

# Instruction Manual



**ECO422D  
SD/HD Changeover Unit  
S/N B020000 and above**

**071-1792-01**

**Warning**

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

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# General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

*Only qualified personnel should perform service procedures.*

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

## To Avoid Fire or Personal Injury

**Use Proper Power Cord.** Use only the power cord specified for this product and certified for the country of use.

**Ground the Product.** This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

**Observe All Terminal Ratings.** To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

**Powering Off.** The power cord provides Mains disconnect.

**Do Not Operate Without Covers.** Do not operate this product with covers or panels removed.

**Use Proper Fuse.** Use only the fuse type and rating specified for this product.

**Avoid Exposed Circuitry.** Do not touch exposed connections and components when power is present.

**Do Not Operate With Suspected Failures.** If you suspect there is damage to this product, have it inspected by qualified service personnel.

**Do Not Operate in Wet/Damp Conditions.**

**Do Not Operate in an Explosive Atmosphere.**

**Keep Product Surfaces Clean and Dry.**

**Symbols and Terms**

**Terms in this Manual.** These terms may appear in this manual:



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**WARNING.** *Warning statements identify conditions or practices that could result in injury or loss of life.*

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**CAUTION.** *Caution statements identify conditions or practices that could result in damage to this product or other property.*

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**Terms on the Product.** These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

**Symbols on the Product.** The following symbols may appear on the product:



CAUTION  
Refer to Manual



WARNING  
High Voltage



Protective Ground  
(Earth) Terminal

# Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

**Do Not Service Alone.** Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

**Disconnect Power.** To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

**Use Care When Servicing With Power On.** Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.



# Environmental Considerations

## Product End-of-Life Handling

Observe the following guidelines when recycling an instrument or component:

**Equipment Recycling.** Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



The symbol shown to the left indicates that this product complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). For information about recycling options, check the Support/Service section of the Tektronix Web site ([www.tektronix.com](http://www.tektronix.com)).

## Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive. This product is known to contain lead, cadmium, mercury, and hexavalent chromium.



# Preface

This manual contains operating and servicing information for the ECO422D.

The information included in this manual explains how to operate, verify, and service the system:

- *Getting Started* describes the instrument, included accessories, installation, configuration, and first time operation.
- *Operating Basics* explains the controls, indicators, connectors, and how to operate the instrument.
- *Specifications* describes functional characteristics and performance requirements for the ECO422D.
- *Theory of Operation* explains how the ECO422D operates.
- *Performance Verification* describes how to verify the functional performance of the ECO422D.
- *Adjustment Procedures* gives the field adjustment procedures.
- *Maintenance* contains the following information:
  - How to safely handle static sensitive modules and components
  - How to remove and replace replaceable parts
  - Corrective maintenance information
- *Replaceable Mechanical Parts* lists all replaceable parts in the ECO422D to a module level. Parts are identified on an indexed illustration to make them easier to identify.
- *Appendices*
  - *Options* lists the available options for the ECO422D.





# Getting Started



# Getting Started

## Product Description

The ECO422D SD/HD Changeover Unit (Figure 1-1 and Figure 1-2) provides automatic selection of reference sources. Automatic changeover may occur upon fault detection in any active source. Automatic transfer ensures uninterrupted signals for critical applications.

The ECO422D is an in-line device without internal buffers. Switching is by mechanical relay. The ECO422D also provides internal termination for unused inputs.

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**NOTE.** A source transition can occur if the channel output amplitude is reduced. This can be caused by over-termination, cable damage, or an accidental short to ground. A channel's selected input and its output are directly connected through an internal relay, therefore the ECO422D detects an output reduction as an input reduction. This does not apply to the three Option ELSW channels, which are buffered.

To avoid this problem, work on an output only when the ECO422D is not in operation. Disconnect the output cable from the ECO422D before working on the cable, and verify proper termination before reconnecting the cable to the ECO422D.

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Option ELSW provides electronic switching on channels 4, 5, and 6, instead of the mechanical relays, for faster switching on NTSC or PAL black burst, or tri-level sync. With Option ELSW the channel 4, 5, and 6 inputs and outputs are internally terminated. A relay is provided to switch the primary input to the output in case of power failure.

There are 11 channels. Each consists of a Primary Input, a Backup Input, and an Output. All relays switch in unison upon fault detection in any active channel, front-panel command, or remote command.

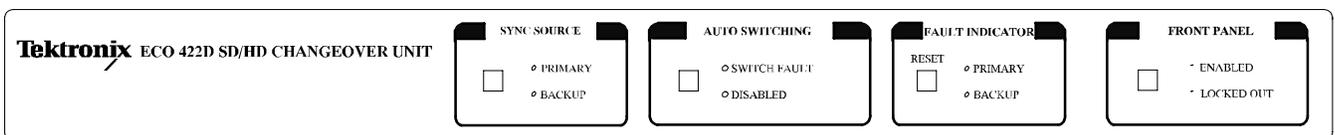
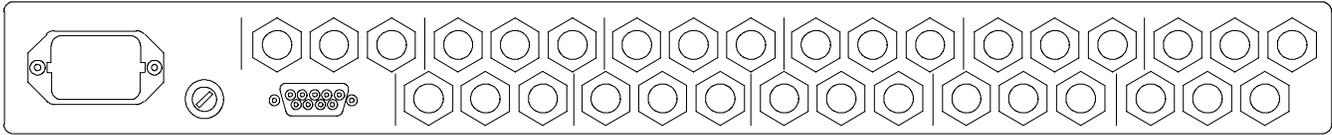


Figure 1-1: Front panel of the ECO422D



**Figure 1-2: Rear panel of the ECO422D**

The ECO422D bases error checking on signal amplitude. You can configure each channel to check for a different type of input. There are six predefined checking levels (seven levels on channels one through six): no checking, PAL analog black burst, NTSC analog black burst, high definition tri-level sync, serial digital high definition and standard definition component video, NTSC serial digital composite video, and serial digital audio. A fault occurs when the signal is between 2 and 6 dB down from nominal, depending on the predefined level chosen. There are also two user-defined checking thresholds available.

Separate indicators on the front-panel display faults for both the primary and backup generator. These indicators remain on until cleared by the operator.

### **Power Up Delay**

The ECO422D has a delay between the time power is applied and the time the ECO422D starts error detection. This delay allows source equipment to become operational before detection begins. In early units this delay was greater than four minutes. With the addition of S13<sup>1</sup> (see Figure 1-9) the delay is adjustable, in approximately 30 second increments, from 0 to approximately eight minutes. See *How to Set the Power Up Delay* on page 2-12.

## **Accessories**

The ECO422D comes with three accessories:

1. Rack slides (351-0751-01, 351-0104-03)
2. Reference card (061-4234-xx)
3. This manual (071-1792-xx)

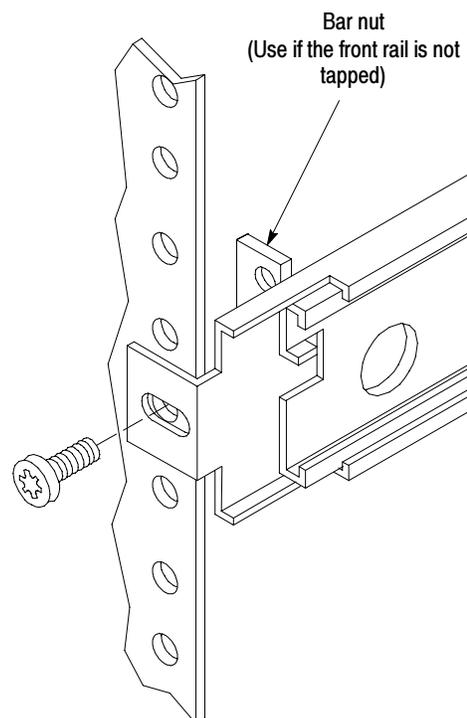
<sup>1</sup> Serial number B030000 and later.

## Installation

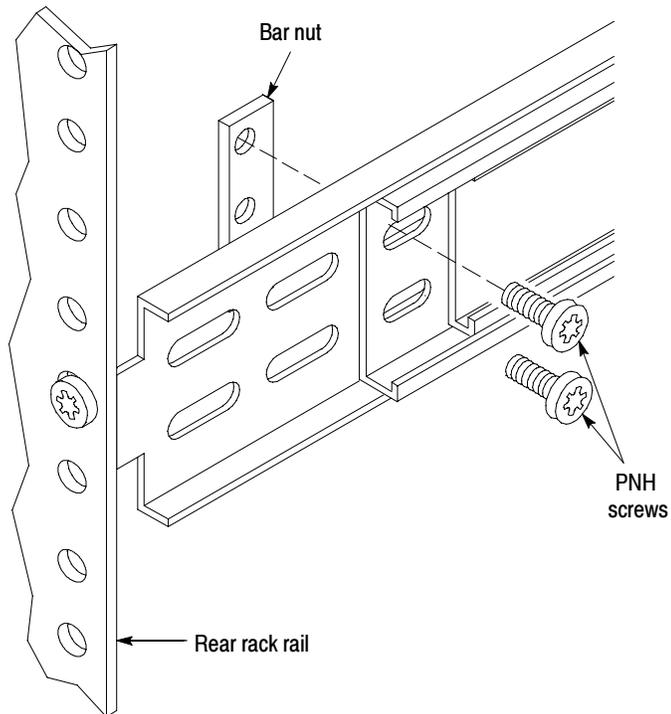
### Mechanical Installation

**Rackmounting.** The ECO422D is shipped with the hardware for rackmounting. The instrument fits in a standard 19-inch rack. Spacing between the front rails of the rack must be at least 17- $\frac{3}{4}$  inches to allow clearance for the slide-out tracks. Rack slides conveniently mount in any rack that has a front-to-rear rail spacing between 15- $\frac{1}{2}$  and 28 inches. The ECO422D requires six inches of clearance between the instrument rear panel and any rear cabinet panel for connector space and to provide adequate air circulation.

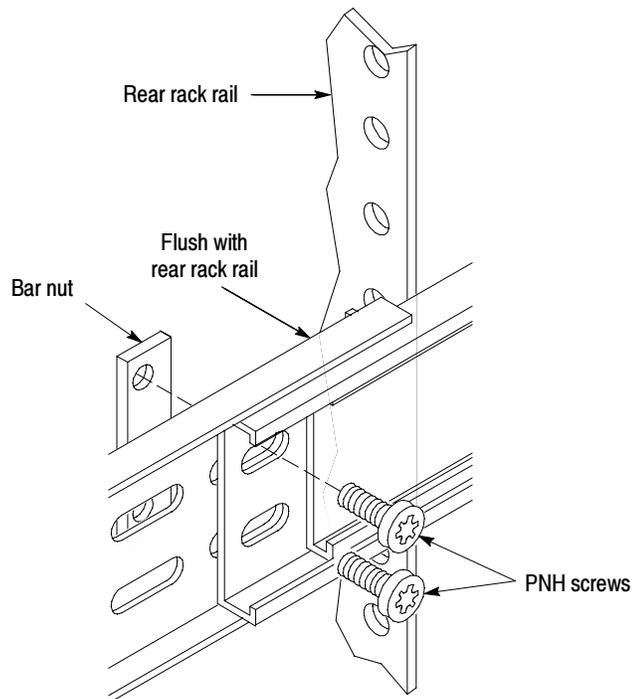
**Mounting the Slide Tracks.** Mount the rails using the enclosed hardware as shown in Figure 1-6. Figures 1-4 and 1-5 show the rail mounting details for both deep and shallow racks. Figure 1-3 shows the front mounting details. Make sure that the stationary sections are horizontally aligned, level, and parallel.



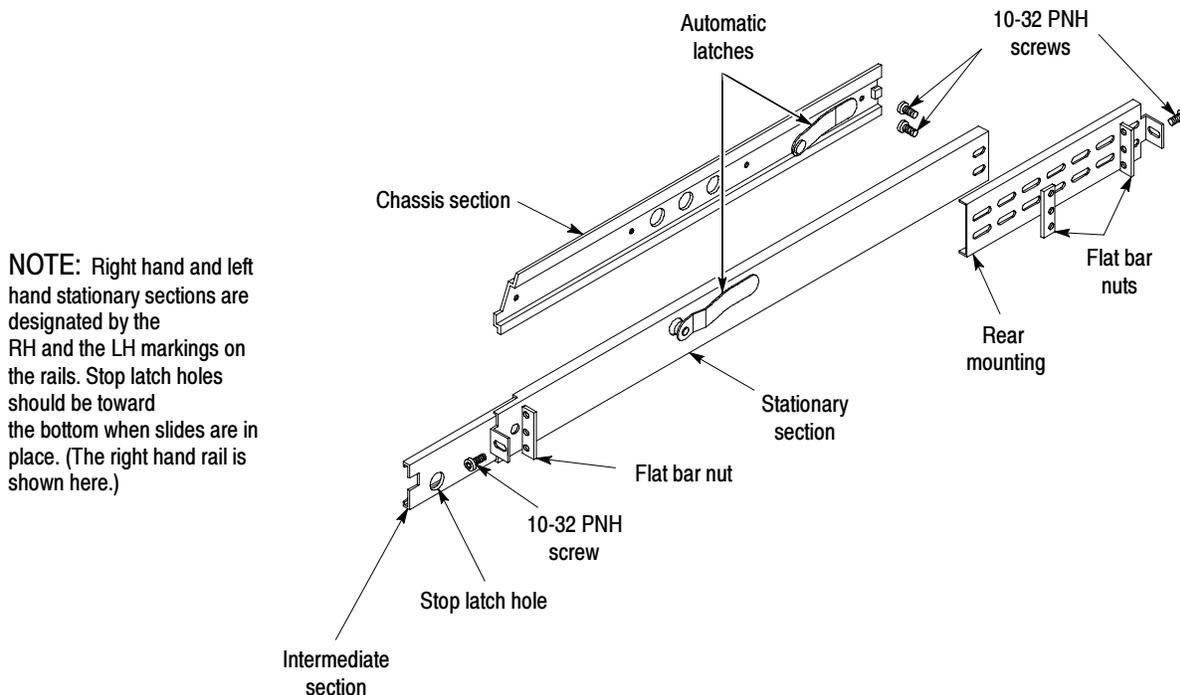
**Figure 1-3: Front rail mount**



**Figure 1-4: Deep rackmount**



**Figure 1-5: Shallow rackmount**



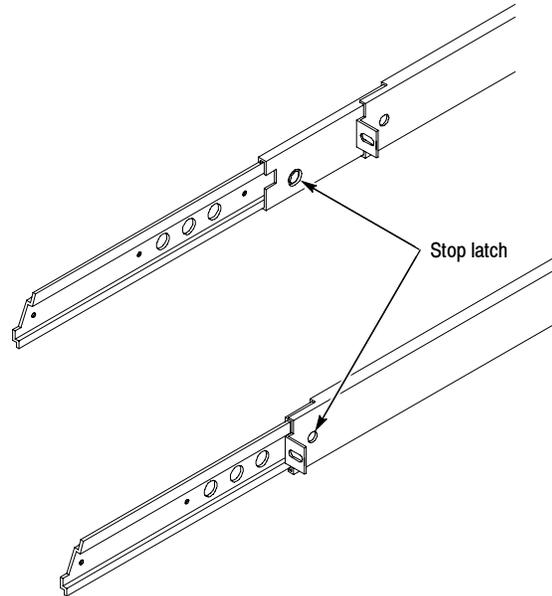
**Figure 1-6: Assembly of rackmounting hardware**

**Installing the Instrument.** Refer to Figure 1-7 to install the instrument into the rack.

1. Pull the slide-out track section to the fully extended position.
2. Insert the instrument chassis sections into the slide-out sections.
3. Press the stop latches and push the instrument toward the rack until the latches snap into their holes.
4. Again press the stop latches and push the instrument fully into the rack.
5. Tighten the front-panel retaining screw.

**Removing the Instrument.** Refer to Figure 1-7 to remove the instrument from the rack.

1. Loosen retaining screw and pull instrument outward until the stop latches snap into the holes.
2. Press stop latches and remove instrument.



**Figure 1-7: Installing or removing the rack slides**

**Rack Adjustments.** After installation, if not properly adjusted, the slide tracks may bind. To adjust the tracks, slide the instrument out about 10 inches, slightly loosen the screws holding the tracks to the front rails, and allow the tracks to seek an unbound position. Retighten the screws and check the tracks for smooth operation by sliding the instrument in and out of the rack several times.

Once the instrument is in place within the rack, tighten the knurled retaining screw to fasten it securely into the rack.

**Rack Slide Maintenance.** The slide-out tracks do not require lubrication. The dark gray finish on the tracks is a permanent, lubricated coating.

**Removing the Instrument.** First, loosen the front-panel knurled retaining screw. See Figure 1-7. Grasp the front handles and pull the instrument out until all three slide sections latch. The instrument is firmly held in this position.

To completely remove the instrument, first be sure to disconnect all cabling. Then, press both release-latch buttons (visible in the stop-latch holes) and carefully slide the instrument free from the tracks.

**Electrical Installation**

You can order any of the following power cord options for the ECO422D. If no power cord option is ordered, the instrument is shipped with a North American 125 V power cord and one replacement fuse.

- Opt. A0 - North America power
- Opt. A1 - Universal EURO power
- Opt. A2 - United Kingdom power
- Opt. A3 - Australia power
- Opt. A5 - Switzerland power
- Opt. A6 - Japan power
- Opt. A99 - No power cord or AC adapter
- Opt. AC - China power

Unless otherwise specified, power cords for use in North America are UL listed and CSA certified. Cords for use in areas other than North America are approved by at least one test house acceptable in the country to which the product is shipped. Power cord part numbers are shown in the Standard Accessories list at the end of the Replaceable Mechanical Parts List, in Section 9.

