

Operating Manual

Keyboard Control Unit

Assistance and Information

TimeLine

1755 La Costa Meadows Drive:
Suite B
San Marcos, CA 92069

Technical Support

Phone: (760) 761-4440
Fax: (760) 761-4449
SUPPORT@TIMELINEVISTA.COM

Software Version

Serial Number

Technical Assistance is available *ONLY* if the Keyboard Control Unit (KCU) is registered. Mail in your Warranty Card immediately to register the KCU.

Remember, when calling for technical support, you must provide the software version and KCU serial number so that we can give you accurate and prompt assistance.

Printing History

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Each revision will cause the letter to the right of the manual part number to change. The purpose for each revision will be listed below. Events such as the addition of a feature or functional test will cause the revision number to change.

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Note: A Note provides information about or an explanation of a topic related to the subject being discussed.

Warning

Warnings describe a procedure that if not followed as specified could potentially cause damage to the equipment, a loss of data, or create an error condition.

Manual Contents and Use

This manual starts with information that is used most frequently and moves to less frequently used information. To use the manual effectively, first review the applications and system configurations presented in the Applications chapter to determine your requirements and preferences.

Then use the Installation chapter to install the Keyboard Control Unit and make the correct equipment connections. Follow the initialization and start up tutorial described in the Getting Started chapter to get a “hands-on” demonstration of the KCU’s capabilities.

If you experience any difficulties, refer to the Troubleshooting chapter to analyze the problem. Refer to the subsequent chapters for detailed information about each of the KCU functions.

- Introduction** Provides KCU features, a system overview, system configurations, and specifications.
- Applications** Illustrates some of the most common KCU applications.
- Installation** Describes KCU installation and interface procedures.
- Getting Started** Describes KCU basic operating procedures.
- Troubleshooting** List the most common KCU messages, prompts, and warnings.
- Features and Controls** Describes the key functions of the KCU.
- Advanced Features** Describes those functions available uniquely in non-080 series

KCU software configurations.

Appendix SMPTE Made Simple

Provides basic information and various applications using SMPTE time code.

Key Combination Guide

Provides Key and Key Combination Identification Numbers for "stuck key" errors.

Glossary

An alphabetic list of terms used during the discussion of the KCU.

Quick Reference Guide

Graphical charts of the KCU Setup options.

Conventions Used for Examples

This manual uses the following conventions.

- Press** Press a key, generally a movement key or function key such as [CLR].
- Select** Press or adjust the indicated key or wheel to obtain a result or display
- You see** A key word, indicator, or number that you can see on the front panel or display.
- [CLR]** This indicates a particular key on the KCU, such as the clear key in this example.
- LED** This is one of the lights on the KCU.
- Key** Each of the buttons, switches or keys on the KCU that you press to cause something to happen.

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Chapter 1 Introduction

The Lynx Keyboard Control Unit (KCU) is a versatile, powerful machine controller and editor, encompassing a wide spectrum of multiple machine synchronization and audio editing applications.

Because the operating environment of the KCU incorporates multiple microprocessors, there are several versions of software available. Features vary with each software version. This manual describes the KCU features and functions when fitted with the following series of operating software:

- KCU080 Stand-alone KCU operation
- KCU300 System Supervisor Unit, multiple controller operation
- KCU600 Stand-alone Varispeed synchronization

This chapter introduces the KCU in the following categories:

- KCU features
- System overview
- System configurations
- Specifications

Keyboard Control Unit Features

The KCU provides comprehensive control of up to six tape or film transports and two programmable GPI (General Purpose Interface) relay closures. Machines may be operated individually, or any selection of available machines may be operated as a synchronized group. Any machine may be operated as the master transport for group operations.

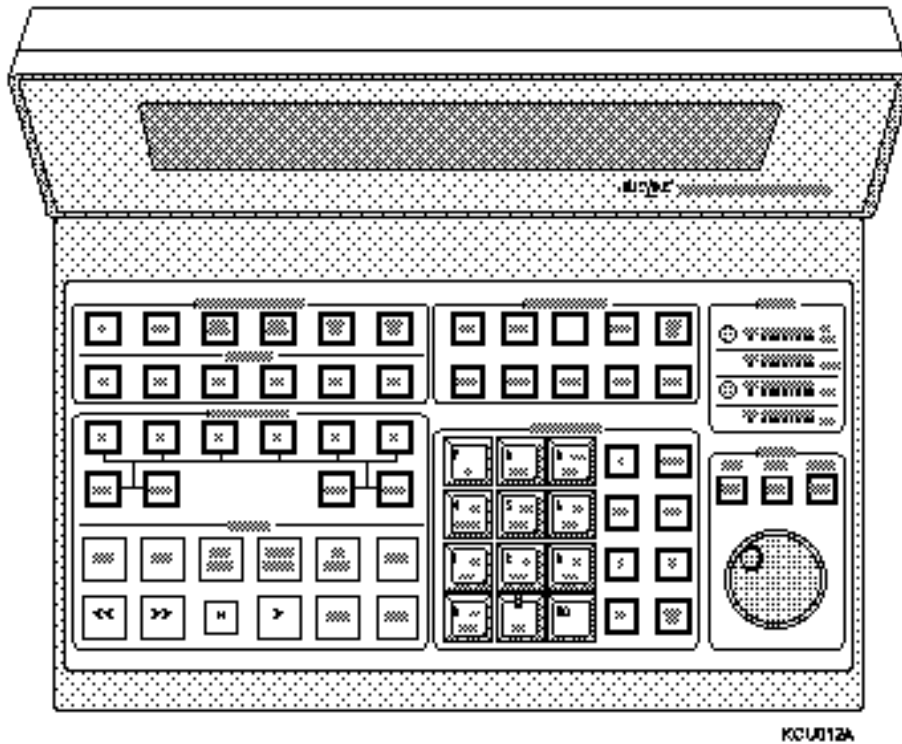


Figure Chapter 1 -1. Keyboard Control Unit

The following is a partial list of features of the Keyboard Control Unit (KCU):

- User panel with lighted keys.
- Two-row alphanumeric display with large (.25" high), blue-green characters.
- Programmable macro keys to execute complex operations with a single keystroke.
- Special function keys for single keystroke time code capture and store-to-key data registers.
- Calculator keypad for direct entry of time code numbers.
- Calculator keypad for track enable.
- Calculator keypad to control data access in system register store and recall operations.
- Jog wheel for shuttle and frame jog functions with VTRs and many ATRs.
- Jog wheel for trimming of data register values in frames and subframes.
- Intuitive, prompting environment to minimize the need for operator training.
- All time code and system setup data retained when powered down, due to independent CPU with battery backed-up RAM.
- Two GPI relays, including dialog beep mode with menu selections for three or four beeps, beep spacing, and beep duration.
- System lock tally.
- Supervisor Port communicates with Lynx System Supervisor Unit.
- Large illuminated transport keys operate single transports (Solo mode) or all selected transports (Group mode).
- 25-foot RS422 cable provided to connect KCU power supply and the first Lynx-2 module.

System Overview

This section describes the following components of the KCU system (shown in the following figure):

- Keyboard Controller Unit (KCU)
- Lynx-2 and Lynx Time Code Modules
- Lynx System Supervisor Unit (SSU)
- Lynx Console Control Unit (CCU)
- Remote Motion Controller (RMC)
- Jog/Shuttle Wheel

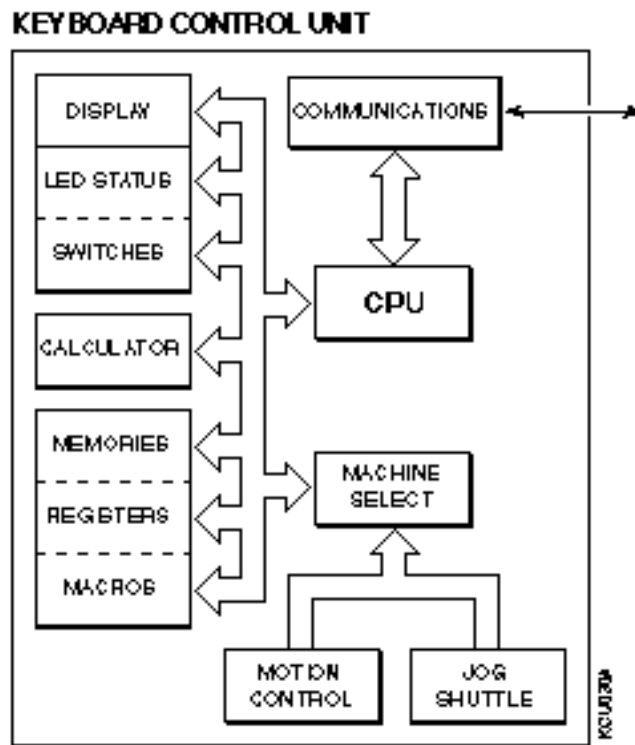


Figure Chapter 1 -2. System Overview

See the Applications chapter of this manual for examples of configurations to meet specific needs.

Keyboard Control Unit (KCU)

The Keyboard Control Unit (KCU) allows remote control of up to six machines. Editing and control commands are entered on the keyboard. Time code status and register contents appear on the 40-character fluorescent display that is hinged above the keyboard.

The control panel is designed with separate key banks for ease of operation for the following:

- Motion control
- Device selection
- Function macros
- Special functions

A numeric calculator keypad addresses specific devices and associated memory registers, performs time code calculations, and allows direct input of time and numeric data.

The KCU keypad jog/shuttle wheel allows jog operations and shuttle operations. The wheel can be used for convenient trimming of numeric data.

Using the KCU is described in the Getting Started and the Features and Controls chapters of this manual.

Lynx System Supervisor Unit (SSU)

The Lynx System Supervisor Unit (SSU) is a sophisticated communications interface unit. The SSU provides integrated control of a variety of devices used in audio and sound post-production environments.

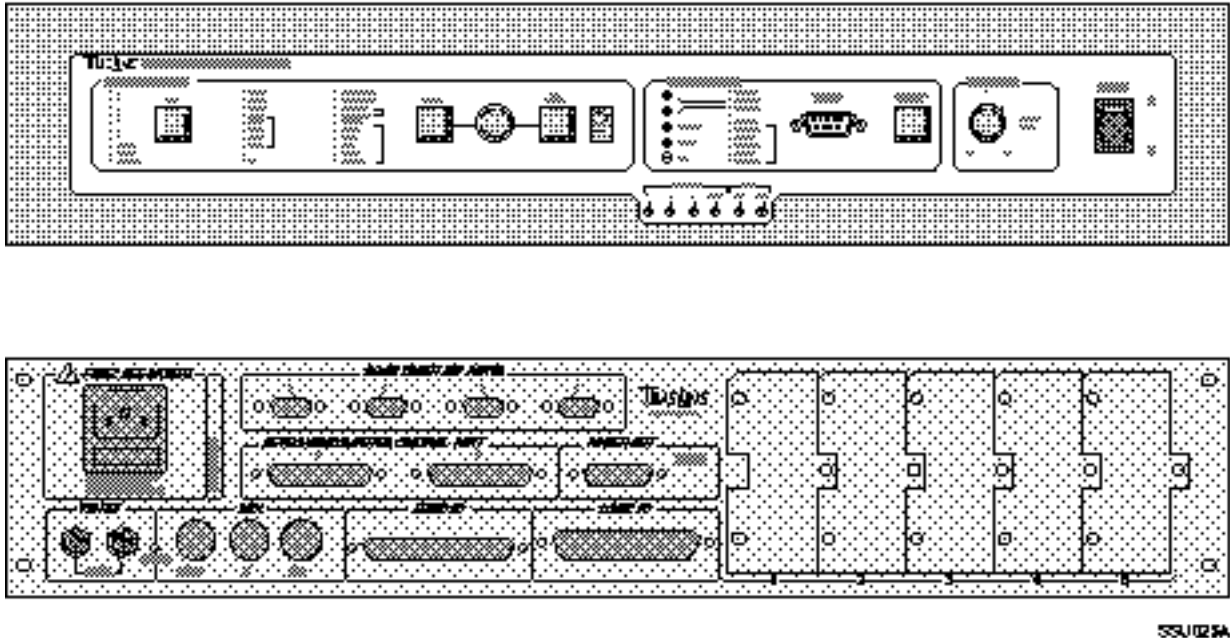


Figure Chapter 1 -4. System Supervisor Unit

The SSU simplifies external computer control of a complex post-production system. The SSU assumes the workload of all high-speed data communications necessary to control and synchronize tape machines and film transports, via Lynx-2 and Lynx Time Code and Film Modules.

The SSU provides a variety of additional control facilities including, but not limited to, eight GPI relays, two annunciator outputs, three externally controllable time code outputs, multiple remote controller connections, and MIDI Time Code output.

Using the Lynx SSU is described in detail in the Advanced Features chapter of this manual.

Lynx Console Control Unit (CCU)

The Console Control Unit (CCU) is a keyboard input accessory for the System Supervisor Unit. A CCU may be used in conjunction with a KCU. The optional Jog/Shuttle wheel assembly is available for console mounting.

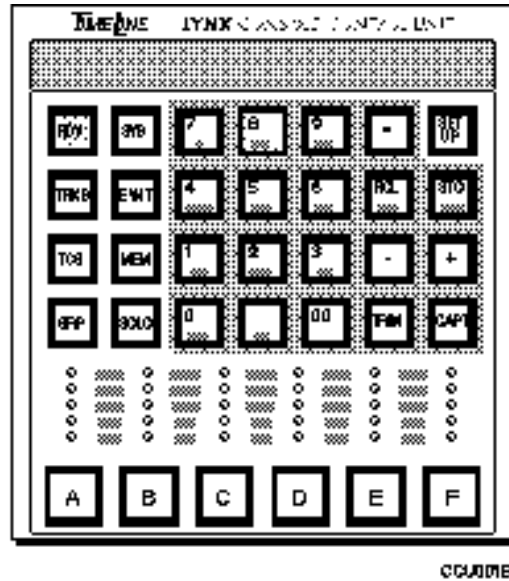


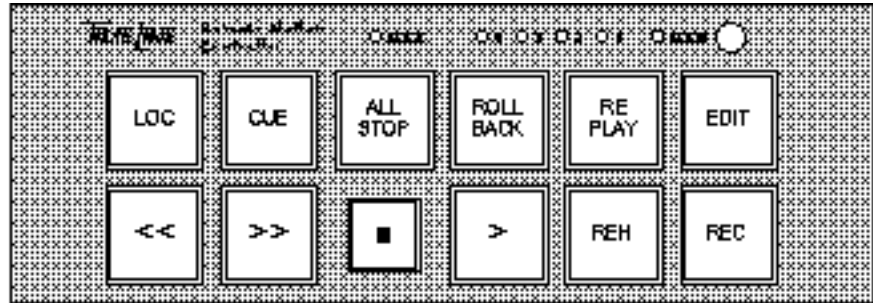
Figure Chapter 1 -5. Console Control Unit

The miniature CCU keyboard mounts in the faceplate of Neve, SSL, and other consoles. The CCU handles up to six transports. Multiple CCUs can be connected to the System Supervisor Unit to provide expanded configurations for film dubbing multiconsoles.

Each operator has individual control of machine transport functions.

Remote Motion Controller

The Remote Motion Controller (RMC) mirrors the motion control switches of the KCU.



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Figure Chapter 1 -6. Remote Motion Controller

The RMC may be added to the System Supervisor Unit to provide an additional remote transport controller, or to provide machine control and editing features for a CCU/SSU installation. The RMC provides LED indications for ADR beep countdown, group lock, and loop. The RMC is available as a kit for mounting into a console or other remote location.

Jog/Shuttle Wheel Assembly Kit

A Jog/Shuttle Wheel assembly kit is available for customer installation into several System Supervisor Unit applications. The Logic I/O connector on the back of the SSU provides for a connection to the Jog/Shuttle Wheel outputs. Please refer to the System Supervisor Unit (SSU) manual for wiring information.

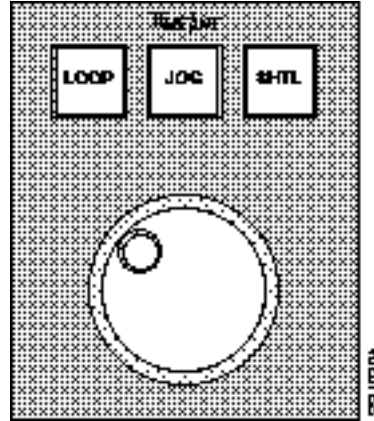


Figure Chapter 1 -7. Jog/Shuttle Wheel

The Jog/Shuttle Wheel assembly provides console-top mounting for CCU or KCU applications, and allows expansion of the Remote Motion Controller. The RMC and Jog/Shuttle Wheel may be configured as a single unit for ease of installation.

System Configurations

In stand-alone operation, the KCU provides control of up to six Lynx-2 or Lynx Time Code or Film modules, two programmable GPIs (General Purpose Interface), and a system lock tally. The KCU handles all the real-time communications with the Lynx Modules via RS422 serial communication.

Lynx modules are daisy-chained to each other with their supplied RS422 connectors, and continue to the KCUs power supply Lynx Port. The 15-pin GPI/Supervisor port on the KCU power supply provides two GPI relay closures to control turntables, CD players, cart machines, and ADR beep outputs. The KCU is connected to its power supply with a supplied 25-pin to 25-pin, 25-foot cable.

When connected to the SSU, the SSU assumes all high speed communication and cabling to centralize operation and installation. The KCU connects to the SSU Computer Control Port, while the Lynx modules connect to SSU Trib Port 1. This configuration provides a total of eight available GPIs, three programmable time code generators, annunciator countdown outputs, a MIDI interface, and system tally status.

See the Applications chapter of this manual for examples of configurations to meet specific needs.

Specifications

This section describes specifications for the KCU.

Keyboard

Display Type	40 character fluorescent, pivot tilting
Keys	57 numeric, function keys 12 transport control keys

Jog/Shuttle Wheel

Communications	RS422, 38.4 k baud asynchronous
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Power Supply

A remote power supply unit connects to the KCU via a supplied single multi-conductor cable, 20 feet long.

Power Supply Mains Input	100-250 VAC at 50/60 Hz W nominal 30 W max.
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Output	+5V, 3A max.
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Physical

Keyboard Size	5 1/8 " high, 12" wide, 8 1/3" deep
Weight	7 lbs., 5 oz.
Mounting	Freestanding

Software Versions

KCU080	Stand-alone KCU operation
KCU300	System Supervisor Unit, multiple controller operation
KCU600	Stand-alone Varispeed synchronization

When the KCU operating software is updated, functional and operational changes are covered in an addendum to this manual. The information on the title page of this manual indicates the date and designation of the latest software version covered by the manual and any included addenda.

TimeLine Vista, Inc. reserves the right to change the design and specification of equipment without notice.

Chapter 2 Applications

Before you configure the Lynx Keyboard Control Unit (KCU), decide what equipment is needed and how you will set up the system.

This chapter illustrates some of the most common KCU applications. Please use these guides in configuring your system to accommodate your specific application:

- Stand-alone KCU operation
- Stand-alone KCU with a VTR
- Varispeed and Gearbox operations with the KCU
- KCU and System Supervisor Unit (SSU) operation

Any combination of Lynx-2 and Lynx modules, fitted with gearbox processor cards and V500 software, can be used with the KCU.

When looking through this chapter, keep in mind that other TimeLine equipment will be configured along with the KCU. Lynx-2 and Lynx Time Code Modules provide the building block starting point for any Lynx Editing System. Install with the greatest attention to detail, as the performance of the entire system depends on their reliability. Please refer to the Lynx-2 manual for system application examples.

Stand-alone KCU Operation

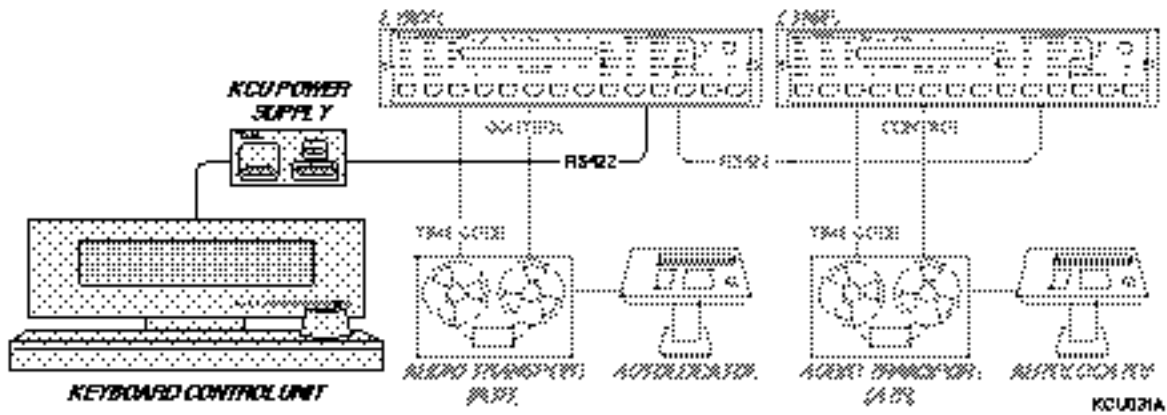


Figure Chapter 2 -1. Stand-alone Keyboard Control Unit

Typical Uses

The KCU adds editing control to multiple machine synchronization systems. The KCU provides a fast and convenient way to perform time code reading and synchronization. It can easily control frequently performed activities such as locating, entering offsets, slipping one tape machine against another, and doing automated edits.

Considerations

The KCU automatically calculates offsets based on machine positioning or register stored time code numbers. You may trim machine offsets with the Jog wheel trim function.

Stand-alone KCU with a VTR

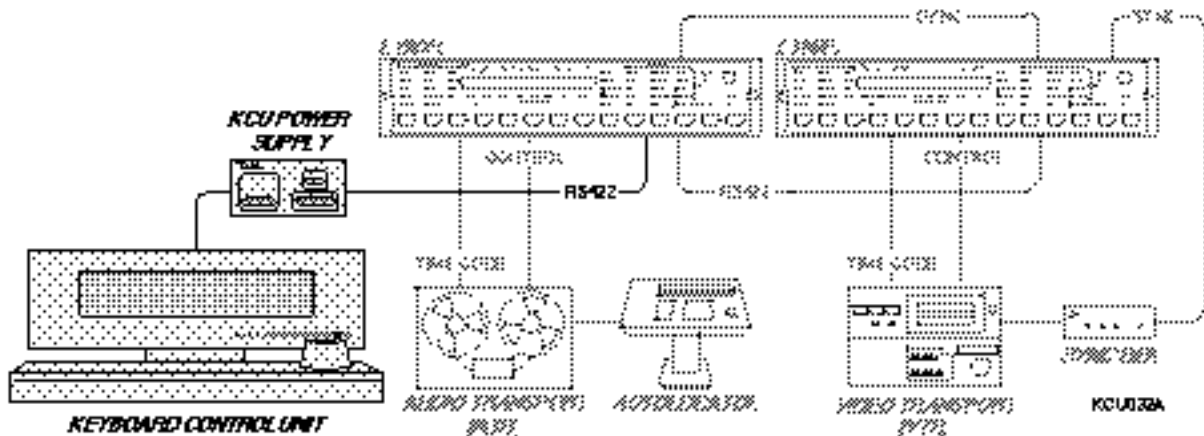


Figure Chapter 2 -2. Stand-alone Keyboard Control Unit with VTR

Typical Uses

TimeLine synchronizers are compatible with numerous video transports including standard 3/4" U-matic, Beta, S-VHS, open reel, and digital VTRs. With the KCU, video machines are always resolved, so they can be selected as master or slave in group machine operations. Track select for serial video machines, including video assembly modes, is available from the KCU calculator keypad.

Considerations

Use an external video sync source as a speed reference source for the Lynx modules and VTRs.

KCU and System Supervisor Unit (SSU) Operation

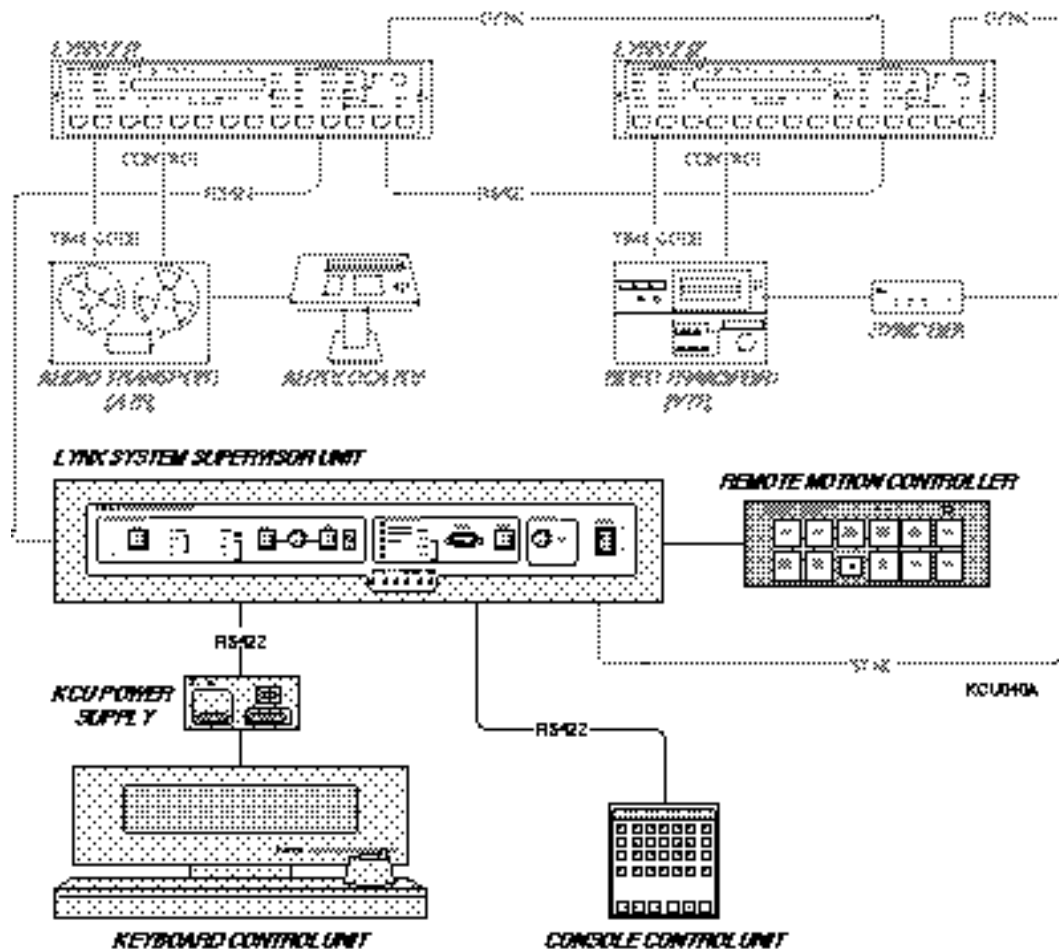


Figure Chapter 2 -4. Keyboard Control Unit and System Supervisor Unit Operation

Typical Uses

Use the KCU with the SSU for unparalleled control of audio, video, MIDI, and console automation systems. Because of the integrated system approach that TimeLine employs, everything can be controlled from the Keyboard Control Unit.

Chapter 3 Installation

This chapter describes installation and interface procedures for the TimeLine Keyboard Control Unit (KCU). It also includes a quick software verification that shows the KCU is operational.

This chapter contains the following information:

- Hardware supplied
- System setup planning
- Installing the KCU
- Quick test and initialization
- Interface diagram

Sections of this chapter assume some prior working knowledge of the Lynx-2 Time Code Module. Correct operation requires that each module be properly installed and initialized. The Installation chapter of the Lynx-2 manual provides detailed information on initialization and installation.

Note: Please save the original factory packaging. It is specially designed to protect your KCU, should it require reshipment.

Hardware Supplied

The KCU includes the following items:

- 1 Keyboard Controller Unit
- 1 KCU Power Supply
- 1 KCU to Power Supply Cable
- 1 KCU to Lynx-2 Cable
- 1 IEC AC Power Cord
- 1 HEX key wrench (to tighten display swivel)

System Setup Planning

Before you install and configure the KCU, there are several fundamental issues to consider.

Power

An AC outlet is required for the KCU. If more than one piece of equipment will be connected to the AC outlet, use a surge-protected power distribution strip as an adequate extension cable.

Cabling

The KCU requires communication and power cabling. Careful connection and routing of cables will ensure a quick and successful installation. Power supply and Lynx-2 cables are included with the KCU.

Power On Initialization

The KCU is supplied from the factory ready for initialization. All parameters of the KCU are stored in RAM, and are restored on subsequent power ups.

On power-up, the KCU will automatically poll any Lynx-2 module that is communicating on the RS422 serial bus. At this point, the KCU is ready to address each module within a group, or individually, for machine control.

Installing the KCU

Because the KCU is a free-standing controller, installation offers configuration choices. The KCU and its power supply have been designed with the utmost in versatility, which provides a simple path for any future upgrade requirements your facility might require.

Cabling

Cable connections are critical. Bad or poorly routed cables are often the cause of installation problems. It is essential that the correct, high quality cables are used to ensure reliable, trouble-free operation.

Cabling harnesses for the power supply and Lynx-2 modules are provided from the factory with every KCU. The KCU power supply also provides outputs for GPI relays and the SSU. Use the following cable requirements diagram to determine what equipment will be connected to the KCU and to verify that the correct cables are available.

