Mini DIN 8-pin Male to 9-pin D-Sub Female	
2	7
3	2
4	5
5	3
7	8
Shell	Shell
1, 6, 8 none	1, 4, 6, 9 none

Bi-phase/Tach/GPI/Pilot Port Interfacing Notes

◆ The six opto-isolators are 6N137 devices. The four GPI input ports pass through 390 ohm series resistors to the cathode. The two Bi-Phase/Tach inputs pass through 634 ohm series resistors to the cathode.

◆ The two TTL-level GPI outputs are driven by a 74FCT541. Each output passes through a 220 ohm series resistor.

◆ 12 volts is supplied at the connector for the purpose of driving the opto-isolators in film tach applications. It is regulated and can supply up to 100mA.

◆ 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 must 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 SYNC I/O or cause personal injury.

index

Numerics

- 14/16 VITC line pair 49
- 1x 67
- 256x Slave Clock 11
- 4% pull down 24
- 4.167% pull up 24
- 9-pin 11, 18
 - MachineControl serial time code 35
 - Port 1 and 2 27

A

- absolute time code (and LTC) 41
- AC Power In 27
- AES/EBU
 - choosing as clock reference 36
 - connecting 13
 - In 27
 - Out 27
- Agency Compliance (FCC) 73
- Auto ID 15
- Auto Switch 43
 - and freewheel duration 67

B

- back panel 26
- base clock
 - external clock output 56
- Bi-Phase/Tach 26, 43, 68
 - controls in SYNC I/O Setup 30
 - for mag, flatbed, projectors 38
 - front panel display of 59
 - GPI Relay Outputs diagram 82
 - GPI/Pilot pin assignments 85
 - input wiring diagram 80, 81
 - positional reference 43
 - technical signal information 68
- black burst 12
 - house video reference 26

- black burst (house video reference) 35
- BNC 36
 - back panel 26

C

- character generation (see Window Dub)
- clock reference 16
 - and clock source 16
 - choosing digital source 36
 - front panel switch 23
 - LEDs 23
 - SYNC I/O Setup 28
- Clock Source 16
- Color, for window dub 52
- Connected to SYNC I/O 29

D

- DASH 36
- DAT signals 67
- DF
 - drop and non-drop 25
 - front panel LED 25
- DF (LED) 25
- DigiSerial Port 3, 11
- digital
 - AES/EBU, Word, Super 67
 - clock reference front panel 56
 - clock, setting 36
- Down switch 33
- drop outs
 - and auto-switch LTC/VITC 67
 - and time code freewheel 41
 - LTC tips 66

E

- emulation
 - of 9-pin deck via Remote mode 11
- external clock out 56

F

- factory defaults, reset 62
- fader start
 - and GPI wiring 88
 - overview of 60
 - using 60
 - wiring instructions 88
- fields (odd/even) indication 28
- firmware
 - updating 20
- flatbed and Bi-Phase/Tach 38
- fps 29
- frame edge 63
- Frame Rate 18
- frame rate
 - front panel switch 25
 - SYNC I/O Setup 29
- freewheel duration 29
 - and auto-switch LTC/VITC 67
 - front panel display of 57
- front panel
 - Lockout mode 31
 - switches and displays 23

G

- generate
 - time code gen/regen 45
- Generator
 - Bi-phase Preset 30
 - controls for 33
 - Preset Mode 46
 - Reference Rule 46
 - Running 29
- Generator/Parameter Controls 33
- GPI
 - and fader start 60
 - back panel connector 26
 - pinout 80
 - TTL wiring 88
- GPI (opto) Inputs 83

H

- Host Serial 26
- house sync
 - connecting 12

I

- Idle MTC Enabled
 - front panel 51
 - in SYNC I/O Setup 51
- installation
 - SYNC I/O and a CPU 8
- internal clock 39

K

- kHz (sample rates) 24

L

- LED Time Code Display 24
- LEDs 24
 - Locked and Speed Cal 17
- legacy interfaces 10
- Locked 17, 25
 - LED and troubleshooting 25
- Loop Master 23
- Loop Sync 14, 27
 - Auto ID 15
 - connecting 10
- LTC 12
 - and clock reference 37
 - generation/regeneration 47
 - In (back panel) 27
 - LTC 1 (fastest) 37
 - LTC 2 (average) 37
 - LTC 3 (smoothest) 37
 - Out (back panel) 27
 - output level (SYNC I/O Setup) 29
 - output level/gain (front panel) 58
 - positional reference 41
 - servo gain 58
 - wiring diagrams 79
- LTC Gain 34