After you have installed the instrument for stand-alone or rackmount use, you are ready to connect the power and signal cables to the instrument. Figure 1-2 shows the instrument rear panel.

**Connecting Power**

To supply power to the ECO422D, connect the power cord to the power-input connector on the rear-panel of the instrument, and then connect the power cord to the local mains supply.

When power is first applied, the front panel AUTO SWITCHING DISABLED LED will flash, during the power up delay. When the ECO422D has completed the power up delay the SWITCH ON FAULT LED should come on. Early units had a power up delay of over four minutes. With the addition of S13<sup>2</sup> the delay is adjustable, in approximately 30 second increments, from zero delay to approximately eight minutes. See page 2-12.

For test purposes, the power up delay can be defeated by pressing the front panel ENABLED button while connecting the power cord.

You can operate the ECO422D using a grounded mains supply with a line-voltage range of 100 VAC to 240 VAC, and a frequency range of 50 Hz to 60 Hz. The ECO422D is grounded through the power cord.

<sup>2</sup> Serial number B030000 and later.

## Cable Installation

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**NOTE.** *The BNC connectors are tightly spaced on the ECO422D rear panel. You may find it necessary to use a BNC Cable Tool to remove or install cables (example: Trompeter RT-1L).*

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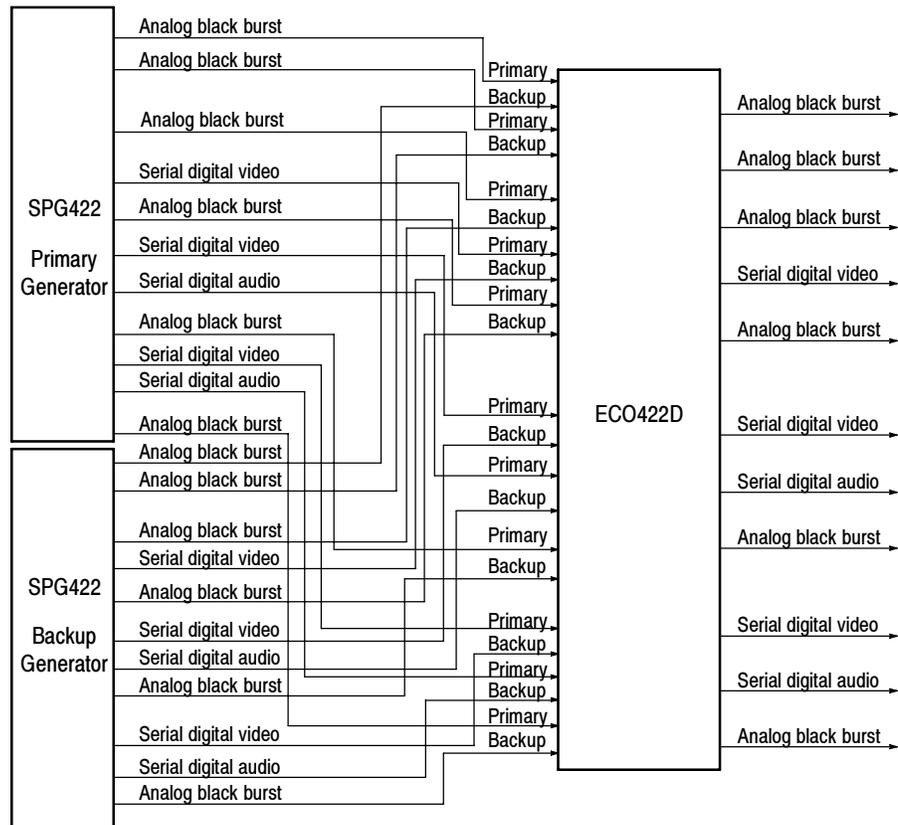
**NOTE.** *A source transition can occur if the channel output amplitude is reduced. This can be caused by over-termination, cable damage, or an accidental short to ground. A channel's selected input and its output are directly connected through an internal relay, therefore the ECO422D detects an output reduction as an input reduction. This does not apply to the three Option ELSW channels, which are buffered.*

*To avoid this problem, work on an output only when the ECO422D is not in operation. Disconnect the output cable from the ECO422D before working on the cable, and verify proper termination before reconnecting the cable to the ECO422D.*

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There are many different ways to configure the ECO422D. The following illustration is only one example. One thing to keep in mind, the ECO422D will automatically change to the Primary signals whenever it loses power. Therefore, always power the Backup source and the ECO422D by the same source and the Primary source separately. Using this scheme both power sources would have to go down before you would lose your signals.

Use the Channel Configuration Switches Log Table on page 1-12 to record what type of signals you have connected to each set of outputs on the rear panel. Then use the DIP selection guide to make sure that the DIP switches are correctly configured. There is also a reference card available to keep track of how the ECO422D is configured and aid in setting up the instrument.



**Figure 1-8: Example of ECO422D connections**

### Hints on Using the User Configuration Switches

There are the several different types of signal checking already available but you may need to feed a different signal through the ECO422D. This section gives one example, active analog video.

**Active Analog Video.** The ECO422D will pass active analog video by using the no checking mode, but there will be times when you need to check for the presence of an active video signal. You have at least two options. First, you can set up a custom checking level using one of the “user-defined” levels. This is great if you are always passing color bars or some other test signal where the average picture level remains constant and never fades to black. If the average picture level drops below the custom set level then an error occurs, causing the ECO422D to switch sources. The set level could easily be well above black burst. The second option is to use the predefined black burst level. This works very well when your goal is to check for “present/not present” active video. It will accept long periods of black without generated an error, but it will switch if the signal goes “completely” away.

Again, to summarize the three options available, if you want active video to pass through the ECO422D:

1. No checking.
2. Set a user-defined level — best for a constant test signal.
3. Use the predefined black setting — best for video with a wide variation of average picture levels or regular fades to blacks.

## Configuration

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**NOTE.** *Make sure that any channel not in use has checking disabled. If checking is not disabled, errors will always be generated. No error checking also allows the maximum voltage, current, and frequency to pass through the ECO422D.*

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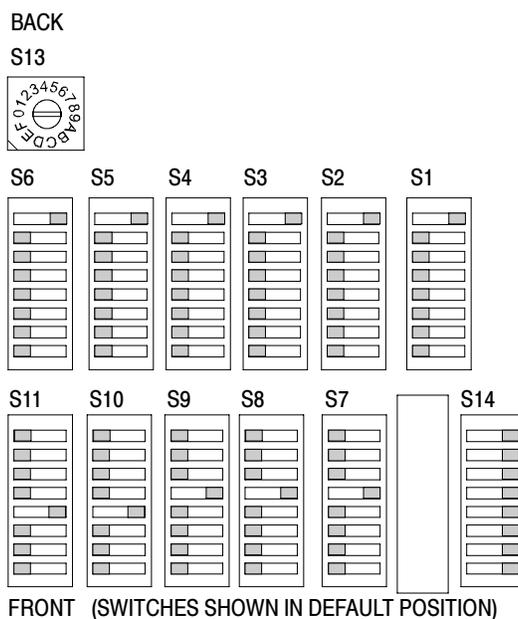
Photocopy the list of the DIP switches, shown in Table 1-2, to log the configuration of your system and use it as a quick reference. If using one of the “user-defined” levels, write the definition on the line as a reminder.

All of these switches are available through a small access panel on top of the ECO422D, eliminating any need to remove the top cover just to change the function of the outputs. The gray shading on the switches in Figure 1-9 indicate the down position of the rocker switch.

There is also a Mode switch, switch S14-8. Set it for either Normal or Override operation. If set for Normal operation, it will not allow you to manually switch to a bad signal, unless both signals are “bad.” For example: you are set for manual operation and the Primary signal is in error while the Backup is good. Press the Sync Source button to change to the Backup source. No matter how many times you press the Sync Source button again, the ECO422D will not allow you to return to the Primary source because it is in error. The only time that you can switch to an “error” signal in Normal mode is when both of the signals are bad. In that case, you can manually switch between the two signals. In Override mode, you can always manually switch to a bad signal. The other positions of S14 are only used for testing purposes, and must be closed for normal operation.

**Power Up Delay.** If desired, hex switch S13<sup>3</sup> may be used to adjust the power up delay. Each setting of S13 increases the delay in increments of approximately 30 seconds, from position 0 (no delay) to position F (over seven minutes). The factory setting is position 5, which provides a delay of slightly under three minutes.

<sup>3</sup> Serial number B030000 and later.



**Figure 1-9: Default position of the User Configuration and Mode switches**

**Table 1-1: Default configuration of switches**

DIP Switch	Input signal
All open	Disabled (signal not checked)
1	NTSC black burst
2	PAL black burst
3	NTSC serial digital video (143 Mb/s)
4	Serial digital video (270 Mb/s) Analog tri-level sync
5	NTSC serial digital audio
6	User defined
7	User defined
8	Serial digital video (1.485 Gb/s) (Channels 1-6) Attenuation (Channels 7-11)

**Table 1-2: Channel configuration switch log (S1 - S11)**

Output # / Switch #	Setting (see above)	Attenuation (set with Sx-8)		Type of signal attached
		On	Off <sup>1</sup>	
1 / S1		NA	X	
2 / S2		NA	X	
3 / S3		NA	X	
4 / S4		NA	X	
5 / S5		NA	X	
6 / S6		NA	X	
7 / S7				
8 / S8				
9 / S9				
10 / S10				
11 / S11				

<sup>1</sup> Attenuation cannot be set on switches S1-S6.

## Functional Check and First Time Operation

This section steps through how the ECO422D will react under its most common operating circumstances: two good signals, loss and then return of the Primary signal, loss and return of the Backup signal, and loss of power. Only two input signals are used here to avoid confusion.

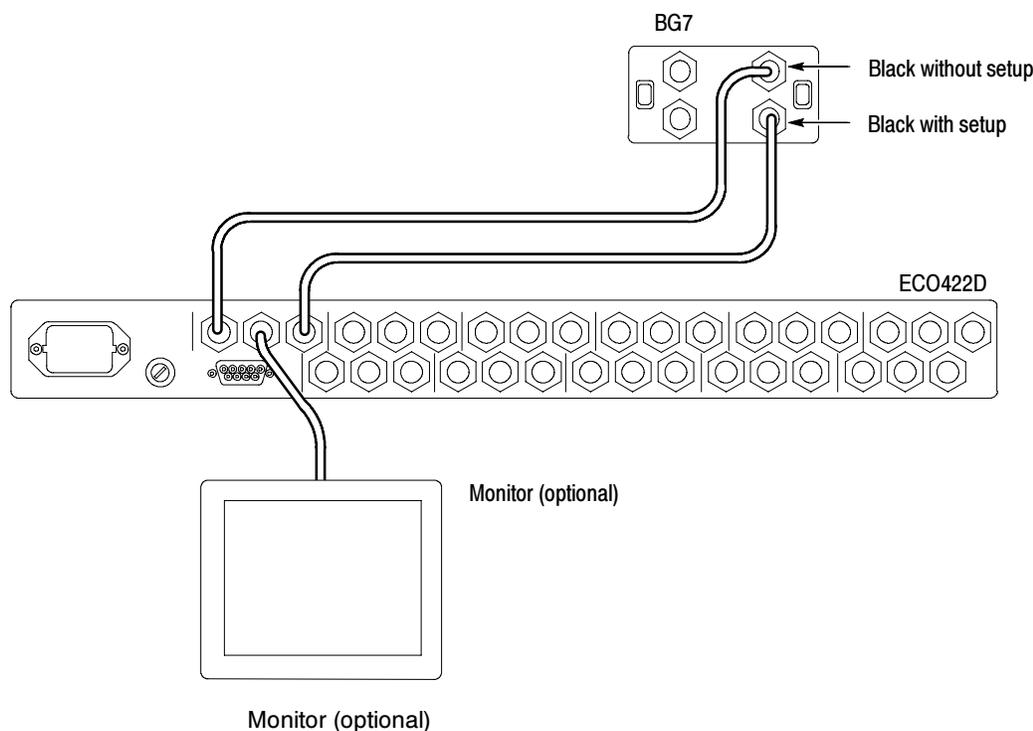
For more details on the controls, what they do, and how they interact, see *Operating Basics*, Section 2.

To check out the entire instrument, repeat these procedures for each of the eleven sets of inputs and outputs.

### Two Good Signals

Power down all instruments.

Connect the ECO422D as shown in Figure 1-10.



**Figure 1-10: Setup for the functional check**

Set all of the DIP switches (S1 - S11) to open, except for S1-1, which should be set to closed (NTSC black burst). Note that Primary input is black burst without setup and the Backup input is black burst with setup. (This is just to illustrate which signal is the Output.)

Set the user switch (S14-8) to Normal (closed).

Power up all instruments.

Enable the front panel, using the Front Panel button.

Set the ECO422D to “Switch on Fault” using front-panel buttons. (This is the default at power on.)

If Primary is not already the source, press the Sync Source button to make Primary the source. (This is the default at power on.)

Note that the output signal is the Primary input signal (black burst without setup) and that none of the fault indicators light.

Press the Sync Source button to change to the Backup source.

Note that the signal changes to black burst with setup (Backup).

Check that there is no error indicated for either signal.

Press the Sync Source button again, to switch back to the Primary input.

### **Loss of the Primary Signal**

Disconnect the Primary signal source. (Remove the cable between the BG7 and the Primary 1 input of the ECO422D.)

Note the signal automatically switches to the Backup input and the Primary fault indicator lights.

Reconnect the Primary signal source. (Replace the cable between the BG7 and the Primary 1 input of the ECO422D.)

Note that the Primary fault indicator remains on and the Sync Source remains the Backup (the ECO422D does not automatically switch back to Primary).

Press the Reset button.

Note that the Primary fault indicator turns off.

Press the Sync Source button to return to the Primary as the source.

Press the Auto Switching button to disable the “Switch on Fault” function.

Remove the Primary input signal. (Again, remove the cable between the BG7 and the Primary 1 input of the ECO422D.)

Note that no switching occurs, but that the Primary fault indicator lights.

Press the Sync Source button to change to the Backup signal.

Press the Sync Source button again to try to change back to the Primary input. (It should not let you change to a bad input.)

Reconnect the Primary input source. (Replace the cable between the BG7 and the Primary 1 input of the ECO422D.)

Press the Reset button to clear the fault indicator LED.

Return the auto switching to “Switch on Fault.”

Note that the sync source is still Backup.

### **Loss of the Backup Signal**

Disconnect the Backup signal. (Remove the cable between the BG7 and the Backup 1 input of the ECO422D.)

Note that the output signal has changed to the Primary input signal and the Backup fault indicator LED lights.

Reconnect the Backup signal. (Replace the cable between the BG7 and the Backup 1 input of the ECO422D.)

Clear the fault indicator by pressing the Reset button.

Press the Sync Source button to return to Backup sync source.

### **Loss of Power to the ECO422D**

Remove the power source from the ECO422D.

Note that the output signal switches to the Primary input signal.

Return the power source.





# Operating Basics



# Operating Basics

## Controls and Indicators

Figure 2-1 shows the layout of the ECO422D front-panel controls and indicators.

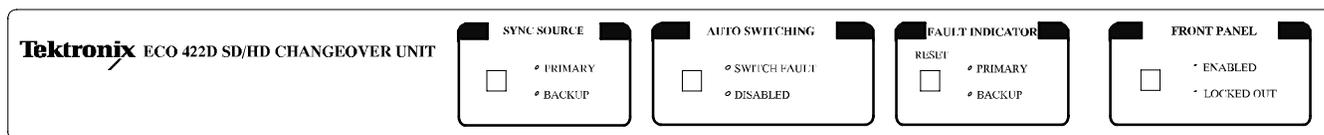


Figure 2-1: Front-panel controls

**Sync Source - Primary/Backup.** The LED indicates the current Output (whether it is from the Primary or Backup input). It can be manually changed using the Sync Source button. (If the ECO422D is in Normal mode, this is only true when the other input is good or both inputs are bad. Refer to *User Configuration Switch (S14-8)* on page 2-4.) Only one of these LEDs can be on. Primary is the default at power-up.

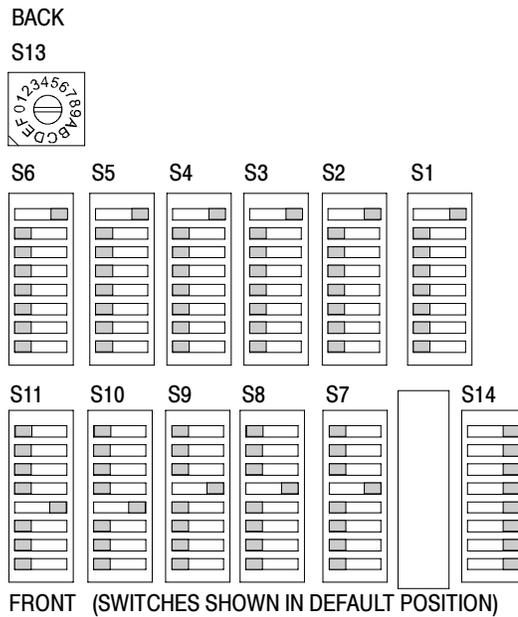
**Auto Switching - Switch on Fault/Disabled.** This selects whether the ECO422D will automatically switch to the other input source whenever it detects a fault (Switch on Fault) or not switch (Disabled). Only one of these LEDs can be on after the power-up delay. Switch on Fault is the default setting. During power-up, the DISABLED LED slowly blinks to indicate disabled front panel and error detection during the power-up delay.