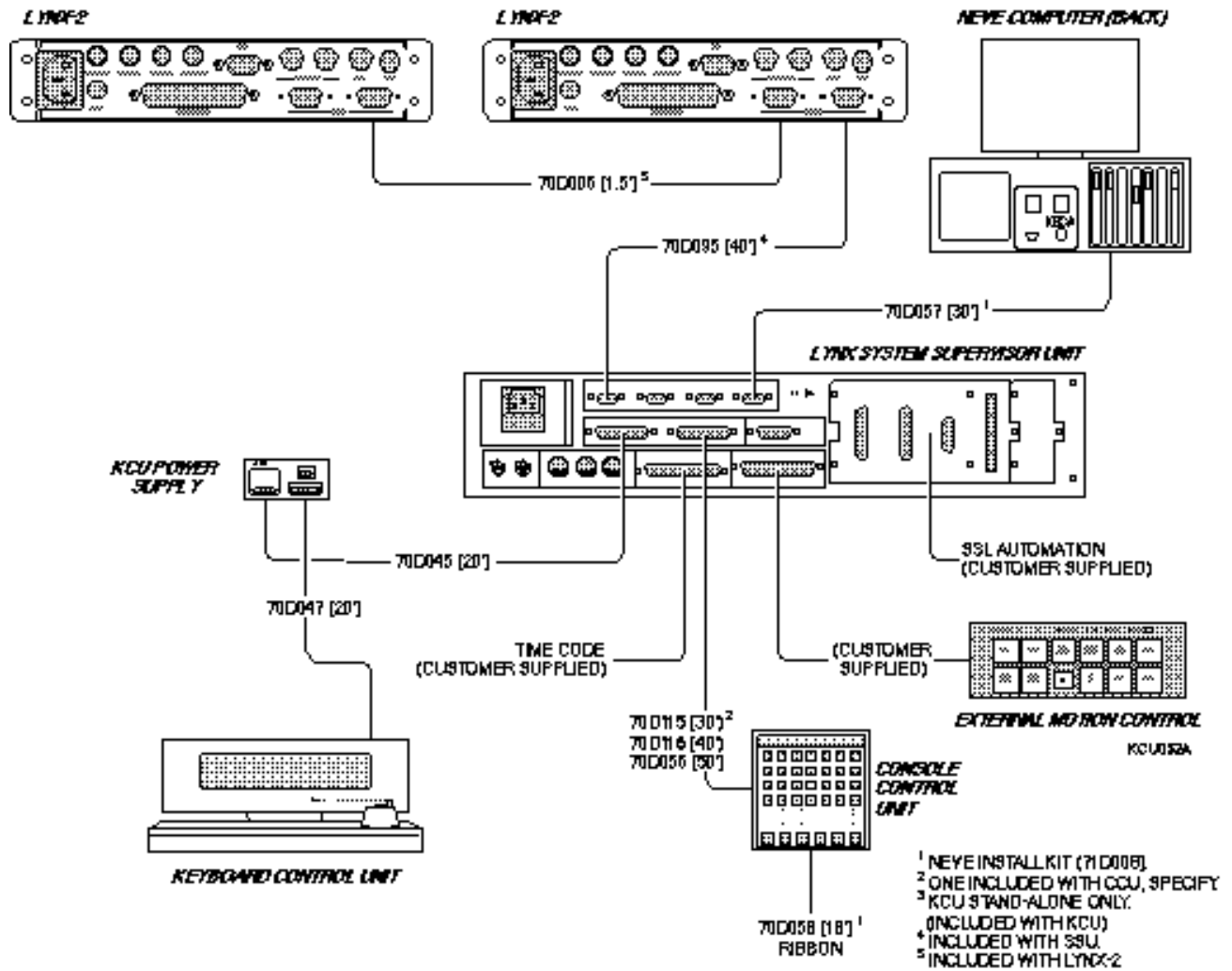


Figure Chapter 3 -1. Cable Requirements

Connecting the KCU and Power Supply Unit

Verify that the KCU power supply is set for the correct AC mains voltage as indicated by a small white button showing through one of the four holes at the right of the IEC power cord receptacle. If the voltage setting is not correct for your facility, please refer to the section *Changing the Mains Voltage Setting*.

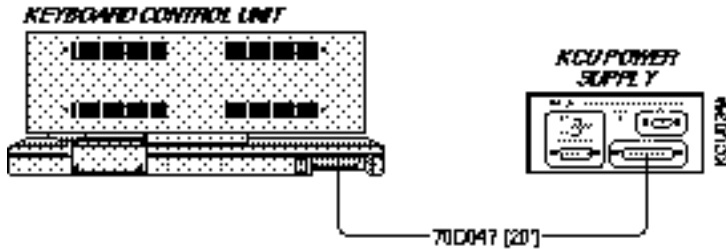


Figure Chapter 3 -2. KCU with Power Supply Connected

Connect the supplied 25-pin cable between the KCU connector on the power supply and the Keyboard Unit. Secure both connections with the retaining screws and secure the cable to the KCU with the supplied cable clamp.

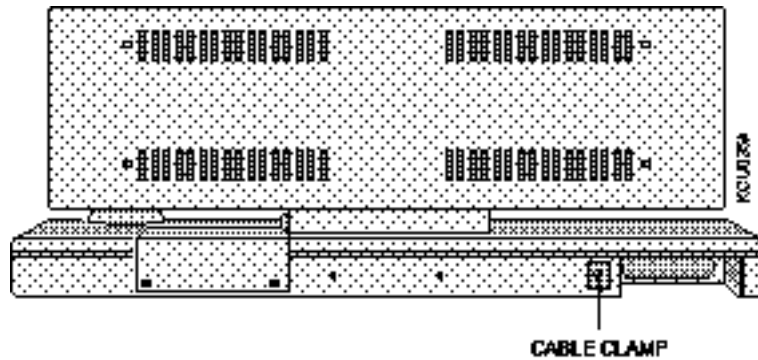


Figure Chapter 3 -3. KCU Cable Clamp

Power Supply

The KCU has an external DC power supply that can be switched to the correct AC voltage for your site. It is suitable for operation at any voltage in any country.

Changing the Mains Voltage Setting

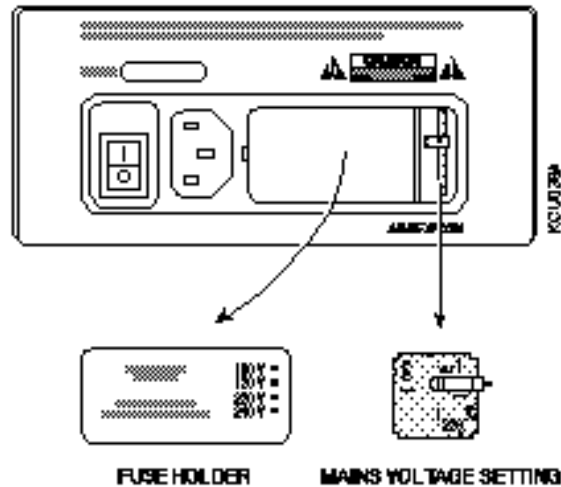


Figure Chapter 3 -4. KCU Power Supply, Rear Panel

1. Remove the AC mains cord from the power supply.
2. With a small slotted screwdriver, gently pry the fuse holder cover off the power supply.
3. Use long-nosed pliers to remove the small printed circuit board from the right side of the compartment.
4. Locate the edge of the circuit board that has the correct AC mains voltage rating printed on it. Manipulate the white nylon tab to position it on the edge opposite the desired mains voltage. This tab position provides the external indication of the voltage selection.
5. Re-insert the circuit board into its compartment in the power supply.
6. Verify that the fuse is the correct type and rating for the new operating voltage. See the *Fuses* section following this procedure.
7. Replace the fuse holder in the power supply and confirm that the tip of the white nylon tab is located in the correct hole in the fuse holder cover.
8. Replace the AC mains cord.
9. Turn on the power switch. Confirm that the POWER LED lights up and the KCU itself powers on.

Fuses

The correct fuse is installed in the power supply by the factory. In the event that the fuse in the KCU power supply needs to be changed, replace it only with the same type and rating fuse. The normal fuse types for the KCU power supply are listed in the following table:

Table Chapter 3 -1. KCU Power Supply Fuse Specifications

100-120 volt AC mains	1/2 ampere, 250 volt, type MDL (slow blow)
220-240 volt AC mains	1/4 ampere, 250 volt, type MDL (slow blow)

Replacing a Fuse

1. With a small slotted screwdriver, pry the fuse holder cover off the power supply.
2. Pull the fuse out of its holder.
3. Use 250V fuses only.

Connecting the Lynx-2 Modules

Connect the supplied 9-pin cable between the LYNX connector on the KCU power supply and either RS422 connector on any Lynx-2 Module in the system. The order in which the modules are connected is arbitrary and does not affect operations. Secure both connections with the retaining screws.

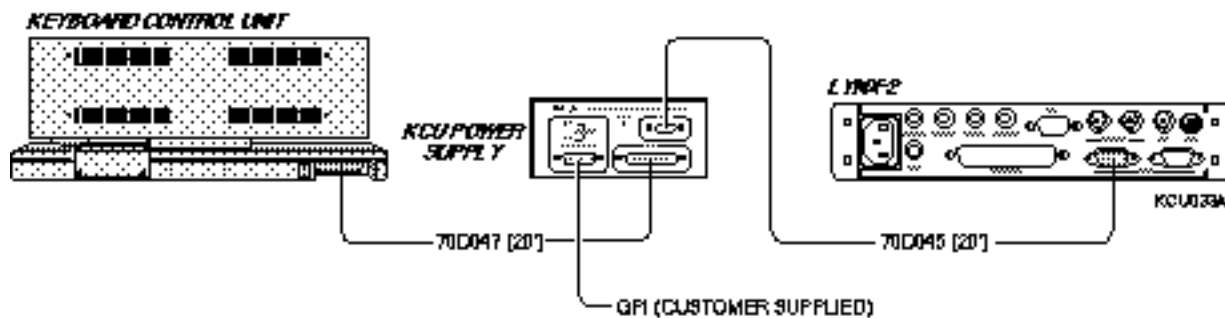


Figure Chapter 3 -5. KCU with Power Supply and Lynx-2 Time Code Module

To daisy-chain the first Lynx-2 Module to the next module, connect a 9-pin jumper cable from the second RS422 connector on the first Lynx-2 Module to either RS422 connector on the next module.

Connect the KCU power supply to a convenient AC mains outlet of the correct voltage. Turn on the power and confirm that the POWER LED indicator on the power supply lights up and the KCU itself powers up.

GPIs

The KCU power supply contains two relays which are used as GPI (General Purpose Interface) closures to trigger a wide variety of external events when the Lynx system doesn't include a System Supervisor Unit. The GPIs in the KCU power supply are presented as a pair of normally-open relay closures on four pins of the GPI/SUPERVISOR connector. The pair of annunciator LEDs on the power supply light simultaneously with each relay closure.

The GPI connector on the KCU power supply is a standard female 15-pin D-subminiature connector.

Table Chapter 3 -2. GPI Pinout

Pin	Signal	Pin	Signal
1		9	
2		10	
3	GPI 2 N/O	11	GPI 2 COM
4	GPI 1 N/O	12	GPI 1 COM
5	+5V	13	Ground
6		14	
7		15	
8			

The GPI relays are rated at 2 Amperes maximum in low voltage DC applications (up to 30 volts DC), or at 0.6 Amperes maximum in higher voltage DC or AC applications.

System Supervisor Unit

In addition to the steps detailed above, connect the cable supplied with the System Supervisor Unit between the GPI/SUPERVISOR connector on the KCU power supply and the COMPUTER/KEYBOARD CONTROL PORT 1 connector on the back panel of the SSU.

When the KCU is connected to the SSU, the Lynx-2 RS422 connections are made directly to the SSU Trip Port 1. The modules are not connected to the KCU. See the System Supervisor Unit manual, Installation chapter for complete details.

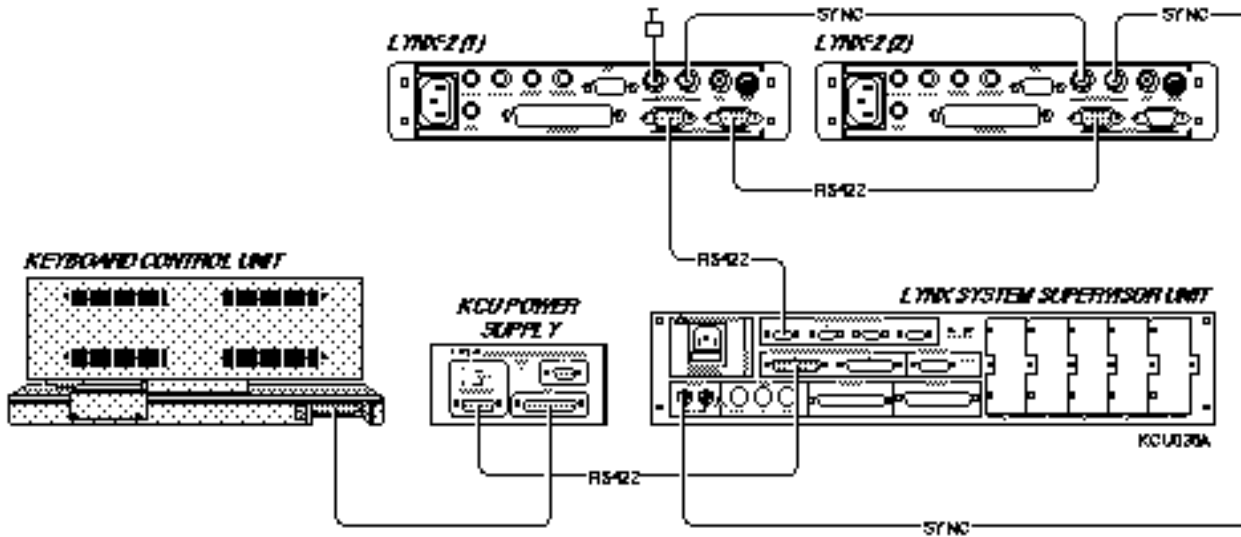


Figure Chapter 3 -6. KCU with Power Supply, Lynx-2 and System Supervisor Unit

Quick Test and Initialization

Follow this procedure to test the communication of different equipment and initialize the KCU. You will be able to operate the system when this procedure is complete.

Specific questions regarding initialization for the SSU and Lynx-2 modules can be addressed from their respective owner's manuals.

Testing the Lynx-2 Modules

To verify that the Lynx-2 modules are communicating to the KCU:

1. Press [POWER] (Lynx-2 module)

Module turns on.

Turn on each Lynx-2 module. Confirm the setup parameters of each Lynx-2.

2. Press [TRAN MODE]

Online LED on

Put all modules online.

Each module must have a unique address. If the KCU detects that the modules have the same address, the KCU will not poll correctly. The message *Press the 'Poll' key to establish communications* is displayed on the KCU.

The Lynx-2 power-on sequence displays the serial address of each module. If you need to review or change the address of a module, press [SHIFT] + [MSTR] simultaneously, then [GEN CODE] to access the address menu. Use the [↑] and [↓] arrow keys to make changes. Press [SHIFT] + [MSTR] to exit setup.

3. Press [PLAY] (Transport)

Time code reader display increments, VID LED on

Lets the Lynx-2 modules read time code for ten seconds.

4. Press [STOP] (Transport)

Display stops incrementing

The Lynx-2 modules are ready to be controlled by the KCU.

Setting Up the KCU

Turn on the KCU power supply unit. The KCU automatically polls the Lynx-2 RS422 Control bus to establish communications with the modules. The LEDs in the KCU STATUS/ON LINE display light, corresponding to the addresses previously set on the modules. The 422 LEDs on each module come on.

Verifying Communications

To verify that the KCU and Lynx-2 modules are communicating correctly,

1. Press [SOLO] then [A] (KCU)

SOLO : a displayed*

This solos the transport assigned to the [A] key.

2. Press [PLAY] (KCU)

SOLO:A>L displayed on the KCU

Play the transport for ten seconds to allow the Lynx-2 to read the time code and lock. If you don't get a lock indication, refer to the Troubleshooting chapter of the Lynx-2 manual.

3. Press [STOP] (KCU)
4. Repeat steps 1-3 for each transport.

Interface Diagrams

This section presents a variety of interface diagrams. Refer to the diagram that most closely represents your system setup and application. Remember, slight differences in equipment may require small configuration modifications.

There are two interface diagrams:

- KCU stand-alone
- Post-production system–System Supervisor Unit

KCU Stand-Alone

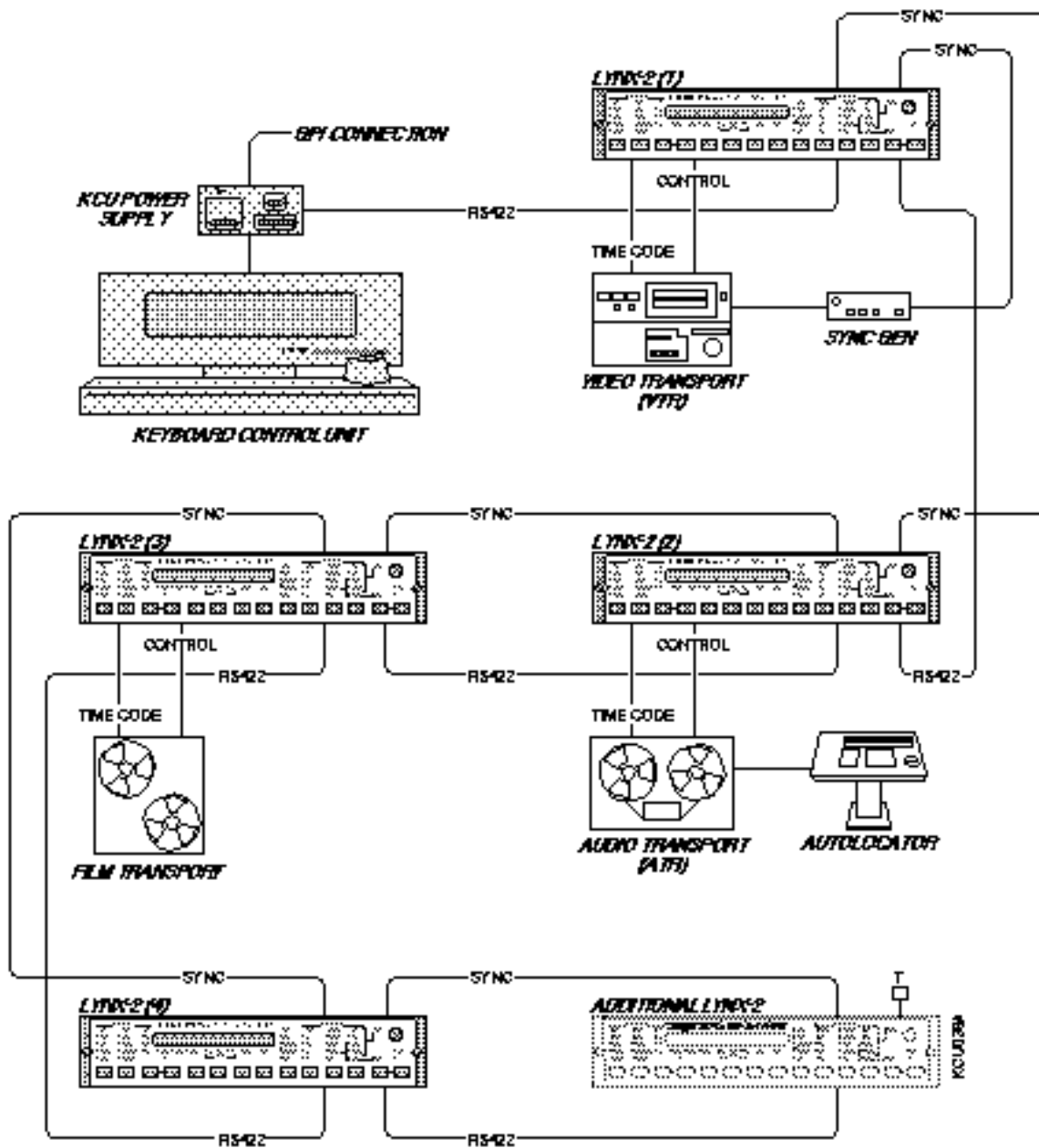


Figure Chapter 3 -7. KCU Stand-Alone Production System

Post-Production System–System Supervisor Unit

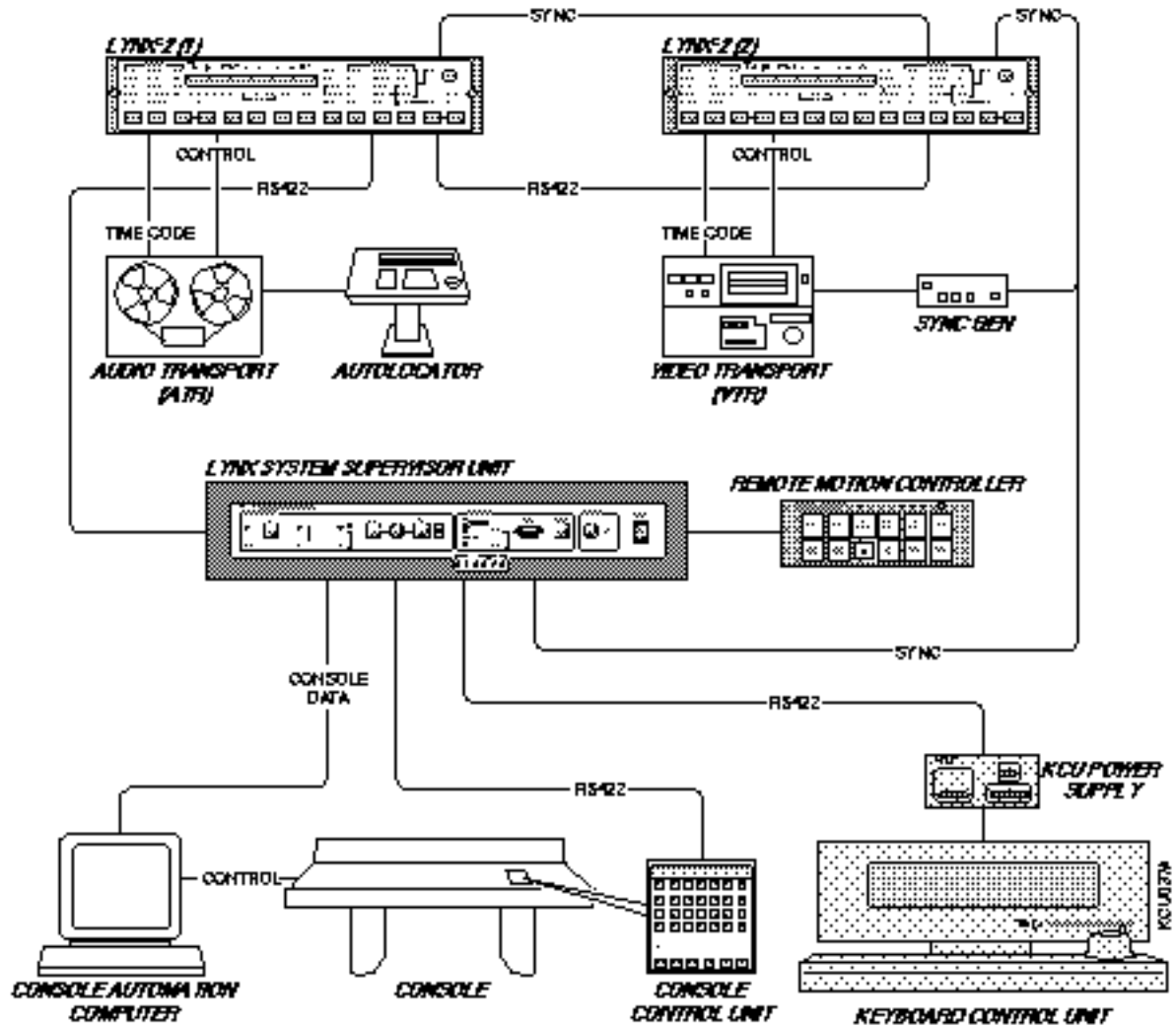


Figure Chapter 3 -8. Post Production System - Audio

Chapter 4 Getting Started

This chapter describes the basic operating procedures to use the Keyboard Control Unit (KCU).

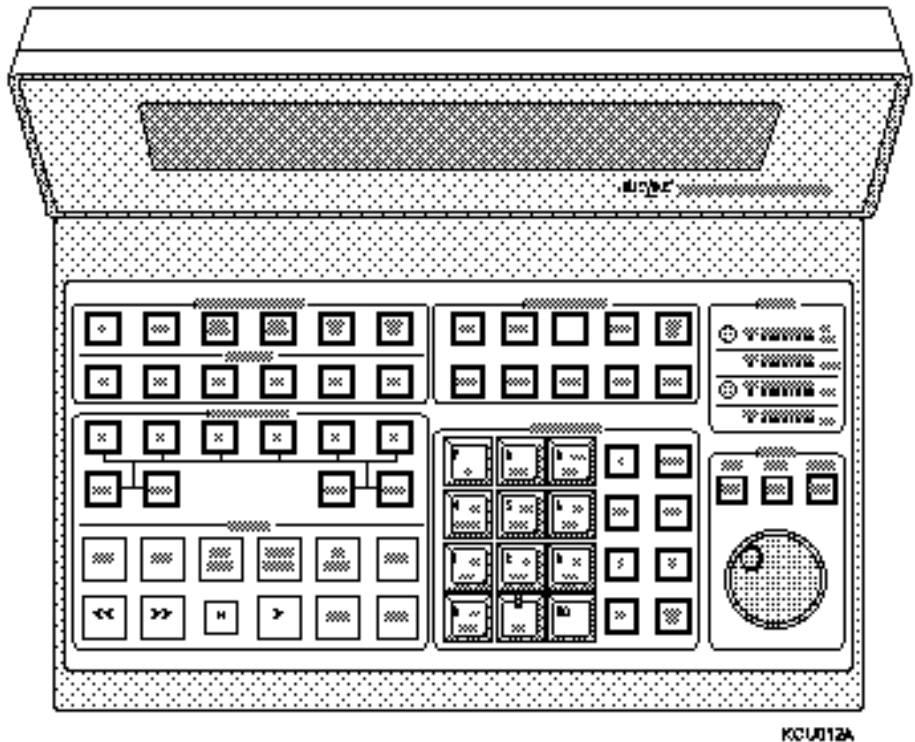


Figure Chapter 4 -1. Keyboard Control Unit

This chapter presents the following topics:

- Initializing and configuring the KCU (to be performed after installation is complete)
- Using KCU memory
- Using time code registers
- Grouping machines with the KCU
- Using offsets
- Editing with the KCU
- KCU messages and errors
- KCU options menu

Initializing and Configuring the KCU

Perform the procedures in this section after the installation is complete, but before you begin using the KCU.

Turning on the KCU

The KCU has a battery backed-up memory system. Each time the KCU is turned on, it powers up in exactly the same condition in which it was powered down. All the setup and transport information previously entered is immediately operational.

When first turned on, the KCU does a quick lamp test and displays the software version(s) installed. The power-on sequence also indicates if the System Supervisor Unit (SSU) is enabled, and the amount of memory locations available (0-9 or 00-99).

At this point, the KCU has finished its sign-on and displays *Press the Poll Key to Establish Communication*. Turn on the Lynx-2 modules and put them on line with the [TRAN MODE] key. Press the yellow status key ([POLL] key) on the KCU to establish RS422 communication.

If the Lynx-2 modules are powered on and placed online prior to the KCU being turned on, the KCU automatically polls the Lynx-2 modules and displays *Hold the GRP Key and add Groups in Order of Priority*.

Resetting the KCU

If it becomes necessary to clear or reset the KCU, use the calculator [CLR] key and the [POLL] key to re-initialize the KCU. All KCU parameters are set to their default settings and the group is erased, with a prompt displayed to re-establish the group at the end of the reset.

To reset the KCU, press and hold the [CLR] key while pressing the [POLL] key. Continue to hold the [CLR] key momentarily after releasing the [POLL] key. The prompt *Lamp Test, Clearing Memory* is displayed while the KCU initializes a lamp and LED test. When the initialization is complete, the KCU prompts you to re-establish the group.

Setting the System Reference

Before using the KCU, determine the system speed reference your machines will be locked to. When a system reference is selected, the KCU synchronizes all Lynx-2 modules, including the master, as slaves to this timing reference. This provides fast and stable locking because each machine is independently controlled and locked.

When a system reference is selected at the KCU, verify that the selected reference is properly connected to every Lynx-2 module in the chain.

There are four reference selections available:

Int Xtal	Lynx-2 Module internal crystal
Ext Vid	External composite or black burst video sync signal
Mains	AC mains frequency
VSO	Variable speed, determined by varispeeding the master transport

The KCU reference defaults to External Video. The system speed or rate is determined by the video source applied to the Lynx-2 modules, either 29.97 Hz for NTSC or 25 Hz for PAL/SECAM. Unless you use a different frame rate, for example 30 Hz, use this reference to get started.

System reference parameters may be changed in the SYS options menu. See *KCU Options Menus* in this chapter for details.

Initializing Lynx Communication

Turn on the Lynx-2 modules and put the modules on line with the [TRAN MODE] key. Make sure each Lynx-2 module is set to a unique address, and has the correct external video sync signal connected (if needed).

1. Press the KCU [POLL] key and confirm that the 422 LED illuminates on each Lynx-2 module. The corresponding STATUS LEDs on the KCU should also illuminate.
2. Press the [SOLO] key

The [SOLO] key will light.

3. Press the [A] key.

The [A] key will light

This solos the corresponding A machine. The current time code position of the A machine is shown in the display.

“SOLO:A” appears in the display with the “.” indicating the machine is stopped. Other soloed machine indicators are “>” for play, “>>” for fast forward, “<<” for rewind, REC for record, and REH for rehearse.