M

- Mac Serial Port
 - pin-outs 85
- MachineControl 18
 - SYNC ports for 8
- mag and Bi-phase/Tach 68
- monotonic VITC 65
- MTC 50
 - and Idle MTC Output 30
 - burst mode 51
 - generation/regeneration 50
 - Out (back panel) 27
 - pinout 83
 - time code output 27
- MTC Out 13

N

- non-drop
 - display of 25
- NTSC
 - about 29
 - or PAL, selecting 59
- null clock 67

O

- operating 31
- oscillator reset 61

P

- PAL
 - about 29
 - and Pilot tone speed 38
 - or NTSC, selecting 59
- phase
 - see Bi-phase 68
- Pilot
 - back panel port 26
 - pinout 80
 - Tone speed 38
 - Tone, general 38
- Pin 1, 2, 3 (LTC) 79
- Pitch Memory 40
 - enabled (SYNC I/O Setup) 30
 - front panel (pitch hold) 58
- Port Relinquished 29

- positional reference 17
 - about 41
 - front panel LEDs 25
 - front panel switch 25
 - SYNC I/O Setup 29
- Pro Tools|24 MIX
 - clock connections 11
- Pull Down
 - actual rates 24
- Pull Rate 28
- Pull Up and generating 45
- Pull Up and Pull Down
 - actual rates 24
- Pulses Per Frame
 - configuring 38
 - front panel 59

Q

- Quadrature Sync 68

R

- Read/Regeneration Mode 45
- reference
 - clock, digital signal information 67
 - list of supported 4
- regenerating time code 45
- relays 60
- Remote Mode
 - about 31
 - and SYNC I/O Setup 31
 - connections for 9-pin deck emulation 11
 - LED for 25
- Remote-Only Mode 31
- Resolver Locked 29
- RUN/STOP+CLEAR 33

S

- sample rate 17
 - and pull options 24
 - and pull up/down rates 24
 - and Speed Cal status display 25
 - front panel (sample frequency) 56
 - front panel LED displays 24
- SECAM 29
 - use PAL 59
- serial port 26
- serial time code
 - and clock reference 35
 - special clock information 35
 - using for positional reference 43
- Servo Gain 58
- Slave Clock
 - 256x clock information 36
- Slave Clock (see SuperClock) 36
- Slave Clock (SYNC I/O Setup) 28
- Speed Cal 17
 - display in SYNC I/O Setup 29
 - front panel LED and troubleshooting 25
- Status
 - in SYNC I/O Setup 29
 - LEDs 25
- Super Clock
 - choosing as clock reference 36
- SYNC I/O 1
 - checking status in SYNC I/O Setup 29
 - control options for 31
- SYNC I/O Setup
 - overview 28
 - serial port requirements 3
 - setting up 19
 - Status 29
 - time code display 28
 - window, features 20
 - wiring diagram for Windows 87
- system requirements
 - Pro Tools|HD 2
 - Pro Tools|24 MIX 2

T

- Tach
 - additional signal information 68
 - connector, back panel 26
- terminated
 - Video Ref 26
 - Video Ref In 26
- time code
 - drop outs, freewheeling 41
 - generating/regenerating 45
 - MIDI (MTC output) 27
 - serial 35
 - SYNC I/O Setup display 28
- TTL 83
 - wiring 88

U

- Universal Slave Driver
 - front panel operation 23
- Up switch 33
- updating firmware 20
- USD Emulation mode 32
- User Sync
 - see base clock 28

V

- Variable Speed Override (VSO) 30, 39
- Vertical Position 52
- video
 - connecting 12
 - format, SYNC I/O Setup 29
 - managing inputs 63
 - NTSC versus PAL, front panel 59
 - odd/even field, display of 28
- Video In
 - back panel connector 26
 - connecting to 12
- Video Out 26
- Video Ref
 - and terminator for 26
- Video Ref In
 - connecting 12
- Video Ref Out
 - back panel connector 26
- Video Ref Thru
 - connecting 12

VITC

- as positional reference 48
- connector for positional reference 26
- default line pair 49
- Generate Lines (SYNC I/O Setup) 29
- Generate Lines, front panel details 57
- Insertion Enabled (SYNC I/O Setup) 30
- Insertion, front panel details 56
- monotonic 65
- positional reference 42
- Read Lines (SYNC I/O Setup) 29
- Read Lines, defaults 29
- Read Lines, front panel details 57
- related settings for 42
- timing rule 65
- video source rule 48

VSO 30

- VTR emulation (see also Remote 9-Pin Deck Emulation) 11

W

window dub

- front panel enable 57
- generating 51
- setting color 52
- vertical position 52

wiring

- SYNC I/O Setup for Windows 87

wiring diagrams 79

Word clock

- 1x clock 36
- about 67
- base clock output 56
- choosing as clock reference 36
- connecting 12
- In connector 27
- Out connector 27