**Fault Indicator (Reset) - Primary/Backup.** Either one or both of these LEDs could be on. They indicate that a fault has occurred on the input. Press the Reset button to clear the fault indicators (turn off the LEDs) after the fault has been corrected. The fault indicator does not automatically reset after an error condition improves. At power-up, the LEDs are reset.

**Front Panel - Enabled/Locked Out.** This control determines whether or not the operator has access to the other front-panel controls. If it is Enabled, then the user can control the instrument from the front panel. If it is Locked Out, then the user can only toggle back to Enabled and no other front-panel controls are available. The ECO422D will automatically lock out after about 1 minute of inactivity to prevent accidental switching. The front panel is automatically locked out at power-up (during power up, both LEDs are lit).

## Internal Controls

**Channel Configuration Switch (11 dip switches S1 - S11; see Figure 2-2).** These switches select the signal type checked on a channel by setting the amplitude comparison level. Only one switch from each DIP package should be enabled (closed) for each channel, except for attenuation (DIP 8 on switches S7 through S11), which is allowed to be combined with either of the user-defined levels.



**Figure 2-2: Default position of the user configuration and mode switches**

The following list shows the functions for each of the switches.

DIP Switch	Input signal
All open	Disabled (signal not checked)
1	NTSC black burst
2	PAL black burst
3	NTSC serial digital video (143 Mb/s)
4	Serial digital video (270 Mb/s) Analog tri-level sync
5	NTSC serial digital audio
6	User defined
7	User defined
8	Serial digital video (1.485 Gb/s) (Channels 1-6) Attenuation (Channels 7-11)

Table 2-1 lists the factory setting of the switches. (NTSC or PAL black burst is determined by the power cord option ordered with the instrument.)

**Table 2-1: Factory settings of channel configuration switches (S1 - S11)**

Output # / Switch #	Setting (see above)	Attenuation (set with Sx-8)		Type of signal attached
		On	Off	
1 / S1	1 or 2	NA	X	Black Burst
2 / S2	1 or 2	NA	X	Black Burst
3 / S3	1 or 2	NA	X	Black Burst
4 / S4	1 or 2	NA	X	Black Burst
5 / S5	1 or 2	NA	X	Black Burst
6 / S6	1 or 2	NA	X	Black Burst
7 / S7	4		✓	Serial Digital Video (Component)
8 / S8	4		✓	Serial Digital Video (Component)
9 / S9	4		✓	Serial Digital Video (Component)
10 / S10	5		✓	Serial Digital Audio
11 / S11	5		✓	Serial Digital Audio

**User Configuration Switch (S14-8) -closed- -Normal-**

**Attenuation.** Attenuation allows larger signals to have their signal level checked. The attenuator adds about 14 dB (x5) attenuation to the signal level being checked. This has no effect on the level of the output signal and only extends the

range of the check circuitry. Use this in conjunction with large H sync pulses to increase the accuracy on the level check. Only use this switch in conjunction with the User Defined Levels.

**User Configuration Switch (S14 - 8).** This switch determines how the ECO422D responds to faulty signals - either Normal or Override.

For Normal operation, the user cannot switch to a bad signal whether the instrument is in manual or auto switch mode. For example, the ECO422D is in manual mode and the Primary signal is bad, while the Backup signal is good. If the user presses the Sync Source button, the output will be the Backup signal. If the user presses the Sync Source button again, the output continues to be the Backup signal. It will not change to Primary until the signal is good and the fault indicator is reset.

In the Override mode, the user can manually switch to a “bad” signal, with Auto mode disabled.

**Reference Level Adjustments (R266 and R265).** These two adjustments set the reference level for the two user-defined signal options. Select these levels with DIPs 6 (R266) and 7 (R265) of the Channel Configuration switches. These allow the user to set their own signal switching level for special applications. Two examples of signals that may require checking are an active video signal or an H Sync signal.

The procedure used to set these levels is on page 2-9.

**Power-up Delay Switch (S13)<sup>4</sup>.** This hex switch (see Figure 2-2) sets the delay duration between the time power is applied and the time the ECO422D starts error detection. Each position of the switch increments the delay approximately 30 seconds (position 0 = no delay). The factory setting is position 5, which provides a delay of slightly under three minutes.

## Connectors

Figure 2-3 shows the layout of the rear panel of the ECO422D.

<sup>4</sup> Serial number B030000 and later.

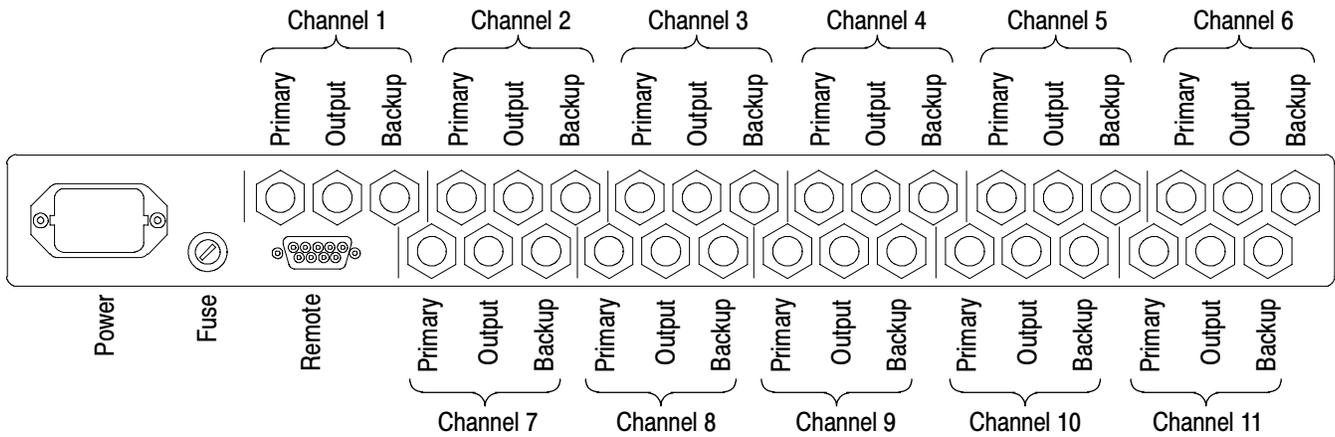


Figure 2-3: Rear panel of the ECO422D

**Power** This instrument is designed to operate from a single-phase power source with one current-carrying conductor at or near earth-ground (the neutral conductor). Only the line conductor is fused for over current protection. Mains frequency is 50 or 60 Hz. The operating voltage range is continuous from 100 to 240 VAC  $\pm 10\%$ .



**WARNING.** To prevent personal injury, do not connect power to the ECO422D if the top cover is not installed. Dangerous potentials are present on the Power Supply board.

**Video Signals (11 Channels)**

There are 33 video connectors on the rear panel, arranged into a Primary input, a Backup input, and an Output for each of the 11 channels. A general overview of each one is below.

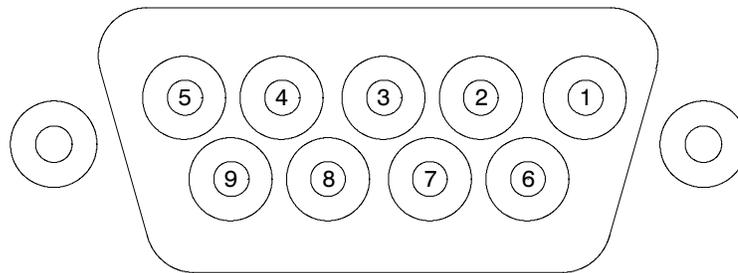
**Primary.** Input from the primary sync generator. It can be PAL black burst, NTSC black burst, analog tri-level sync, serial digital video, or serial digital audio if signal checking is desired. There are also two user-defined levels available. If no signal checking is required, almost any signal can pass through the unit (within the bandwidth and voltage/current limitations). This should be the same signal type as its Backup signal pair.

**Output.** Signal output. It is either from the Primary or the Backup source. How the ECO422D is configured determines under what conditions the source changes.

**Backup.** Input from the backup sync generator. This should be the same signal type as its Primary signal pair.

**Opt. ELSW.** With Opt. ELSW, channels 4, 5, and 6 are designed for use only with NTSC or PAL black burst, or tri-level sync.

**Remote** The rear-panel connector is a 9-pin female D-connector, with one pin tied to ground (see Figure 2-4).



**Figure 2- 4: Remote connector pins**

The pin-out is shown in Table 2-2.

**Table 2-2: Remote connector pin-out**

Pin	Signal function
1	Auto switching (input)
2	Toggle sync source (input)
3	Indicate primary sync source active (output)
4	Indicate backup sync source active (output)
5	Fault alarm (output)
6	Fault reset
7	Fault reporting +
8	Fault reporting -
9	Ground

Auto Switching (active low) If low, the automatic switching function from the front panel is disabled. The front panel cannot override this remote command.

**Toggle Sync Source (active low)** Operates the same as the Sync Source button on the front panel. A low pulse will cause the ECO422D to toggle between Primary and Backup as the output signal.

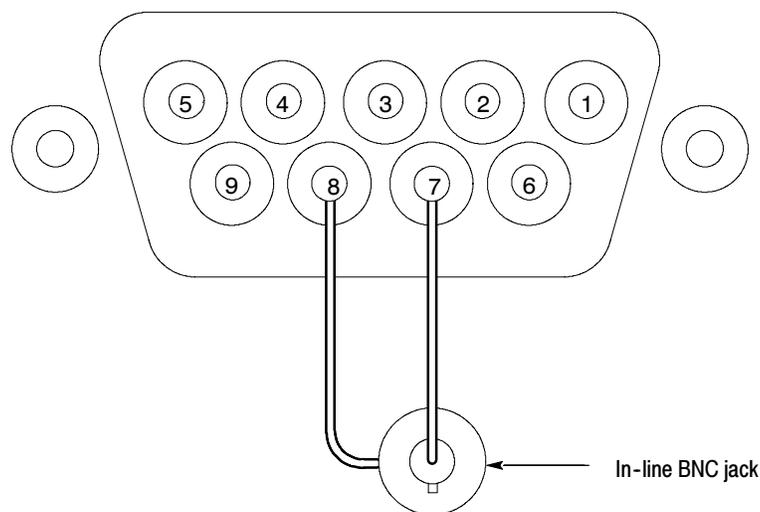
**Indicate Primary Sync Source Active (active high)** Indicates that the Primary signals are the sync source.

**Indicate Backup Sync Source Active (active high)** Indicates that the Backup signals are the sync source.

**Fault Alarm (active high)** Indicates that at least one of the Primary or Backup input signals is “bad.” This alarm signal is latched and will remain high until the error is cleared and the Reset button is pressed.

**Fault Reset (active low)** This operates like the front-panel Reset button. It clears the fault indicators (turns off the LEDs) after the fault has been corrected.

**Fault Reporting - and +** It is normally open, indicating that everything is good. It will close in the cases of: loss of power to the ECO422D or one (or more) input signals are bad. The fault is latched and will remain until the fault is cleared. This fault reporting system follows SMPTE 269M guidelines except the interface is 2 pins of the Remote connector (7 & 8) instead of the standard isolated BNC connector and there is no pulsing. When in the open state, the leakage across the closure is less than 100  $\mu$ A at any voltage from 0 to 5 VDC. The closure is able to withstand 24 VDC in the open state without damage. In the closed state, the maximum voltage drop across the closure should not exceed 2 V at 20 mA. The sensing device should not supply more than 20 mA of current to the reporting device. To provide compliance with the standard, wire a BNC connector adapter as shown in Figure 2-5.



**Figure 2-5: Wiring required to conform with SMPTE fault reporting**

## Operating Basics

In normal operation, the ECO422D is basically a switch that triggers whenever an error occurs in any channel. All 11 Channels switch at the same time.

If any channel is not being used, it is mandatory that its checking function be disabled. Otherwise it will always trigger an error and the ECO422D will not operate properly.

This section covers the state machine discussions (what will happen when some signals go bad) and how to adjust the user-defined inputs.

## State Machine Description

Table 2-3 is a truth table that gives the various states the ECO422D outputs based on the state of the inputs. Note that Primary is set to check a given level.

Power - the state of the power supply.

User Config - the state of the user configuration switch. It can either be N (Normal) or O (Override). In Normal mode, the ECO422D will not switch to a “bad signal.” In Override operation, the user is allowed to manually switch to a “bad signal.”

Switch - Indicates whether or not the Sync Source button on the front panel or the Toggle Sync Source on the remote control has been selected. Note that the front panel and the remote control commands are ANDed together (active low) to produce the switch results.

P - Primary input status - the state of the input detector circuit on a Primary input.

B - Backup input status - the state of the input detector circuit on a Backup input.

O Auto - Resulting output signal with the ECO422D set to “Auto Switching” (switch on error). It can either output Primary or Backup.

O Manual - Resulting output signal with the ECO422D set to “Manual” (no switching on error). It can either output Primary or Backup.

0 - bad signal.

1 - good signal.

↑ - switch (change the current output signal).

↓ - no switch (stay with the current signal).

X - Don't care.

**Table 2-3: Truth table for ECO422D switching**

Power	User config	Switch	P	B	O auto	O manual
1	N	↓	0	0	↓	↓
1	N	↓	0	1	B	↓
1	N	↓	1	0	P	↓
1	N	↓	1	1	↓	↓
1	N	↑	0	0	↑	↑
1	N	↑	0	1	B	B
1	N	↑	1	0	P	P
1	N	↑	1	1	↑	↑
1	O	↓	0	0	↓	↓
1	O	↓	0	1	B	↓
1	O	↓	1	0	P	↓
1	O	↓	1	1	↓	↓
1	O	↑	0	0	↑	↑
1	O	↑	0	1	B	↑
1	O	↑	1	0	P	↑
1	O	↑	1	1	↑	↑
0	X	X	X	X	P	P

### How to Adjust the User-Defined Threshold Levels

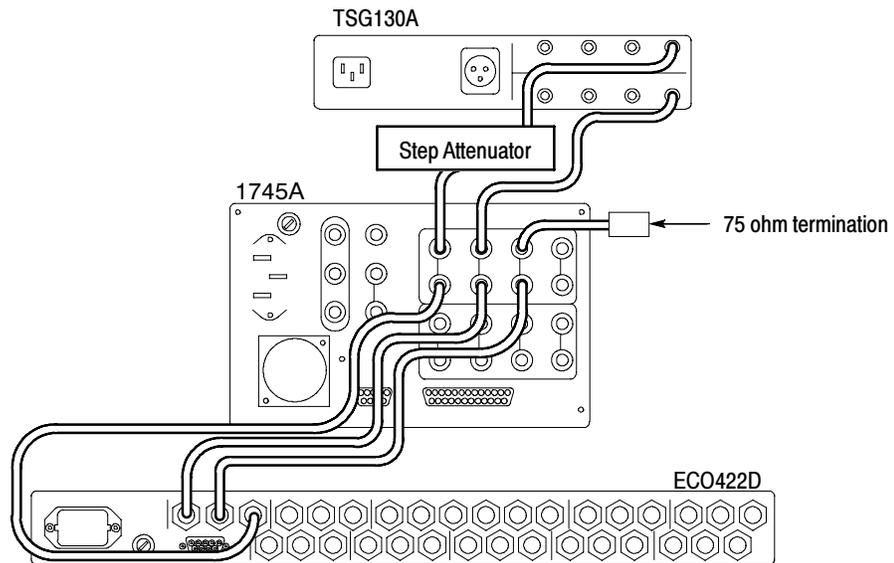
The User-defined Threshold Levels are the two levels available from User Configuration switches 6 and 7. They are available so that the user can trigger on signal levels other than the seven predefined levels.

In order to set the Threshold Levels, you need:

- Two good versions of the type of signal you want to check
- A step attenuator (example: 847 Attenuator from KAY Elemetrics)
- A waveform monitor or oscilloscope (optional)
- The ECO422D

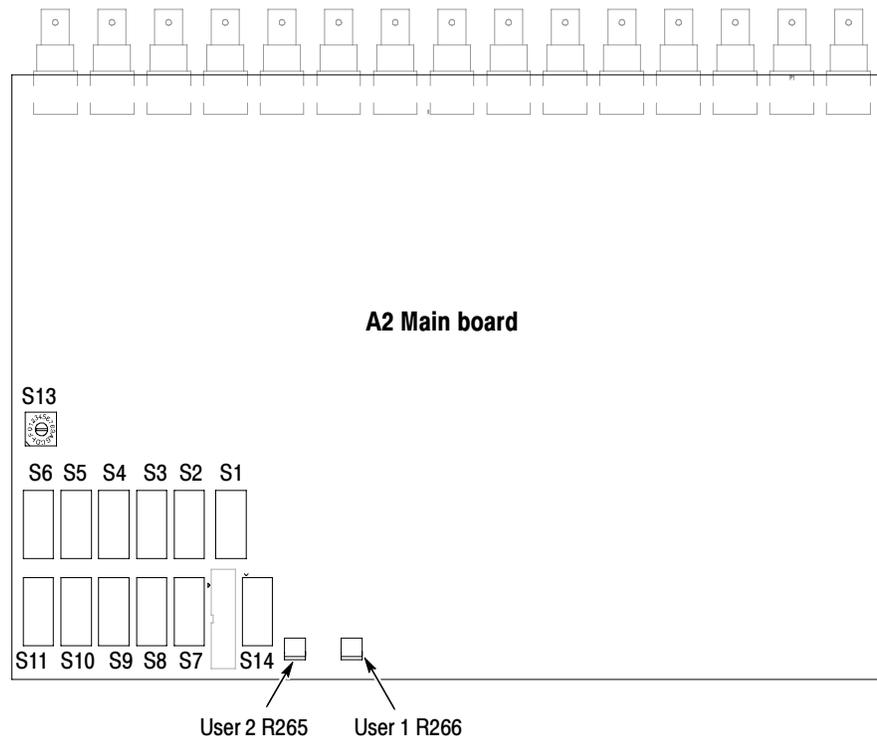
The example sets switch 7 for NTSC active video with the threshold set for a 3 dB down color bar. It uses a TSG 130A as the signal source, a 1745A waveform monitor (optional) to view the signal level, and a step attenuator.