The “Err: 0.-” display shows the offset error, in frames and subframes, to lock. When the machine is played, the offset error value is counted down to .00 to indicate that the machine has been properly synchronized.

4. Press the [>] (Play) key.

The [>] key lights. Time code display updates.

“SOLO : A > L” indicates the soloed machine is in play and locked.

5. Press the [■] (Stop) key.

The [■] key lights and the time code display stops.

6. Repeat steps 3 through 5 for each Lynx-2 module.

Using KCU Memory

This section describes the use of KCU memory functions.

The KCU can capture and store in memory up to 100 time code values. Time code values can be retrieved and used as auto-locate positions or for other time code operations.

Capturing a Time Code Value

Capture and locate a time code value in either solo or group mode. The machine in this example is in solo mode.

1. Press the [A] key.

This solos the corresponding A transport.

2. Press [>].

Play to the time code that you want to capture and save.

3. Press the [CAPT] key.

[CAPT] key flashes, [STO] key flashes

The KCU has captured a time code and is ready to store the value.

4. Press the [MEM] key.
[MEM] key flashes
“Store Memory” is displayed, prompting you to choose a memory location.
5. Press [1].
The KCU stores the data into memory location 1.
6. Press [CLR].
Clears the display.

Retrieving a Time Code Value

1. Press the [MEM] key.
[MEM] key flashes
The KCU is ready to recall a time code value stored in a memory location.
2. Press [1].
Mem1 xx:xx:xx is displayed
The value stored in memory 1 is retrieved.
3. Press [LOC] to locate using the value in the Calculator Entry register (lower right of display) as the locate point.
The [LOC] key lights, “SOLO : A Loc xx:xx:xx” is displayed.
The transport locates to the time code value retrieved from memory location 1, displayed in the Calculator register plus the preroll amount.

Changing Memory Size

Memory size determines the number of memory spaces that will be available for storing values. Press [SETUP], then [MEM], to change memory size.

See *Using KCU Memory* in this chapter for more information.

Using Time Code Registers

Values may be stored to or recalled from any of the time code registers.

The calculator keys provide access to the time code register values. The registers correspond to the numbered (00-9) calculator keys:

- 00/ZERO for the Local Zero register
- 0/TIME for the Time register
- 1/PRE for the Preroll register
- 2/POST for the Postroll register
- 3/REF for the Reference Sync Point register
- 4/SYNCP for the Source Sync Point register
- 5/OFST for the Offset register
- 6/ERR for the Error register
- 7/IN for the In Point register
- 8/OUT for the Out Point register
- 9/DUR for the Duration register

The following special function keys provide additional access to registers:

- IN for the In Point register
- OUT for the Out Point register
- REF SYNC for the Reference Sync Point register
- SRC SYNC for the Source Sync Point register
- CUE PT for the Cue Point register

Local Zero Register

The calculator [00/ZERO] key provides access to the Local Zero register, which is used to store an offset value that will be subtracted from values stored to memory registers. This function is used mainly for film applications.

The Local Zero register is available with KCU 600 and KCU 300 series software.

Time Register

The calculator [TIME] key provides access to the Time register. The Time register is used to store a time code value to the Lynx-2 or Lynx-2 Film Module.

Press [STO], then [TIME], to store a new value in the Time register. The current time code of the selected machine is displayed.

Press [RCL], then [TIME], to recall the current in the Time register. The current time code of the selected machine is displayed.

To display the current time code of a different machine, press the appropriate machine select key, then [RCL], then [TIME].

Preroll Register

The calculator [PRE] key provides access to the Preroll register. The preroll position is the time code location that the KCU uses to cue the master machine during locate and edit functions.

The value in the Preroll register is used to calculate the preroll position using the following equation:

$$\textit{Preroll position} = \textit{In Point} - \textit{Preroll value}$$

The default value for the Preroll register is 5 seconds.

The Preroll register may be accessed during store, recall, and trim operations.

Postroll Register

The calculator [POST] key provides access to the Postroll register. The value in the Postroll register is used by the KCU to calculate the postroll time code position at the end of an edit sequence.

The postroll position is the time code location to which the KCU rolls the transports at the end of an edit. The postroll position is calculated using the following equation:

$$\textit{Postroll position} = \textit{Out Point} + \textit{Postroll value}$$

The default value for the Postroll register is 5 seconds.

The Postroll register may be accessed during store, recall, and trim operations.

Reference Sync Point Register

The KCU uses the time code value in the Reference Sync Point register to calculate offsets for any source machines with source sync points. Offsets are calculated using the following equation:

$$\text{Offset} = \text{Source Sync Point} - \text{Reference Sync Point}$$

If you change the reference sync point value (either in Trim mode or by entering a new value), the KCU recalculates and stores the correct offset for all source machines with active source sync point values.

Accessing the Reference Sync Point Register

The calculator [REF] key provides access to the Reference Sync Point register during store, recall, and trim operations.

The special function [REF SYNC] key provides access to the Reference Sync Point register.

Clearing the Reference Sync Point Register

Press [CLR] and [REF] simultaneously to clear the Reference Sync Point register.

Press and hold [CLR] and press special function [REF SYNC] key to deactivate the value in the Reference Sync Point register without actually clearing the value. The [REF SYNC] key is no longer lighted.

Source Sync Point Register

The [SYNCP] key provides access to the Source Sync Point register for a specified machine. The KCU uses the time code value in the Source Sync Point register of each machine to calculate an offset for a source machine relative to the reference sync point. Each source machine in the system has a separate sync point register. The reference machine can not have a Source Sync Point register.

The offset is displayed as a positive or negative number with an absolute value of 12:00:00:00 (12 hours) or less. The offset is calculated using the following equation:

$$\text{Offset} = \text{Source Sync Point} - \text{Reference Sync Point.}$$

If the source sync point has a higher time code value than the source sync point, the keyboard displays the offset as a small negative number. For example, -1:10:00:00 is displayed rather than the equivalent large positive number 22:50:00:00.

If you change the source sync point value (either in Trim mode or by entering a new source sync point value), the KCU recalculates and stores the correct offset for that machine.

Accessing the Source Sync Point Register

The calculator [SYNCP] key provides access to the Source Sync Point register during store, recall, and trim operations.

The special function [REF SYNC] key provides access to the Reference Sync Point register.

Clearing the Source Sync Point Register

Solo a machine, then press [CLR] and [SYNCP] simultaneously to clear the Source Sync Point register.

Press and hold [CLR] and press the special function [SRC SYNC] key to deactivate the value in the Source Sync Point register without actually clearing the value. The [SRC SYNC] key is no longer lighted.

Offset Register

The [OFST] key provides access to the Offset register for a specified machine. This register may be accessed during store, recall, and trim operations. Each slave machine in the system has a separate Offset register. The reference machine cannot have an offset.

Offsets are discussed in detail in the *Using Offsets* section of this chapter.

Error Register

The [ERR] key provides access to the machine offset Error register. The Error register does not store any values, but provides a display of the positional error of a machine.

Press [RCL], then [ERR], to display the Error register for a selected machine. The error is displayed in status mode.

In Point Register

The In Point register stores the time code value of the current programmed edit. The value is expressed in terms of the master machine time code. The edit in point is used to calculate source machine offsets if no reference sync point is entered.

The special function [IN] key is illuminated whenever there is an active value in the In Point register.

If no in point is set, it will be calculated automatically when you enter an out point and a duration. The equation for calculating an in point is:

$$\text{In Point} = \text{Out Point} - \text{Duration}$$

The KCU calculates an in point value based on the current position of the source machine and the source machine offset value. This occurs if a source or slave transport is soloed when you press the special function [IN] key (the reference machine time code is not running at the time). The in point value is calculated in the reference time code type.

If there is no active value in the In Point register when you select an edit mode, the error message *Set an "in" point* is displayed and the edit command is canceled.

The value in the In Point register is also used as the Reference Sync Point in any automatic offset calculations if there is no value in the Reference Sync Point register.

Accessing the In Point Register

The calculator [IN] key provides access to the In Point register during store, recall, and trim operations.

Press the special function [IN] key at any time to store the current reference machine time code value into the In Point register.

Clearing the In Point Register

Press [CLR] and calculator [IN] simultaneously to clear the In Point register.

Press and hold [CLR], then press special function [IN], to deactivate the value in the In Point register without actually clearing the value. The [IN] key is no longer lighted.

Out Point Register

The value stored in the Out Point register is the record out point of the current programmed edit. The value is expressed in terms of the master machine time code.

The out point is calculated and stored automatically when you enter an in point and a duration. The equation for calculating an out point is

$$\textit{Out Point} = \textit{In Point} + \textit{Duration}$$

The special function [OUT] key is illuminated whenever there is an active value in the Out Point register.

If there is no active value in the Out Point register when you select an edit mode, the message *Warning: open end* is displayed and the KCU performs an open-ended edit. In an open-ended edit, the duration shows as open during the preroll, and is incremented a single frame at a time during the actual edit period.

If a source or slave transport is soloed when you press the special function [OUT] key (the reference machine time code is not running at the time), the KCU calculates an Out Point value in the reference machine's time code based on the current position of the source, or slave, machine and its offset value.

Altering the value of the duration also causes the out point to be recalculated. Altering the out point causes the duration to be recalculated.

Accessing the Out Point Register

The calculator [OUT] key provides access to the Out Point register during store, recall, and trim operations.

Press the special function [OUT] key to store the current reference machine time code value in the Out Point register.

Clearing the Out Point Register

Press the [CLR] and calculator [OUT] keys simultaneously to clear the Out Point register.

Press and hold [CLR], then press the special function [OUT] key to deactivate the value in the Out Point register without clearing the value.

Duration Register

The [DUR] key provides access to the Duration register. Whenever there are active values in the In Point and Out Point registers, there is a calculated time code value in the Duration register.

The value in the Duration register is the length of the current programmed edit. If either the in point or out point are changed, the duration is automatically recalculated. The equation for calculating the duration is

$$\textit{Duration} = \textit{Out Point} - \textit{In Point}$$

The Duration register may be accessed during store, recall, and trim operations.

Press [CLR] and [DUR] simultaneously to clear the Out Point register. Clearing the duration register automatically cancels the out point register, leaving the in point register as is.

Cue Point Register

The special function [CUE PT] key provides access to the Cue Point register.

Grouping Machines with the KCU

The KCU can simultaneously control up to six tape machines. When the transport control keys are pressed, all machines assigned to the group will chase and synchronize.

Machine Modes

When the KCU is first initialized, no machines have been placed in the group.

Using Solo Mode

Press [SOLO] and the appropriate machine select key (A-F). The transport control keys control only the selected machine. All other machines remain in their current state of motion. To select a different machine, press the appropriate machine select key (A-F).

The [GEN] key is also available with KCU 300 series software. [SOLO GEN] is normally used only to generate time code, but it can be used to control a time code-only chase device.

Assigning a Machine to a Group

All machines assigned to the group will be controlled together by the transport control keys (synchronously in play). In group mode, the display shows the status of the master machine. Individual machine status can be viewed by pressing the corresponding machine select key.

To assign a machine to a group,

1. Press the [GRP] key.

[GRP] key lights, "Hold the "GRP" key, and add groups in order of priority" is displayed.

This is the machine selection prompt.

2. Press and hold the [GRP] key, while pressing the machine select (A-F) keys.

The machine keys light as they are added to the group.

The master machine is displayed as an uppercase letter and the slave machines as lowercase letters. The first machine put into the group is always the master reference machine.

3. If you need to change the group assignments, press the amber [POLL] key, which repolls the Lynx-2 modules on the 422 bus and erases any previous group designation.
4. Press [B] to put the B machine into group status mode.

The [B] key flashes and the Group display changes to STAT.

In status mode, you can check the current running time code value and error for that machine.

5. Press [GRP] or [B] to return to the Group display mode.

STAT display changes to group display and the [B] key is solid.

Removing a Machine from the Group

1. Press [GRP] and the machine select key to remove a machine from the group.

The [B] key lamp is turned off.

2. Press [GRP] + [B].

The [B] key lights.

The slave machine B is placed back into the group.

Locking in a Group

Before locking machines in a group, it is good practice to let each machine resolve and lock by itself. By doing this, each Lynx-2 module remembers its transport type and subsequently locks the transport considerably faster.

The KCU display indicates whether the machine and group are in lock. To lock machines in a group,

1. Press the [GRP] key.

[GRP] key lights, "Hold the "GRP" key, and add groups in order of priority" is displayed.

This is the machine selection prompt.

2. Press and hold the [GRP] key, while pressing the machine select (A-F) keys.

The machine keys light as they are added to the group.

The master machine is displayed as a capitol letter and the slave machines as lower case letters. The first machine that is put into the group is always the master reference machine.

3. Press the [SOLO] key.

The [SOLO] key lights as well as the [A] key.

When the [SOLO] key is pressed, it addresses a single machine in the group. Press any machine select key when the [SOLO] key is lighted to address that machine. The display identifies the soloed machine as "SOLO: A" in the display. The machine's current time code position "A : xx:xx:xx:xx", and the offset error position of the machine to lock "Err:0.-" are displayed

4. Press the [>] key.

The [>] key lights and the transport is put into play..

As the tape machine plays, the running time code value is displayed. The machine automatically resolves and locks. "SOLO: A > L" is displayed, indicating that the machine is in play and is locked.

5. Press the [■] key when the machine has achieved lock.

The [■] key lights and the machine is stopped.

6. Solo the next machine by pressing the next machine select key (A-F). Repeat steps 4-5 for each machine.

7. Press the [GRP] key.

The [GRP] key lights along with any Machine Select keys that have been put into the group.

The display changes to the group status mode, showing machine status and the current time code position of the master machine.

8. Press [ALL STOP], then the [■] key.

The slave machines chase to the correct park ahead position of the master machine.

9. Press [PLAY].

The group plays and locks. Lock status is indicated by the LL at the right of the time code. The first L indicates that the master machine is locked, and the second L indicates that all the slave machines have resolved and locked.

Changing the Master Machine

The KCU allows any machine to be the group master. The master machine can be changed at any time with all positional relationships maintained. Any offsets are transferred to the slave machines. The reference machine cannot have an offset.

The following example assumes a group of A and B, with A the master machine.

1. Press the [GRP] key.
2. Press and hold [SETUP], then press [B].

The master machine is reselected to the B machine. The master machine now has an offset if B has an offset.

Separating the Master and Reference Machines

The reference machine is always the first machine placed into the group after the KCU has polled, making it the master machine.

To separate the master and reference machines,

1. Press the [POLL] key to re-poll the KCU.
2. Press and hold [GRP] + [A-F] to make a group with the A machine the reference master.

[GRP] key lights, A-F keys light (according to addresses assigned)

3. Press [SETUP] + [B].

The A machine remains the reference machine (designated by an asterisk), and the B machine becomes the master (designated by a capital letter).

Using Offsets

Offsets are used if the time code on two or more tapes does not match. For example, if tape A starts at 00:00:00:00 and tape B starts at 02:00:00:00, a record in point of 00:30:00:00 cannot be correct for both machines. Use the KCU to enter offsets to compensate automatically for the time code difference between the tapes.

The offset is the difference in the number of frames between the reference and slave or master tape at the point where they are to be synchronized. For example:

02:00:00:00 (Slave time code)
-01:00:00:00 (Reference time code)
=+1 hour offset (number of frames)

A positive offset indicates that the source machine time code position is in advance of the reference machine time code position. If the machine selected is the reference tape machine, the offset register value will be zero since offsets are only applied to slave machines.

When a machine has an offset, the corresponding machine AUX LED in the STATUS display will light.

Setting an Offset

Offsets cannot be set for the reference machine.

The KCU always calculates a machine offset from the reference machine. The KCU indicates the reference machine with an *, the master machine with a capital letter and slave machines with lower case letters. By default, the first machine selected into the group is the reference master machine, indicated by "A*".

To change the reference machine, repoll the KCU. Press and hold the [GRP] key, and reselect the machines. If required, the reference machine can be different from the master machine, allowing the master machine to have an offset from the reference machine. (See *Changing the Master Machine* section.)

In the following example, A is the master reference machine and B is the slave machine. A and B are grouped together.

1. Press [SOLO] + [A] to solo the master A machine.

The SOLO LED and A LED come on.

2. Press [PLAY].

The A machine goes into play.

3. Press [STOP] to locate the machine to a point and stop.

4. Press the [B] key.

5. Press [PLAY].

The B machine goes into play.

6. Press [STOP] to locate the machine to a point and stop.

7. Press the [CAPT] key.

The CAPT and STO LEDs flash.

The slave time code position is captured and the KCU prompts for a register to store it in. In this case, the value is stored to the offset register.

8. Press Calculator key [5] (Offset).

The slave offset is automatically calculated and stored.

9. Press the [GRP] key to return machines to group mode.

A LED on, B LED on, GRP LED on.

The B transport is marked with an AUX LED in the Status display to show that an offset is present.

10. Press [PLAY].

The machines go into play and lock with the offset.

11. Press [STOP].

Calculating Offsets Using Sync Points

The special function keys may be used to shortcut certain keystrokes on the KCU. In this example, the [REF SYNC] and [SRC SYNC] keys will automatically capture and store sync points to the individual machines.

1. Press [SOLO], then [A] to Solo the master machine.

SOLO LED on, A LED on.

2. Press [CAPT], then the [REF] (3) calculator key.

This captures the current time code value for the master machine, then stores that value as the reference sync point. A reference point for the master machine is a position on the master tape to which slave tape sync points position.

3. Press [B] to Solo the slave machine.

4. Press [CAPT], then the [SYNCP] (4) calculator key.

This captures the current time code value of the slave (B) machine and stores it into the sync point register. The offset is calculated automatically and stored in the Offset register.

5. Press the [RCL] key, then [OFST] (5), to verify the correct offset. Use the [RCL] key if desired.

6. Press [SOLO], [A], then [>], to Solo the A machine in play mode.

7. Press the [REF SYNC] key.

This captures and stores a reference sync point to the master machine Sync Point register.

8. Press [STOP].

9. Press [SOLO], [B], then [>], to Solo the B machine in play mode.

10. Press the [SRC SYNC] key.

This captures and stores a source sync point to the slave machine Sync Point register.

11. Press [STOP].

12. Press the [GRP] key.

A LED on, B LED on, GRP LED on.

13. Press [ALLSTOP], then [STOP].

The B machine chases and parks to the master machine position.

14. Press [PLAY].

The machines go into play with the offset.

Trimming an Offset

An offset can be trimmed by increasing or decreasing the frame or subframe amount in any register. Default trim values are 1 frame and 1 subframe.

Trim Frame: The value can be adjusted between 1 and 10 frames.
Trim Subframe The value can be adjusted between 1 and 25 subframes.

In the following example, assume that the A and B machines are grouped. Although the tape machines are in stop in this example, an offset can be trimmed dynamically with the tape machines in play.

1. Press [GRP] + [STOP].

2. Press the [B] key.

This changes the Group display to Status display for the B machine.

From Group display mode, press a machine key to enter the status display for that machine. From the status mode, memory registers can be addressed directly for that machine.

3. Press the [TRIM] key.

Trim key flashes, + LED on, — LED on.

The frame trim increment is displayed and the Offset register is called.

4. To change the offset dynamically,
 - Use the [+] key to increase the offset. Press and hold the [+] key to make the key auto-repeat.
 - Use the [-] key to decrease the offset. Press and hold the [-] key down to make the key auto-repeat.
 - Use the jog wheel to trim the offset up or down instead of using the [+] and [-] keys.
5. To exit trim mode and save the new offset, do one of the following:
 - Press [TRIM] to return to status mode, or
 - Press [B] to return to group mode.

Storing an Offset

The following is an example of the procedure for storing an offset to the In Point register.

1. Type 20min:15frames:12sec into the calculator display.
00:20:15:12
Enters (or recall) a time code value.
2. Press [STO]
STO LED flashes.
3. Press a calculator key to select a register. Or, press [MEM] and a calculator key to select a memory.
4. Press [7 / IN]
STO LED turns off.
The time code value is stored to the In Point register.

Offsets in Differing Time Codes

The KCU handles offsets correctly in either drop frame or non-drop frame time code as well as in mixed time code situations. Offsets are always stored and displayed in the code format of the reference transport time code, regardless of the type of code that is present on each source machine. For example, if the reference time code is drop frame, all offsets are handled and displayed by the KCU as drop frame time code values, even if a particular offset is related to a machine with non-drop frame code.

Drop frame code is displayed on the KCU with the frames digits separated from the seconds digits by a semi-colon rather than a colon, as in *03:20:40;00*.

In mixed code situations, the actual offset value necessary to achieve the desired synchronization in the KCU system is the sum of the following three components:

- The actual (clock) difference between the two time code values.
- A correction to the clock offset based on the difference in frame counts between the two time code formats.
- A correction for the accumulated frame count difference since 00:00:00:00 (time code 'midnight'). This applies to drop frame/non-drop frame time code only.

For example, if you want to synchronize 1:00:00:00 (non-drop frame) with 1:00:00,00 (drop frame), an offset of 3 seconds and 18 frames is required to account for the difference in running frame count since 'midnight'.

The simplest method of calculating offsets is to use sync points or capture the frame count and let the KCU calculate the correct time code offset value.

Editing with the KCU

The KCU has comprehensive Rehearse, Record and Replay edit routines. In and out points can be quickly marked with the special function keys. The KCU cues all transports in the group to the preroll point, executes an automated record at the in point, and drops out of record at the out point.

Editing Example

For this example, A is the master reference machine and B is the slave machine. Other machines may be added if desired.

1. Press the [>] PLAY key.

The group goes into play and locks.

2. Press the [IN] key.

The [IN] key lights and the display shows the captured record In point in the lower right hand portion of the display.

The [IN] key can be pressed during any group mode, solo mode, or status mode operation for direct storage to the record In Point register. Once pressed, it updates the In Point register to the current time code value addressed in the display. If group mode is selected, the in point always reflects the master machine time code.

3. With the group still in play, press the [OUT] key.
The [OUT] key lights and the display shows the captured record Out point in the lower right hand portion of the display. The record out point is marked and stored into the Out Point register.
4. Press the [EDIT] key.
[EDIT] key lights, [CUE] key flashes, [REPLAY] key flashes, [REC] key flashes, [REH] key flashes.
 Edit mode selection keys flash to prompt for a selection.
5. Press the [REC] key.
[EDIT] lamp on, [CUE] lamp on, [REC] lamp flashes.
 The Edit/Record mode has been selected. The group cues to the cue point that equals the in point minus the preroll time, which defaults to 5 seconds.
6. After the last machine in the group goes into play and locks, the prompt *WARNING: No Active Transports Enabled* is displayed, describing the machine record status. Press and hold the round red [REC STATUS] key and press machine keys [A-F] as required to record enable each machine.
 The preroll time counts down and the group goes into record at the in point. The group drops out of record at the out point and rolls through the postroll. The postroll default time is 5 seconds.
7. Press the [LOOP] key.
[LOOP] key lights.
 If LOOP is selected before the edit is complete, the group rescues to the preroll point and repeats the sequence indefinitely.

Setting a Sync Point

1. Press [SOLO], [B] to Solo a slave machine.
2. Press [CAPT].
STO LED flashes and the current time code value for the B transport is captured into the calculator display.
3. Enter or capture a time code value and select a register to store the value.

4. Press [4/SYNCP].

Display shows the captured time code value stored to the Sync Point register.

The value is stored in the Sync Point register. If a reference sync point exists, a new offset is calculated and stored for the slave machine.

Clearing a Sync Point

1. Press [SOLO] + [B] to Solo a slave machine.
2. Press [CLR] + [4] to clear the value in the Sync Point register.
3. Press [RCL] + [4]

You can verify that the clear operation occurred by recalling the Sync Point register contents.

KCU Messages and Errors

The KCU automatically displays non-system messages to prompt an action or to provide a description, suggestions, or status information. System errors are not displayed automatically.

Refer to the Troubleshooting chapter for a list of error messages.

Displaying System Error Messages

System error messages are available only with KCU 330 series software.

System errors are not displayed automatically. The SYS LED flashes when a system error occurs.

To display system error messages,

1. Press [SYS] to enter error mode.

The SYS LED lights.

The first error message is displayed.

2. Press [SYS] again to display the next error message.

The SYS LED flashes until all of the errors have been cleared.

After the last error is displayed, all messages are cleared and the KCU automatically exits the error mode.

3. To exit to exit error mode at any point without clearing the error messages, press [CLR].

Displaying Version Numbers

Version number display is available only with KCU 330 series software.

To display software version numbers, press [RCL], then [SYS]. The version number for each PROM is displayed.

Accessing Status Mode

When the KCU display is in group mode, press a machine key A-F to select status mode and recall the Error register. The Error register contains the error between the master and slave tape position in frames and subframes.

The error register display is programmed to show the most relevant information at all times. There are occasions when the offset error display has no meaning. The following table shows the error register status in each transport mode.

<u>Display Mode</u>	<u>STOP</u>	<u>PLAY</u>	<u>Rewind/FWD</u>
Solo	0.--	Resolve error (in subframes)	0.--
Group	0.--	Resolve error (Mast machine)	0.--
Stat slave	Distance from Mast (park-ahead)	Resolve error (in subframes)	Distance from Mast (Offset err)
Stat master	0.--	Resolve error (Mast machine)	0.--

The KCU automatically displays subframe error when the error is less than 1 frame.

When the displayed error is greater than 1 frame, the subframe component is suppressed and shows only as "x.--".

Setup [SETUP] Options

The KCU allows comprehensive customization of the keyboard for a particular operating mode, transport, or application.

To enter setup mode,

1. Press the [SETUP] key.

The [SETUP] key flashes.

2. Select the category to modify.
3. Use the following keys to move through the menu:
 - [LAST] or [NEXT] selects the next or previous item in a top-level menu.
 - [+] or [-] selects the next or previous item in the selected menu.

4. After modifying the selected option, exit setup mode by pressing the [SETUP] key a second time.

The [SETUP] key stops flashing.

Setup Options

Setup options are listed in the following table. All selections and associated numbers are listed.

Table Chapter 4 -1. SETUP Menu Options

KEY	MENU	SUB-MENU	RANGE
EDIT	Editing Options	0 Edit Q/C	Off, <i>Normal</i> , Stop
		1 Edits Roll As	Mast/Slave, <i>All Slaves</i>
EVENT	Select GPI Options		
	1 Keyboard GPI 1	0 Mode	Normal, <i>Autoset</i> , Rec Tally, Edit-Rec, Group Lock
		1 Beep Mode	Off, <i>On</i>
		2 Beep Spacing	10-30 (<i>20</i>)
		3 Last Beep	<i>Muted</i> , On
	2 Keyboard GPI 2	0 Mode	Normal, <i>Autoset</i> , Rec Tally, Edit-Rec, Group Lock
FILM	Film Options	0 Ref Code Type	24, 25, DF, <i>30</i>
		1 NTSC Default	<i>29.97</i> , 30.00
F1-F6	Macros		
LIST	SSU List Menu	0 SSU Capture To	GPI 1-GPI 8 (<i>GPI 1</i>)
LOOP	Edit Looping	0 After Edit	<i>Re-edit</i> , Replay
		1 After Replay	<i>End</i> , Repeat
		2 After End	<i>Stop</i> , Recue
MEM	Memory Menu	0 Memory Size	<i>0-9</i> , 00-99
ROLLBACK, REH, REC	Key Options	0 Rollback Key	<i>Rollback</i> , Play-Rev
		1 REH (Rehearse By)	<i>Play+Reh</i> , Reh Only
		2 REC (Record By)	<i>Play+Rec</i> , Rec Only
SYS	System Options	0 System Ref SRC	Int Xtal, <i>Ext Vid</i> , Mains, VSO
		1 Calc Entry Mode	<i>Normal</i> , CMX Style
		2 Flash Rec Lamp	<i>No</i> , Yes
		3 Wheel Rate	1-10 (<i>1</i>)
		4 Supervisor On	<i>No</i> , Yes
TRKS	Track Select	0 Video Tracks	<i>Safe</i> , Enabled
		1 Video Auto-Rst	<i>Off</i> , On
TRAN	Tran Options		
	A-F Machine Keys	0 Capstan Mode	Wild, <i>Resolved</i>
		1 Ser TC Option	<i>Enable</i> , Inhibit
		2 Track Select	<i>KCU</i> , Transport

Setup Example

1. Press [SETUP].

[SETUP] key flashes, LAST and NEXT LEDs light, [+] and [-] keys light.

The system is in setup mode.

2. Press [MEM]. There are two options, + and -.

Memory key lights.

- Press [+] to set the memory contents register to hold up to 100 memory locations.

Display shows Memory size: 00-99.

- Press [-] to set the memory contents register to hold up to 10 memory locations.

Display shows Memory size: 0-9.

6. Press [SETUP] to exit setup mode.

Display exits setup mode.

7. Exit and save the memory key selection.

KCU Options Menu

To access a menu, press [SETUP], then press one of the following menu select keys:

EDIT	Editing options
EVNT	Events (GPI relay closures) options
FILM	Film options
LIST	SSU list options
LOOP	Edit looping options
SYS	System options
TRKS	Track select options
TRAN	Transport options

If power to the KCU is turned off, all settings are saved. The last settings entered will be restored when the KCU is next powered on.

Editing [EDIT] Options Menu

Press [SETUP], then the motion control [EDIT] key, to access the Editing options menu. The Editing options menu offers two choices, EDIT Q/C and EDITS ROLL AS.

Table Chapter 4 -2. Edit Options Menu

KEY	MENU	SUB-MENU	RANGE
EDIT	Editing Options	0 Edit Q/C	Off, <i>Normal</i> , Stop
		1 Edits Roll As	<i>Mast/Slave, All Slaves</i>

When the default setting (ALL SLAVES) is used, all transports in the group are treated as slaves and locked to the KCU timeline. This ensures that all machines lock to the same exact time code position for absolutely accurate edits. If MAST/SLAVE is selected, the master transport resolves and locks to the selected reference, and the slave machines in turn lock to the timeline of the master machine.