1. Connect the equipment as shown in Figure 2-6.



**Figure 2-6: Setup for adjusting R265 (the user level for SX-7)**

2. Set all of the User Configuration switches to “open” except for S1-7 (for channel 1).
3. Set all S14 switches “closed.”
4. Set the ECO422D to Primary Sync Source.
5. Set the ECO422D Auto Switching to “Switch on Fault.”
6. Set the step attenuator to 0 dB of attenuation.
7. Turn the potentiometer R265 fully. (You are attempting to allow the minimum signal level to pass through before the threshold is reached.)



**Figure 2-7: Selection switches and user level control locations**

8. Press the fault indicator Reset button. (This clears any errors.)
9. Check the fault indicator for an error indication on either the Primary or Backup channels. If there are no faults, then proceed to the next step. Otherwise, try rotating the potentiometer in the other direction. (You are trying to get the minimum signal level to pass through before reaching the switching threshold.)
10. Set the step attenuator to 3 dB of attenuation (or whatever attenuation is required for your application).
11. Check to see that the sync source has not changed to Backup and no faults are on the Primary channel.
12. Slowly adjust R265 until the ECO422D switches to the Backup sync source and a fault occurs on the Primary channel. Press Reset to verify that the fault is still preset. If the Primary fault indicator LED goes out, continue adjusting the potentiometer. If the LED remains on, S1-7 through S11-7 are set for your user-defined level.

---

**NOTE.** *If you cannot adjust R265 satisfactorily, move the cables from Channel 1 to Channel 7, open S1-7, close S7-7 and activate the Channel 7 attenuator by closing S1-8. Repeat the adjustment steps starting with step 6.*

---

Adjust R266 in the same manner to set a user-defined level for S1-6 through S11-6.

### How to Set the Power Up Delay

Hex switch S13<sup>5</sup> (see Figure 2-2) sets the delay between the time power is applied and the time the ECO422D starts error detection. Each position of the switch increments the delay approximately 30 seconds, from position 0 (no delay) to position F (over seven minutes). The factory setting is position 5, which provides a delay of slightly under three minutes.

## Exterior Cleaning

Clean the instrument often enough to prevent dust or dirt from accumulating. Dust accumulating in the instrument acts as an insulating blanket, preventing proper cooling, and possibly causing overheating and component breakdown. Under high humidity conditions, accumulated dust can also provide an electrical conduction path.



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**CAUTION.** *To avoid damage to the instrument, do not expose it to sprays, liquids, or solvents. Do not use chemical cleaning agents; they can damage the instrument. Avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.*

---

Clean the exterior surfaces of the instrument with a dry, lint-free cloth or a soft-bristle brush. If dirt remains, use a cloth or swab dampened with a 75% isopropyl alcohol solution. A swab is useful for cleaning in narrow spaces around the controls and connectors. Do not use abrasive compounds on any part of the instrument.



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**CAUTION.** *Avoid getting moisture inside the instrument during exterior cleaning and use only enough solution to dampen the cloth or swab. Use a 75% isopropyl alcohol solution as a cleanser, and rinse with deionized water.*

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<sup>5</sup> Serial number B030000 and later.



# Specifications



# Specifications

## Introduction

The items listed in the following tables describe the performance of the ECO422D Changeover Unit. Performance Requirements are generally quantitative and can be tested by a Performance Verification procedure contained in the service part of this manual.

Supplemental Information is valuable data pertaining to the operation and output capabilities of this instrument. Only a few items listed in this category may be tested in the Performance Verification procedure.

Performance Conditions - The requirements listed in the electrical specification apply over an ambient temperature range of 0 °C to +40 °C. The rated accuracies are valid when the instrument is calibrated at an ambient temperature range of +20 °C to +30 °C, after a warm-up time of 20 minutes. Test equipment used to verify Performance Requirements must be calibrated and working within the limits specified under the Equipment Required list.

These instruments are intended to operate from an AC power source that will not apply more than 264 V<sub>RMS</sub> between the supply conductors or either supply conductor and ground. A protective ground connection by way of the grounding conductor is essential for safe operation.

Environmental specifications are listed toward the back of the following tables. In addition a list of appropriate safety and electromagnetic interference (EMI) standards also can be found there.

**Table 3- 1: General characteristics**

Characteristics	Performance requirements	Supplemental information
Return Loss (All Inputs and Outputs) Channels 1-6  Channels 4-6 (Opt. ELSW Only) Channels 7-11		30 dB, 0 to 10 MHz 15 dB, 10 to 750 MHz 10 dB, 750 MHz to 1.5 GHz  30 dB, 0 to 10 MHz (Internally terminated)  30 dB, 0 to 10 MHz 15 dB, 10 to 270 MHz 12 dB, 270 to 360 MHz (15 dB typical)
Insertion Loss Channels 1-6  Channels 4-6 (Opt. ELSW Only) Channels 7-11		0.2 dB DC to 10 MHz 10 MHz to 1.5 GHz <sup>1</sup>  0.3 dB DC to 10 MHz  0.2 dB, DC to 10 MHz 0.5 dB, 10 to 200 MHz 1.0 dB, 200 to 360 MHz
Maximum Switched Voltage  Channels 4-6 (Opt. ELSW Only)		±5 V  ±1 V (designed to use NTSC/ PAL Black Burst or TriLevel sync only)
Maximum Switched Current		100 mA
Crosstalk (unselected input to output or channel to channel) Channels 1-6  Channels 4-6 (Opt. ELSW Only)  Channels 7-11		-60 dB to 10 MHz -30 dB to 1.0 GHz -20 dB to 1.5 GHz  -55 dB to 10 MHz -45 dB to 30 MHz  -60 dB to 10 MHz -30 dB to 200 MHz -15 dB to 360 MHz

**Table 3-1: General characteristics (Cont.)**

Characteristics	Performance requirements	Supplemental information
Relay Switch Time		Time that it takes for the relays to switch and settle. Approximately 10 msec.
Channel Switch Time Channels 4-6 (Opt. ELSW Only)		Within 100 ns ( <i>measured with NTSC/PAL Black Burst signal</i> )
Power-up delay		> 4 minutes, to allow source generator signals to stabilize. With the addition of S13 the delay is adjustable from zero to over seven minutes (see page 2-4).
Insertion Delay Channels 4-6 (Opt. ELSW Only)		Approximately 4 ns (refer to Input signal)

<sup>1</sup> In the frequency range of 10 MHz to 1.5 GHz, the instrument approximates less than 20 meters of Belden 1694A cable.



**Figure 3-1: Typical eye-pattern of 20 m of Belden 1694A cable**



**Figure 3-2: Typical eye-pattern of Channels 1-6 HD output (Channels 1-3 with Opt. ELSW)**

**Table 3-2: Signal loss detection**

Characteristics	Performance requirements	Supplemental information	Performance Ver. step
Input Signal	Switching Level within:	These are the defined switching thresholds set with the internal Channel Configuration switch.  Between 2 and 4 dB down from nominal.	
NTSC Black Burst (sync level)	-180 to -230 mV	-200 mV	2 & 4
PAL Black Burst (sync level)	-190 to -240 mV	-210 mV	3 & 5
Serial Digital Video (NTSC Composite)	450 to 630 mV	540 mV (between 2 and 5 dB down)	10 & 11
Serial Digital Video (270 Mb/s)	450 to 630 mV	540 mV (between 2 and 5 dB down)	7 & 8
Serial Digital Video (1.485 Gb/s)	450 to 630 mV	540 mV (between 2 and 5 dB down)	16 & 17
Serial Digital Audio	630 to 790 mV	710 mV	13 & 14
User Adjustable	-100 to -700 mV  -700 to -3500 mV	Using the two user-defined Channel Configuration switches.  Using the user-defined Channel Configuration switch with the attenuator on.	
Attenuation		approximately x5	
Analog tri-level sync	400 to 565 mV	475 mV (between 3 and 6 dB down)	<sup>2</sup>

<sup>2</sup> Performance is verified indirectly by completing Performance Verification steps 2-5 & 10-11.

**Table 3-3: Power supply**

Characteristics	Performance requirements	Supplemental information
External Power Voltage	100 to 240 VAC $\pm$ 10%	Full range, no selector
Input Frequency Range		48 Hz to 62 Hz
Power Consumption		20 Watts, typical 40 VA, maximum
Supply Accuracy +5 V -5 V		+5 V $\pm$ 200 mV -5 V $\pm$ 200 mV
Hum +5 V -5 V		Typical values: 10 mV 10 mV
Noise +5 V -5 V		(5 MHz measurement bandwidth) $\leq$ 50 mV $\leq$ 50 mV
Crest Factor		$\geq$ 1.35
Fuse Required		1 ampere medium blow fuse for all applications.

**Table 3-4: Mechanical (physical) characteristics**

Characteristics	Supplemental information
Rackmount Dimensions	
Height	1.734 inches (4.4 cm)
Width	19.0 inches (48.3 cm)
Length	22.1 inches (56.1 cm)
Net Weight	10.8 lbs (4.9 kg)
Shipping Weight	18 lbs, 5 oz (8.3 kg)

**Table 3-5: Environmental characteristics**

Characteristics	Supplemental information
Temperature Nonoperating Operating	-40 °C to +65 °C 0 °C to +40 °C.
Altitude Nonoperating Operating	to 12,192 meters (40,000 feet) to 2,000 meters (6,562 feet).
Humidity	5 - 95% humidity, noncondensing
Vibration Operating	From 5 to 350 Hz: 0.0002 g <sup>2</sup> /Hz Acceleration Power Spectral Density (APSD). From 350 to 500 Hz: -3 dB/Octave Slope. At 500 Hz: 0.00014 g <sup>2</sup> /Hz APSD. 0.31 overall GRMS. 10 minutes/axis.
Nonoperating	From 5 to 100 Hz: 0.020 g <sup>2</sup> /Hz (APSD). From 100 to 200 Hz: -3 dB/Octave Slope. From 200 to 350 Hz: 0.010 g <sup>2</sup> /Hz APSD. From 350 to 500 Hz: -3 dB/Octave Slope. At 500 Hz: 0.007 g <sup>2</sup> /Hz APSD. 2.46 overall GRMS. 10 minutes/axis.
Shock (nonoperating)	Half Sine Wave Shock levels: 50 g's (instrument), 11 msec duration, 3 shocks per direction.
Transportation	Qualified under NTSB Test Procedure 1A, Category II (24-inch drop).
Vehicle Vibration (Random Vibration)	Vibrate along all three axes at an overall vibration level of 1.33 GRMS. One hour per axis.
Second Manual Handling (Shock)	Drop on all sides once from a height of 24 inches. Drop on the bottom from a height of 48 inches.

**Table 3-6: Certifications and compliances**

Category	Standards or description
EC Declaration of Conformity - EMC	<p>Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:</p> <p>EN 55103                      Product family standard for audio, video, audio-visual, and entertainment lighting control apparatus for professional use.</p> <p>Environment                      E2 - commercial and light industrial</p> <p>Part 1 Emission</p> <p>EN 55022                      Class B radiated and conducted emissions</p> <p>EN 55103-1, Annex A              Radiated magnetic field emissions</p> <p>EN 55103-1, Annex B              Inrush current, I<sub>pk</sub> = 3.7 A.</p> <p>Part 2 Immunity</p> <p>IEC 61000-4-2                      Electrostatic discharge immunity</p> <p>IEC 61000-4-3                      RF electromagnetic field immunity</p> <p>IEC 61000-4-4                      Electrical fast transient / burst immunity</p> <p>IEC 61000-4-5                      Power line surge immunity</p> <p>IEC 61000-4-6                      Conducted RF Immunity</p> <p>IEC 61000-4-11                      Voltage dips and interruptions immunity</p> <p>EN 55103-2, Annex A              Radiated magnetic field immunity</p> <p>EN 55103-2, Annex B              Balanced ports common mode immunity</p> <p>EN 61000-3-2                      AC power line harmonic emissions</p> <p>EN 61000-3-3                      Voltage changes, fluctuations, and flicker</p>
Australia / New Zealand Declaration of Conformity - EMC	<p>Complies with EMC provision of Radiocommunications Act per the following standard(s):</p> <p>AS/NZS 2064.1/2                      Industrial, Scientific, and Medical Equipment: 1992</p> <p>AS/NZS 3548.                      Information Technology Equipment: 1995</p>
EMC Compliance	<p>Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the directive if used with other products.</p>
Russian Federation	<p>This product was certified by the GOST ministry of Russia to be in compliance with all applicable EMC regulations.</p>
FCC Compliance	<p>Emissions comply with FCC 47 CFR, Part 15, Subpart B for Class A equipment.</p>

**Table 3-6: Certifications and compliances (cont.)**

<b>Category</b>	<b>Standards or description</b>
EC Declaration of Conformity - Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union: Low Voltage Directive 2006/95/EC EN 61010-1:2001 .Safety requirements for electrical equipment for measurement control and laboratory use.
U.S. Nationally Recognized Testing Laboratory Listing	UL3111-1 Standard for electrical measuring and test equipment.
Canadian Certification	CAN/CSA C22.2 No. 1010.1 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Additional Compliance	ANSI/ISA S82.02.01:1999 Safety standard for electrical and electronic test, measuring, controlling, and related equipment. IEC61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use.
<b>Safety Certification Compliance</b>	
Temperature, operating	0 to +40 °C
Altitude (maximum operating)	2000 meters
Equipment Type	Test and measuring
Safety Class	Class 1 - grounded product
Overvoltage Category	Overvoltage Category II (as defined in IEC 61010-1)
Installation (Overvoltage) Category Definition	Terminals on this product may have different installation (overvoltage) category designations. The installation categories are: CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location. CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected. CAT I Secondary (signal level) or battery operated circuits of electronic equipment.

**Table 3-6: Certifications and compliances (cont.)**

Category	Standards or description
Pollution Degree	Pollution Degree 2 (as defined in IEC 61010-1). Note: Rated for indoor use only.
Pollution Degree Definition	<p>A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.</p> <p>Pollution Degree 1      No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.</p> <p>Pollution Degree 2      Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.</p> <p>Pollution Degree 3      Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.</p>

**WARNING**

***The following servicing instructions are for use only by qualified personnel. To avoid injury, do not perform any servicing other than that stated in the operating instructions unless you are qualified to do so. Refer to all safety summaries before performing any service.***





# Theory of Operation



# Theory of Operation

This section provides information on how the ECO422D circuitry works, in order to troubleshoot the instrument.

## Logic Conventions

Signal names are all capital letters. For example, SIGNAL.

An active low signal (normally denoted by an overscore) is a signal name enclosed in parentheses. For example, (SIGNAL).

The aside of a signal name is always in square brackets. For example, [SIGNAL].

The aside of an active-low signal is the signal name in parentheses and then enclosed in square brackets. For example, [(SIGNAL)].