Event Select GPI [EVNT] Options Menu

This discussion of the Event Select GPI options menu is applicable to KCU 080 and 600 series software. For information regarding this menu in configurations of KCU with SSU, and of KCU 300 series software (SSU), see the Advanced Features chapter of this manual.

To access the Event Select GPI options menu, press [SETUP], then [EVNT]. Choose KEYBOARD GPI 1 or KEYBOARD GPI 2 from the Event Select GPI options menu.

Table Chapter 4 -3. Event Options Menu

KEY	MENU	SUB-MENU	RANGE
EVENT	Select GPI Options		
	1 Keyboard GPI 1	0 Mode	Normal, <i>Autoset</i> , Rec Tally, Edit-Rec, Group Lock
		1 Beep Mode	Off, <i>On</i>
		2 Beep Spacing	10-30 (<i>20</i>)
		3 Last Beep	<i>Muted</i> , On
	2 Keyboard GPI 2	0 Mode	Normal, <i>Autoset</i> , Rec Tally, Edit-Rec, Group Lock

Film [FILM] Options Menu

Use the Film options menu to change the reference time code type. This option is available only when using a Lynx-2 Film Module or Film Lynx Gearbox Module. This option is not available with KCU 300 series software.

Press [SETUP], then the device select [FILM] key, to access the Film options menu.

Table Chapter 4 -4. Film Options Menu

KEY	MENU	SUB-MENU	RANGE
FILM	Film Options	0 Ref Code Type	24, 25, DF, <i>30</i>
		1 NTSC Default	<i>29.97</i> , 30.00

SSU List [LIST] Options Menu

List is available only with KCU 080 series software. Press [SETUP], then the device select [LIST] key, to access the SSU List options menu. The List options menu has the single choice of 0-SSU CAPTURE TO.

Table Chapter 4 -5. List Options Menu

KEY	MENU	SUB-MENU	RANGE
LIST	SSU List Menu	0 SSU Capture To	GPI 1-GPI 8 (<i>GPI 1</i>)

Edit Looping [LOOP] Options Menu

Press [SETUP], then [LOOP], to select the loop options. This menu has three choices to define the loop process after edit and replay passes: AFTER EDIT, AFTER REPLAY, and AFTER END.

Table Chapter 4 -6. Loop Options Menu

KEY	MENU	SUB-MENU	RANGE
LOOP	Edit Looping	0 After Edit	<i>Re-edit, Replay</i>
		1 After Replay	<i>End, Repeat</i>
		2 After End	<i>Stop, Recue</i>

System [SYS] Options Menu

To access the System options menu,

1. Press [SETUP].

[SETUP] key flashes.

2. Press the [SYS] key.

*[SYS] key flashes, the LAST and NEXT LEDs light, and the [+]
and [-] keys light.*

The message *System Ref Src: Ext Vid* is displayed.

3. Use the [+] or [-] key to change the reference selection.
4. Press [SETUP] to exit the menu.

The following choices are available from the System options menu:

Table Chapter 4 -7. System Options Menu

KEY	MENU	SUB-MENU	RANGE
SYS	System Options	0 System Ref SRC	<i>Int Xtal, Ext Vid, Mains, VSO</i>
		1 Calc Entry Mode	<i>Normal, CMX Style</i>
		2 Flash Rec Lamp	<i>No, Yes</i>
		3 Wheel Rate	<i>1-10 (1)</i>
		4 Supervisor On	<i>No, Yes</i>

Track Select [TRKS] Options Menu

Press [SETUP], then [TRKS], to enter the Track Select options menu.

The Track Select options menu offers two choices: VIDEO TRACKS and VIDEO AUTO-RST. These choices relate specifically to video machines. These options are designed to protect the audio facility from inadvertently recording on the video portion of a work tape. However, in some circumstances video track enable may be necessary, such as when a transfer is being done from one machine to another.

The following are the Track Select options menu choices:

Table Chapter 4 -8. Track Select Options Menu

KEY	MENU	SUB-MENU	RANGE
TRKS	Track Select	0 Video Tracks	Safe, Enabled
		1 Video Auto-Rst	Off, On

Transport [TRAN] Options Menu

Press [SETUP], then [TRAN], to enter the Transport options menu.

Press [SETUP] again to exit and store the transport settings. The transport selections are retained in memory and should only need to be reset if the transport type is changed.

Table Chapter 4 -9. Transport Options Menu

KEY	MENU	SUB-MENU	RANGE
TRAN	Tran Options		
	A-F Machine Keys	0 Capstan Mode	Wild, Resolved
		1 Ser TC Option	Enable, Inhibit
	2 Track Select	KCU, Transport	

Resetting a Machine Select Key

Use [CLR] + [TRAN] to reset a machine select key to factory default settings. To solo a transport, press and hold the [CLR] key, and press [TRAN]. *Transport Clearing Now* is displayed as the transport parameters are reset.

This feature is not available in KCU 330 series software.

Chapter 5 Troubleshooting

The KCU displays the following levels of user information, described in this chapter:

- Keyboard power-up messages
The KCU has a power-up sequence that provides operational information.
- Prompts
Prompts are displayed as a reminder when a specific keyboard entry sequence is required.
- Self-test messages
The KCU offers a self-test.
- System error messages
These error messages are displayed only with KCU330 series software (SSU).
- Warnings
Warnings are displayed when a command sequence is entered incorrectly, or a precondition is required for a command to operate.

Keyboard Power-Up Messages

The KCU has a power-up sequence that provides operational information. The following information is displayed during power up.

Lamp test, holding memory

The KCU scrolls a lamp test of the motion control switch lamps and holds previously entered and stored data in RAM.

Lynx Keyboard Control Unit, Version Kxx.xx

The KCU displays the software version installed.

Supervisor Disabled, 9 memories

The KCU tells you if the System Supervisor Unit is on, or offline and displays the memory size selected, either 0-9 or 00-99.

Hold the “GRP” key and add groups in order of priority

This is the end of the power-up sequence and prompts the user for a group designation.

Prompts

Prompts are displayed as a reminder when a specific keyboard entry sequence is required.

Hold “GRP” key and add groups in order of priority

Cause: The KCU requires that machines are selected to the group for synchronization. If no machines are selected to the group then this prompt is displayed. The [GRP] key and available machine select keys (A-F, GEN*) will flash.

*GEN appears for K-330 operation only.

Solution: Hold the [GRP] key and press machine select keys (A-F) to make a group.

Press ENTER to confirm

Cause: A data clear function has been selected (e.g., [CLEAR] + [Poll key]). The KCU prompts for a confirmation before performing the command. When this prompt is displayed, the command will involve resetting the system.

Solution: Press [ENTR] if you wish to proceed or any other key to exit.

Recall Memory

Cause: [MEM] has been pressed and the KCU is prompting for a memory selection.

Solution: Select a memory number.

Recall reg or mem

Cause: [RCL] has been pressed and the KCU is prompting for a register or memory selection.

Solution: Select a valid register or press [MEM] followed by the memory number.

Select valid register

Cause: Trim mode has been selected and an invalid register or no register is present in the calculator data entry buffer.

Solution: Use [RCL] to select the register you want to trim or [CLR] to cancel.

Set an “in” point

Cause: Edit mode has been entered and no edit In Point has been set.

Solution: Capture or enter a time code value and store it to the In Point register.

Solo a group first

Cause: You have attempted to recall or store a sync point or offset while in group mode.

Solution: Sync point and offsets may only be stored in solo or group status mode. Select solo or status mode and repeat the operation.

Solo the “ref” group

Cause: A reference sync point can not be captured while in group mode or if a slave machine is selected in solo mode.

Solution: Solo or Group status the reference machine.

Store reg or mem

Cause: The [CAPT] or [STO] key has been pressed. The KCU is prompting for a valid register or memory number.

Solution: Select a valid register or press [MEM] followed by the memory number (location).

Self Test Messages

The KCU offers a self-test. To invoke the self-test, press [GRP] then [SYS]. Press [ENTER] to confirm the key selection.

The following messages and information is displayed during the self test process.

Running self test

Cause: The KCU self-test procedure has been initiated.

Checking RAM: 8K

Cause: The KCU RAM is being checked.

Checking ROM: 64K

Cause: The KCU PROM is being checked.

Checksum: xxxx

Cause: The KCU PROM is read and the checksum is displayed. Press [CLR] to continue the self test.

No keys pressed

Cause: The keyboard key test is entered. Press keys to confirm that they are being correctly scanned. The associated LED is also tested. Press [SETUP] + [CLR] to exit the key test.

System Error Messages

These error messages are displayed only with KCU330 series software (SSU).

Tran: X tape out

Cause: The specified transport is not responding to transport commands.

Solution: Make sure the transport is correctly connected to the Lynx-2 module, and that the correct tape machine is selected in the menu. Make sure the tape is correctly laced on the transport.

Tran:X Play speed 30 ips

Cause: The specified transport speed has changed to 30ips.

Tran:X Play speed 15 ips

Cause: The specified transport speed has changed to 15ips.

Tran:X Play speed 7.5 ips

Cause: The specified transport speed has changed to 7.5ips.

System error XXXX

Cause: An internal communications inconsistency has occurred. The error type xxxx is a hex number that will assist the factory in locating the problem. System error codes are specific to different parts of the KCU system.

Solution: Note the system error number and contact the factory for further information.

Tran:X capstan error

Cause: The capstan of the specified transport is not responding to synchronization control.

Solution: Make sure that the specified transport is set for external control.

Tran:X transport in local

Cause: The specified serially controlled transport is switched to local.

Solution: Check that the remote switch is set to remote at the machine.

Warnings

Warnings are displayed when a command sequence is entered incorrectly, or a precondition is required for a command to operate.

All groups not locked, Edit aborted

Cause: All machines within a group have not locked before the In Point in an Edit sequence. The KCU will retry the Edit unless Edit Q/C has been set to Stop in the Edit Options menu.

Solution: Establish which transport is not locking and rectify the problem. Lengthen the preroll, or if it is the master machine try operating in Group, Master/Slave mode.

All groups not locked, Q/C off

Cause: All machines within a group have not locked before the In Point in an Edit sequence. The KCU will continue to roll the edit unless Edit Q/C has been disabled in the Edit Options menu

Solution: Establish which machine is not locking and rectify the problem.

Cue point after normal preroll, ignored

Cause: An Edit command has been issued and the Cue Point is after the In Point minus the preroll.

Solution: Clear or set a new Cue Point.

Edit ended early

Cause: An edit sequence ended before the machines had reached the Out Point. This normally is the result of pressing [PLAY] or [STOP].

Lamp test, Clearing memory

Cause: A KCU cold boot operation has been initialized. The KCU will re-initialize to default parameters. Some information will be cleared.

Lamp test, Holding memory.

Cause: A KCU warm boot operation has been initialized. The KCU variables will re-initialize. No information will be cleared.

No in-point or cue point set

Cause: A Cue command to locate the transports to the Cue Point has been issued and no cue or in point is set.

Solution: Set a Cue or In point.

Set an In Point

Cause: An edit command has been issued and no In Point exists.

Solution: Set an In Point.

“Out” must be later than “In”

Cause: An edit command has been issued when the out point is before the in point.

Transport clearing now

Cause: A [CLR] + [TRAN] command has been issued for the soloed transport. The transport will reset to default parameters.

Tran:X Play speed 30 ips

Cause: The specified transport speed has changed to 30ips.

Tran:X Play speed 15 ips

Cause: The specified transport speed has changed to 15ips.

Tran:X Play speed 7.5 ips

Cause: The specified transport speed has changed to 7.5ips.

Track is safe or not available

Cause: A track record enable command has been ignored because the track has been set to safe or the KCU can not enable it.

Solution: Use the setup menu to select and set the track to ready and then set the track enable.

WARNING: open end

Cause: An Edit command has been issued and no edit Out Point has been entered.

Solution: Set an out point.

Warning: No active transports enabled.

Cause: No transports have been record readied in Edit; therefore, the KCU will not issue the Record or Rehearse commands.

Solution: Set one or more transports to record ready by using the red [POLL] key and machine select keys.

Chapter 6 Features and Controls

This chapter describes the key functions of the Keyboard Controller Unit (KCU). The following categories are discussed:

- Display screen provides machine and time code information, machine status, and a calculator scratch pad.
- Transport controls provide transport motion control, including a jog/shuttle wheel.
- Device select keys determine the system operating mode and set operating parameters.
- Machine (group) select keys determine machine mode.
- KCU calculator keys perform arithmetic calculations and a variety of additional functions.
- Auxiliary functions keys work in combination with other keys to facilitate arithmetic and other KCU operations.
- KCU status indicators include function keys as well as lighted status displays.
- Special function keys accelerate specific edit operations.

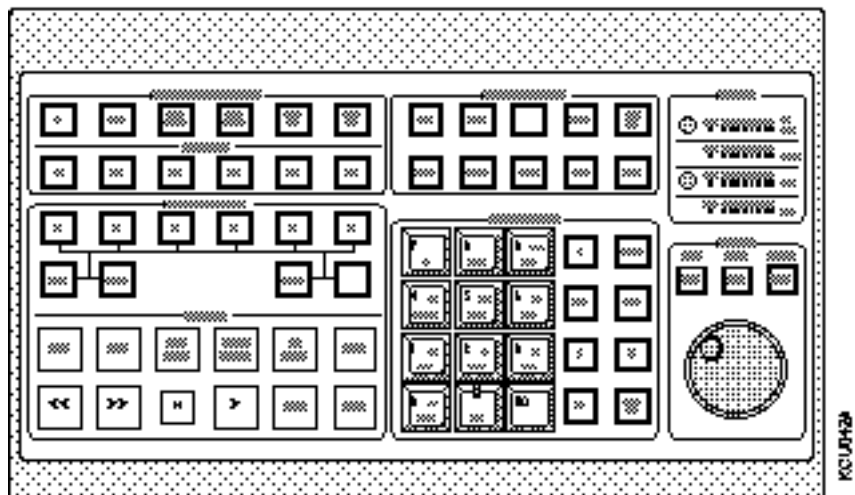


Figure Chapter 6 -1. KCU Key Layout

KCU Display Screen

The KCU uses a bright, 80-character dot matrix vacuum fluorescent display. The display provides transport and time code status, setup displays, register contents, prompt and error messages, and a calculator scratch pad for numeric time code calculations. Information is grouped in the following areas, corresponding to the example in the following figure:

- Machine information in the upper left, **A* b c d**
- Time code information in the upper right, **A> 2:40:55:20: LL**
- Machine status in the lower left, **>L >L >L >L**
- Calculator scratch pad in the lower right, **12:34:56:78 .25**

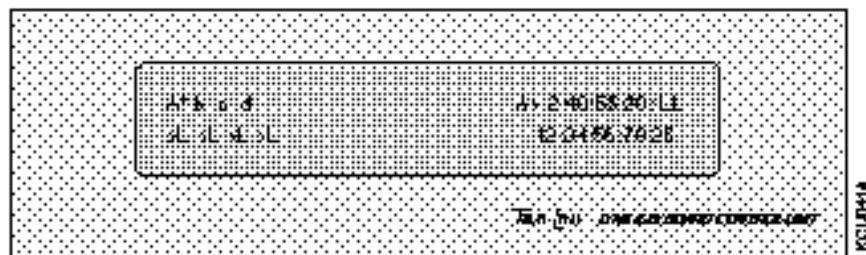


Figure Chapter 6 -2. KCU Display Screen

Machine Information

The machine information displayed provides information about the group and solo transport status, including time code position, lock error, transport control status, and master and slave designations.

Solo Mode Display

Solo is accessed from the group operating display by pressing the [SOLO] key. In Solo, the display updates information about the current soloed transport. Time code position, group status and transport control status are all updated in the KCU display screen for the selected solo machine. Pressing the [SOLO] key again returns the display to the group operating display.

Group Mode Display

The group display mode provides master transport time code position, lock status, and transport status.

- A capital letter (A) in the upper left portion of the display indicates that the machine is the master. Any machine can be the master.
- A lower case letter (b, c) indicates that the machine is a slave.

- An asterisk (*) indicates that the machine is the time code reference machine.
- >L indicates that the machine is in play and locked.
- >W indicates that the machine is in wild speed. That is, the KCU is controlling the machine, but not synchronizing it.

Time Code Information

Time code for the group or selected machine is always displayed in the upper right. The time code displayed is dependent on group or machine status selected. For example, when the GRP LED is lit, group machine status and master machine time code are displayed.

Press a machine select key [A-F] while in group display to display machine status and the transport time code. If the SOLO LED is pressed, the selected soloed machine time code is displayed.

Leading zeros are not displayed. For example, 3 minutes, 13 seconds, and 2 frames *00:03:13:02* is displayed as *3:13:02*.

- The example is non-drop frame code, indicated by separating the seconds and frames digits with a colon.
- If the example was drop frame code, it would be indicated by separating the seconds and frames digits with a comma rather than a colon, written as *3:13,02*.

Machine Status

Tape machine transport status is displayed in the lower left corner.

>L	Lock
<<	Rewind
CUE	Cueing
R	Record
>>	Fast Forward
RLB	Rollback
r	Rehearse
< >	Jog/Shuttle
LOC	Locate
Ch	Chase
•	Stop
REP	Replay
NC	No Code

If a transport module is offline, a dash (-) is displayed as the status for that machine, indicating that no control of that module is available until it is placed online.

The following reference designations indicate to which system reference the machine or group is locked:

I	Internal Fix
i	Internal Variable
L	External Video
A	Aux (not implemented in current software)
M	Mains (available with K330 software only)
V	VSO
P	Pilot (not implemented in current software)
T	External Time Code

In solo mode, a single letter is displayed.

In group mode, two letters are displayed. The first letter indicates that the master machine is locked to the system speed reference. The second letter indicates that all of the other machines in the synchronized group are also locked. For example, LL indicates that External Video is selected as the system reference.

Calculator Scratch Pad

This area of the display is active whenever any of the calculator keys are pressed or a time code register or memory is recalled.

- Clear the current value in the display with the [CLR] key.
- Clear the last digit entered with the [BS] key.

The calculator can be accessed from Group, Status, or Solo machine modes.

The calculator lets you perform a variety of time code calculator operations as outlined in the following examples:

1. Press the [CLR] key to clear the calculator display.
2. Using the keys, type in 1:25:15:10.
3. Press the minus [-] key.

Minus is displayed in the calculator section.

4. Type 10:10 (ten seconds, 10 frames).

5. Press the equal [=] key.

1:25:05:00 is displayed as the correct calculation.

This number can in turn be stored to any register or memory location. Numbers can also be recalled from registers, have calculations performed, and the new value can be used.

Transport Controls

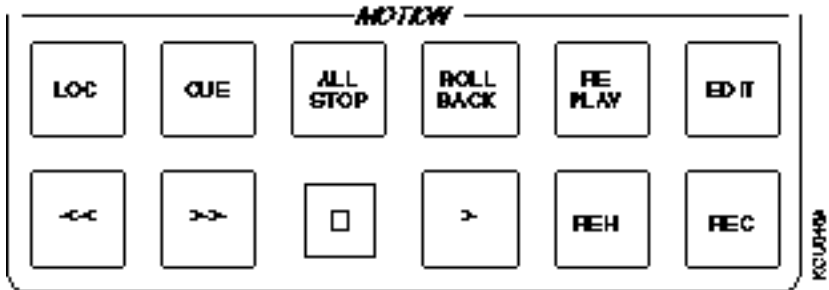


Figure Chapter 6 -3. Motion Control Keys

LOC (Locate) Key

In solo mode, the KCU locates the soloed machine to the time code in the calculator data entry area, minus the system preroll.

In group mode, the KCU locates all transports currently assigned to the group to the time in the calculator data entry area, minus the system preroll.

CUE Key

In solo mode, the KCU cues the soloed machine to the time code in the Cue Point register.

In group mode, the KCU cues all machines currently assigned to the group to the time code stored in the Cue Point register. If a cue point is not set, the KCU uses the value in the In Point register. If there is no cue point or in point set, the *No in point or cue point set* message is displayed.

ALL STOP Key

The [ALL STOP] key issues an immediate Stop command to all transports on the system, regardless of group status, solo status, or transport mode. All machines will stop. This key stops unexpected transport operations.

ROLLBACK Key

The [ROLLBACK] key rewinds the selected machine or group by a predetermined amount. The rollback time can be changed by entering a new value, then pressing the [STO] and [ROLLBACK] keys.

Default rollback value is 15 seconds.

The [ROLLBACK] key can also be used as a reverse play key for transports that can play backward. To change the [ROLLBACK] key to PLAY REV,

1. Press [SETUP].
2. Press [ROLLBACK].
3. Use the [+] and [-] keys to select the desired function.

REPLAY Key

Use the [REPLAY] key with the [EDIT] key to replay the current edit. Pressing [EDIT] followed by [REPLAY] cues the selected machines in the group to cue to the current edit preroll position and commence an edit replay sequence.

The [REPLAY] key also has an associated replay register that stores the time code when the [>] (PLAY) key was last pressed. Press [REPLAY] to locate to the time code in effect when the [>]key was last pressed.

Press [>]while the machines are playing to update the replay register and set a new replay register time code.

EDIT Key

Use the [EDIT] key to initiate an edit sequence.

See *Editing with the KCU* in the Getting Started chapter for detailed information on editing.

In edit, record, and rehearse, the KCU GPI's can be selected to operate at the edit in point. In edit replay, GPI's are disabled. See the *Event Select GPI [EVNT] Options Menu* in the Getting Started chapter for further information on the GPI relays.

<< (Rewind) Key

In solo mode, the Rewind command is issued only to the machine that is soloed.

In group mode, the Rewind command puts all machines currently assigned to the group into rewind or chase.

>> (Fast Forward) Key

In solo mode, the Fast Forward command is issued only to the transport that is soloed.

In group mode, the Fast Forward command puts all transports currently assigned to the group into fast forward or chase.

■ (Stop) Key

In solo mode, the Stop command is issued only to the machine that is soloed.

Pressing [■] (STOP) in group mode initiates an intelligent stop function. The master machine stops immediately. Each slave machine is parked at a position that corresponds to the master machine position, taking individual offsets into account. The system is cued and ready to synchronize.

The [■] key also has an associated Drum Stop command that can have a serially controlled video machine initiate a drum stop. This effectively causes the VTR to de-lace the tape off of its drum, preventing unwanted drum and tape wear.

> (Play) Key

In solo mode, the Play command is issued only to the machine that is soloed.

In group mode, the Play command puts machines currently assigned to the group into play.

In play, the KCU synchronizes and locks each of the machines including the master machine to the system speed reference.

REH Key

In solo mode, the Rehearse command is issued to the soloed machine if it is record enabled and in lock.

In group mode, the Rehearse command is issued to all machines currently assigned to the group that are record enabled, if the group is locked.

The Rehearse command can be issued manually by pressing the [REH] key or by pressing the [REH] and [PLAY] keys together. The Rehearse command can also be issued automatically as part of the KCU edit routine.

See the *Setup Options Menu* section in the Getting Started chapter for information on altering the [REH] key option.

The [REH] key has an associated REH LED. In solo mode, the REH LED indicates the rehearse status of the soloed machine. In group mode, the REH LED indicates the rehearse status of all the machines currently assigned to the group. If any machine in the group is in rehearse, then the REH LED is lighted.

REC Key

In solo mode, the Record command is issued to the soloed machine if it is record enabled and in lock.

In group mode, the Record command is issued to all machines currently assigned to the group that are record enabled, if the group is locked.

The Record command can be issued manually by pressing the [REC] key or by pressing the [REC] and [PLAY] keys together. The Record command can also be issued automatically as part of the KCU edit routine.

The [REC] key has an associated REC LED. The Lynx-2 machine interface cables monitor the actual record status of each machine. The REC LED is a true record tally. When lighted, the LED indicates that the machine is actually in record.

In solo mode, the REC LED indicates the record status of the soloed machine. In group mode, the REC LED indicates the record status of all the machines currently assigned to the group. If any machine in the group is in record, the REC LED is turned on.

Using the Jog/Shuttle Wheel and Controls

Use the jog/shuttle wheel in trim, jog, and shuttle modes to do the following:

- Spool machines at controlled wind speeds.
- Nudge or bump a tape one frame at a time.
- Trim the offset of a source machine in real time to achieve a precise time relationship between the master and slave machines.

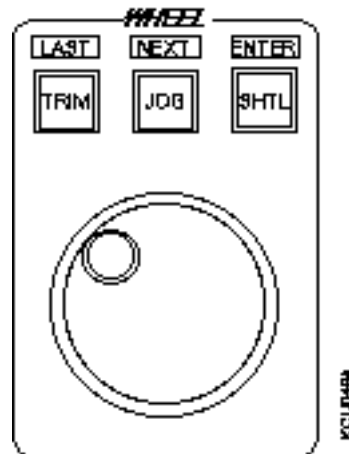


Figure Chapter 6 -4. Jog/Shuttle Wheel and Controls

TRIM Key

The [TRIM] key selects trim mode. Use the jog wheel and the [+] and [-] keys to adjust register values. You may adjust the values in most registers. After selecting trim, recall a register; then press the [+] or [-] key or use the jog wheel to increase or decrease the time code value. Press and hold the [+] or [-] key to cause the key to auto-repeat.

Each time that you press [TRIM], the KCU selects the last register that was trimmed. Press a register key on the calculator keypad to select a different register to trim.

The following keys are also active in trim mode:

[CLR] Clears any number from the data entry area of the display and exits trim mode.

[STO] Initiates a Store command and prompts for a register to store to.

[LAST] In setup mode, the [TRIM] key is used as the [LAST] key. This key steps backwards to the previous item in a menu.

JOG Key

In jog mode, the wheel bumps a transport forward (clockwise) or backward (counter-clockwise) a small amount each time that it is turned. If you turn the wheel continuously, the tape scrubs past the heads with a velocity proportional to how fast you turn the wheel.

NEXT Key

In setup mode, the [JOG] key is used as the [NEXT] key. This key steps forward to the next item in a menu.

SHUTTLE Key

In shuttle mode, turn the wheel clockwise to move the selected machines forward with a velocity proportional to the amount that you rotate the wheel from its starting position. Turn the wheel counter-clockwise to initiate variable-speed backward motion. Shuttle speed may be varied from a slow crawl to several times normal play speed.

Shuttle mode is a controlled speed mode generally on video transports only. Most audio tape machines do not have a variable speed shuttle mode, so the shuttle function is implemented by rapidly toggling between rewind and fast forward. The actual velocity is determined by the ballistics of the particular machine.

Shuttle is used most effectively in solo mode to position a single machine accurately for setting sync points and in and out points. If you use shuttle in group mode, the wheel controls only the master machine; all other machines will chase the master machine and attempt to maintain their correct park-ahead offsets.

ENTR Key

The [ENTR] key confirms operations that may cause a loss of data or setup information. For example, [CLR] + [POLL] resets the system only after you press [ENTR] to confirm this action.

Device Select Keys

Use the device select keys to determine the system operating mode, and to set operating parameters for system, transport, GPI, and Film Lynx-2.

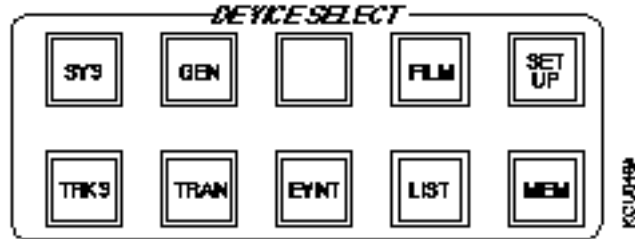


Figure Chapter 6 -5. Device Select Keys

SYS Key

The [SYS] key displays the software version numbers for the KCU system microprocessors, when used with the System Supervisor Unit (SSU), and provides access to the system error list.

For further information, see the *System Options Menu* and the *KCU Messages and Errors* sections in the Getting Started chapter.

GEN Key

This key is available with KCU 3.00 series software only. The [GEN] (Time Code Generator) key provides access to the system reference and timing options.

For further information, see the *Time Code Generator GEN Options Menu* and the *Using Time Code Registers* sections in the Getting Started chapter.

FILM Key

The [FILM] key changes the time code display from *Hours:Minutes:Seconds:Frames* to *Feet and Frames*. Use this if you prefer feet and frame operation to change the numeric properties of the KCU to a film-style environment.

SETUP Key

The KCU has a comprehensive setup procedure for customizing the system for a particular mode, transport or application.

For further information, see the discussion of the [SETUP] key in the *KCU Options Menus* section in the Getting Started chapter.

TRKS Key

Use the [TRKS] key to record enable specific tracks on a tape or video machine. This feature generally is used on serially controlled machines.

1. Press the [TRKS] key to enter track select mode.
2. Press the appropriate machine select key [A-F].
3. Press the corresponding calculator key (1-4, etc.), of the tracks to enable.

The [0] key arms the video track. The [9] key puts a machine into assemble.

When a track is enabled,

- The track number is displayed
- A line (–) is displayed if the track is safe
- XXX indicates that the track is safe or unavailable

For further information, see the *Tracks Options Menu* section in the Getting Started chapter.

TRAN Key

Press [TRAN], then a machine select key [A-F]. The display indicates the selected transport type, the Lynx-2 time code module software version, the time code frame rate, capstan control (resolved or wild), and track select mode (KCU or Local).

For further information, see the *TRAN Options Menu* section in the Getting Started chapter.

EVNT Key

The [EVNT] key accesses KCU GPI relays. GPI relays can be made to operate or follow several internal time code registers. In this mode, the relays follow the edit in point. When the in point is changed, the GPI execution point changes with it.

Each GPI has a Preroll and Duration register. The Preroll register is used to advance the closure time to allow for slow start of externally triggered devices. Duration can be set to suit the closure type required.

The following transport keys affect GPI operation:

STOP Takes the GPI offline.

PLAY Sets the GPI to ready or active.

REH Rehearses the closure.

Default setting for the GPIs is Auto-set.

For further information, see the *EVNT Setup Options Menu* and the *Using Time Code Registers* sections in the Getting Started chapter.

LIST Key

This function is not currently in use.

MEM Key

The [MEM] or Memory register key is used with the calculator keypad. Use [STO] to store time code numbers to a memory register and [RCL] or [MEM] to recall numbers from a memory register.

For further information, see the *Using KCU Memory* section in the Getting Started chapter.

Machine (Group) Select Keys

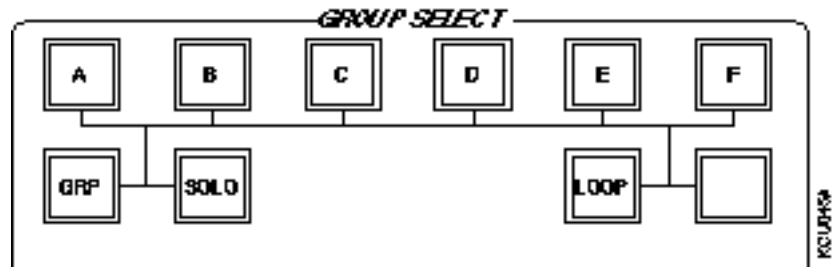


Figure Chapter 6 -6. Machine (Group) Select Keys

A-F Machine (Group) Select Keys

The KCU can control up to six machines that are assigned to the machine (group) select keys A-F.

The Time Code Generator (TCG) allows the [GEN] key to be considered as a machine when the SSU is used with the KCU (K330). When the SSU is in use, the [GEN] key controls the LTC and the MTC generators of the System Supervisor Unit.

The six machines and the TCG may be operated individually in solo mode, or synchronously in group mode.

GRP (GROUP) Key

Press [GRP] to operate selected tape machines as a synchronous group. When group is active, the GRP LED and the selected machine keys (A-F, GEN) are lighted. See *Grouping Machines with the KCU* in the Getting Started chapter for more information.

SOLO Key

Press [SOLO] and the appropriate machine select key [A-F] to place a machine in solo mode. The transport motion control keys control only the soloed machine. All other machines remain in their previous state. Press the [SOLO] key a second time, or the [GRP] key, to switch back to group mode.

LOOP Key

Press the [LOOP] key to select Edit Loop or Cycle mode. The [LOOP] key continuously cycles an edit until it is interrupted by a transport command.

BANK Key

The [BANK] key is not used at this time.

Calculator Keys

The Calculator keys offer the following functional categories:

- Numeric keypad
- Register and memory access (see *Using Time Code Registers* in the Getting Started chapter for information on using calculator keys to access register values)
- Auxiliary function keys

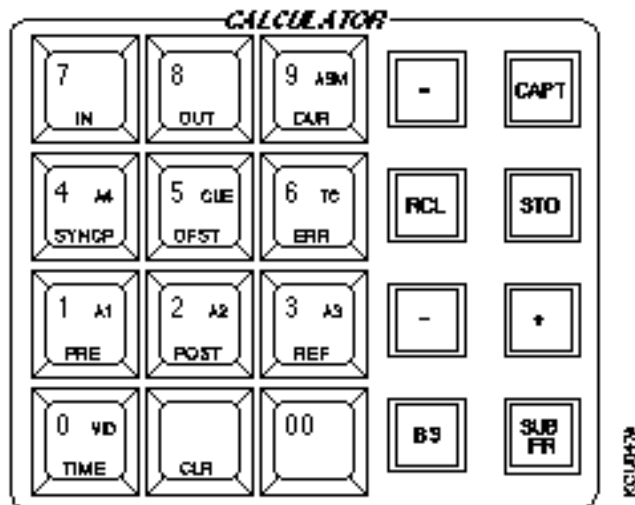


Figure Chapter 6 -7. Calculator Keys

The calculator is active whenever you press a numbered key. Calculator numbers are entered from left to right, with the most significant digit first. Leading zeros are ignored. Auxiliary function keys [+], [-], and [=] are used with the calculator.

When a numbered key is pressed after [TRIM], [CAPT], [RCL], or [STO], the alternate function of the numbered key becomes active.

When any of the calculator keys (00-9) are pressed, the digit is displayed in the calculator scratch pad located in the lower right area of the display screen. The calculator can be used to perform time code additions or subtractions. In the following example, an addition is performed.

1. Enter the following number with the calculator keys:
11270603

2. Press the [=] (PLUS) key.

The operation selected is displayed.

3. Enter a time of 10 seconds with the calculator keys:

1000

4. Press the [=] (EQUAL) key.

The sum is displayed in the lower right portion of the display.

11:27:16:03

Accessing Time Code Registers

Calculator keys provide access to the time code register values. Values may be stored to or recalled from any of the registers. See *Using Time Code Registers* in the Getting Started chapter for information on using calculator keys to access register values.

The registers available correspond to the numbered (00-9) calculator keys:

00/ZERO	Local Zero register
0/TIME	Time register
1/PRE	Preroll register
2/POST	Postroll register
3/REF	Reference Sync Point register
4/SYNCP	Source Sync Point register
5/OFST	Offset register
6/ERR	Error register
7/IN	In Point register
8/OUT	Out Point register
9/DUR	Duration register

00–ZERO Key

The [00] key inserts two zeros into the display. This is particularly useful when entering time code numbers. The [00] key also provides access to the Local Zero register.

CLR Key

Press [CLR] to perform the following functions:

- Exit calculator mode and return to the normal operating display.
- Clear incorrect entries for any key or function.
- Clear the data entry buffer. If a number is entered but not yet stored to a register, the original register value is retained.
- Clear registers. To clear a specific register, simultaneously press the [CLR] key and the calculator key for the register to

be cleared. For example, press and hold the [CLR] key and press [OFST] to clear the offset register for a slave machine.

- Clear the transport type data buffer and return to default parameters. Solo the machine. Press and hold the [CLR] key and press [TRAN] to clear the transport register for a particular Lynx-2 module.

0–TIME/VID Key

When not used as a [0] in calculator mode, the [TIME] key provides access to the Time register. The Time register is used to store a time code value to the Lynx-2 or Lynx-2 Film Module.

Press the [VID] key in TRKS mode to select and deselect the video track record enable on a video machine.

1–PRE/A1 Key

When not used as a 1 in calculator mode, the [PRE] key provides access to the Preroll register. The preroll position is the time code location that the KCU uses to cue the master machine during locate and edit functions

The Preroll register may be accessed during store, recall, and trim operations.

Press the [A1] key in TRKS mode to select and deselect the A1 (Audio Channel 1) track record enable.

2–POST/A2 Key

When not used as a 2 in calculator mode, the [POST] key provides access to the postroll register. The KCU uses the value in the Postroll register to calculate the postroll time code position at the end of an edit sequence.

Press the [A2] key in TRKS mode to select and deselect the A2 (Audio Channel 2) track record enable.

3-REF/A3 Key

When not used as a 3 in calculator mode, the [REF] key provides access to the Reference Sync Point register during store, recall, and trim operations.

Press the [A3] key in TRKS mode to select and deselect the A3 (Audio Channel 3) track record enable.

4-SYNCP/A4 Key

When not used as a 4 in calculator mode, the [SYNCP] key provides access to the Source Sync Point register for a specified machine. Each source machine in the system has a separate sync point register. The Source Sync Point registers may be accessed during store, recall, and trim operations.

Press the [A4] key in TRKS mode to select and deselect the A4 (Audio Channel 4) track record enable.

5-OFST/CUE Key

When not used as a 5 in calculator mode, the [OFST] key provides access to the Offset register for a specified machine.

Press the [CUE] key in TRKS mode to select or deselect the CUE track record enable on a video machine.

6-ERR/TC Key

When not used as a 6 in calculator mode, the [ERR] key provides access to the machine offset Error register. Press [RCL], then [ERR], to display the Error register for a selected machine. The error is automatically displayed in status mode.

Press the [TC] key in TRKS mode to select and deselect the time code track record enable for a video transport.

7-IN Key

When not used as a 7 in calculator mode, the [IN] key provides access to the In Point register.

8-OUT Key

When not used as an 8 in calculator mode, the [OUT] key provides access to the Out Point register.

9-DUR/ASM Key

When not used as a 9 in calculator mode, the [DUR] key provides access to the Duration register during store, recall, and trim operations.

Press the [ASM] key in TRKS mode to select or deselect the Assemble function for a video machine.

= (EQUAL) Key

The [=] (equal) key is used in conjunction with the [+] and [-] keys to perform time calculations. It is used to complete a calculation sequence. When pressed, the sum or difference is calculated and displayed. The value is displayed in the time code format of the master machine.

+ (PLUS) Key

The [+] or [PLUS] key is used with the [=] key to combine two values.

Additions are computed in frames and displayed in the code type or format of the master machine. Press [CLR] to begin a new calculation or to return to the normal operating display. The arithmetic is correctly performed even if the numbers entered are incorrectly formatted. For example, if you enter 1:65:43, it will be translated to 2:06:13 (30 frame calculation) during the calculation.

The [+] key is also used in setup mode to select the next option in a menu. It is used in trim mode to bump or increase the numerical value stored in a selected register by the trim register value.

- (MINUS) Key

The [-] or [MINUS] key is used with the [=] key to subtract one time code value from another. Subtractions are computed in frames and displayed in the code type or format of the master machine. After performing the calculation, it may be stored to a register. Press [CLR] to begin a new calculation or return to the normal operating display.

The [-] key is used in setup mode to select the previous option in a menu, and in trim mode to bump or decrease the numerical value stored in a selected register by the trim register value.

If you subtract a large number from a smaller one, the result will be displayed as a negative time code number.

KCU Auxiliary Function Keys

Auxiliary function keys perform arithmetic operations with the calculator keys and in combination with other keys to facilitate KCU operations. Auxiliary function keys are located at the right of the calculator keys.

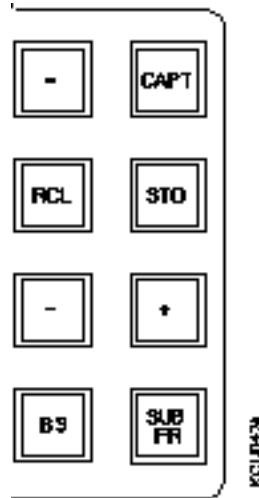


Figure Chapter 6 -8. Auxiliary Function Keys

RCL Key

The [RCL] key recalls time code values that are stored in the KCU registers and memories. Some registers, such as , sync point and offset, are specific to each machine. To display the sync point or offset value for a machine, solo the machine or select status mode before recalling the register.

1. Press [RCL] to enter Recall mode.

[RCL] key flashes. "Recall reg or mem" is displayed.

2. Press [IN].

The value stored in the In Point register is displayed.

STO Key

The [STO] key is used to store time code values in KCU registers and memories.

1. Press the [STO] key.

Store reg or mem is displayed.

2. Press one of the calculator keys to store the value in the calculator data entry buffer to the corresponding register.
3. Press the [MEM] key, then a number representing the memory location.

4. Press [CLR], or press [STO] again, to cancel the command.

The time code value to be stored may be captured, entered, or calculated. If the [CAPT] key is used to capture a time code value, the store function is automatically invoked.

The [STO] key can be used to store a value to any of the following registers:

- Time
- In Point
- Out Point
- Duration
- Sync Point
- Offset
- Preroll
- Postroll
- Reference
- Rollback

For further information, see *Using Time Code Registers* in the *Getting Started* chapter.

CAPT Key

The [CAPT] key captures the current time code value for storage in any of the KCU registers or memories. When you press the [CAPT] key, the value of the time code shown in the display is captured.

Press a register or memory key to store the time code value. If you do not want to store or save the value in a register, press [CLR], or press [CAPT] a second time.

SUBFR Key

The KCU stores time code values in high resolution format. In normal operation, the high resolution or subframe content of all time code numbers except for the error display is suppressed.

Press the [SUBFR] key to enter or trim the subframe information. SUBFR is commonly used when adjusting offsets between machines. This can be done dynamically so that it is possible to easily adjust the positional relationship between machines until the audio phases.

The KCU defaults to a subframe trim value of 01 subframes.

For further information, see *Trimming an Offset* in the *Getting Started* chapter.

KCU Status Keys and LED Indicators

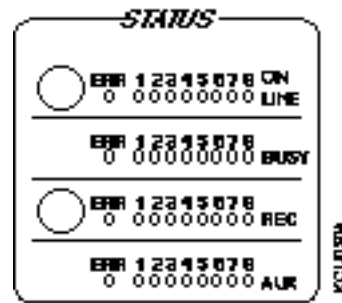


Figure Chapter 6 -9. Status Keys and LED Indicators

ON LINE (Poll) Key and LEDs

Press the yellow [POLL] key to cause the KCU to establish communications with the Lynx-2 Modules by polling the serial communications bus looking for connected devices. As each module responds to the KCU, the corresponding On Line LED is lighted. On power up, the KCU automatically polls any Lynx-2 Module connected on the serial bus.

After polling, the KCU displays the message *Press the GRP Key and Add Groups in Order of Priority.*

If no On Line LEDs stay illuminated when you press the status [POLL] key, the KCU did not find any modules when it polled the serial bus. Common causes include a faulty RS422 connection between the KCU and Lynx-2 Modules, or Lynx-2 Modules assigned to the same serial address.

If a serious serial communications error exists, the On Line ERR LED begins to flash along as well as an On Line LED corresponding to the Lynx-2 Module(s) involved. This error might result from turning off the power of a Lynx-2 Module that is online with the KCU, or from a bad connection somewhere along the RS422 connection chain. Press the status [POLL] key to poll again the serial bus. This should clear the error condition and re-establish communications between the KCU and all Lynx-2 Modules properly connected to it.

Busy LEDs

The individual Busy LEDs indicate when the various transports in the system are busy executing an action. As with On Line LEDs, each Busy LED corresponds numerically to the serial addresses assigned to the connected Lynx-2 Modules.

A good example of the Busy LEDs is seen when you play two or more transports in the group. When Play is first initiated, the Busy LED is lighted for each of the active transports. As each transport is pulled into resolve and lock, the corresponding LED goes out. When all transports are locked, no LEDs are lighted. LL is displayed to indicate that all active transports are now synchronized.

REC (Record Enable) Key and LEDs

Use the red status [REC] key with machine select keys to specify which transports in the system will be issued a Rehearse or Record command. During the record portion of a programmed edit, or during a manually initiated record condition, the status [REC] key and the motion control [REC] key both are lighted.

To record enable a specific transport, press and hold the status [REC] key while you press the machine select key A-F corresponding to the desired transport.

To remove the transport from record enable status, press the machine select key [A-F] a second time.

When a transport is in record enable state, the KCU issues record and rehearse commands to the Lynx-2 Module controlling the transport. Unless the KCU supports serial track arming for that transport, you will need to record enable individual tracks or channels of the transport on the transport itself.

The REC (Record Status) LEDs indicate when a transport has been record enabled. RED LEDs correspond numerically to the serial addresses assigned to the connected Lynx-2 Modules.

AUX LEDs

The AUX LEDs indicate when any slave or source transport has a non-zero offset. When indicating an offset, the AUX LEDs correspond numerically to the serial addresses of the Lynx-2 Modules.

The AUX LEDs also display the relative velocity of a transport in shuttle and jog modes. This display mode temporarily overrides the normal indication of offsets.

When in shuttle mode, the transport is stationary. Only the center AUX LED is lighted. If you turn the control wheel clockwise, the transport begins to move forward. Additional LEDs at the right of the center AUX LED light up in proportion to transport shuttle speed. As shuttle speed increases, more LEDs are lighted until all four LEDs on the right are lighted. As the speed increases beyond this point, LEDs begin to go out, starting at the center, until only

the right most LED is lighted. The display for the reverse direction is exactly the same except that it uses the AUX LEDs left of center.

Special Function Keys

Special function keys mark current time code numbers showing in the KCU display into the following registers:

- In Point register
- Out Point register
- Reference Sync Point register
- Source Sync Point register
- Cue Point register



Figure Chapter 6 -10. Special Function Keys

Whenever you press a special function key, the current time code number in the KCU display is captured and stored automatically into the indicated register.

IN Key

Press the special function [IN] key to store the current reference machine time code number into the In Point register. The [IN] key is illuminated whenever there is an active value in the In Point register.

OUT Key

Press the special function [OUT] key to store the current Reference machine time code number in the Out Point register. The [OUT] key is illuminated whenever there is an active value in the Out Point register.

REF SYNC Key

The special function [REF SYNC] key provides access to the Reference Sync Point register.

SRC SYNC Key

The special function [SRC SYNC] key provides access to the Source Sync Point register.

CUE PT Key

The special function [CUE PT] key provides access to the Cue Point register.

END PT Key

The special function [END PT] key is not in use in this release.

Macros

Macro keys store and recall a series of key presses.



Figure Chapter 6 -11. Macro Keys

To define a macro,

1. Press the macro key [F1-F6] that will contain the macro.
2. Each subsequent keystroke is remembered, in sequence, and stored in the macro key.
3. To end storage of a macro keystroke sequence, again press the macro key [F1-F6].

A macro sequence may not be included or nested within another macro sequence.

Chapter 7 Advanced Features

This manual describes the functions available with the standard Keyboard Control Unit (KCU) 080 series software. This chapter describes those functions uniquely available in other configurations, including KCU 600 and KCU 300 series software.

The Advanced Features chapter has the following product sections:

- Varispeed (KCU 600 series software)
 - Varispeed configuration requirements
 - X-frame synchronization
 - Varispeed operation with KCU
 - Varispeed pivot points and offsets
 - Varispeed options menu differences
 - Calculating with varispeed
 - Displaying varispeed status
 - Varispeed error messages
- System Supervisor Unit (KCU 300 series software)
 - Installing the SSU
 - KCU options menus with the SSU
 - Event [EVNT] Select GPI options menu
 - Group [GRP] options menu
 - Record Enable [REC] options menu
 - System options menu
 - Time Code Generators

Varispeed (KCU 600 Series Software)

With the KCU, Lynx-2 modules will operate both X-Frame rate and Varispeed synchronization. Varispeed synchronization permits machines to be locked together and run at different speeds to allow time compression or expansion.

Varispeed synchronization allows many operational features:

- Tapes that have different running times can be fitted together.
- Program material with non-synchronous time code can be locked.
- NTSC 0.1% pull up and pull downs available.
- Standard conversion between 24- and 25-frame time codes requiring 4% speed compensation can be performed.

Varispeed Configuration Requirements

Varispeed synchronization requires KCU 600 series software, and Lynx-2 software version V-700, or Lynx V-600 or higher. Please contact the factory for ordering and installation information.

Any combination of Lynx-2 and Lynx modules fitted with Gearbox Option cards and V500 modules can be used with the KCU.

X-Frame Synchronization

X-Frame synchronization of mixed code types is only possible with Lynx-2 and V600 slave modules. V500 modules can be used as slave modules, but only with the code type combinations that are shown in the following table. When a combination of Lynx modules are used in a system, the most flexible configuration can be obtained by selecting a V500 module as the master machine. The permitted combinations are shown in the following tables.

Table Chapter 7 -1. X-Frame Combinations

LYNX-2 SOFTWARE X-FRAME RATE COMBINATIONS

		V500 SLAVE				LYNX-2 SLAVE			
		30	DF	25	24	30	DF	25	24
LYNX-2 MASTER	30	✓	✓			✓	✓	✓	✓
	DF	✓	✓			✓	✓	✓	✓
	25			✓		✓	✓	✓	✓
	24				✓	✓	✓	✓	✓
		V500 MASTER				LYNX-2 SLAVE			
		30	DF	25	24	30	DF	25	24
V500 MASTER	30	✓	✓	✓	✓	✓	✓	✓	✓
	DF	✓	✓	✓	✓	✓	✓	✓	✓
	25	✓	✓	✓	✓	✓	✓	✓	✓
	24	✓	✓	✓	✓	✓	✓	✓	✓

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Varispeed Operation with KCU

To varispeed a tape, varispeed must be turned on and a varispeed source sync point marked. The KCU detects Lynx-2 modules and Lynx modules fitted with V600 on the Lynx bus, and switches for X-Frame and Varispeed operation automatically.

In some instances when using the KCU, subframe amounts appear in the time code registers. This is a normal side effect of either the X-Frame time code conversion or varispeed adjustment process. For example, 30:15 in 30 frame code will become 30:12.50 if it is converted to 25 frame time code. The internal calculations performed by the KCU are all high precision and always take into account the subframe contents of the time code registers.

Varispeed Pivot Points and Offsets

The *varispeed pivot point*, or the absolute offset, is the only point in the 24 hour clock where the actual offset is completely independent of the varispeed adjustment. Regardless of the varispeed rate selected, the positional relationship of the machines does not change.

On the slave tape, it is at this point that the offset is defined. The pivot point is the place where the difference between the off tape time code is exactly the same as the value in the slave offset register.

In non-varispeed KCU operation, setting a source sync point is optional and used only as a method of calculating offsets. Machines in varispeed, by default, must have a pivot point for the varispeed synchronization calculation. If a sync point (varispeed pivot point) is not set, the KCU uses zero for the varispeed calculations regardless of accuracy. It is very important that the source sync point entered is related to the program material. If not, the sync relationship moves significantly when the varispeed amount is changed.

The significant difference from non-varispeed operation is that a source sync point must be set, even if no offset is required between the machines. Capturing an offset or using sync points to calculate an offset automatically enters the varispeed pivot point at a suitable time code.

Example of Pivot Points

In this example, the varispeed pivot point is at 00:00:00 (no offset has been entered). There are two tapes with a zero offset. The master machine is running at standard speed, and the slave running with a +10% varispeed. If these tapes are played from 00:00:00, at 10 minutes the master machine will be at 10:00:00 and the slave time 11:00:00. Even though the tapes started with a zero offset, at 10 minutes the tapes have a positional offset of one minute.

If the master tape is at 10:00:00 and the slave varispeed percentage is changed from +10% to 0%, the slaves actual offset will be recalculated, and the tape would move back one minute to establish its proper, positional relationship at the new zero varispeed rate.

There is only one place where the varispeed percentage does not affect the tape position. If the slave tape as well as the master tape had been at 00:00:00 (the varispeed pivot point, altering the varispeed percentage would not have moved the tape as it is already in the correct place.

In practice, the varispeed pivot point is not set at 00:00:00, but at the start of the program material, or at some other relevant point (i.e., the beginning of a sound effect). Then, if the varispeed rate needs to be altered, the start time is locked in place and the sync does not move.

Setting Pivot Points

Set varispeed pivot points for machines in either of the following ways:

- Enter slave Source Sync (SRC SYNC) points and master a Reference Sync (REF SYNC) point.
- Enter slave Source Sync points and slave offset numbers.

If source sync points are not entered, the default time of 00:00:00 hours is used as the varispeed pivot point.

Using Offsets with Varispeed

Slave machines lock internally in varispeed. A machine in varispeed can be thought of as having a constantly moving offset. At any point, the actual offset (the real difference between the tape and time codes) is made up of two parts: the entered offset (time in the offset register) plus a varispeed offset adjustment. These two offset components determine the positional relationship between machines.

Machines running in varispeed can be offset by all standard methods. The offset can be entered manually, captured, or calculated from sync points. Offsets can be recalled and trimmed dynamically, if required, using the [+] and [-] keys or the Jog/Shuttle wheel. When offsets are calculated for X-frame machines, the time codes are converted in the offset calculation to the reference machine code type.

Manually entered offsets are applied at the slave source sync point (varispeed pivot point). Some care must be taken when manually entering or adjusting offsets. If the slave tape is not located at or close to the source sync point, the machine will relocate to maintain the correct varispeed positional relationship.

Capturing Varispeed Offsets

Offsets can be captured by soloing the slave machine and pressing [CAPT], followed by the [OFST/5] key. Offsets are calculated by subtracting the current master position from the current slave position. If either of the machines is operating in X-Frame rate mode, the time code is converted in the offset calculation to the reference code type.

The source sync register is updated automatically to the current time code value. In normal operation, each time an offset is captured [CAPT], [OFST], and the source sync point register is inactive, [SRC SYNC] key LED off. The source sync point remains inactive (LED off), but the new value is used as the slave varispeed pivot point.

If the source sync point is active when the offset is captured, the register will not be overwritten and the captured offset will be compensated by the varispeed adjustment. This action makes the offset value correct at the varispeed pivot point (source sync point).

Calculating Offsets

The normal offset calculation functions of the reference sync [REF SYNC] and source sync [SRC SYNC] keys and registers have not been changed. If reference and source sync points are set for varispeed machines, the offset will be calculated in the normal way and applied at the source sync point. If no reference sync point is set, the system uses the record edit in point to calculate the offset.

When the reference sync or edit in points are changed, all machines with active source sync point registers will have their offset recalculated and reposition. The source sync point is active if the [SRS SYNC] key LED is on in solo or status modes. If you do not want a particular slave machine offset to recalculate, the source sync point for that machine should be made inactive by holding the [CLR] key and pressing the [SRC SYNC] key, before changing the reference or edit in points.

Making the source sync point inactive does not affect the varispeed pivot point. The system continues to use the value in the source sync point register for the varispeed calculation.

KCU sync point software allows slave varispeed pivot points to be moved without changing the actual offset relationship with the master machine. In normal operation, if a slave varispeed pivot point is moved and the offset is not changed, the slave machine will recalculate its position and relocate.

If the reference sync and edit points are inactive, the KCU does a special calculation to prevent the slave from moving when a new source sync point is entered. The KCU automatically updates the slave machine offset to take into account the varispeed offset adjustment between the old and new source sync points. By updating the offset, the positional relationship defined by the previous source sync point and offset is maintained.

Clearing In Points

To clear the reference or edit in points temporarily, press [CLR] and the [REF SYNC] and [IN] special function keys simultaneously. The register values are not cleared, but are made inactive and can be recalled and restored if needed after the slave machine sync point has been moved.

Varispeed Options Menu Differences

Two additional setup options are available in the Transport options menu and one additional option in the System options menu to control varispeed setup and operation.

Transport [TRAN] Options Menu Differences

Varispeed setup options are in the Transport options menu. These options are available only with KCU 600 series software.

Press [SETUP], then [TRAN], to access the transport options menu. There are two options specific to varispeed, 3-VARISPEED and 4-VARIABLE %.

Access the options by pressing the appropriate calculator key (3 or 4), or step through the list using the [LAST] and [NEXT] keys.

Table Chapter 7 -2. Transport Options Menu

KEY	MENU	SUB-MENU	RANGE
TRAN	Tran Options		
	A-F Machine Keys	0 Capstan Mode	Wild, <i>Resolved</i>
		1 Ser TC Option	<i>Enable</i> , Inhibit
		2 Track Select	KCU, Transport
		3 Varispeed	<i>Off</i> , -0.1%, +0.1%, Variable
4 Variable %	85.00-115.00 (<i>100.00</i>)		

- **3-VARISPEED.** +0.1%, -0.1% are highly accurate preset calculations used for pulling up or down the NTSC 29.97 fps to the 30.00 fps frame rate difference. The pull up and down settings are used to run machines at the correct speed when synchronizing with NTSC tapes. Select -0.1% to run a slave tape at 29.97 fps when using a PAL reference. Select +0.1% to run slave tapes at 25 or 24 fps when using a NTSC reference. X-Frame rate code combinations for the preset NTSC varispeed settings are shown in the following table.

Table Chapter 7 -3. NTSC Varispeed Corrections

Ref Src Rate	Slave Code			
	30	DF	25	24
30.00*	-0.1%	-0.1%	0	0
29.97	0	0	+0.1%	+0.1%
25.00	-0.1%	-0.1%	0	0
24.00	-0.1%	-0.1%	0	0

* This case is unusual, because 29.97 fps would normally be selected for NTSC operation.

VARIABLE is used with the VARIABLE % option to set varispeed rates to synchronize program material with different running times, or where standards conversion is required.

- **4-VARIABLE %.** The variable percentage can be adjusted by $\pm 15\%$. The jog/shuttle wheel adjusts in 10ths of a percent, and the [+] and [-] keys in 100ths of a percent. Use the [CLR] key to reset the varispeed amount back to 100%, the default setting. The varispeed percentage will be automatically updated if varispeed sync, in and out points are entered in the Transport varispeed calculation register to calculate a varispeed rate. (See *Calculating with Varispeed.*)

System [SYS] Options Menu Differences

Press [SETUP], then the [SYS] key to access the System Options Menu

Table Chapter 7 -4. System Options Menu

KEY	MENU	SUB-MENU	RANGE
SYS	System Options	0 System Ref SRC	Int Xtal, Ext Vid, Mains, VSO
		1 Calc Entry Mode	Normal, CMX Style
		2 Flash Rec Lamp	No, Yes
		3 Wheel Rate	1-10 (1)

Calculating with Varispeed

Unless the varispeed is a standard value, the simplest method of determining the correct varispeed rate is to use the KCU varispeed calculator. The calculator calculates the rate as a ratio of two durations, or from four points or positions on tape:

- Reference start
- Reference end
- Slave start
- Slave end

The KCU varispeed software has a special transport mode for varispeed percentage calculation. This mode is independent from non-varispeed KCU operation and is only used for marking points on each tape or for entering known program durations for varispeed calculation. In transport setup mode, the calculator automatically recalculates the rate, each time a point is marked, and enters the new varispeed value for that machine.