## ECO422D Block Level Description

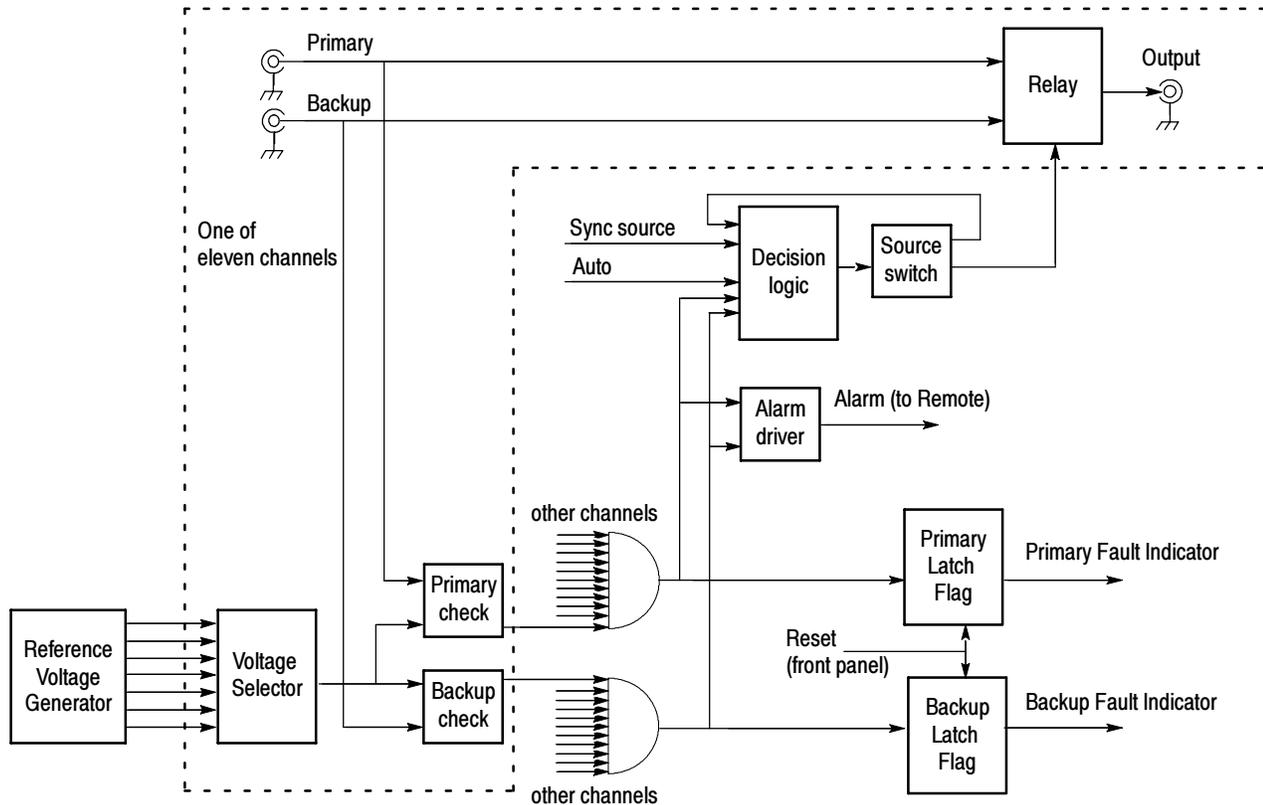


Figure 4-1: ECO422D Block diagram

The Primary and Backup signals for each channel enter through the BNCs and are applied directly to a Relay, where one signal is switched through to the rear-panel Output and the other terminates in 75  $\Omega$ . The rest of the circuitry determines which signal goes to the Output.

The Primary and Backup signals are also applied to the Primary and Backup Check circuitry. This block consists of a peak detector which compares the peak level of the incoming signal with a predefined level from the Reference Voltage Generator, selected by the Voltage Selector. The result of this check is ANDed with the results from the ten other input sets and sent to the Decision Logic circuit that determines the state of the relays. Additional circuitry runs the Alarm Driver for the remote output and the fault indicators on the front panel.

## ECO422D Option ELSW Block Level Description

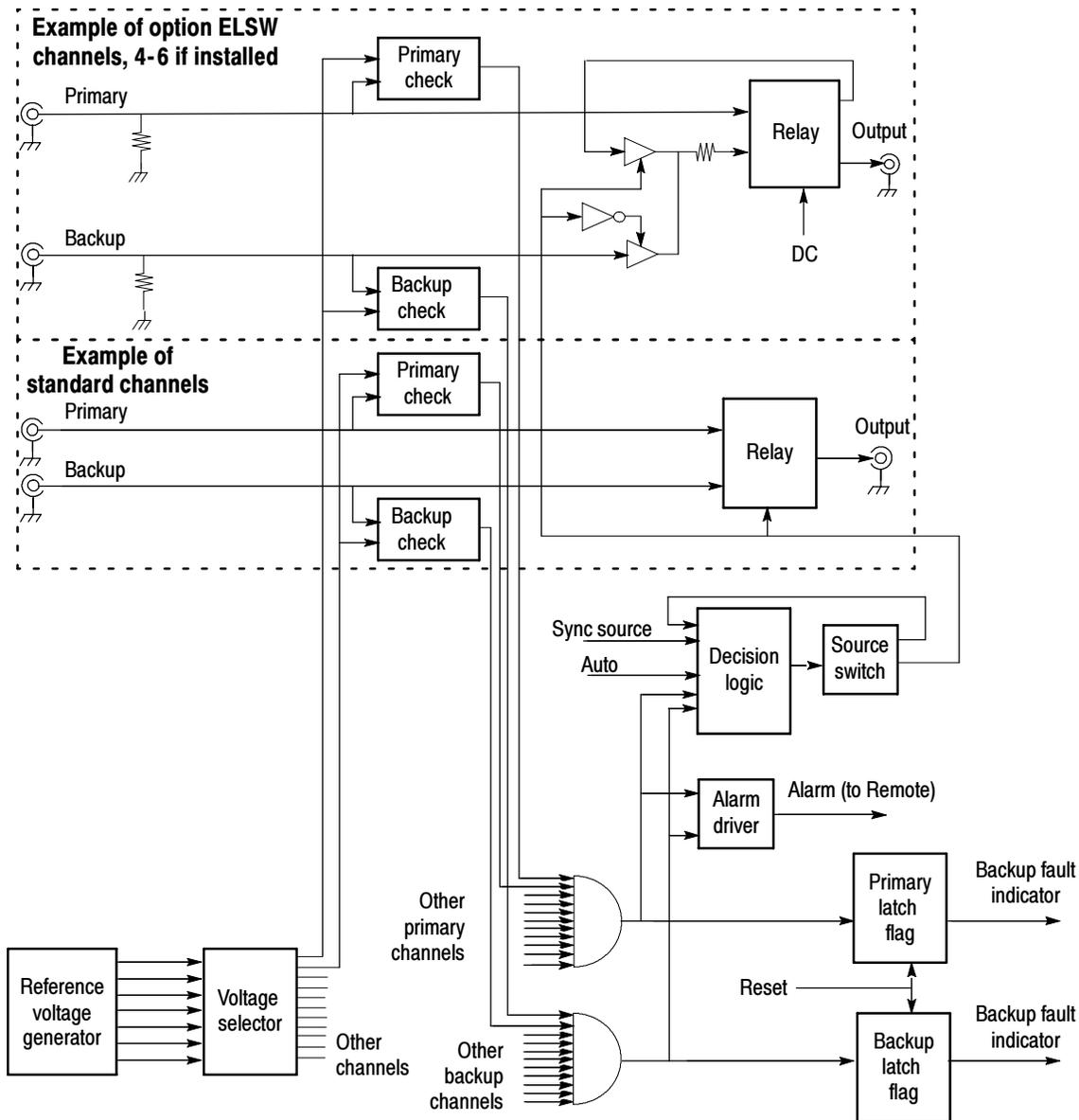


Figure 4-2: ECO422D Option ELSW Block diagram

In the standard instrument, switching between the Primary and Backup signals is accomplished with mechanical relays. With Option ELSW, channels four, five, and six employ electronic switching. This is faster than the mechanical relays and glitch-free, to provide transparent switching of analog sync signals.

This electronic switching design uses two current feedback amplifiers. These two amplifiers are controlled by the same Source Switch signals that control the relays in the other channels. The Source Switch signal is applied directly to the amplifier Output Enable control in the Primary signal path, and is inverted before being applied to the Output Enable control of the amplifier in the Backup signal path. In this way one amplifier or the other is enabled, but not both at the same time.

With Option ELSW the Primary and Backup inputs are terminated in 75  $\Omega$ , and the Outputs provide a 75  $\Omega$  source for the signal path.

In addition, there is a mechanical relay that switches the Primary signal directly to the Output in the event of power failure. This aligns with the way the standard channels operate, and maintains return loss performance for Option ELSW.

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**NOTE.** *There are three fuses in the instrument. One is accessible through the rear panel, one is on the Main board, and the third is on the power supply. Make sure to check both internal and external fuses if the instrument will not power up. The replacement fuse on the power supply should be a 3.15 A, 250 V fuse. The rear panel and Main board fuse requirements are listed in Replaceable Mechanical Parts.*

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# Performance Verification



# Performance Verification

This section consists of checklists and detailed procedures to use in verifying performance parameters and adjusting it to within tolerances.

The order of these procedures has been chosen to minimize changes in equipment setups. Performance parameters may be checked in any order.

## Calibration Data Report

The Calibration Data Report that follows can be used to document instrument performance. In addition, it can be used as a short-form Performance Check for those familiar with the Performance Verification Procedure. Only steps that have numeric Performance Requirements are included in this report form. (Some steps have been omitted.)

### Calibration Data Report

Instrument ECO422D

Cal. Date \_\_\_\_\_

Serial Number \_\_\_\_\_

Certificate Number<sup>6</sup> \_\_\_\_\_

Technician \_\_\_\_\_

Procedure 070-8472-00

Revision Date \_\_\_\_\_

STEP	OPERATION	MINIMUM TOLERANCE	MAXIMUM TOLERANCE	INCOMING	OUTGOING
1	Overall Switching Disabled				
	<b>Channel 1:</b>				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		
11	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
16	Serial Digital 1.485 Gb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
17	Serial Digital 1.485 Gb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
	<b>Channel 2: (swap S2 for S1)</b>				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		

<sup>6</sup>Certificate number is not provided, unless "Certificate of Traceability" is issued.

STEP	OPERATION	MINIMUM TOLERANCE	MAXIMUM TOLERANCE	INCOMING	OUTGOING
11	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
16	Serial Digital 1.485 Gb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
17	Serial Digital 1.485 Gb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
	<b>Channel 3: (swap S3 for S1)</b>				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		
11	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
16	Serial Digital 1.485 Gb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
17	Serial Digital 1.485 Gb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
	<b>Channel 4: (swap S4 for S1)</b>				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7 <sup>7</sup>	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8 <sup>7</sup>	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10 <sup>7</sup>	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		

Performance Verification

STEP	OPERATION	MINIMUM TOLERANCE	MAXIMUM TOLERANCE	INCOMING	OUTGOING
11 <sup>7</sup>	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13 <sup>7</sup>	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14 <sup>7</sup>	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
16 <sup>7</sup>	Serial Digital 1.485 Gb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
17 <sup>7</sup>	Serial Digital 1.485 Gb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
	<b>Channel 5: (swap S5 for S1)</b>				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7 <sup>7</sup>	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8 <sup>7</sup>	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10 <sup>7</sup>	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		
11 <sup>7</sup>	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13 <sup>7</sup>	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14 <sup>7</sup>	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
16 <sup>7</sup>	Serial Digital 1.485 Gb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
17 <sup>7</sup>	Serial Digital 1.485 Gb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
	<b>Channel 6: (swap S6 for S1)</b>				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7 <sup>7</sup>	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8 <sup>7</sup>	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10 <sup>7</sup>	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		

STEP	OPERATION	MINIMUM TOLERANCE	MAXIMUM TOLERANCE	INCOMING	OUTGOING
11 <sup>7</sup>	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13 <sup>7</sup>	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14 <sup>7</sup>	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
16 <sup>7</sup>	Serial Digital 1.485 Gb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
17 <sup>7</sup>	Serial Digital 1.485 Gb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
	<b>Channel 7:</b> (swap S7 for S1)				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		
11	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
	<b>Channel 8:</b> (swap S8 for S1)				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		
11	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		

STEP	OPERATION	MINIMUM TOLERANCE	MAXIMUM TOLERANCE	INCOMING	OUTGOING
	<b>Channel 9:</b> (swap S9 for S1)				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		
11	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
	<b>Channel 10:</b> (swap S10 for S1)				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		
8	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		
11	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		
	<b>Channel 11:</b> (swap S11 for S1)				
2	NTSC Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
4	NTSC Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
3	PAL Black Burst Switch - Primary	switch at 2 dB down	switch at 4 dB down		
5	PAL Black Burst Switch - Backup	switch at 2 dB down	switch at 4 dB down		
7	Serial Digital 270 Mb/s Switch - Primary	switch at 2 dB down	switch at 5 dB down		

STEP	OPERATION	MINIMUM TOLERANCE	MAXIMUM TOLERANCE	INCOMING	OUTGOING
8	Serial Digital 270 Mb/s Switch - Backup	switch at 2 dB down	switch at 5 dB down		
10	NTSC Serial Digital Composite Switch - Primary	switch at 2 dB down	switch at 5 dB down		
11	NTSC Serial Digital Composite Switch - Backup	switch at 2 dB down	switch at 5 dB down		
13	Serial Digital Audio Switch - Primary	switch at 2 dB down	switch at 4 dB down		
14	Serial Digital Audio Switch - Backup	switch at 2 dB down	switch at 4 dB down		

<sup>7</sup> Exclude this step for Opt. ELSW

## Equipment Required

Signal Source - TG700 mainframe with the following modules:

DVG7 Opt. BK: Composite Signal Set. Must be able to output serial digital composite video with optional Black output.

HDVG7 Opt. BK: 1.485 Gb/s Signal Set with optional Black output.

BG7: Analog Black generator with four independently selectable outputs.

AG7: audio signal generator providing eight channels (four AES/EBU pairs) of audio signal generation.

Step Attenuator - The step attenuator must be able to attenuate a signal at least 6 dB and step from 1 to 5 dB in 0.5 dB steps. (Example: 847 Attenuator from KAY Elemetrics Corp.)

Oscilloscope or waveform monitor. Used only to monitor the signals. (Oscilloscope should have a 1 GHz bandwidth, for example, a TDS7000 Series oscilloscope; Example waveform monitor: 1745A Waveform Monitor.)

75  $\Omega$  terminations. (Example: Tektronix part number 011-0163-00 for serial digital video or 011-0102-01 for analog and audio)

75  $\Omega$  Cables. (Example: Tektronix part number 012-0074-00)

## Performance Verification Procedure

### Signal Checking Disabled

#### 1. Check Overall Switching Disabled

Disconnect all signals (if any) from the ECO422D and power down the instrument.

Set all switches on S1 through S11 to “open” to disable switches on all channels.

Power the ECO422D up. (No inputs or outputs are required at this point.)  
Wait for the power-up delay to complete (over 4 minutes).

With the addition of S13<sup>8</sup> the power up delay is adjustable, from no delay to over seven minutes (see page 2-4).

**CHECK** - that there are no error shown on the front panel.

### Black Burst Checks

#### 2. NTSC Black Burst Check for Channel 1 Primary Switch between 2 and 4 dB down from nominal

Connect the equipment as shown in Figure 5-1.

Power down all equipment.

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all DIP switches on S1 through S11 to “open”).

Set the Channel Configuration switch to NTSC Black Burst for Channel 1 (set S1-1 to “closed” and S1-2 through S1-8 “open”).

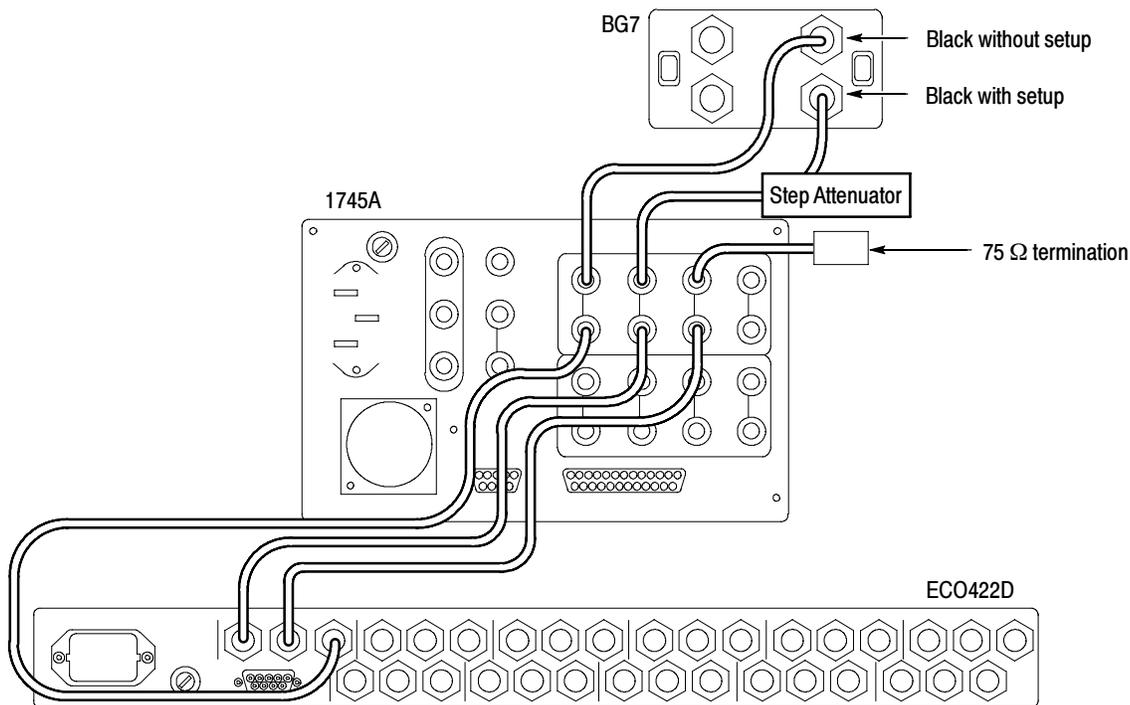
Set the step attenuator to 0 dB of attenuation.

Power up all equipment.

Set the TG700 BG7 to output an NTSC black burst signal.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

<sup>8</sup> Serial number B030000 and later.



**Figure 5-1: Setup to check Black Burst levels**

Set the ECO422D to “Primary” Sync Source and Auto Switch “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Primary input signal until the signal source switches to the Backup.

Press the Reset button on the front panel and try to return the signal source to Primary.

**CHECK** - that the Primary signal still shows an error and automatically switches back to Backup. If the ECO422D doesn’t continue to show the Primary signal in error after the reset, continue adding attenuation until the Primary signal switches to Backup again.

**CHECK** - that the ECO switches between 2 and 4 dB down.

**3. PAL Black Burst Check for Channel 1 Primary  
Switch between 2 and 4 dB down from nominal**

Connect the equipment as shown in Figure 5-1.

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S2 through S11 to “open”).