The current varispeed percentage is shown if the selected machine will varispeed. If the varispeed percentage flashes, it indicates that the rate, computed from the current varispeed calculator register values, doesn't match the actual varispeed percentage. A varispeed percentage will not be shown for the reference machine and V500 modules.

Accessing the Varispeed Calculator

Press the [TRAN] key twice to access the varispeed calculator. The KCU flashes the *TRAN: (A-F) VARISPEED* message to indicate that the KCU is in the transport varispeed mode.

The varispeed calculator uses the [IN/7] and [OUT/8] calculator keys to store start and end times for each machine. The calculator then compares the slave times with the reference machine times and calculates the slave varispeed percentage. Because each machine has independent In and Out registers, it is possible to

enter different points on the reference machine to calculate individual varispeed rates for each slave machine.

Varispeed Tran Mode

Varispeed tran mode is a special version of the normal solo mode. When varispeed tran mode is engaged, the KCU transport functions can be used to solo a transport in the usual way, and to locate to specific points on the tape for marking the start and end time registers for each machine. In varispeed tran mode, the start and end point registers for each machine can be captured, stored, recalled, and trimmed in the usual way.

The tran mode In and Out varispeed calculation registers are not the same as the edit In and Out registers.

Press the [TRAN] key to enter varispeed tran mode. The [TRAN] key LED flashes, and information relating to the selected machine is displayed.

Press the [TRAN], [GRP], [SOLO] or [ALLSTOP] key to exit varispeed tran mode.

Calculating by Duration

The varispeed rate also can be calculated by entering two program durations. If the existing running time is stored in the reference machine Duration register, and the new running time in the slave Duration register, the calculator compares the two durations and calculates a varispeed percentage.

See *Using Time Code Registers* in the Getting Started chapter for a discussion of Duration registers.

Displaying Varispeed Status

The KCU and the Lynx-2 module have status displays to indicate X-Frame and varispeed status of each machine.

The Lynx-2 module front panel indicates that a machine is in varispeed by lighting the VARI LED, and by displaying *VL 00* in the offset error display. In X-Frame, a Lynx module code type LED flashes to indicate the reference machine code type if the type is different from the off-tape time code type.

The KCU displays XL for machines in X-Frame lock, and VL for machines in varispeed lock in both group and solo modes. If a machine is in X-Frame and Varispeed lock, only VL is displayed.

The double letter group lock indicators in the upper right portion of the display have not been changed, and still indicate the system reference source. For example, LL indicates external video and II indicates internal crystal. When VV is displayed, it indicates that VSO is the system reference. VV is not an indication of varispeed lock status.

Varispeed Error Messages

A varispeed limits error message is displayed when an out of range varispeed calculation has been entered. The KCU software recalculates the speed every time the reference or slave In, Out, or Duration varispeed calculation registers are altered.

When a number is entered that causes the varispeed to exceed the $\pm 15\%$ range, the varispeed percentage for that machine is reset to 100%, and the *Varispeed reset, Limits exceeded!* message is displayed. Because the speed calculation may have been exceeded the actual values in each register are retained temporarily while new points are entered, the actual values in each register are retained.

System Supervisor Unit (KCU 300 Series Software)

With the System Supervisor Unit (SSU), the KCU becomes a powerful editor/controller within console and automation systems. The SSU becomes the central communication hub of a TimeLine machine control system.

Installing the SSU

In installation, the KCU and Lynx modules are all routed through the SSU. The ES bus communications of the SSU will monitor and control all communication, including KCU/CCU and RMC machine controllers, console automation systems, TimeLine Lynx and Lynx-2 modules, Digital Audio Workstations (DAWs), and system tally and GPI controllers.

Software Requirements

The KCU requires software version KCU 330 or later. The SSU must have software version 1.40 or later. Please contact the factory if software upgrades are needed.

Connecting the System Supervisor Unit

Instead of daisy-chaining Lynx modules from the KCU power supply, the ES bus software of the KCU requires that the KCU be connected to the SSU. The Lynx modules are daisy-chained from the RS422 port of the SSU.

1. Connect the KCU to its power supply.
2. Connect a KCU Serial cable between the KCU power supply GPI/SUPERVISOR connector and the SSU COMPUTER/CONTROL PORT 1.
3. Connect the Lynx modules to the TRIBUTARY PORT 1.

Initializing the System Supervisor Unit

After initialization, all setup and control functions take place at the KCU. The SSU need only be used as a communications monitoring device, as all SSU communications become transparent within the system.

To initialize the KCU with the SSU,

1. Verify that the KCU, SSU, and Lynx modules are powered ON.
2. Place the Lynx modules to be used ONLINE.
3. Press the KCU status [POLL] key to poll the communications bus.

Note: When the system is powered on, communication on the bus is unavailable until the KCU polls the system.

4. Verify the RS422 Tributary Port 1 and COMPUTER/CONTROL PORT 1 communications on the SSU.

Using the SSU

When the KCU and SSU are installed and initialized with the Lynx modules, KCU operation is the same as stand-alone operations. The KCU is controlling all fundamental operations of the SSU and Lynx modules, while functioning as the editing controller.

In some cases, console automation systems will be used along with the KCU. This in no way limits any operations or functions of the KCU, but allows machine control from either the console transport keys, or the KCU transport keys. Commands will be overwritten from the last location where the command was issued.

KCU Options Menus with the SSU

This section describes only those options unique to the KCU in SSU operation. See the *KCU Options Menus* section of the Getting Started chapter for detailed information on options menus.

The following KCU options menus contain options specific to SSU operations, or are available only with the SSU:

- Event [EVNT] Select GPI options menu
- Group [GRP] options menu
- Record Enable [REC] options menu
- System options menu
- Time Code Generators and TCG [GEN] options menu.

Event [EVNT] Select GPI Options Menu

The Event Select GPI options menu contains several settings that are used exclusively with the SSU.

- There are eight available GPIs rather than the two available in stand-alone KCU systems.
- The additional GPI SYS MUTE option sets the relay during machines all locked mode, all stopped mode, and Master machine shuttle mode. The relay is reset during any machine motion that is non-play.
- ADR beep options are located in GPI 8. The beep options are identical in both systems.

For an SSU configuration, refer to the following information on the Event options menu. This information supersedes the discussion of the Event Select GPI options menu in the Getting Started chapter.

GPIs in the SSU

GPI switch closures are output from the SSU, rather than from the KCU power supply as in stand-alone operation. A 4-3-2-1 annunciator countdown is also available prior to each GPI relay closure. An additional output is programmed as system lock indicator. Status indicators for all eight GPIs are located on the front panel of the SSU.

Accessing the Event [EVNT] Select GPI Options Menu

Each GPI has a Preroll and Duration register. The Preroll register is used to advance the closure time to allow for slow start of externally triggered devices. Duration can be set to suit the closure type required. The following transport keys affect GPI operation:

STOP	Takes the GPI offline.
PLAY	Sets the GPI to ready or active.
REH	Rehearses the closure

To access the Event Select GPI options menu, press [SETUP], then [EVNT].

Event Options Menu Choices

The KCU 080 series software Event options menu has two GPI choices. Configured with the SSU, the KCU 300 software offers eight choices. Choose GPI 1 through GPI 8 from the Event Select GPI options menu.

Table Chapter 7 -5. Event Options Menu

KEY	MENU	SUB-MENU	PARAMETERS
EVENT	Select GPI Options		
	1 GPI	0 Mode	Normal, Autoset, <i>Rec Tally</i> , <i>Edit Rec</i> , <i>Reh Tally</i> , <i>Edit Reh</i> , <i>Lock Tally</i> , <i>Sys Mute</i>
	2 GPI 2	0 Mode	<i>Edit Rec</i>
	3 GPI 3	0 Mode	<i>Reh Tally</i>
	4 GPI 4	0 Mode	<i>Edit Reh</i>
	5 GPI 5	0 Mode	<i>Lock Tally</i>
	6 GPI 6	0 Mode	<i>Autoset</i>
	7 GPI 7	0 Mode	<i>Autoset</i>
	8 GPI 8	0 Mode	Normal, <i>Autoset</i> , <i>Rec Tally</i> , <i>Edit Rec</i> , <i>Reh Tally</i> , <i>Edit Reh</i> , <i>Lock Tally</i> , <i>Sys Mute</i>
		1 Beep Mode	Off, <i>On</i>
		2 Beep Spacing	10-30 (<i>20</i>)
	3 Last Beep	<i>Muted</i> , <i>On</i>	

Group [GRP] Options Menu

The Group options menu contains settings for group machine operation. The Group options menu is only available with KCU 300 series software.

Press [SETUP], then [GRP], to access the Group options menu.

Table Chapter 7 -6. Group Options Menu

KEY	MENU	SUB-MENU	RANGE
GRP	Group Options	0 Search Mode	Chase, <i>Group</i>
		1 Ref Follow Mstr	<i>Off</i> , On
		2 Group Parkahead	0-30 (25)

- CHASE allows each controlled transport to locate and chase at its fastest wind speed.
- GROUP (default) restricts the slave machine chase speed to that of the master machine. The slave machines locate to a point as a group, rather than on their own.
- REF FOLLOW MSTR indicates that whenever the master machine is designated, it will automatically be the reference machine. This is true even if the master machine is redesignated.
- GROUP PARK AHEAD is the time, in frames, that slave machines will park ahead of the master machine.

Record Enable [REC] Options Menu

Press [SETUP] followed by the red status [REC] key to access the Record Enable options menu. This is available in 300 software.

Table Chapter 7 -7. Record Enable Options Menu

KEY	MENU	SUB-MENU	RANGE
RDY	Record Options	0 Flash Rdy Lamp	<i>No</i> , Yes
		1 Bar Status	Track Enable, <i>Rec Enable</i>

- The setting of FLASH REC LAMP determines if the REC (Record Status) LED flashes when a transport is in record.
- BAR STATUS sets the REC (Record Status) LEDs to indicate either that a machine is in record ready, or that individual tracks are armed on a specific transport.

System Options Menu

For an SSU configuration, refer to the following information on the System options menu. This information supersedes the discussion of the System options menu in the Getting Started chapter.

To access the System options menu,

1. Press [SETUP].

[SETUP] key flashes.

2. Press the [SYS] key.

[SYS] key flashes, the LAST and NEXT LEDs light, and the [+] and [-] keys light.

The message *System Ref Src: Ext Vid* is displayed.

3. Use the [+] or [-] key to change the reference selection.
4. Press [SETUP] to exit the menu.

The following choices are available from the System options menu:

Table Chapter 7 -8. System Options Menu

KEY	MENU	SUB-MENU	RANGE
SYS	System Options	0 Calc Entry Mode	<i>Normal, CMX Style</i>
		1 Jog Speed	<i>1-10 (0)</i>
		2 Trim Frame	<i>01-10 (01)</i>
		3 Trim Subframe	<i>01-25 (01)</i>

Time Code Generators

The time code generator (TCG) operates as another machine in the group, similar to a virtual machine. The TCG can be either the master or slave. An offset can be applied if the time code output needs to be offset from the master machine time code. The TCG can be soloed to stripe time code onto a transport.

When using the KCU with the SSU, TCGs can be added from the SSU.

When the KCU is initialized with the SSU, the message *Press the GRP key and adds Groups in order of priority* is displayed. At this point, the [GEN] key flashes in addition to any machine keys that are flashing to prompt a new group. Adding the TCG into the group as a slave allows you to control the time code generator output of the SSU as if it were another machine. The TCG jams the master machine time code during all transport operations, allowing TCG output to control a console automation system, digital audio workstations, or another time code-controlled device.

Time Code Generator [GEN] Options Menu

The Time Code Generator options menu is available only with KCU 300 series software. The GEN (Time Code Generator) key provides access to the system reference and timing options.

Press [SETUP], then device select [GEN] key, to access the Time Code Generator options menu.

Table Chapter 7 -9. Time Code Generator Options Menu

KEY	MENU	SUB-MENU	RANGE
TCG	TCG Options	0 System Ref	Intfix, Intvar, <i>Extvid</i> , Mains, Pilot, Exttc, VSO Master, Aux
		1 System Spd/Code	24 Hz/24, 25 Hz/25 (<i>PAL</i>), 29.97 Hz/DF, 29.97 Hz/30 (<i>NTSC</i>), 30 Hz/DF, 30 Hz/30
		2 Varispeed %	82.00-118.00 (<i>100.00</i>) Jog/Shuttle Wheel = $\pm 0.1\%$ +/- = $\pm 0.01\%$
		3 TCG Group Mode	Play, Run; Play, Mute; <i>Play, Wind</i>
		4 TCG Still Mode	Off, <i>On</i>
		5 TCG Tran Mode	Virtual (<i>SSL/Neve</i>), <i>Machine</i>

- SYSTEM REF selects the system reference for the SSU.
- SYSTEM SPEED/CODE defines the time code type and speed of the SSU time code generators.
- VARISPEED % allows adjustment of the internal crystal synthesizer of the SSU.
- JOG/SHUTTLE WHEEL adjusts the setting in 0.1% amounts.
- TCG GROUP MODE determines the operating parameters of the virtual machine time code generators of the SSU. Choices are PLAY/RUN, PLAY/MUTE, and PLAY/WIND.

PLAY/RUN starts generating time code when a play command is detected, and continues generating time code until an All Stop command is used.

PLAY/MUTE generates time code in play only.

PLAY/WIND (default) generates time code in play and wind speeds.

- TCG STILL MODE causes the time code generator to generate the same time code value for one second after a stop command is issued.

- TCG TRAN MODE configures the SSU time code generators for use with console automation systems.

VIRTUAL is used during NEVE and SSL operation. In this mode, the TCG automatically groups itself with the machines grouped to provide time code to the automation system in use.

MACHINE is used to group the TCG manually with the other machines.

MIDI Time Code

When the TCG is active and generating time code, MIDI time code is also generated out the MIDI connectors of the SSU. This can be used to control a MIDI device or other equipment that requires a MIDI time code input.

Introduction

The appendix has four sections: SMPTE Made Simple, Key Combination Guide, Glossary, and Quick Reference Guide.

SMPTE Made Simple

Provides basic information and various applications using SMPTE time code.

Key Combination Guide

Provides Key and Key Combination Identification Numbers for “stuck key” errors.

Glossary

An alphabetic list of terms used during the discussion of the KCU.

Quick Reference Guide

Graphical charts of the KCU Setup Options.

SMPTE Made Simple

The Time Code Tutor from TimeLine

Introduction

When the television broadcast industry moved from film and live performance to prerecorded video production, a method was required to reliably synchronize and edit the new medium. Historically, film rushes were lined up at the clapper board and rubber stamped with footage numbers, and by default film was mechanically held in sync by the sprocket holes. Unfortunately, video tape had neither of these attributes. This created a problem of how to get the music, pictures, dialogue, and effects all to begin and run at the same time.

The solution was SMPTE time code. SMPTE is a signal with specific address information that can be recorded on audio or video tape and used to position them, accurately.

Why SMPTE?

In 1971, the Society of Motion Picture and Television Engineers chose **SMPTE** to be the industry standard for synchronization. It became officially known as SMPTE/EBU Time Code when the society was joined by its' overseas counterpart, the European Broadcast Union (EBU). Since it is quite a mouthful, most people just say SMPTE.

What Can You Do with SMPTE?

There are hundreds of uses for SMPTE time code in every branch of audio production. They include records, video, film, advertising and industrials. Let's start with the how and why of some of the most basic applications.

Synchronizing Multiple Audio Machines

Imagine you are a recording engineer. You've just used up all the available tracks on your multitrack machine, but your project is nowhere near completion. How are you going to get some extra tracks? Use a second multitrack recorder.

The question is, "how do you lock the two machines so that the music plays back in perfect synchronization – first time, every time." You *could* try to hit the Play buttons on both machines at exactly the same moment and then cross your fingers, but the odds of this working even once are *very* slim.

The correct solution is to use SMPTE time code *AND* a TimeLine synchronizing system. It works like this: a TimeLine Lynx or Micro Lynx generates time code that is recorded onto the audio tapes. The time code is then used as a common reference point, the "glue" that holds the two machines in sync.

On playback, a SMPTE time code reader reads time code from one tape recorder and passes the timing data to a synchronizer connected to the other tape recorder. Based on this incoming time code, the synchronizer regulates the playback speed of the slave so that it always stays in perfect sync with the master.

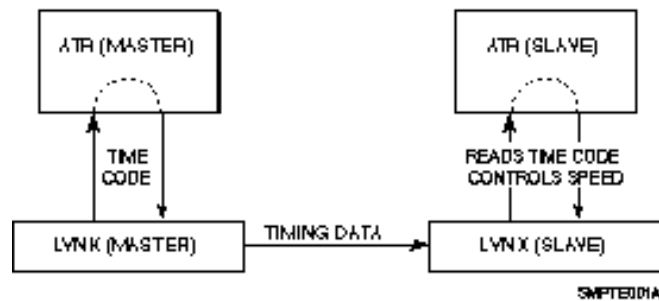


Figure Appendix A-1. Basic SMPTE Time Code Setup

This simple example is the basis for all SMPTE applications. For instance, if you are locking to film or video using a digital audio workstation or a sequencer, you'd just substitute the appropriate controlling device to suit the equipment for that application.

Locking to Picture

Suppose you have footage on videotape and you need to create an audio track to go with it. It could be music, dialog, effects, or all three. How do you lock the sound to picture?

Use SMPTE and a Micro Lynx or two Lynx modules, exactly as described in the previous audio example. SMPTE works just as well with video as it does with digital or analog tape. You can use SMPTE to lock video to analog, digital to analog, in fact, just about anything to anything; even sound sources that don't use tape.

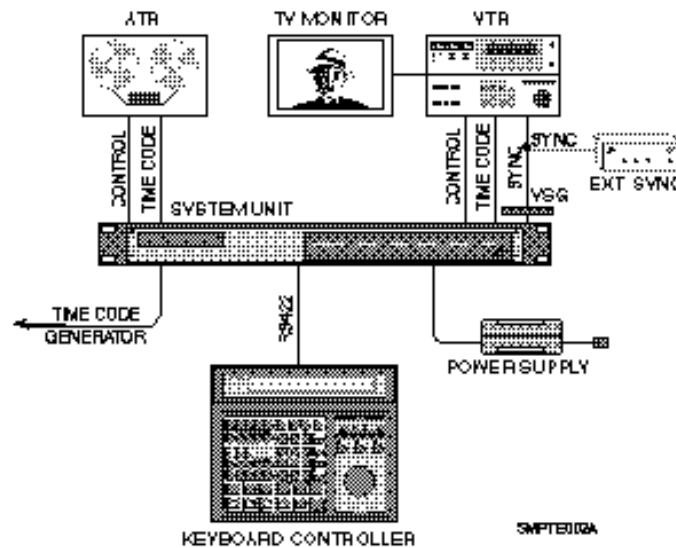


Figure Appendix A-2. Synchronize to Video

Mix Automation and More

If you have a MIDI sequencer and some synthesizers that you want to lock to your multitrack tape or to picture, the TimeLine Micro Lynx can translate SMPTE time code into the MIDI data that the sequencer needs to lock to tape.

SMPTE can be used to control just about anything that has micro processor intelligence – and what piece of audio gear doesn't these days? For instance, mixing console automation will run to time code and can therefore be locked to tape and other time code devices for complete system automation.

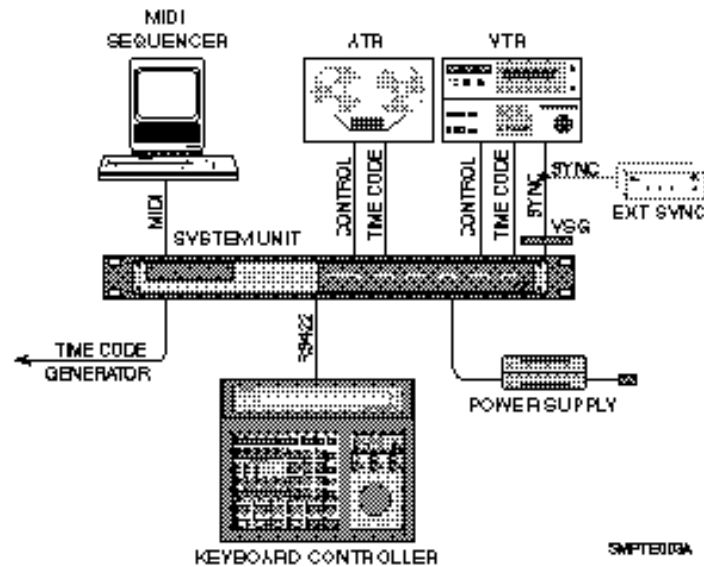


Figure Appendix A-3. MIDI Sequencer and Time Code

Complete Systems

The ultimate SMPTE application is the complete studio system. Just as two devices can be locked to a common time reference, so can a whole roomful: tape machines, consoles, synthesizers, effects processors, and hard disk recorders. With an efficient controller like the Micro Lynx Keyboard, all of these different machines can be operated as easily as a single set of transport controls. Later, we'll explain how SMPTE is used to build large, multi-machine networks for video editing and music recording.

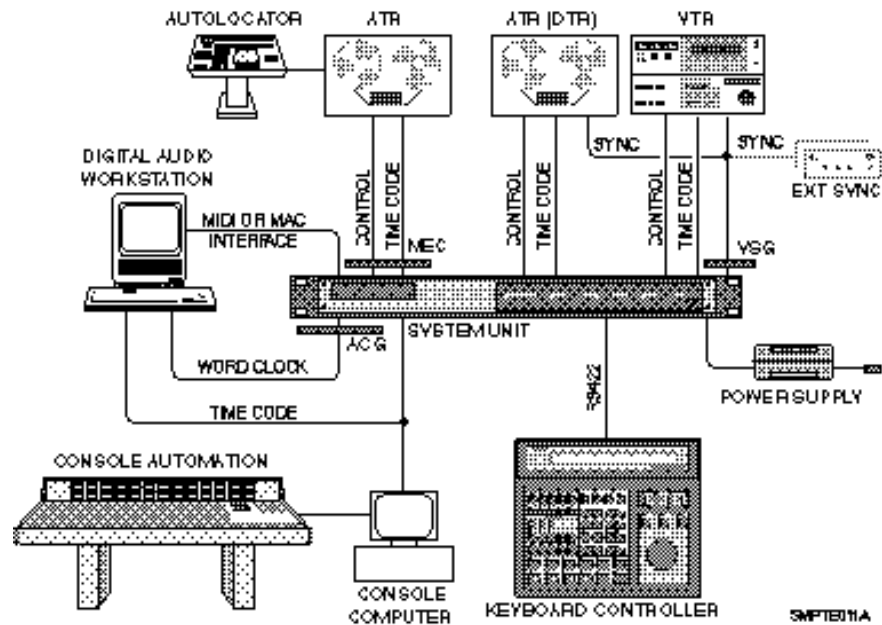


Figure Appendix A-4. Complete Studio System

How Does SMPTE Do It?

If you know precisely where a piece of program is and how fast it is playing, then it is possible to use this information to control other machines so that they are all in the right place at exactly the same time. SMPTE does just this, it is an absolute timing reference that indicates both the speed and position of a tape as it travels across a tape machine transport.

What You Can Do with a Speed Reference

Many pre-SMPTE sync codes could only indicate speed. The most widely used was control track or pilot tone. Pilot tone is an audio signal derived from a stable source, historically 60 Hz AC wall current. By reducing the voltage with a suitable transformer, the resultant continuous sine wave could be recorded on tape.

Machine speed is normally regulated by monitoring tach pulses from the tape machine's capstan motor. They indicate how many times the capstan revolves in a given time interval, just as an automobile's tachometer indicates how fast an engine is turning.

When playing a tape with pilot tone back, the sine wave on tape is compared with a reference sine wave coming from the wall current or some other guaranteed signal.

If the tape slows down, the frequency of the pilot tone, or the number of cycles that tick by each second, will decrease. If the

tape speeds up, the frequency will increase. A controlling device, tied into the tape machine's capstan motor, senses the difference between the reference tone and the pilot tone on tape; and varies the speed of the tape machine motor to make the two match up again.

This process of matching tape machine speed to a stable reference is called resolving. The two sets of sine waves are brought *in phase* with one another, so they match up perfectly, peak for peak, trough for trough. Which is why this is sometimes called phase locked.

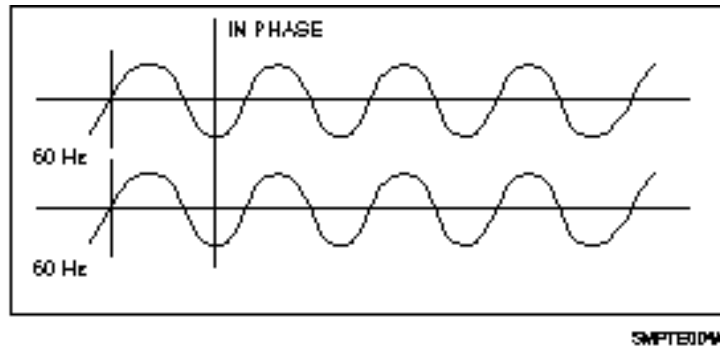


Figure Appendix A-5. Two Sine Wave Signals in Phase

Just as pilot tone on one tape machine is made to match the reference source, it can also be made to match pilot tone on a second master tape machine. Thus, pilot tone can be used to synchronize the speed of the two tape machines.

However, There Is a Problem:

One sine wave looks exactly like another. While the slave machine can phase lock with the master, it has no way of knowing whether the master is playing the first verse or the third chorus or if the master is three-and-a-half seconds into a scene or right at the beginning. As a tool for synchronization, pilot tone is severely limited. The same is true for other *speed only* sync codes such as Frequency Shift Key (FSK) and Din Sync.

To work, master and slave must be carefully lined up at the beginning of playback and there's no way to run the machines accurately to the middle of the program material since the slave never knows where the master is, *only* how fast it is playing.

SMPTE: What You Can Do with a Speed and Position Reference

This is where SMPTE time code enters the picture. As we said, SMPTE indicates not only tape *speed*, but also tape *position*. SMPTE time code is a complex digital signal, equivalent to the simple, analog pilot tone signal with a unique number assigned to each cycle of the sine wave.

Time code is recorded onto tape as an audible signal – a rapid-fire series of *blips*. These blips are “read” by a microprocessor as a unique number: an address, consisting of separate numbers for hours, minutes, seconds and fractions of a second, called frames.

So, if you have a gunshot at the climactic scene of a suspense melodrama, SMPTE tells you exactly where the gunshot “lives;” what its address or location is on tape. SMPTE can say, “This gunshot occurs one hour, 31 minutes, 12 seconds and 19 frames into the film.” This means you can shuttle to the exact spot on tape where that gunshot occurs, and replace the existing blast with a more convincing sample; one the sound effects engineer just acquired.

Think of what that means: the master machine can find *ANYTHING* on a tape, and all slave machines will chase the master to that very same spot. At this point, we’re a long way from just locking one faceless sine wave with another and rolling from the top. We’ve moved into the realm of position accuracy.

Anatomy of a SMPTE Frame

A SMPTE frame or word consists of 80 bits that convey SMPTE’s message of hours, minutes, seconds, and frames. Each bit is represented by a binary ‘1’ or ‘0’ that is specifically encoded for recording onto tape. The method used is called biphase encoding. This coding reverses the signal polarity halfway through a bit to represent a ‘1’ and leaves the bit polarity unchanged to represent a ‘0’. A continuous string of these 80-bit words is recorded linearly along the tape to form the time code.

Let’s look at the jobs the bits perform. Each frame is broken up into 16 groups of 4 bits and a 16-bit sync word.

- Eight 4-bit groups are assigned to the hours, minutes, seconds, and frame number.
- Eight 4-bit groups are user bits. They are reserved for information such as ID, reel numbers, session, dates or another time code number.
- The remaining bits form a sync word, to provide direction information and mark the end of the 80-bit frame.

- The time code reader uses the direction sense bits to determine whether the tape is running forwards or backwards.
- The sync word is a series of preset 1's that allow the speed and phase of two time codes to be read and compared by the Lynx or Micro Lynx module to establish synchronization.

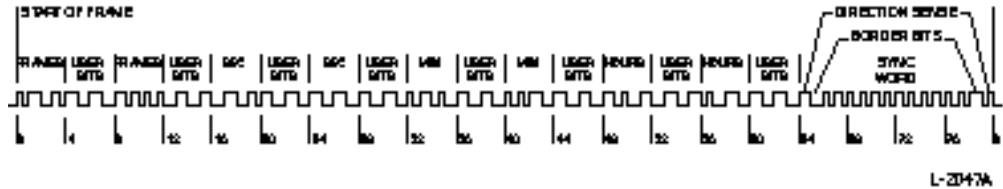


Figure Appendix A-6. Time Code Address

SMPTE words, one for each frame, are recorded along the length of the tape; hence the name Longitudinal Time Code (LTC). The code's design and organization make it suitable for use over a very wide range of play speeds, both forwards and backwards.

The frequency of the LTC signal is always proportional to the tape speed. However, the signal cannot be read in stop or freeze-frame mode. Consequently video frequently uses another form of time code: Vertical Interval Time Code (VITC), which can be reliably read in stop and at very slow play speeds.

Time Code Formats

There are 60 minutes in an hour; 60 seconds in a minute, but how many frames are there in a second? Frame rate is the term used to express the number of frames-per-second in SMPTE time code. Frame rate was originally measured as one-half the power line frequency.

Since there are different power line frequencies in the U.S. and Europe, time code has several different formats, defined by the frame rate used in each country.

National Television Standards Committee (NTSC)

Wall current in the U.S. has a frequency of 60 Hz, making 30 frames-per-second the standard frame rate for American black and white television.

Phase Alternate Line (PAL)

In Europe, the standard wall current frequency is 50 Hz. Thus we have another format: 25 frames-per-second or the PAL format, the standard for European color television.

Drop Frame (DF)

What about American color TV? When it was invented by RCA, they reduced the American black and white frame rate of 30 frames-per-second to 29.97 frames-per-second, to allow both color encoding and compatibility with existing black and white television sets. This became the standard color TV format for America.

The problem is that 30-frame time code running at this rate measures slightly slower than real time.

60 sec x 30 frames/sec	=	1800/min x 60 min/hr	=	108,000 frames
60 sec x 29.97 frames/sec	=	1798.2/min x 60 min/hr	=	<u>107,892 frames</u>
		Difference	=	108 frames

So for every hour, by the clock on the wall, the time code is 108 frames short. Just a few frames off might disastrously make your lead guitarist end his solo two chords early! To correct this, a time code format called Drop Frame (DF) was developed. Drop frame skips the first two frame counts in each minute (with the exception of minutes 00, 10, 20, 30, 40, and 50) to force the time code to match the clock time.

Film

Film is our final consideration. It has run at a frame rate of 24 frames-per-second ever since Thomas Edison invented it. Although this is a “non-standard” time code, it is sometimes used in the field.

Different Frame Rate Formats

In summary, the important thing to remember is that SMPTE conveys two pieces of information: *tape speed* and *tape position*.

Frame rate, is the speed at which the code will run, and frame type (30/DF/25/24), is the way in which frame positions are counted.

30. Thirty frames-per-second can be drop frame (DF) or non-drop frame. If drop frame is selected, then the actual frame count is reduced by 108 frames-per-hour.

25. Twenty-five frames-per-second is the European standard.

24. Twenty-four frames-per-second is the film standard.

Table Appendix A-1. Frame Rate Formats

Counting Rate (Hz)	Counting Method (Frames-per-Second)	Displayed Time Accuracy	Application
24	24 frame	Real Time	Motion pictures and film
25	25 frame	Real Time	EBU standard for European television
29.97 ¹	30 drop frame ³	Real Time	NTSC standard USA & Japan
29.97 ¹	30 non-drop frame ⁴	0.1 % slow	USA & Japan
30.00 ²	30 drop frame ³	0.1 % fast	Non-standard
30.00 ²	30 non-drop frame ⁴	Real Time	USA & Japan

- ¹ 29.97: Generated by all “color television” sync generators (i.e., almost all sync generators built after 1970). This is the speed at which a “black burst” signal runs (not to be confused with “black & white”). It is a standard color signal with a “color of black.” *Use this* as your standard frame rate unless you are an expert and have a reason not to.
- ² 30.00: Usually available only in “internal crystal mode” of a time code generator, or from black & white television sync generators. *Don't use* this non-standard speed unless you are an expert and have a good reason. This is sometimes used in conjunction with motion picture film systems.
- ³ Skips 108 frames/hour at regular intervals.
- ⁴ Many users prefer 30 (full frame) counting because no numbers skip in the counting sequence, even though the elapsed time accuracy at 29.97 frame rate is slightly different from real time.

VITC

Vertical Interval Time Code (VITC) is another form of SMPTE that is used only with video, and is printed horizontally at the beginning of each field, as part of the video signal. Longitudinal Time Code (LTC) is printed linearly along an audio track.

Unlike LTC, VITC cannot normally be added to a video tape after the picture has been recorded. It must be recorded with the video signal when the original tape is generated.

Each picture has 525 lines (625 for PAL). To facilitate picture clarity, the lines are divided into two interlaced (odd and even) fields. This means that 262 even lines are scanned, then the scanner returns to the beginning of the picture and scans the 263 odd lines. As the lines are scanned, a number of lines at the top and bottom of the picture are never displayed; they are “blank” space. These lines are available to store information. VITC is recorded on two of these spare lines, at the top of each field. One complete VITC data word is recorded on each line.

VITC uses a 90-bit data word instead of the 80-bit data word used by LTC. The extra bits are used to provide error correction and to prevent bad time code values from being read. VITC allows accurate reading of tape position even when the tape is stopped in freeze frame, which is something that LTC can't do. VITC is often used in conjunction with LTC in applications that involve both audio and video.

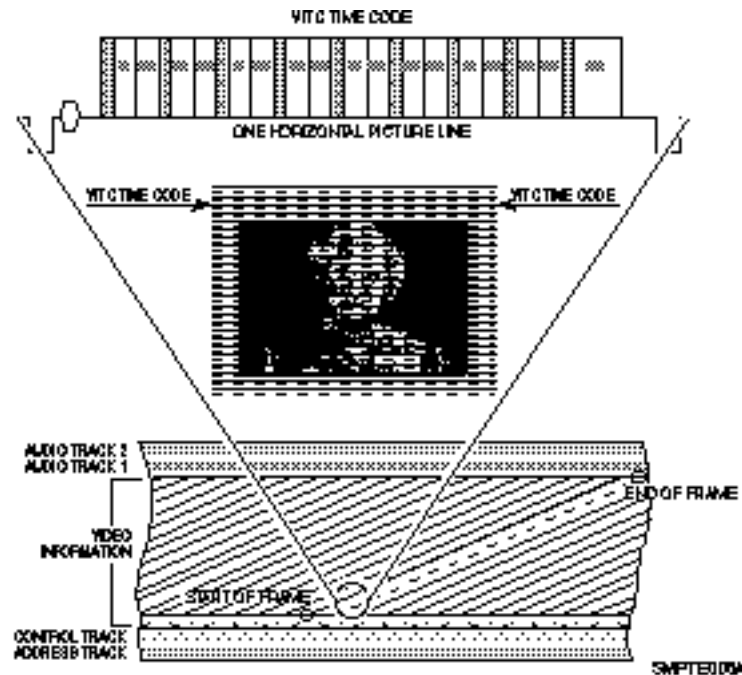


Figure Appendix A-7. Video Tape and VITC Time Code

SMPTE, MIDI and MTC

MIDI is not the same as SMPTE, even though both are binary codes. They each carry very different types of information.

SMPTE, as we've seen, answers the questions "Where are we," and "How fast are we going?" MIDI however, answers an equally vital but totally different question, "What do we do now?" It answers that question for synthesizers, drum machines, and other electronic music devices. MIDI is the language that a computer uses when it tells a synthesizer, "Play middle C, play it mezzo forte, and play it ... *now!*"

But when is *now*? If we're talking about playing back an electronic composition in concert, *now* is a relative term. *Now* might be the third beat of the fourteenth measure, and whether that beat hits at 10:31 or 10:32 PM is something no one usually notices. However, if that beat has to coincide with the cocking of

an assassin's pistol in a feature film thriller, or coincide with a soul-wrenching wail from a vocalist on audio tape, it becomes necessary to pin *now* down.

The traditional way is to slave a MIDI sequencer to SMPTE. Many popular sequencers can read incoming SMPTE and lock their musical tempos (their beats-per-minute) to the time code.

It works beautifully, but it leaves the film or TV composer with the awkward situation of flitting continually between two highly dissimilar sets of numbers. While his sequencer counts beats and measures, his work print, cue list, director's instructions and everything else that pertains to the visual side of the equation, all talk of hours, minutes, seconds and frames. The two sets of numbers never coincide neatly, forcing the composer to pull all sorts of tricks on his sequencer.

MIDI is a computer code that uses 8-bit data words or bytes that cannot contain SMPTE's 80-bit word. This is the reason for the invention of MIDI Time Code (MTC). MTC, quite simply, takes SMPTE time code and translates it into the MIDI data format. To translate SMPTE into MIDI, the MIDI time code format transmits a MTC message byte every 1/4 frame. The first two 1/4 frame bytes contain only the frames. The next two MTC bytes convey the seconds, the next two the minutes, the next two the hours, and so forth.

This whole process takes exactly two SMPTE frames to complete. As soon as one complete SMPTE address is transmitted, the MTC generator updates the time code by 2 frames and starts again.

The TimeLine Micro Lynx and Lynx System Supervisor Unit can take SMPTE from a master tape and generate MTC. Thanks to this, the film/TV composer can now use a cue-sheet style program, as well as conventional music, and if desired, deal exclusively in the realm of hours, minutes, seconds, and frames.

Although SMPTE and MTC are not the same thing, they make a powerful combination when the Micro Lynx or System Supervisor puts them together.

Using SMPTE

Any SMPTE time code application involves three basic functions. First you need a generator to produce the actual SMPTE signal that goes onto tape. Second, you need a reader to read the SMPTE time code from tape. Finally, there's the job itself – what you want to accomplish.

SMPTE can be used with a resolver, to ensure that a single tape machine runs at a consistent speed. It can also be used with an autolocator that stores a number of SMPTE addresses in memory and chases to those addresses on command, or when you want to lock one or more devices to a master tape machine with a synchronizer.

In the early days, a different device was quite often required to perform each of these functions. Today, TimeLine has several products that perform them all: the Lynx Time Code Module with a Keyboard Control Unit, compact, high-end, high performance units; and the Micro Lynx, a high performance project or smaller studio system.

Things To Know About Generating Time Code

Time code, generated and striped on tape, must ultimately be played back and read, so you must determine the optimum level for your master tape before generating the time code. Master tapes are generally printed at about -6 dB. If you print code at too low a level, the reader will have trouble reading it, but if you print it too hot, it will bleed audibly onto adjacent tracks. For this reason, many engineers leave a guard band – a blank track next to the time code track – even when printing at the correct level. To remove the need for leaving two blank tracks (one track on either side), time code is usually printed on the outermost track in multitrack formats (i.e., track 24 on a multitrack machine).

In video and digital audio applications, always make sure that the time code generator and machines are properly referenced together when printing time code. Your generator must be connected to the same external video sync signal as the video or digital machine, otherwise, when synchronizing, the video machine's will start off in the right place, then slowly drift apart.

With digital audio machines, the sample rate or word clock must be locked to the time code. This is normally done by using a video sync signal as a common timing reference for the generator and the digital machine. Set both to “EXT VID” before printing time code. If you do not have a sync pulse generator, the Micro Lynx Video Sync Generator (VSG) option card can be installed and used to generate a referenced composite sync signal for your video or digital machine.

Specific types of video sync include black burst, color bars and composite. These video sync signals are often collectively called *house sync*, or the signal that’s universal throughout the production facility or house. To reference your generator to video sync, set it to “EXT VID” mode and connect a video sync signal. This ensures that the tapes you are striping will have a common reference and on playback will sync properly.

Reshaping Time Code

Reshaping, or cleaning up the time code signal, should always be performed when dubbing time code from one tape to another. If you simply copy time code from one tape to another without reshaping, it will deteriorate quickly due to generation loss and will eventually become unusable. Reshaping is not recommended when the time code on tape has begun to deteriorate badly.

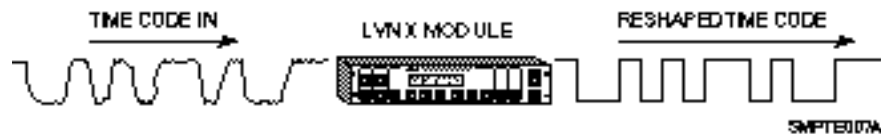


Figure Appendix A-8. Reshaping Time Code

When reshaping, existing code is passed through the reader, which puts out “squared-up” code. If a tape has been copied several times or is very worn, then it is likely that the time code will have dropouts or bad spots that a time code reader will not be able to read. The reshape output of a time code reader can only put out a clean copy of its input. So if the code drops out completely, the reshaped output will have a corresponding dropout. To overcome this, the code must be regenerated rather than reshaped.

Regeneration or Jam Sync

Jam Sync, is a generator function that is a better alternative to reshaping. It is used to create a new time code that is related to an existing time code on tape. It is extremely useful for repairing a break in an existing time code track, or creating a continuous time code track from an edited or discontinuous track. Code is read up to the last “good” address. Then the generator uses the next consecutive address to generate new code.

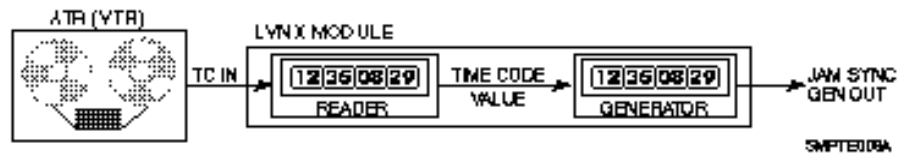


Figure Appendix A-9. Jam Sync

Jam sync is used extensively in video editing; where different pieces of tape, each with different time code, are spliced together. Jam sync provides the resulting program with continuous time code. TimeLine’s Micro Lynx and Lynx both have manual and automatic jam modes, that quickly and simply let you repair or create new time code tracks to overcome the problems that are detected with bad code.

About Time Code Readers

A Wide Band Reader, such as the Lynx Time Code Module or Micro Lynx, reads time code even at the high tape speeds used for Fast Forward and Rewind. Wide band reader capabilities are essential, since SMPTE addresses provide the only accurate means of locating positions on tape.

If time code on tape becomes unreadable, the TimeLine readers automatically search for the next best sync source on tape. After SMPTE, the reader searches for serial time code, then pilot tone, and finally tach pulses that are derived from the rotation of the tape machine’s capstan motor.

Synchronizer Essentials

A synchronizer reads time code from two or more machines; then by manipulating the speed of each machine’s capstan, it forces the two machines to play tape at the same speed. This process is called locking. The Micro Lynx system offers the following synchronization mode.

Phase or Sync Lock

Phase or Sync Lock emulates the old control track or pilot tone method of synchronization. The TimeLine system reads the time codes and synchronizes the transport, taking into account any deliberate offsets. Once the system is locked, the slaves only use the speed information that is derived from the time code, and specific time code addresses are ignored.

This allows the tape machines to stay in lock even if the time code relationships change. The time code change is reported, but the synchronizer makes no corrective action. This is the normal method of operation.

Advanced Applications

Video Editing

Video editing is the process of assembling raw footage into a finished television program. Shooting the raw footage is part of what's called television production. Video editing is part of the post-production process. Consider an average television program, perhaps a sitcom or a documentary. The action constantly shifts from one scene to another, moving indoors, outdoors, all over the place. Within a given scene, the perspective also shifts (i.e., from one camera to another, each shooting the scene at a different angle).

In editing, there are multiple video machines, each loaded with footage of different scenes, shot by different cameras. The potential for chaos is great. Fortunately, there's SMPTE time code. Each reel of raw footage is striped with SMPTE, and each frame has a specific and unique location or address. In some cases, both LTC and VITC are on the tape.

During editing, selected scenes of raw footage are transferred onto a master video tape, one after another in sequence, as they will appear in the finished show. The master video tape, as its name implies, contains the master or program time code.

A video editor, locks the source video machines loaded with raw footage to the master video machine. Additionally, one or more audio tape machines may be locked to the master. These contain the production audio: the dialog and incidental sounds recorded during shooting of the raw footage.

Video editing is normally a two-stage operation. First comes offline editing. The person editing the show receives work tapes, i.e., copies of all the raw footage, with time code “burned in” so that it’s visible in one corner of the picture. Any footage initially shot on film, is usually transferred to video at this point. From the work tapes, a basic sequence of scenes is selected. For example, the second scene should be the bar room brawl that occurs, say, between addresses’ 05:40:59:11 and 05:44:12:22 on one of the raw footage reels. In the finished program, this scene needs to start exactly six minutes, five seconds and nine frames (00:06:05:09) into the show and run to 00:09:18:20.

When all the scenes have been sequenced in this manner, an Edit Decision List (EDL) is compiled. The EDL is a complete, computerized directory of the location of the scenes in the show, along with the addresses locating each scene in the raw footage.

Later, when the project moves to online editing, the EDL can be downloaded and the final video master assembled from the original raw footage, which has been pristinely sitting aside while the work tapes endured the rigors of offline editing.

Audio-For-Video

Just like the raw video footage, all the audio elements that go into a video production must be assembled. This procedure is generally known as audio-for-video or audio post-production. There are several different branches of audio post, since there are many different types of sound sources that go into a typical video show.

First, there’s production audio, which is dialog and sounds recorded during shooting. Often, incidental noises on the set, flubbed lines, and other uncontrollable aspects of the shoot make the production audio unusable. Which brings us to the three main branches of post-production audio.

For dialogue, there’s Automated Dialog Replacement (ADR) in which actors re-record production dialog in the controlled acoustic environment of a sound studio. This replacement dialog is recorded onto audio tape that is locked to a video work print, which the actors carefully watch as they read their lines.

Second, is Foley (named after the man who invented it), the process whereby an abundance of “real-life” sounds, i.e., footsteps, coat zippers, car door slams, etc., are recorded by specialized actors called Foley walkers. They also make their recording while watching a work print that’s synchronized, by SMPTE and a TimeLine synchronizer to an audio tape machine that records the sounds they make.

Third, are sound effects. This is mainly the spectacular stuff – explosions, rocket blasts, gunshots. Today, most sound effects work, as well as some Foley, is created using digital audio samplers. Samplers are devices that can be locked to SMPTE through MTC or MIDI.

Then there’s that all-important audio element – music. This is supplied by the composer, who works to rough cuts (preliminary edits) of the finished show and ultimately to the finished video master. The composer may record real instruments onto audio tape that is locked to picture using SMPTE and Lynx modules, or he may work with MIDI instruments that are locked to tape by a Micro Lynx or Lynx System Supervisor.

Ultimately, there are a number of different Audio Tape Machines (ATRs) or film dubbers with the finished music, dialog, and effects. These ATRs are locked to the video master using a TimeLine system controller, such as the Keyboard Control Unit or Console Control Unit. Then the multiple audio sources are balanced by a mixing console to provide a finished audio master for the program. Because this can be quite an elaborate process, many modern post-production facilities use automated mixing consoles, which store mix data, such as fader moves, mutes, etc., in computer memory. These automated systems can also be locked to the video and audio tape machines via the Lynx System Supervisor and Lynx console interfaces.

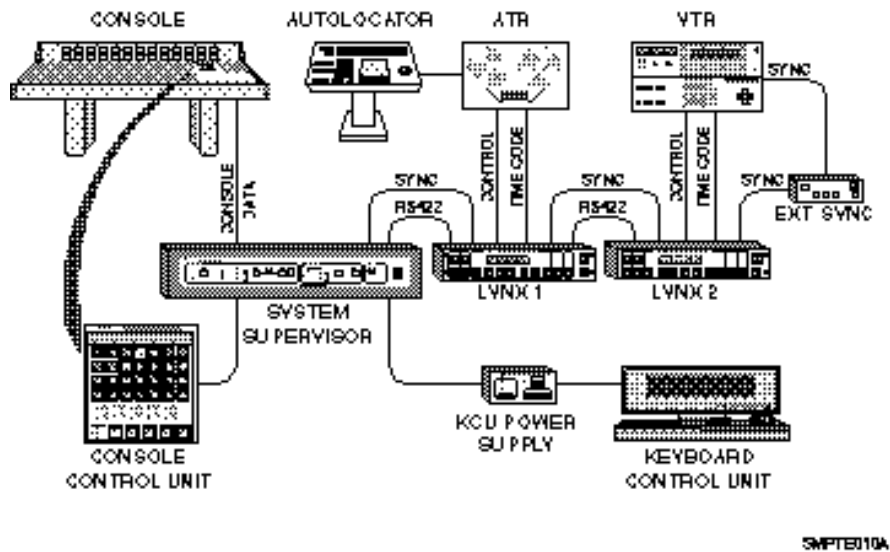


Figure Appendix A-10. Automated Mixing System

The Modern Electronic Recording Studio

Today, many record projects and other music recording applications are as elaborate as video post-production, with the number of machines involved and the use of SMPTE time code. Two multi-track tape machines are typically locked together by the Micro Lynx to provide enough audio tracks for instruments and vocals. Some productions require more than two interlocked multitracks. Console fader automation is also the norm for record mix downs, and an absolute necessity for “dance” mixes.

In addition, many projects also involve virtual tracks. Virtual tracks are MIDI synthesizer and drum machine parts that are synchronized to tape, and played back “live” in real time, rather than being recorded onto multitrack. The Micro Lynx provides the all-important SMPTE to MIDI translation.

MIDI is also the protocol used to automate effects processors, such as digital reverbs, harmonizers, etc. These MIDI devices can change programs mid-song, and even perform real time individual parameter changes mid-program. Some mixing consoles, particularly those designed for personal use and project studios also have MIDI automated switching or mixing features.

In short, just about every device in the recording studio – tape machines, consoles, effects processors, and electronic instruments, can now be automated using SMPTE, and MIDI, and the appropriate TimeLine equipment. Thus the Electronic Recording studio is created.

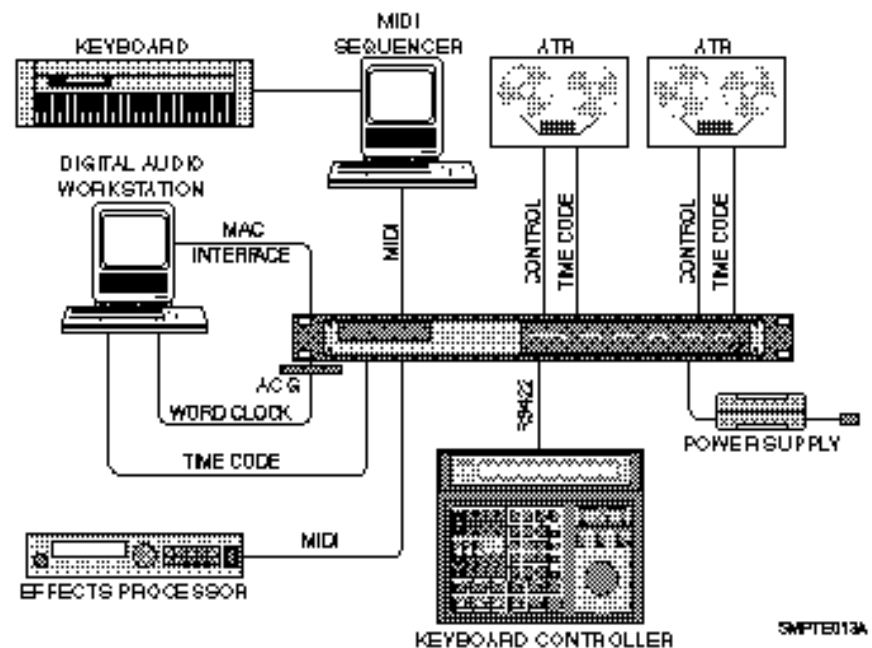


Figure Appendix A-11. The “Modern” Electronic Studio

SMPTE and the Digital Audio Workstation

The Digital Audio Workstation (DAW) is an important tool for post-production and music recording. The DAW records, edits, manipulates and mixes multiple tracks of audio in a single digital environment. Like the biosphere, it's a self contained, self-sufficient system; but at some point, it must sync with the real world. Digital audio workstations must eventually be slaved to picture or a master tape machine.

This can present a problem. DAWs are always referenced to their own internal sample rate clock. The workstation can use time code to locate and park at a specific SMPTE address. When that address comes up on the master tape, it goes into play; but it's running "wild," locked to nothing but its own internal clock. In short, we're back to something only just a little better than the scenario presented in the beginning: attempting to press two start buttons on two machines at the same time and crossing our fingers.

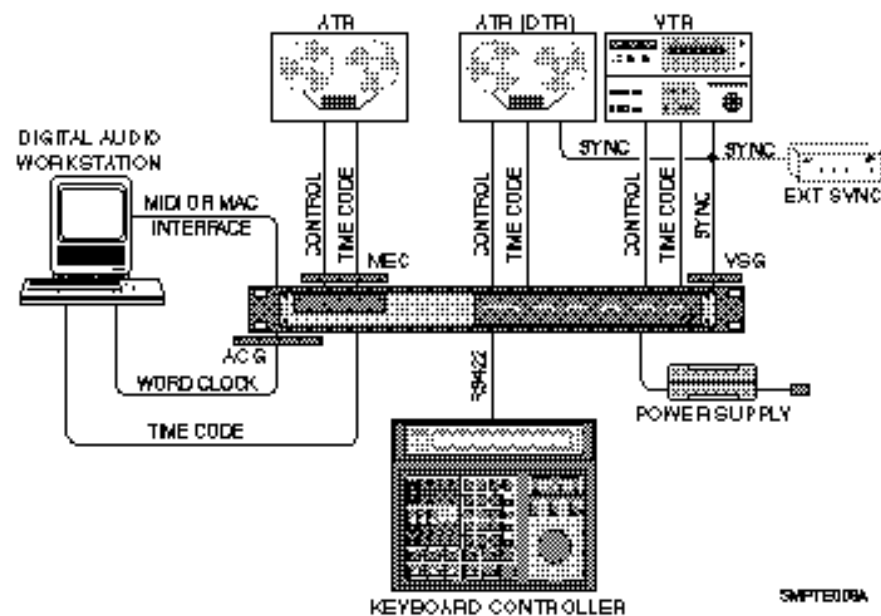


Figure Appendix A-12. Micro Lynx with a Digital Audio Workstation

An excellent solution to the problem is offered by the Micro Lynx Digital Audio Clock Generator (ACG) Card option. It provides a means of referencing the digital audio workstation to the master time code, using word clock (sample rate) data or AES/EBU digital audio bit stream, which contains timing data. The ACG card generates a *digital audio* clock that is locked to the Micro Lynx system reference, and DAW uses it to lock and run its internal sample rate clock.

It's even possible to varispeed the master tape. The Digital Audio Clock Card automatically adjusts the ACGs word clock rate. If the tape speeds up or slows down, the DAW will adjust to match the new play speed (within the limits of the disk system).

As we enter the digital era, time code continues to be an important, practical solution to multiple equipment communication and control.

The SMPTE Future

SMPTE Time Code and MTC are already being used for applications far beyond their original purpose. Outside the worlds of music recording and video post-production, SMPTE is used to automate light shows at rock concerts, control laser beams at theme park attractions, and trigger flashpot explosions.

Its uses are many and they will continue to grow as time goes on. HOWEVER, the basics of SMPTE will never change. Now that you know them, you're ready for the future.

Key and Key Combination Identification Numbers

K080 OR K600

# on Screen	Stuck Key or Combination
0	STOP + RW
1	STOP + FF
2	EDIT
3	REPLAY
4	ROLLBACK
5	ALL STOP
6	CUE
7	LOC
8	CUE + LOC
9	REC
10	PLAY + REC
11	PLAY + REH
12	PLAY (>)
13	STOP (■)
14	FF (>>)
15	RW (<<)
16	SUBFR
17	BS
18	MINUS (-)
19	PLUS (+)
20	RCL
21	STO
22	EQUAL (=)
23	CAPT
27	MEM
28	LIST
29	EVNT
30	TRAN
31	TRKS
32	RDY
33	POLL

# on Screen	Stuck Key or Combination
35	SETUP
36	FILM
39	SYS
42	END
43	CUE
44	SRC
45	REF
47	IN
50	F6
51	F5
52	F4
53	F3
54	F2
55	F1
56	OUT
58	REDO
59	LOOP
62	STAT
63	GRP
64	8
65	9
66	00
67	CLR
68	SHTL OR ENTER
69	JOG OR NEXT
70	TRIM OR LAST
71	MEM + CAPT
72	0
73	1
74	2
75	3

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# on Screen	Stuck Key or Combination
76	4
77	5
78	6
79	7
82	F
83	E
84	D
85	C
86	B
87	A
130	GRP + F
131	GRP + E
132	GRP + D
133	GRP + C
134	GRP + B
135	GRP + A
136	CLR + 0
137	CLR + 1
138	CLR + 2
139	CLR + 3
140	CLR + 4
141	CLR + 5
142	CLR + 6
143	CLR + 7
144	CLR + 8
145	CLR + 9
154	CLR + END
155	CLR + CUE

# on Screen	Stuck Key or Combination
163	RDY + E
164	RDY + D
165	RDY + C
166	RDY + B
167	RDY + A
170	CLR + F6
171	CLR + F5
172	CLR + F4
173	CLR + F3
174	CLR + F2
175	CLR + F1
176	CLR + RDY
177	CLR + POLL
179	CLR + SETUP
183	CLR + SYS
188	CLR + LIST
190	CLR + TRAN
191	CLR + TRKS
194	SETUP + F
195	SETUP + E
196	SETUP + D
197	SETUP + C
198	SETUP + B
199	SETUP + A
239	REH
242	CLR + EDIT
246	CLR + CUE

# on Screen	Stuck Key or Combination
156	CLR + SRC
157	CLR + REF
158	CLR + OUT
159	CLR + INPT
162	RDY + F

KCU 300

# on Screen	Stuck Key or Combination
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	00
11	CLR
12	MINUS (-)
13	PLUS (+)
14	EQUAL (=)
15	STO
16	RCL
17	CAPT
18	SUBFR
19	TRIM
20	BS
23	A
24	B
25	C
26	D
27	E
28	F
29	TCG
30	F1
31	F2
32	F3
33	F4
34	F5
35	F6
40	SETUP
41	SYS
42	TRAN
43	EVNT
44	LIST
45	MEM

# on Screen	Stuck Key or Combination
46	BLANK KEY
47	FILM
50	GRP
51	SOLO
52	LOOP
53	BANK
54	RDY
55	TRKS
60	IN
61	OUT
62	REF
63	SRC
64	CUE
65	END
70	LOC
71	CUE
72	ALL STOP
73	ROLLBACK
74	REPLAY
75	EDIT
76	RW (<<)
77	FF (>>)
78	STOP (■)
79	PLAY (>)
80	REH
81	REC
82	JOG
83	SHTL
95	CUE + LOC
96	STOP + RW
97	STOP + FF
98	PLAY + REH
99	PLAY + REC
144	CLR + 0
145	CLR + 1
146	CLR + 2
147	CLR + 3
148	CLR + 4
149	CLR + 5
150	CLR + 6

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# on Screen	Stuck Key or Combination
151	CLR + 7
152	CLR + 8
153	CLR + 9
154	CLR + 00
160	CLR + CUE
161	CLR + EDIT
162	CLR + RDY
163	CLR + SYS
164	CLR + TRAN
165	CLR + TRKS
166	CLR + SETUP
167	GRP + SYS
168	POLL
169	MEM + CAPT
177	CLR + F1
178	CLR + F2
179	CLR + F3
180	CLR + F4
181	CLR + F5
182	CLR + F6
186	CLR + IN

# on Screen	Stuck Key or Combination
192	GRP + A
193	GRP + B
194	GRP + C
195	GRP + D
196	GRP + E
197	GRP + F
198	GRP + TCG
200	RDY + A
201	RDY + B
202	RDY + C
203	RDY + D
204	RDY + E
205	RDY + F
208	SETUP + A
209	SETUP + B
210	SETUP + C
211	SETUP + D
212	SETUP + E
213	SETUP + F
214	SETUP + TCG

# on Screen	Stuck Key or Combination
187	CLR + OUT
188	CLR + REF
189	CLR + SRC
190	CLR + CUE
191	CLR + END

Glossary

- 24** '24' refers to both the film-standard speed and code type.
- 25** '25' refers to both the EBU/PAL speed and code type.
- 29.97** '29.97' refers to a SMPTE frame rate only, in frames-per-second.
- 30** '30' refers to a SMPTE frame rate only, in frames-per-second.
- Address** SMPTE/EBU time code address. Also referred to as time code value. A specific and unique address in the time code data stream.
- A set of SMPTE or EBU time code numbers indicating a specific position on tape. A complete SMPTE address includes hours, minutes, seconds, and frames.
- ADR** Automated Dialog Replacement. A technique for replacing production dialog in the studio.
- AES/EBU** A professional standard for the high speed transfer of two channels of digital audio data. Developed jointly by the Audio Engineering Society (AES) and the European Broadcast Union (EBU).
- Amplitude** Signal displacement from a zero point. The amplitude of an analog signal is the measurement of voltage increase or decrease.
- Analog Audio** The "traditional" means of recording and reproducing sound, using fluctuating electronic voltages to replicate audio waveforms.
- ATR** Audio Tape Recorder.
- Autolocator** A device that can hold multiple tape locations in memory and chase to those locations on command, using SMPTE addresses, tach pulses, or control track pulses to find a desired point on tape.
- Bandwidth** The frequency range of a signal.
- Binary Numerical System** A system for expressing numerical values using two digits, 0 and 1. The binary system is used in digital audio, SMPTE, MIDI, and other microprocessor-related data formats.
- Biphase Encoding** The way in which SMPTE time code gets encoded onto tape. It

expresses binary '1' and binary '0'.