Set the Channel Configuration switch to PAL Black Burst for Channel 1 (set S1-1 to “open,” S1-2 “closed,” and S1-3 through S1-8 “open”).

Set the step attenuator to 0 dB of attenuation.

Set the TG700 BG7 to output a PAL black burst signal.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D to “Primary” Sync Source and Auto Switch “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Primary input signal until the signal source switches to the Backup.

Press the Reset button on the front panel and try to return the signal source to Primary.

**CHECK** - that the Primary signal still shows an error and automatically switches back to Backup. If the ECO422D does not continue to show the Primary signal in error after the reset, continue adding attenuation until the Primary signal switches to Backup again.

**CHECK** - that the ECO switches between 2 and 4 dB down.

**4. NTSC Black Burst Check for Channel 1 Backup  
Switch between 2 and 4 dB down from nominal**

Connect the equipment as shown in Figure 5-1, except swap the Primary and Backup input signals at the ECO422D so that the step attenuator is on the Backup channel.

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S1 through S11 to “open”).

Set the Channel Configuration switch to NTSC Black Burst for Channel 1 (set S1-1 to “closed” and SW1-2 through S1-8 “open”).

Set the step attenuator to 0 dB of attenuation.

Set the TG700 BG7 to output an NTSC black burst signal.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D to “Backup” Sync Source and Auto Switch to “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Backup input signal until the signal source switches to the Primary.

Press the Reset button on the front panel and try to return the signal source to Backup.

**CHECK** - that the Backup signal still shows an error and automatically switches back to Primary. If the ECO422D does not continue to show the Backup signal in error after the reset, continue adding attenuation until the Backup signal switches to Primary again.

**CHECK** - that the ECO switches between 2 and 4 dB down.

#### **5. PAL Black Burst Check for Channel 1 Backup Switch between 2 and 4 dB down from nominal**

Connect the equipment as shown in Figure 5-1, except swap the Backup and Primary input signals at the ECO422D, so that the step attenuator is on the Backup input signal.

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S2 through S11 to “open”).

Set the Channel Configuration switch to PAL Black Burst for Channel 1 (set S1-1 to “open,” S1-2 “closed,” and S1-30 through S1-8 “open”).

Set the step attenuator to 0 dB of attenuation.

Set the TG700 BG7 to output a PAL black burst signal.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D to “Backup” Sync Source and Auto Switch to “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Backup input signal until the signal source switches to the Primary.

Press the Reset button on the front panel and try to return the signal source to Backup.

**CHECK** - that the Backup signal still shows an error and automatically switches back to Primary. If the ECO422D does not continue to show the Backup signal in error after the reset, continue adding attenuation until the Backup signal switches to Primary again.

**CHECK** - that the ECO422D switches between 2 and 4 dB down.

**6. Check the NTSC & PAL Black Burst for Channels 2 - 11  
Switch between 2 and 4 dB down from nominal**

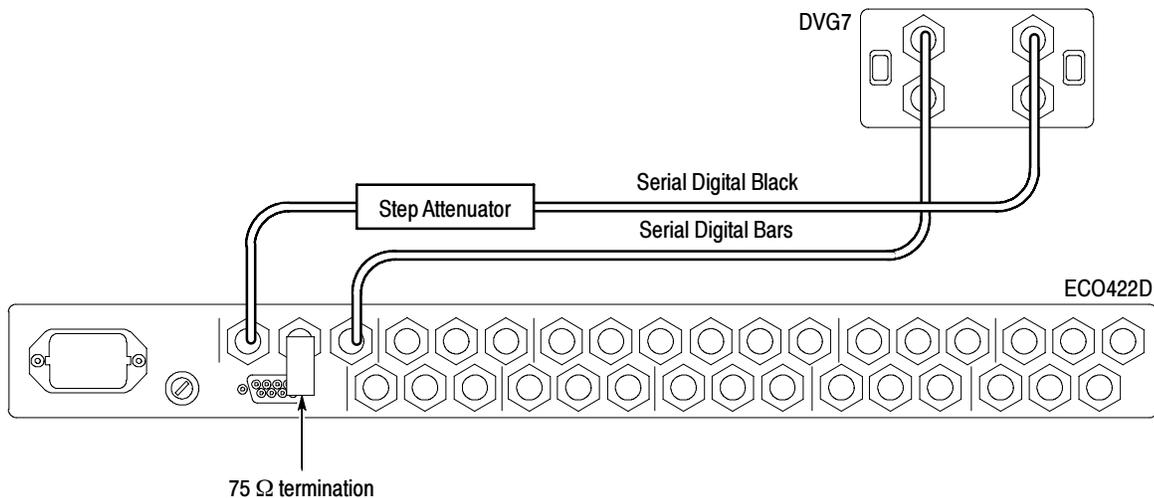
Repeat the four previous procedures for Channels 2 - 11 of the ECO422D. Move the cables from Channel 1 to the channel under test. Replace the switch setting for S1 as given in the following Table.

<b>Channel No.</b>	<b>Switch No.</b>
2	S2
3	S3
4	S4
5	S5
6	S6
7	S7
8	S8
9	S9
10	S10
11	S11

## Serial Digital Video Checks

### 7. Serial Digital Component Check for Channel 1 Primary Switch between 2 and 5 dB down from nominal

Connect the equipment as shown in Figure 5-2.



**Figure 5-2: Setup to check the component serial digital video levels**

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S1 through S11 to “open”).

Set the Channel Configuration switch to Serial Digital Video Component for Channel 1 (set S1-4 to “closed,” S1-1 through S1-3 “open,” and S1-5 through S1-8 “open”).

Set the step attenuator to 0 dB of attenuation.

Set the TG700 DVG7 to output any serial digital bars signal using the 525/59.94 standard.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D (using the front panel) to “Primary” Sync Source and Auto Switch “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Primary input signal until the signal source switches to Backup.

Press the Reset button on the front panel and try to return the signal source to Primary.

**CHECK** - that the Primary signal still shows an error and automatically switches back to Backup. If the ECO422D does not continue to show the Primary signal in error after the reset, continue adding attenuation until the Primary signal switches to Backup again.

**CHECK** - that the ECO switches between 2 and 5 dB down.

Repeat using the 625/50 standard bars signal as the input.

#### **8. Serial Digital Component Check for Channel 1 Backup Switch between 2 and 5 dB down from nominal**

Connect the equipment as shown in Figure 5-2, except swap the Primary and Backup input signals so that the step attenuator is on the Backup input.

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S1 through S11 to “open”).

Set the Channel Configuration switch to Serial Digital Video Component for Channel 1 (set S1-4 to “closed,” S1-1 through S1-3 “open,” and S1-5 through S1-8 “open”).

Set the TG700 DVG7 to output any serial digital bars signal using the 525/59.94 standard.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D (using the front panel) to “Backup” Sync Source and Auto Switch “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Backup input signal until the signal source switches to Primary.

Press the Reset button on the front panel and try to return the signal source to Backup.

**CHECK** - that the Backup signal still shows an error and automatically switches back to Primary. If the ECO422D does not continue to show the Backup signal in error after the reset, continue adding attenuation until the Backup signal switches to Primary again.

**CHECK** - that the ECO switches between 2 and 5 dB down.

Repeat using a 625/50 bars signal as the input.

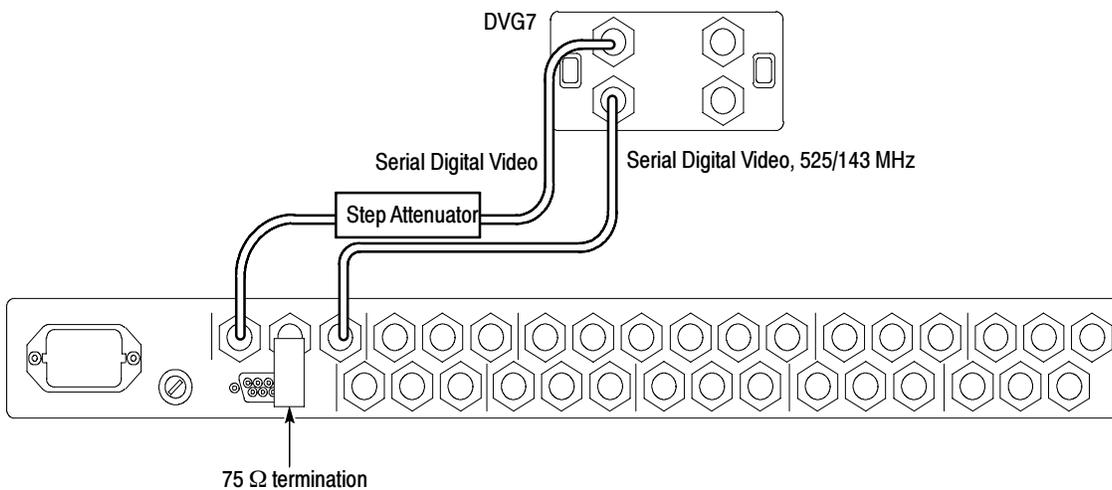
### 9. Check Serial Digital Video (Component) for Channels 2 through 11 Switch between 2 and 5 dB down from nominal

Repeat the previous two procedures for Channels 2 through 11 of the ECO422D, for standard instruments (exclude Channels 4 through 6 if Opt. ELSW is installed). Move the cables from Channel 1 to the channel under test. Replace the switch setting for S1 as given in the following table.

Channel No.	Switch No.
2	S2
3	S3
4	S4
5	S5
6	S6
7	S7
8	S8
9	S9
10	S10
11	S11

### 10. NTSC Serial Digital Composite Check for Channel 1 Primary Switch between 2 and 5 dB down from nominal

Connect the equipment as shown in Figure 5-3.



**Figure 5-3: Setup to check the serial digital video composite levels**

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S1 through S11 to “closed”).

Set the Channel Configuration switch to NTSC Serial Digital Video Composite for Channel 1 (set S1-3 to “closed,” S1-1 and S1-2 “open,” and S1-4 through S1-8 “open”).

Set the step attenuator to 0 dB of attenuation.

Set the TG700 DVG7 to output any serial digital composite signal of 525/143 MHz format (do not use the SDI Check Field signal).

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D to “Primary” Sync Source and Auto Switch to “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Primary input signal until the signal source switches to Backup.

Press the Reset button on the front panel and try to return the signal source to Primary.

**CHECK** - that the Primary signal still shows an error and automatically switches back to Backup. If the ECO422D does not continue to show the Primary signal in error after the reset, continue adding attenuation until the Primary signal switches to Backup again.

**CHECK** - that the ECO switches between 2 and 5 dB down.

#### **11. NTSC Serial Digital Composite Check for Channel 1 Backup Switch between 2 and 5 dB down from nominal**

Connect the equipment as shown in Figure 5-3, except swap the Primary and Backup signals, so that the step attenuator is on the Backup input.

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S1 through S11 to “closed”).

Set the Channel Configuration switch to Serial Digital Video Composite for Channel 1 (set S1-3 to “closed,” S1-1 and S1-2 “open,” and S1-4 through S1-8 “open”).

Set the step attenuator to 0 dB of attenuation.

Set the TG700 DVG7 to output any serial digital composite signal. (Do not use the SDI Check Field signal.)

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D to “Backup” Sync Source and Auto Switch “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Backup input signal until the signal source switches to Primary.

Press the Reset button on the front panel and try to return the signal source to Backup.

**CHECK** - that the Backup signal still shows an error and automatically switches back to Primary. If the ECO422D does not continue to show the Backup signal in error after the reset, continue adding attenuation until the Backup signal switches to Primary again.

**CHECK** - that the ECO switches between 2 and 5 dB down.

## 12. Check Serial Digital Video (Composite) for Channels 2 through 11 Switch between 2 and 5 dB down from nominal

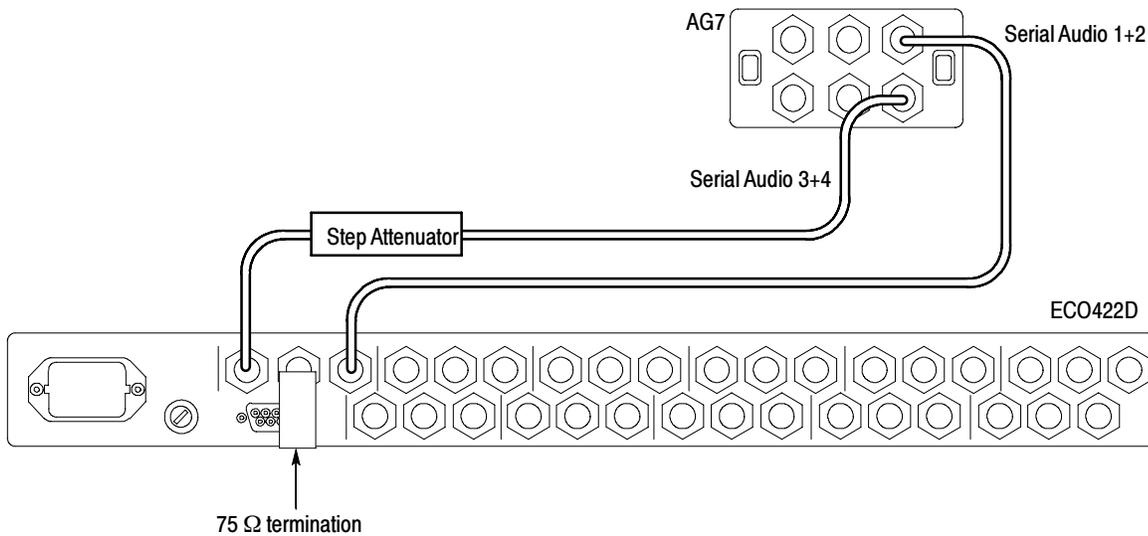
Repeat the previous two procedures for Channels 2 through 11 of the ECO422D, for standard instruments (exclude Channels 4 through 6 if Opt. ELSW is installed). Move the cables from Channel 1 to the channel under test. Replace the switch setting for S1 as given in the following table.

Channel No.	Switch No.
2	S2
3	S3
4	S4
5	S5
6	S6
7	S7
8	S8
9	S9
10	S10
11	S11

## Serial Digital Audio Checks

### 13. Serial Digital Audio Check for Channel 1 Primary Switch between 2 and 4 dB down from nominal

Connect the equipment as shown in Figure 5-4.



**Figure 5-4: Setup to check the serial audio levels**

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S1 through S11 to “open”).

Set the Channel Configuration switch to Serial Digital Audio for Channel 1 (set S1-5 to “closed,” S1-1 through S1-4 “open,” and S1-6 through S1-8 “open”).

Set the step attenuator to 0 dB of attenuation.

Set the TG700 AG7 to output either a 1000 or 800 Hz serial digital audio tone on channels 1+2 and 3+4.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D to “Primary” Sync Source and Auto Switch to “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Primary input signal until the signal source switches to Backup.

Press the Reset button on the front panel and try to return the signal source to Primary.

**CHECK** - that the Primary signal still shows an error and automatically switches back to Backup. If the ECO422D does not continue to show the Primary signal in error after the reset, continue adding attenuation until the Primary signal switches to Backup again.

**CHECK** - that the ECO switches between 2 and 4 dB down.

#### **14. Serial Digital Audio Check for Channel 1 Backup Switch between 2 and 4 dB down from nominal**

Connect the equipment as shown in Figure 5-4 except swap the Primary and Backup cables so that the attenuator is on the Backup side.

Set the Channel Configuration switches to Disabled (Signal not checked) for all channels. (set all the DIP switches on S1 through S11 to “open”).

Set the Channel Configuration switch to Serial Digital Audio for Channel 1 (set S1-5 to “closed,” S1-1 through S1-4 “open,” and S1-6 through S1-8 “open”).

Set the step attenuator to 0 dB of attenuation.

Set the TG700 AG7 to output either a 1000 or 800 Hz serial digital audio tone on channels 1+2 and 3+4.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D to “Backup” Sync Source and Auto Switch to “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Backup input signal until the signal source switches to Primary.

Press the Reset button on the front panel and try to return the signal source to Backup.

**CHECK** - that the Backup signal still shows an error and automatically switches back to Primary. If the ECO422D does not continue to show the Backup signal in error after the reset, continue adding attenuation until the Backup signal switches to Primary again.

**CHECK** - that the ECO switches between 2 and 4 dB down.

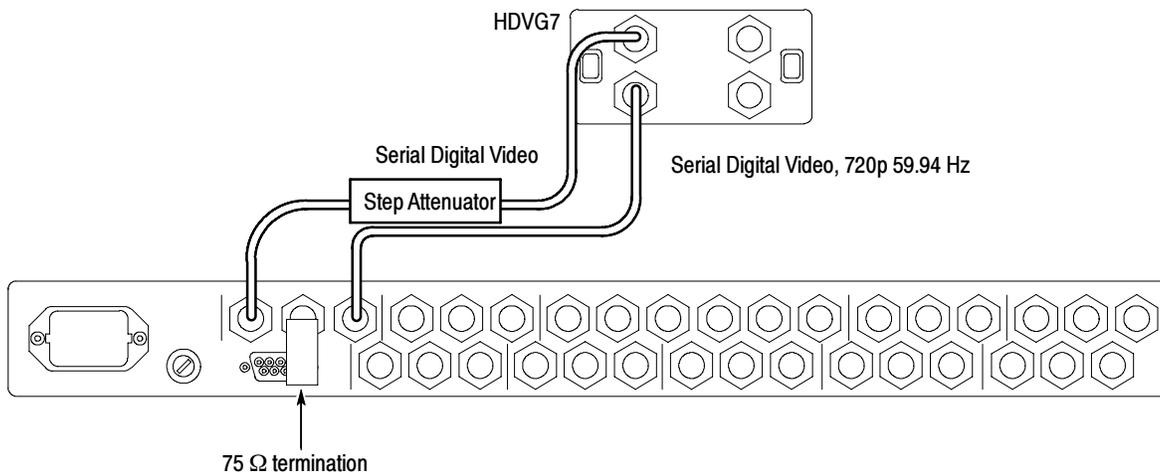
**15. Check Serial Digital Audio for Channels 2 through 11  
Switch between 2 and 4 dB down from nominal**

Repeat the previous two procedures for Channels 2 through 11 of the ECO422D, for standard instruments (exclude Channels 4 through 6 if Opt. ELSW is installed). Move the cables from Channel 1 to the channel under test. Replace the switch setting for S1 as given in the following table.