Biphase encoding reverses the signal polarity halfway through a bit to represent a '1' and leaves the bit polarity unchanged to represent a '0'.

BIT Short for BInary digiT; a number which is either one or zero.

Blanking Interval The blanking interval occurs at the end of a frame. Video information is absent during the blanking interval. The interval occurs when the CRT electron gun scanner goes from the bottom right corner of the screen to the beginning of the next field in the top left corner.

BNC Bayonet-Nut Coupler. Used for the connection of video and high frequency clock signals.

Byte A group of related binary data or a word, which can be read, interpreted, and acted on by a microprocessor. A byte is made up of bits, which can be either a 0 or 1.

Capstan On a tape recorder the motor driven spindle that drives the tape across the heads. A synchronizer controls the capstan motor to keep the tape in sync.

Code Type See Time Code Type

Configuration See Setup Mode. The process of defining the user-selected operational parameters, such as defining a specific transport or lifter-defeat mode.

Control Track A synchronizing signal on the edge of a tape, which provides a reference for tracking control and tape speed.

CPU Central Processing Unit. A computers central microprocessor, responsible for all system logic and memory organization.

DAW Digital Audio Workstation. Usually refers to a computer-based, hard disk recording and editing environment.

Decibel (dB) The unit of measurement used to describe a sounds amplitude. The measurement is relative and logarithmic.

DF Drop frame. See drop frame

Differential Input Input amplifier that is designed to amplify the difference between two signals and reject common signals.

Differential Output Output amplifier designed to provide two signals that are

completely identical but with opposite phase.

- Digital** Literally “using digits”. A Computer is a typical digital device.
- Digital Audio** Audio signal that has been converted (digitized) into a stream of binary numbers for storing or transmitting, that are equivalent to the original analog audio signal.
- Display** Numeric display. Time Code/Message Display.
- Drop Frame** Drop frame is one of the two SMPTE code types, and is the NTSC color television standard. When using this code type, 108 specific frame numbers are “dropped” for each hour of time code. See the Appendix for more detailed time code information.
- EBU** EBU time code is a 25-frame code running at 25 fps.
- Edit Decision List (EDL)** A list, either on paper or in computer memory, of time code addresses indicating successive scenes of source video footage that make up a complete program.
- EDL** See Edit Decision List.
- ERR** Error or offset error. Indicates that the display shows the difference between the actual position of the machine in relation to where the system expects it to be.
- EXT VID** A source of external video sync used by the synchronizer as a timing reference. Can be color black, black burst, color bars or composite sync.
- Filter** A digital or analog process which has the effect of removing unwanted frequencies from an audio signal.
- Foley** The process of adding incidental sounds, such a footsteps, door slams, etc., to a video program or motion picture.
- Format** See Time Code Format.
- Frame** A single image on a motion picture film or a television picture formed from two interlaced fields. One complete video scanning cycle, one complete SMPTE time code word.
- Frame Lock** Frame lock maintains synchronization between the Master and Slave transports, using the position information available in the time code address.
- Frame Rate** The number of frames that go by in one second of audio, film or

video tape. Film and different types of video all have different frame rates.

30	30 fr/s	Monochrome TV, & audio
NTSC	29.97 fr/s	Color videotape, TV operations
PAL	25 fr/s	European TV, European Broadcast, & audio
Film	24 fr/s	Film cameras & projectors

- Frequency** The number of wave cycles that occur in a given period of time (one second). The unit of measurement is the Hertz (Hz).
- Generate** Running the system time code generator so that time code is available at the rear panel GEN OUT jack.
- Generator** A time code generator. Each synchronizer has a time code generator. This generator receives its speed reference from one of the internal or external sources.
- GEN REF** Generator reference. May also be referred to as reference source.
- Groups** A group of machines that have a defined positional relationship. Machines are placed in group mode for synchronization. Machines in a group will operate together as if they were a single transport.
- GRP** See Groups.
- Guard Band** A track of multitrack tape adjacent to the sync track (such as SMPTE or Control Track), which is left unrecorded in order to prevent the time code from bleeding onto the audio program material.
- HH:MM:SS:FF** Hours:Minutes:Seconds:Frames. A SMPTE time code address or value.
- Initialize** Completely clear the synchronizers RAM. Press and hold the CLR key while you power-up the module.
- INT XTAL** A system speed reference that is derived from the unit's internal crystal. This reference should be selected when an external reference (video or word clock) is not required.
- Jam Sync** A technique used to start a time code generator from another running time code. It can be used to recreate missing time code or to external existing time code on tape.
- Jam Time Code** The Jam Time Code or Jam Sync function. See Jam Sync.
- KCU** Keyboard Control Unit. TimeLine's external machine control unit. The KCU provides centrally-controlled access to all synchronizers in a system.
- LCD** Liquid Crystal display. The KBD display is of this type.

- LED** Light emitting diode.
- Lifter** A tape transport's head lifter mechanism. Tape machines normally lift the tape off the heads when in wind (FFW/RWD). The synchronizer intelligently controls the machines lifter operation, to read time code when required.
- Local Transport** The machine or transport that the synchronizer is connected to and controlling.
- Lock** The transport is synchronized with the system reference GEN REF.
- LTC** Longitudinal Time Code. Time code information encoded in binary coded decimal (BCD) form which is recorded as an audio signal on a designated track of a VTR or an ATR.
- Machine** Machine refers to the generic concept of tape record/playback hardware.
- Machine Control** The wide ranging field of transport control. This covers basic transport operation, synchronization and more complex functions such as electronic editing.
- MACROS** Preprogrammed or user programmed keys permitting complex key sequences to be stored and executed by pressing a single key. Sometimes known as smart keys.
- MIDI** Musical Instrument Digital Interface. This serial data language is used by microprocessors in synthesizers, sequencers, drum machines, signal processors, and computers. It provides musical pitch and rhythm information, synthesizer performance parameters, song position markers, stop/start/continue commands for sequencers and computers, and synchronizing data called MIDI Clock, which is based on 24 pulses per quarter-note. MIDI is frequently used with SMPTE for sync-to-tape functions.
- MIDI is transmitted between microprocessors at 32.125 kBits per second. It can also be used by lighting systems and mixing consoles.
- MIDI Time Code** A MIDI system real time message that assigns a unique address for a specific moment in time. MIDI Time Code takes two frames to transmit a complete address in bursts of data that are transmitted every 1/4 frame.
- Motion Controls** The basic set of six transport control keys (Play, Stop, Rec, Reh, Rwd & FF) and the six additional transport control functions (Loc, Cue, Allstop, Rlb, replay & Edit).
- MTC** See MIDI Time Code.
- Multitrack** A tape machine, analog or digital which has more than two audio

tracks.

N/A Not available. Not active. Not applicable.

Non Drop Frame NDF or ND is one of the two SMPTE code types and is the black & white television standard. When using this code type, every frame of time code is counted in real time. See the Appendix for more time code information.

Non-contiguous Not a continuous, predictable sequence. i.e., 1, 2, 4, 5, 6, 8, 9 is a non-contiguous number sequence.

NTSC A system of coding color information for television transmission used primarily in the USA and Japan. Named after the National Television System Committee.

Offset Offset is the difference between two time codes at the point at which they are to be synchronized. Offsets are subframe-accurate and are displayed using the HH:MM:SS:FF format. Offsets are always applied to the slave machines.

Oversampling A process by which a computer interpolates between adjacent digital audio numbers to provide in-between values and reduce quantization error.

PAL Phase Alternate Line. PAL is another name for the 25 time code format, which is the standard for European color and B&W television.

Phase Lock A mode of synchronizer operation that uses phase information derived from SMPTE time code and, after initial synchronization, ignores specific frame addresses. It is also called Sync Lock.

Pilot Tone The Pilot output signal is a sinusoidally-shaped output, which is always two times the frame rate of the time code that is being referenced or generated.

Post-production Activities that take place after the raw footage has been shot for a video program or motion picture. Includes video editing and a number of audio processes, such as ADR, Foley, and mixing.

Production The initial stages in the making of a film or television program, which includes the shooting of raw footage and recording of production audio.

RAM Random Access Memory. The module's configuration parameters are stored in battery-backed RAM. And recalled each time the unit is turned on.

Rate Frame rate or speed. See Frame Rate or Speed.

REF SRC Reference source. The signal that is used to determine the rate

that the generator and synchronizer will run at. The reference source can be thought of as the system time base. The reference source can be internal crystal, external video, MAINS, or external pilot tone or the time code reader (VSO).

- Register** The generator register is the module's memory buffer that holds numeric time code values that are entered or captured. Each synchronizer also has reader, sync point, offset, user bit and error registers.
- Reshape** The output signal is the same as the input signal, but it has been reshaped with correct rise time values and a fixed voltage output. This type of output does not correct for bit or timing errors.
- Resolving** A technique for regulating the play speed of a tape machine by matching the rate of pulses recorded on tape with a pulse rate from another stable source or a master tape machine.
- RLB** See Rollback.
- Rollback** The rollback function is used to rewind machines by a predetermined amount from the current position. The default rollback time is 15 seconds.
- S-PDIF** A consumer standard similar to AES/EBU for the high speed transmission of digital audio data. Jointly developed by Sony and Philips.
- Sequencer** A device that can record performance data for synthesizers and other electronic instruments and then, on playback, pass that data on to the instruments so that they'll play what has been recorded. Modern sequencers use MIDI as their communications protocol.
- Serial** A type of computer interface where all data is sent down a single wire or pair of wires one bit at a time. Examples of serial interfaces are RS422 & RS232.
- Serial Port** The physical computer connection through which serial data is transmitted and received.
- Setup Mode** The process of defining the user-selected operational parameters, such as defining a specific transport or lifter-defeat mode.
- Shuttle** Fast-wind. Fast-forward or Rewind.
- SMPTE** Society of Motion Picture and Television Engineers. An industry standards committee. The group responsible for developing SMPTE time code.
- SOLO** Literally "using alone". A tape transport in solo will be controlled

by itself, without affecting other transports in the system.

- Speed** Speed, Frame Rate and Rate are synonymous. Time code speed is counted in frames-per-second (fps). SMPTE time code has two speeds: 30 fps and 29.97 fps.
- SU** See System Unit
- SUBF UBITS** Sub frame user bits.
- Sync Lock** See Phase Lock.
- Sync Word** Included at the end of every 80-bit time code word is a 16-bit Sync Word. The sync word provides direction and Phase-lock speed information, and marks the end of each time code word.
- Synchronizer** A device that reads time codes recorded on two or more tape machines, compares the codes, and adjusts the machine's tape positions and speeds based on the results of that comparison.
- System BUS** When two or more synchronizers are used to form a system, a communications link must be established between the modules. This is done by looping from one module to the next, via the RS422 ports on the rear panel of the system unit.
- System Unit** The rack mounting part of the Micro Lynx machine control system. The unit contains the control (CP) and machine control (MC) microprocessors.
- TCA** Time Code Address. The HH:MM:SS:FF bits of the TC word.
- TCG** See Time Code Generator.
- Time Code Format** Time code format defines both the frame rate and code type being used. Example: To describe a time code format as 30 NDF is to say that the frame rate is 30 fps and the code type is non-drop frame. Simply saying either 30 or drop frame defines only part of the SMPTE time code.
- Time Code Generator** A special signal generator designed to generate and transmit SMPTE time code at one of the international formats and rates.
- Time Code Reader** A counter designed to read and display SMPTE time code.
- Time Code Type** The word "type" is the key to understanding this phrase. *Type* defines the counting method that is employed by the time code module. There are two SMPTE types: 30 (also called non-drop "ND" or non-drop frame "NDF") and drop frame (DF). EBU and film types are the same as their respective speeds, 25 and 24.
- Toggle** To toggle is to consecutively press a key several times in order to

step through a series of choices.

- Track** A place for the storage of audio information. Analog tape recorders have one or more physical tape tracks. MIDI sequencers and digital audio workstations provide areas of memory to store control or audio data.
- Track Select** The process of enabling (arming) specific tape machine tracks for recording.
- Transport** Transport refers to a part or subassembly of a machine, i.e., a transport connector or a transport cable.
- TRS** Tip - Ring - Sleeve. A 1/4", balanced termination plug or jack. Typically wired T = +, R = -, S = shield.
- Type** See Time Code Type.
- UB** See User Bit.
- User Bit** Each time code frame or word consists of 80 bits that convey SMPTE/EBU time code information. Thirty-two of those bits are user bits, and are available for storing information such as IDs, reel numbers, session dates or another time code number.
- Value** Values are generally time code addresses. They may also be a custom user bit IDs.
- Video Sync** A reference video signal generated by an extremely stable source. This signal is used to control the speed of video machines, digital audio machines and is used as a timing reference to ensure accurate synchronization.
- Virtual Tracks** Used to describe any circumstance whereby the method for reproducing audio tracks is not directly analogous to the linear tape track format. Hard disk systems (DAW's) and MIDI sequencers are typical examples.
- MIDI performance commands can be stored in a sequencer. Because the sequencer can "play" these parts in real time, synchronized to tape, they can be regarded as extra or "virtual" tracks, not on the tape, but present nonetheless.
- VITC** Vertical Interval Time Code. An alternative to the LTC format of SMPTE time code. It is recorded in the blanking interval of the video signal, which is not used for the picture.
- VSO** Variable Speed Override. Variable Speed Oscillator.
- VTR** Video Tape Recorder.
- Wideband** A signal that is distributed over most or all of the frequency

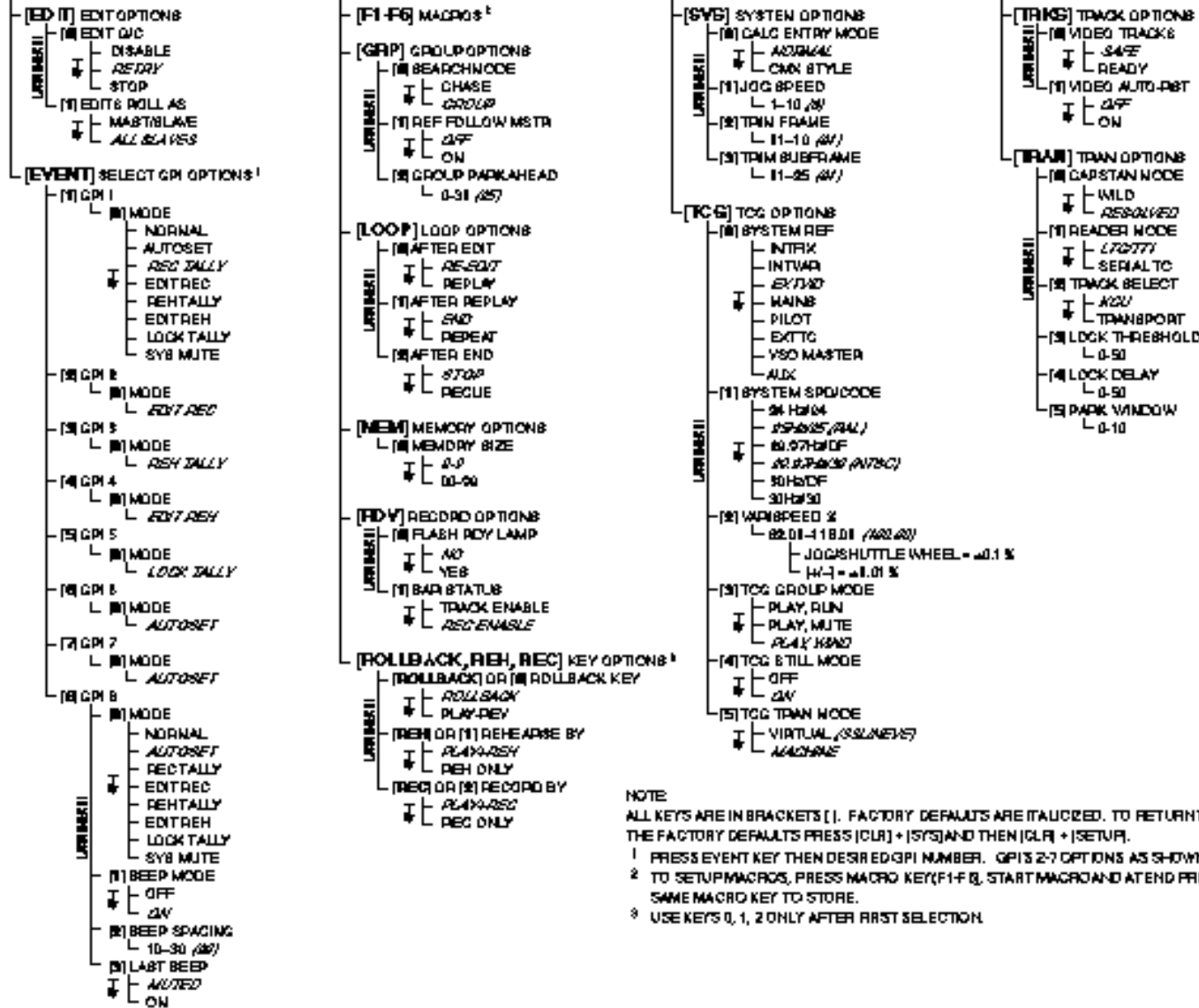
spectrum. A wide band input amplifier is capable of processing signals that are well outside the audio bandwidth.

Word Clock An extremely stable synchronization signal that is used to control the rate at which digital audio data is converted or transmitted.

Workstation See DAW.

TIME|LINE Keyboard Control Unit, 3.00 Series Software, Setup Configuration

[SETUP]



NOTE
ALL KEYS ARE IN BRACKETS []. FACTORY DEFAULTS ARE ITALICIZED. TO RETURN TO THE FACTORY DEFAULTS PRESS [CLR] + [SYS] AND THEN [CLR] + [SETUP].

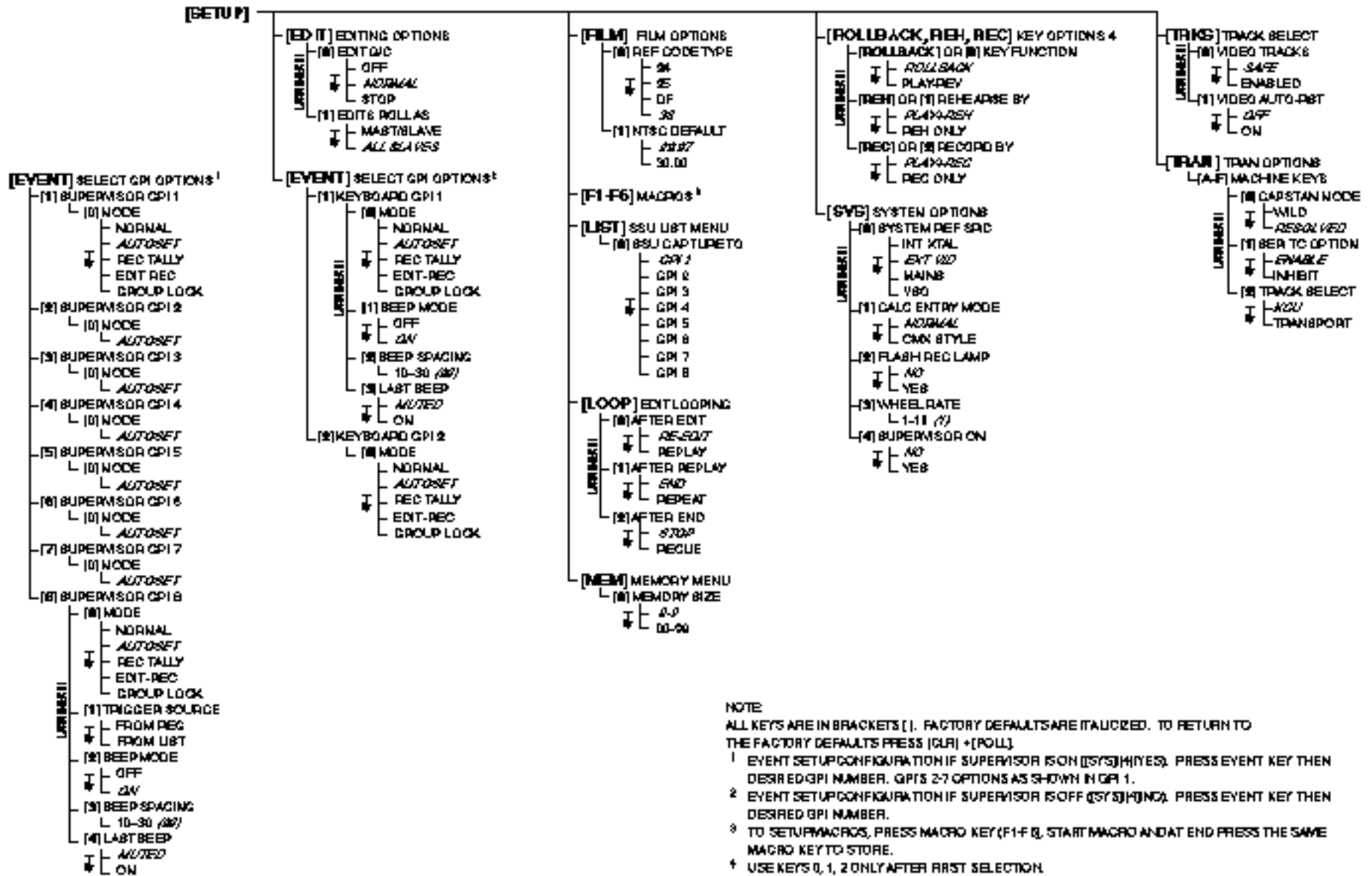
¹ PRESS EVENT KEY THEN DESIRED GPI NUMBER. GPI'S 2-7 OPTIONS AS SHOWN IN GPI 1.

² TO SETUP MACROS, PRESS MACRO KEY (F1-F 6), START MACRO AND AT END PRESS THE SAME MACRO KEY TO STORE.

³ USE KEYS 0, 1, 2 ONLY AFTER FIRST SELECTION.

KCU013B

TIME|LINE Keyboard Control Unit, 080 Series Software, Setup Configuration



NOTE

ALL KEYS ARE IN BRACKETS []. FACTORY DEFAULTS ARE ITALICIZED. TO RETURN TO THE FACTORY DEFAULTS PRESS [CLR] + [POLL].

¹ EVENT SETUP CONFIGURATION IF SUPERVISOR IS ON ([SYS] [H] [YES]). PRESS EVENT KEY THEN DESIRED GPI NUMBER. GPI'S 2-7 OPTIONS AS SHOWN IN GPI 1.

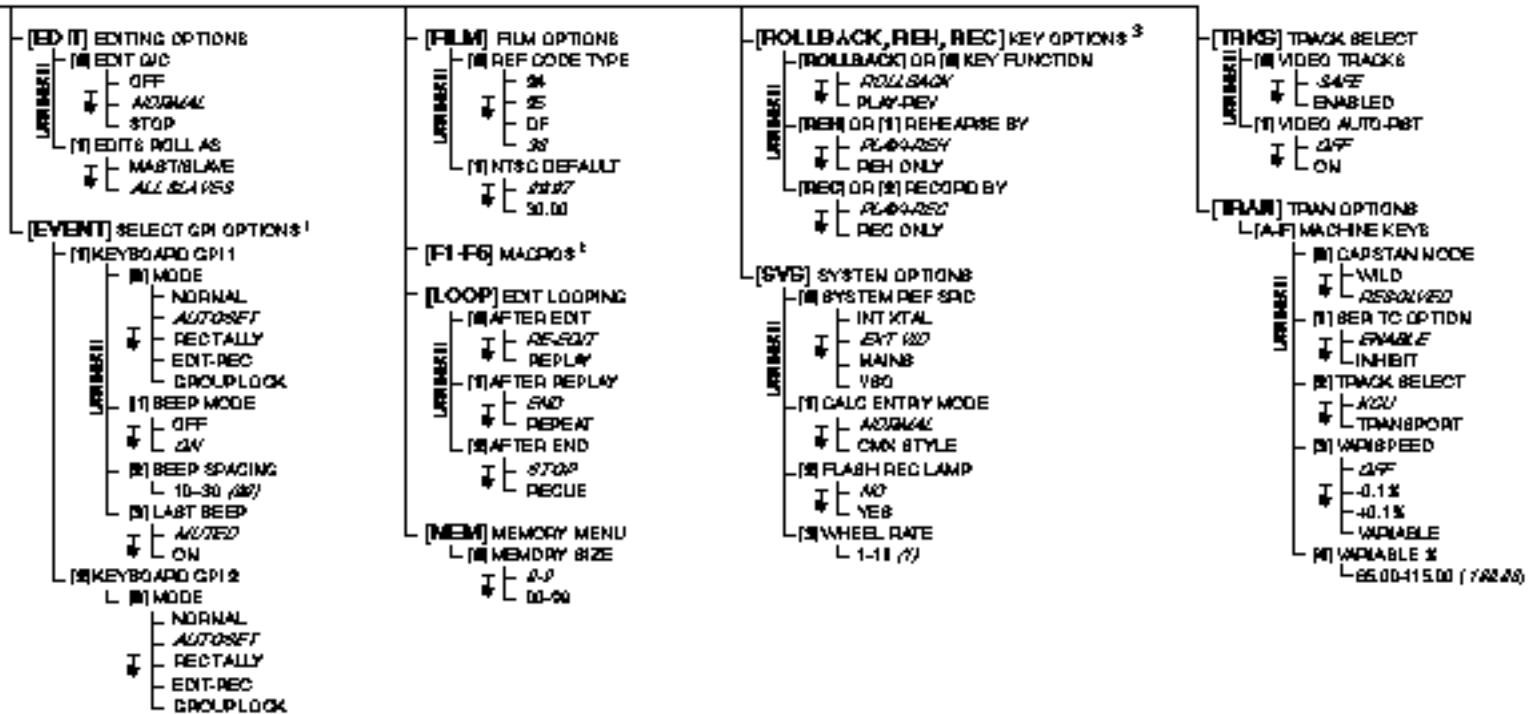
² EVENT SETUP CONFIGURATION IF SUPERVISOR IS OFF ([SYS] [H] [NO]). PRESS EVENT KEY THEN DESIRED GPI NUMBER.

³ TO SETUP MACROS, PRESS MACRO KEY (F1-F 6), START MACRO AND AT END PRESS THE SAME MACRO KEY TO STORE.

⁴ USE KEYS 0, 1, 2 ONLY AFTER FIRST SELECTION.

TIME|LINE Keyboard Control Unit, 600 Series Software, Setup Configuration

[SETUP]



NOTE

ALL KEYS ARE IN BRACKETS []. FACTORY DEFAULTS ARE ITALICIZED. TO RETURN TO THE FACTORY DEFAULTS PRESS [CLR] + [ROLL].

1 PRESS EVENT KEY THEN DESIRED GPI NUMBER.

2 TO SETUP MACROS, PRESS MACRO KEY (F1-F 6), START MACRO AND AT END PRESS THE SAME MACRO KEY TO STORE.

3 USE KEYS 0, 1, 2 ONLY AFTER FIRST SELECTION.

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