Channel No.	Switch No.
2	S2
3	S3
4	S4
5	S5
6	S6
7	S7
8	S8
9	S9
10	S10
11	S11

**16. HD Serial Digital Component Check for Channel 1 Primary  
Switch between 2 and 5 dB down from nominal**

Connect the equipment as shown in Figure 5-5.



**Figure 5-5: Setup to check the component serial digital video levels**

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S1 through S11 to “open”).

Set the Channel Configuration switch to Serial Digital Video 1.485 Gb/s for Channel 1. (Set S1-8 to “closed,” S1-1 through S1-7 to “open.”)

Set the step attenuator to 0 dB of attenuation.

Set the TG700 HDVG7 to output any serial digital bars signal using the 720p/59.94 Hz standard.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D (using the front panel) to “Primary” Sync Source and Auto Switch “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Primary input signal until the signal source switches to Backup.

Press the Reset button on the front panel and try to return the signal source to Primary.

**CHECK** - that the Primary signal still shows an error and automatically switches back to Backup. If the ECO422D does not continue to show the Primary signal in error after the reset, continue adding attenuation until the Primary signal switches to Backup again.

**CHECK** - that the ECO switches between 2 and 5 dB down.

#### **17. HD Serial Digital Component Check for Channel 1 Backup Switch between 2 and 5 dB down from nominal**

Connect the equipment as shown in Figure 5-5, except swap the Primary and Backup input signals so that the step attenuator is on the Backup input.

Set the Channel Configuration switches to Disabled (signal not checked) for all channels (set all the DIP switches on S1 through S11 to “open”).

Set the Channel Configuration switch to Serial Digital Video Component for Channel 1 (set S1-8 to “closed,” and S1-1 through S1-7 to “open.”)

Set the step attenuator to 0 dB of attenuation.

Press Reset.

**CHECK** - that there are no errors shown for either the Primary or Backup ECO422D sync sources.

Set the ECO422D (using the front panel) to “Backup” Sync Source and Auto Switch “Switch on Fault.”

Add attenuation, 0.5 dB at a time, to the Backup input signal until the signal source switches to Primary.

Press the Reset button on the front panel and try to return the signal source to Backup.

**CHECK** - that the Backup signal still shows an error and automatically switches back to Primary. If the ECO422D does not continue to show the Backup signal in error after the reset, continue adding attenuation until the Backup signal switches to Primary again.

**CHECK** - that the ECO switches between 2 and 5 dB down.

**18. HD Serial Digital Component Check for Channels 2 through 11  
Switch between 2 and 5 dB down from nominal**

Repeat the previous two procedures for Channels 2 through 11 of the ECO422D, for standard instruments (exclude Channels 4 through 6 if Opt. ELSW is installed). Move the cables from Channel 1 to the channel under test. Replace the switch setting for S1 as given in the following table.

<b>Channel No.</b>	<b>Switch No.</b>
2	S2
3	S3
4	S4
5	S5
6	S6
7	S7
8	S8
9	S9
10	S10
11	S11



# **Adjustment Procedure**



# Adjustment Procedure

The only adjustments required for the ECO422D are the user-defined threshold levels.

## **How to Adjust the User-Defined Threshold Levels**

The user-defined threshold levels are the two levels available from User Configuration switches SX-6 (R266) and SX-7 (R265). They are available so that the user can check the levels of signals other than the five predefined levels.

The procedure to adjust these levels is an operator adjustment, not a service adjustment. Therefore it is given in the user portion of this manual; see page 2-9.





# Maintenance



# Maintenance

This section discusses the various options available for servicing the Tektronix ECO422D. It also contains instructions for preventive maintenance, general troubleshooting, and corrective maintenance. If the instrument does not function properly, troubleshooting and corrective measures should be taken immediately to circumvent additional problems.

## Service Options

A number of servicing options are available. They range from returning the instrument to Tektronix for repair and/or recalibration, to a major assembly exchange, to full component level servicing by the customer (at the installation site). Each of these options should be investigated as to which will be the most time efficient and cost effective.

### **Tektronix Service**

Tektronix maintains service centers around the world to provide quick turn-around repair and recalibration services. When this service is used, even during the warranty period, the instrument should be tagged and repackaged according to the instructions at the end of this section.

## Preparation

- Read the Safety Summary and the Service Strategy
- Read Operating Basics

## Inspection and Cleaning

Preventive maintenance consists of cleaning, lubricating, visual inspection, checking performance, and readjusting the ECO422D on a regular schedule. The inspection and cleaning schedule should be established based on the amount of use and the surrounding environment of the ECO422D. Under average conditions, a preventive maintenance check should be performed on a one year interval (severe environmental conditions may dictate a shorter time interval).

### Cleaning

Clean the instrument often enough to prevent dust or dirt from accumulating. Dust accumulating in the instrument acts as an insulating blanket, preventing proper cooling, and possibly causing overheating and component breakdown. Under high humidity conditions, accumulated dust can also provide an electrical conduction path.

Clean the instrument often enough to prevent dust or dirt from accumulating. Dust accumulating in the instrument acts as an insulating blanket, preventing proper cooling, and possibly causing overheating and component breakdown. Under high humidity conditions, accumulated dust can also provide an electrical conduction path.



**CAUTION.** *To avoid damage to the instrument, do not expose it to sprays, liquids, or solvents. Do not use chemical cleaning agents; they can damage the instrument. Avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.*

---

Clean the exterior surfaces of the instrument with a dry, lint-free cloth or a soft-bristle brush. If dirt remains, use a cloth or swab dampened with a 75% isopropyl alcohol solution. A swab is useful for cleaning in narrow spaces around the controls and connectors. Do not use abrasive compounds on any part of the instrument.



**CAUTION.** *Avoid getting moisture inside the instrument during exterior cleaning and use only enough solution to dampen the cloth or swab. Use a 75% isopropyl alcohol solution as a cleanser, and rinse with deionized water.*

---

### Visual Inspection

Visually inspect the instrument during the preventive maintenance routine for signs of damage, scorched components, and loose or disconnected pin connectors. If you discover heat damaged parts, try to determine the cause of the overheating before replacing the damaged parts; otherwise, the damage may repeat.

Periodic checks of the transistors and integrated circuits are not recommended. The best measure of performance is the actual operation of the component in the circuit.

## Static-Sensitive Components



**CAUTION.** *Static discharge can damage or degrade many semiconductor components.*

This instrument contains electrical components that are susceptible to damage or degradation from static discharge. See Table 7-1 for relative susceptibility of various classes of semiconductors. Higher static discharge voltages than the levels listed in Table 7-1 can degrade the performance and reliability of the semiconductor components. Static voltages of 1 kV to 30 kV are common in unprotected environments.

**Table 7-1: Static-sensitive components**

Semiconductor classes	Relative susceptibility levels
MOS or CMOS microcircuits or discrete or linear microcircuits with MOS inputs (most sensitive)	100 to 500 V
EL, 74F, 74ALS, and 155- P/N parts	200 to 500 V
Schottky Signal Diodes	250 V
Schottky TTL	500 V
High-frequency Bipolar Transistors and ICs	400 to 600 V
JFETs	600 to 800 V
Low-frequency Linear Microcircuits	400 to 1000 V
Low-power Schottky TTL	900 V
TTL (least sensitive)	1200 V

**NOTE.** *Static discharges of less than 2 kV are seldom felt.*

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers or on nonconductive surfaces.
3. Discharge the static voltage from your body by wearing a grounded wrist strap while handling these components. Service static-sensitive components or assemblies only at a static free workstation by qualified personnel. If soldering is involved, use a soldering iron connected to earth ground and special antistatic desoldering tools.

4. Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge. Carpeted floors should be sprayed to reduce static problems. Also nothing capable of generating or holding a static charge should be allowed on the workstation surface.
5. Keep the component leads shorted together whenever possible.
6. Pick up the components by the body, never the leads.
7. Do not slide the components over any surface.
8. Use a soldering iron that is connected to earth ground.
9. Use only special antistatic, suction, or wick-type desoldering tools.

### **Performance Verification and Readjustments**

Instrument performance should be checked after each 2000 hours of operation, or every 12 months. This will help to ensure maximum performance and assist in locating defects that may not be apparent during regular operation. The Performance Verification and Adjustment Procedures are included in this manual.

## **Corrective Maintenance**

The following procedure is designed to assist in isolating problems, which in turn expedites repairs and minimizes down time. There are no specific troubleshooting procedures for this instrument because it is a very simple instrument.

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**NOTE.** *There are three fuses in this instrument. One is accessible through the rear panel, one is on the power supply, and the third is on the Main board. Make sure to check the internal fuse if the instrument will not power up. The replacement fuse on the power supply should be a 3.15 A, 250 V fuse. The Main board and rear panel fuse requirements are listed in Replaceable Mechanical Parts.*

---

### **General Troubleshooting Procedures**

Ensure that the malfunction is in the instrument. This is done by making sure that the instrument is operating as intended by Tektronix (see Operating Basics), and by checking that a malfunction has not occurred upstream or downstream from the ECO422D.

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**NOTE.** A source transition can occur if the channel output amplitude is reduced. This can be caused by over-termination, cable damage, or an accidental short to ground. A channel's selected input and its output are directly connected through an internal relay, therefore the ECO422D detects an output reduction as an input reduction. This does not apply to the three Option ELSW channels, which are buffered.

To avoid this problem, work on an output only when the ECO422D is not in operation. Disconnect the output cable from the ECO422D before working on the cable, and verify proper termination before reconnecting the cable to the ECO422D.

---

Determine and evaluate all trouble symptoms. This is accomplished by isolating the problem to a general area, such as an assembly. The block diagram and the Theory of Operation, are valuable aids in signal tracing and circuit isolation.



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**CAUTION.** Use extreme care when probing with meter leads or probes. The components are very dense and there is only limited access within the instrument. The inadvertent movement of leads or a probe could cause a short circuit or transient voltages capable of destroying components.

---

Determine the nature of the problem. Attempt to make the determination of whether the instrument is out of calibration or if there has been a component failure. Once the type of failure has been determined, proceed on to identify the functional area most likely at fault.

Visually inspect the suspect assembly for obvious defects. Most commonly these will be broken or loose components, improperly seated components, overheated or burned components, chafed insulation, etc. Repair or replace all obvious defects. In the case of overheated components, determine the cause of overheating and correct the cause before reapplying power.

Use successive electrical checks to locate the source of the problem. The primary tool for the problem isolation is the oscilloscope. Use the Performance Verification procedure to determine if a circuit is operating within specifications. At times, it may be necessary to change a calibration adjustment to determine if a circuit is operational, but since this can destroy instrument calibration, care should be exercised. Before changing an adjustment, note its position so that it can be returned to its original setting.

Determine the extent of the repair. If the necessary repair is complex, it may be advisable to contact your local Tektronix field office or representative before continuing. If the repair is minor, such as replacing a component, see the parts list for replacement information. Removal and replacement procedures for the assemblies can be found in this section.



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**CAUTION.** *Always remove the assembly from the instrument prior to attempting to replace a solder-in component. See this section for the correct procedure.*

---

## Tektronix Service Offerings

Tektronix maintains a worldwide service organization that provides a number of services to assist in optimizing your instrument's performance at its specified levels. The services include a range of calibration, repair, upgrade, and installation services that are performed on-site or at a Tektronix service depot. In addition replacement parts are available for self-service customers.

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**NOTE.** *When considering which service offerings best suit the current need, remember that Tektronix provides a limited parts and service warranty for all its products. No customer repairs should be attempted during the warranty period.*

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As the original manufacturer, our unique expertise and calibration lab equipment enables us to efficiently return your Tektronix instrument to its factory settings. We make it easy for you to keep instruments operating at peak performance and compliant with regulatory and quality standards, with services and accreditations that include:

- Functional Verification
- Traceable Calibration
- Accredited Calibration

In addition, you have purchased an instrument engineered and manufactured to the highest level of reliability and performance. All customers prefer to protect their investments, so Tektronix has created a range of coverage offerings to keep your instrument performing optimally and reduce downtime to an absolute minimum.

- Coverage purchased with instrument - best value option
- Coverage purchased during the warranty period - high value
- Coverage after the warranty expires - economic value compared to on-demand repair

**Service Centers**

Tektronix maintains service centers worldwide. These centers provide calibration and repair services for Tektronix instruments. They can be contacted through your Tektronix field office or representative. You can also find service and support information at:

<http://www.tektronix.com/serviceandsupport>

Not all service centers are equipped to repair or calibrate all instruments; please be prepared to provide the instrument model and serial number when calling for assistance.

**Factory Replacement Parts**

Replacement parts are available through the local Tektronix field office or representative. However, many common electric parts are available through local sources. Using a local source, where possible, will eliminate shipping delays.

Changes to Tektronix instruments are sometimes made to accommodate improved components, as they become available, and to improve circuit performance. Therefore, it is important to include the following information when ordering parts:

1. Part Number
2. Instrument Type or Number
3. Serial Number
4. Modification or Option Number (if applicable)

**Etched Circuit Boards**

The instrument consists of etched circuit boards. All of the circuit boards are designed as assemblies. Each assembly has an alphanumeric designation (A1 through A4). These assemblies are listed in the Replaceable Mechanical Parts list of this manual.

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**NOTE.** A 2% RMA flux content solder is recommended for making repairs in this instrument. Cleaning of rosin residue is not recommended. Most cleaning solvents tend to reactivate the rosin and spread it under components where it may cause corrosion under humid conditions. The rosin residue, if left alone, does not exhibit these corrosive properties.

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## Removal/Replacement Instructions

### Removal/Replacement Instructions

In general, the boards are held down with Torx screws. Please make sure to use a Torx tip to remove or replace the screws. Also, check that you have removed all screws (or nuts on the BNC connector) before trying to remove a board.

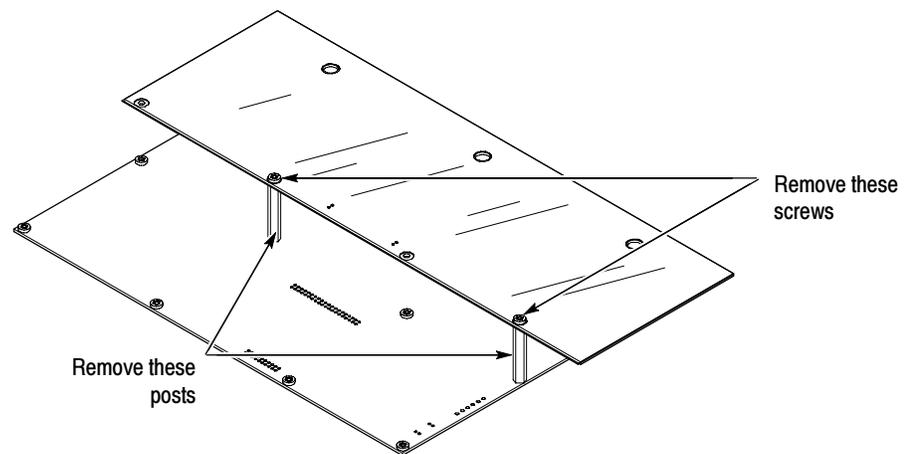
### Special Instructions for the Connector Board

To remove the Connector board, first remove all the nuts from the top row of BNCs. Then remove the two screws from the posts (see Figure 7-1). Next, unscrew the posts from the Main board and remove them (see Figure 7-1). Finally, keeping the board level, slide the board towards the front of the instrument until the BNCs clear both the rear panel and the clips (see Figure 7-2).

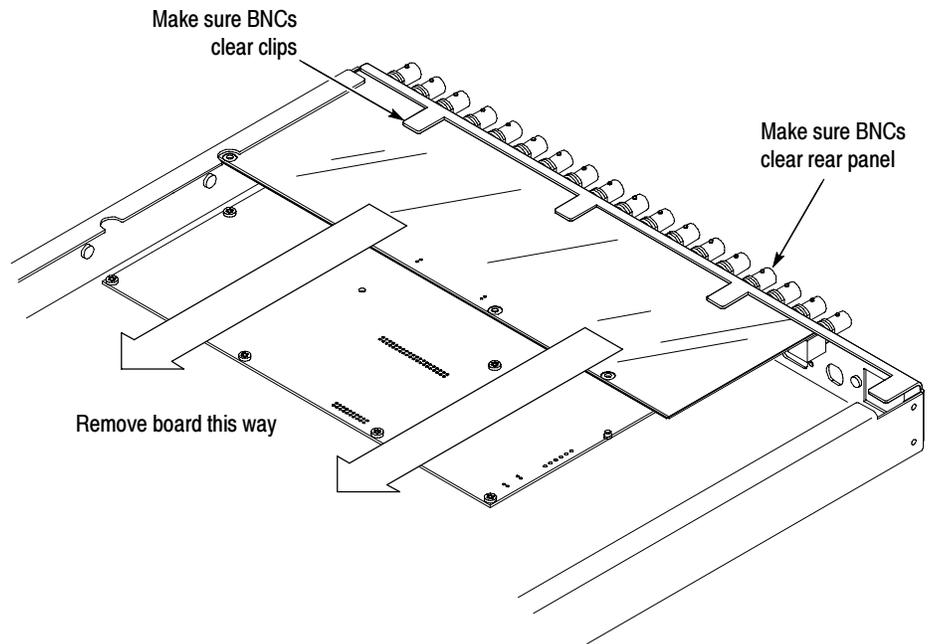
---

**NOTE.** During installation, remember to include the spacer strip on the BNC connectors.

---



**Figure 7-1: Remove these screws and posts before attempting to remove the Connector board**



**Figure 7-2: Slide the Connector board out this way**



**CAUTION.** Use extreme care when sliding any of the boards to clear the rear panel because there are components on both sides of the boards.

## Repackaging Instructions

### Identification Tag

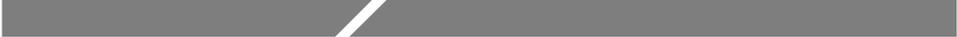
If the instrument is to be shipped to Tektronix Service Center for service or repair, attach a tag to the instrument showing:

1. Owner (with complete address) and the name of the person at your firm that can be contacted.
2. Instrument serial number and a description of the service required.

### Repackaging for Shipment

Repackage the instrument in the original manner to provide adequate protection. If the original packaging is not available or is unfit for use, repackage the instrument as follows:

1. Obtain a corrugated cardboard carton whose inside dimensions are at least six inches greater than the dimensions of the instrument to allow room for cushioning. The shipping carton should have a test strength of at least 275 pounds.
2. Surround the instrument with polyethylene sheeting to protect the finish.
3. Cushion the instrument on all sides by tightly packing dunnage or urethane between the carton and the instrument. Allow three inches on all sides for cushioning.
4. Seal the carton with shipping tape or an industrial stapler.



# **Replaceable Electrical Parts**





## **Replaceable Electrical Parts**

Refer to the Mechanical Parts List chapter for a complete listing and description of replaceable parts for the ECO422D.





# **Replaceable Mechanical Parts**



# Replaceable Mechanical Parts

This section contains a list of the components that are replaceable for the ECO422D. Use this list to identify and order replacement parts.

## Parts Ordering Information

Replacement parts are available from or through your local Tektronix, Inc., Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit improvements. Therefore, when ordering parts, it is important to include the following information in your order.

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc., Field Office or representative will contact you concerning any change in part number.

## Using the Replaceable Mechanical Parts List

The tabular information in the Replaceable Mechanical Parts list is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replaceable parts.

**Abbreviations**      Abbreviations conform to American National Standards Institute (ANSI) standard Y1.1.

**Chassis Parts**      Chassis-mounted parts and cable assemblies are located at the end of the Replaceable Electrical Parts list.

## Column Descriptions

<b>Figure &amp; Index No. (Column 1)</b>	Items in this section are referenced by figure and index numbers to the illustrations.
<b>Tektronix Part No. (Column 2)</b>	Indicates part number to be used when ordering replacement part from Tektronix.
<b>Serial No. (Column 3 and 4)</b>	Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.
<b>Qty (Column 5)</b>	This indicates the quantity of mechanical parts used.
<b>Name and Description (Column 6)</b>	<p>An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.</p> <p>Following is an example of the indentation system used to indicate relationship.</p> <pre> <b>1 2 3 4 5      Name &amp; Description</b> Assembly and/or Component Mounting parts for Assembly and/or Component *MOUNTING PARTS*/*END MOUNTING PARTS*     Detail Part of Assembly and/or Component     Mounting parts for Detail Part     *MOUNTING PARTS*/*END MOUNTING PARTS*         Parts of Detail Part         Mounting parts for Parts of Detail Part         *MOUNTING PARTS*/*END MOUNTING PARTS*                 </pre> <p>Mounting Parts always appear in the same indentation as the Item it mounts, while the detail parts are indented to the right. Indented items are part of and included with, the next higher indentation. <b>Mounting parts must be purchased separately, unless otherwise specified.</b></p>

## Replaceable Mechanical Parts

Fig. & index no.	Tektronix part no.	Serial number		Qty	12345	Name & Description
		effective	discontinued			
1-1	200-4678-00			1		COVER, TOP: ALUMINUM, ECO422D *MOUNTING PARTS*
-2	211-0538-00			16		SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL *END MOUNTING PARTS*
-3	200-4679-00			1		COVER, TOP: SMALL DOOR; ALUMINUM, *MOUNTING PARTS*
-4	211-0538-00			4		SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL *END MOUNTING PARTS*
-5	367-0437-03			1		HANDLE: ALUMINUM *MOUNTING PARTS*
-6	211-0538-00			2		SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL *END MOUNTING PARTS*
-7	367-0437-01			1		HANDLE: ALUMINUM *MOUNTING PARTS*
-8	211-0538-00			2		SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL *END MOUNTING PARTS*
-9	213-0216-00			1		THUMBSCREW: 10-32 X 0.85, 0.375 OD HD, SST
-10	354-0025-00			1		RING, RETAINING: EXTERNAL, U/O 0.187 DIA SFT
-11	426-2512-00			1		FRONT FRAME: ALUMINIUM *MOUNTING PARTS*
-12	211-0538-00			4		SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL *END MOUNTING PARTS*
-13	333-4400-00			1		FRONT, PANEL: FRONT PANEL, ECO422D *MOUNTING PARTS*
-14	211-0324-00			10		SCR, ASSEM WSHR: 4-40 X 0.188, PNH, SST, PASS, T-9 TORX DR, MACHINE *END MOUNTING PARTS*
-15	671-3241-01			1		A1 - FRONT PANEL CKT BD ASSY
-16	119-4112-00			1		A4 - POWER SUPPLY: SWITCHING, AUTO IN 85-264VAC, 47-440HZ, OUT 5VDC 5A, +15V2A, -15V 0.5A *MOUNTING PARTS*
-17	211-0408-00			3		SCR, ASSEM WSHR; 4-40 X 0.250, PNH, STL, ZINC, T-10 TORX DR, SEMS *END MOUNTING PARTS*
	220-0187-00			1		NUT, HEX; CAP NUT, 4-40, NYLON SAFETY CONTROLLED
	211-0101-00			1		SCREW, MACHINE; 4-40 X 0.25, FLH, 100 DEG, STL CD PL, POZ
-18	337-3738-00			1		SHIELD, ELEC: POWER SUPPLY,
-19	671-5274-05			1		A3 - CONNECTOR BD CKT BD ASSY
	671-8002-00			1		A3 - CONNECTOR BD CKT BD ASSY, OPT ELSW *MOUNTING PARTS*
-20	211-1117-00			2		SCREW, MACHINE; 4-40 X 0.187, PAN HEAD, STL, CD PL, T-10, TORX DR
-21	129-1449-00			2		SPACER, POST: ECO422D, 1.282 L
-22	220-0256-00			18		NUT; NICKEL PLATED, VENDOR P/N B90010
-23	210-0199-00			18		WASHER, LOCK; NICKEL PLATED, VENDOR P/N B91008 *END MOUNTING PARTS*
-24	337-4007-00			1		SHIELD, ELECT: ECO422D
-25	671-8001-00		B029999	1		A2 - MAIN BOARD CKT BD ASSY
	671-8001-01	B030000		1		A2 - MAIN BOARD CKT BD ASSY
-26	211-1117-00			6		SCREW, MACHINE; 4-40 X 0.187, PAN HEAD, STL, CD PL, T-10, TORX DR
-27	220-0497-00			15		NUT, PLAIN, HEX: 0.5-28 X 0.562 HEX, BRS CD PL
-28	210-1039-00			15		WASHER, LOCK: 0.521 ID, INT, 0.025 THK, SST

## Replaceable Mechanical Parts

Fig. & index no.	Tektronix part no.	Serial number		Qty	12345	Name & Description
		effective	discontinued			
-29	337-4008-01			1		SHIELD,ELEC:ECO422D
-30	131-4131-00			1		CONN,PLUG,ELEC:MALE W/LOCKING ADPTR,EXT MTG *MOUNTING PARTS*
-31	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375,PNH,STL *END MOUNTING PARTS*
-32	351-0104-03			1		SL SECT,DWR EXT:12.625 L,W/O HARDWARE *MOUNTING PARTS*
-33	212-0158-00			8		SCREW,MACH:8-32 X 0.375,PNH,STL,CDPL,T-20 TORX DR *END MOUNTING PARTS*
-34	441-2268-00			1		CHASSIS:ECO422D
-35	159-5016-00			1		FUSE; 2.0A,125V,FAST BLOW,0.1 X 0.1 X 0.24,UL REG,CSA CERT,SAFETY CONTROLLED (A2F1, on Main Board)
-36	386-7347-00			1		PLATE, SPACER; REAR PANEL, BNC, 0.090 AL, 5052-H3X
	159-0022-00			1		FUSE,CARTRIDGE:3AG,1A,250V,FAST BLOW (F100, on Rear Panel) *ATTACHED PARTS*
	162-0531-00			1		INSUL SLVG,ELEC:HT SHRINK,0.165 IDPOLYOLEFIN,BLK, 0.02 THK W
	196-3419-00			1		LEAD,ELECTRICAL:DESCRETE;CUT,18 AWG,1000V, 8-01,GRAY W/BLK&BRM STRIPES,0.25 STRIP BOTH
	200-0237-04			1		COVER,FUHLR:PLASTIC
	200-2264-00			1		CAP,FUSEHOLDER:3AG FUSES
	204-0832-00			1		BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES
	220-0187-00			1		NUT,HEX:4-40,NYLON *END ATTACHED PARTS*
	119-1536-00			1		FILTER,RFI:3A,250VAC,50/60HZ (FL100 Line Filter) *ATTACHED PARTS*
	174-3369-00			1		CA ASSY,SP:DESCRETE;CPM,2,18 AWG,9-01,13.0250 CUT & STRIP (CONNECTS FROM FL100 TO A4J1)
	196-3418-00			1		LEAD,ELECT:DESCRETE;PSC,18 AWG,5-4,4.0 L,0.25 CUT& STRIP X 0.146 ID,RING TONGUE,45 DEG ANGLE,SAF CONT
	211-0503-00			1		SCREW, MACHINE; 6-32 X 0.188, PNH, STL CD PL, POZ *END ATTACHED PARTS*
	175-9877-00			1		CA ASSY,SP,ELEC:10,28 AWG,12.5 L,RIBBON (J100) (CONNECTS FROM REAR PANEL "REMOTE" TO A2J17) *MOUNTING PARTS*
	214-3903-01			2		SCREW,JACK:4-40 X 0.312 EXT THD,4-40 INT THD,0.188 HEX,STEEL,CADPLATE *END MOUNTING PARTS*
	174-1495-00			1		CA ASSY,SP,ELEC:20,28 AWG,3.0 L,RIBBONSAF CONT (W18) (CONNECTS FROM A2J18 TO A3J19)
	174-3370-01			1		CA ASSY,SP:DESCRETE;PSC,6,18 AWG,12.0 L,0.156 CTR,1X6,0.156 CTR,RCPT,W/FRICTION LOCK BOTH ENDS,GOLD PL (W21) (CONNECTS FROM A2J21 TO A4J2)
	335-1453-00			1		MARKER IDENT; ECO422D ELSW CONN; SAFETY CONTROLLED (OPTION ELSW ONLY)

Fig. & index no.	Tektronix part no.	Serial number		Qty	12345	Name & Description
		effective	discontinued			
						<b>STANDARD ACCESSORIES</b>
	061-4234-00			1		CARD,INFO:REFERENCE,ECO422D
	071-1792-xx			1		MANUAL,TECH:INSTRUCTION, ECO422D
-37	351-0751-01			1		TRK SL OUT SECT:STATIONARY & INTERMEDIATE SAFETY CONTROLLED
-38	161-0216-00			1		CABLE ASSY,PWR,:3,18 AWG,2.5M L,BLACK (STANDARD ONLY)
						<b>OPTIONAL ACCESSORIES</b>
	161-0215-00			1		CABLE ASSY,PWR,:3,0.75MU,2.5MM L,GREY (EUROPEAN OPTION A1 ONLY)
	161-0066-10			1		CA ASSY, PWR: 3,0.1MM SQ, 250V/10A, 2.5 METER,STR, IEC320,RCPT X 13A, FUSED UK PLUG (13A FUSE), UNITED KINGDOM, SAFETY CONTROLLED
	161-0066-11			1		CA ASSY,PWR:250V/10A,2.5 METER,STR, IEC320,RCPT, (AUSTRALIAN OPTION A3 ONLY)
	161-0154-00			1		CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER,STR, (SWISS OPTION A5 ONLY)
	161-A008-00			1		CA ASSY, PWR:THREE 2.0MM SQ, 125V, 15A, 12M L W/HOLDER &LATCH;SAFETY CONTROLLED (JAPAN OPTION A6 ONLY)



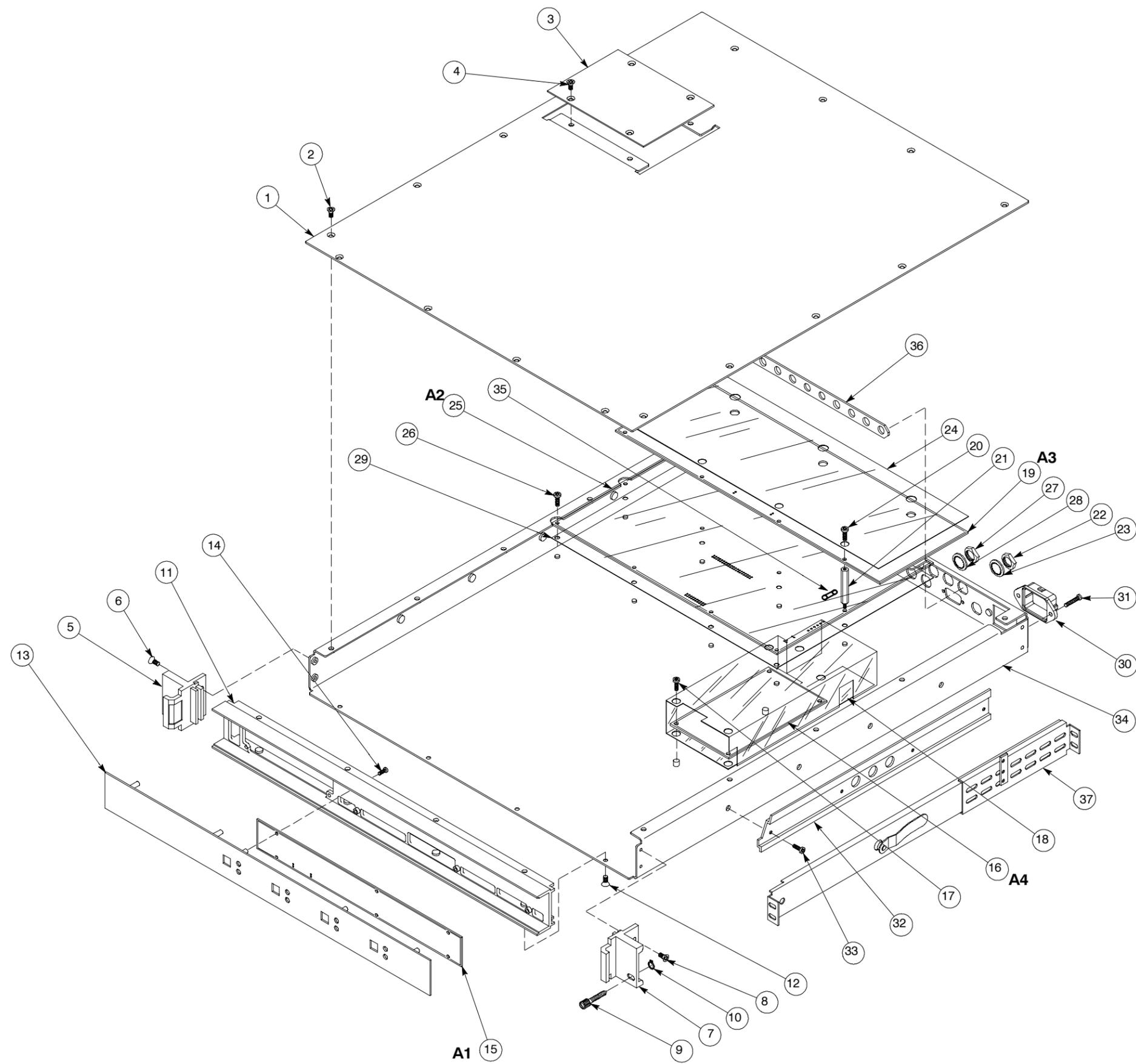


FIG. 1 EXPLODED VIEW

ECO422D





# Appendices



# Appendix A: Options

This section describes the instrument options available for the ECO422D Changeover Unit.

## Option ELSW

Option ELSW provides electronic switching on channels four, five, and six, instead of the mechanical relay switching used in the standard instrument. This enhancement provides faster, glitch-free switching for analog sync signals. If the Primary and Backup generators are properly genlocked the customer may not even notice the switchover. Option ELSW is fully documented in this manual.

