ECO8000 Series
Automatic Changeover Unit

Service Manual

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Tektronix

ECO8000 Series
Automatic Changeover Unit

Service Manual

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- Worldwide, visit www.tektronix.com to find contacts in your area.

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Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page vii, *Service safety summary*.)

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of 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.

Do not use the provided power cord for other products.

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, make sure that the product is properly grounded.

Do not disable the power cord grounding connection.

Power disconnect. The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product.

Do not operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product.

Provide proper ventilation. Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

Provide a safe working environment. Always place the product in a location convenient for viewing the display and indicators.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use only the Tektronix rackmount hardware specified for this product.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

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 product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

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.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

Terms in this manual

These terms may appear in this manual:

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

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

Symbols and 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.

When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:

CAUTION
Refer to Manual

Protective Ground
(Earth) Terminal

Preface

This manual provides information needed to service an ECO8000 Series Automatic Changeover Unit to the module level.

If the instrument does not function properly, troubleshooting and corrective measures should be taken immediately to prevent additional problems.

NOTE. *Contact your local Tektronix representative for information on where to return your instrument if it requires repair during the warranty period.*

To prevent personal injury or damage to the ECO8000 Series, consider the following before beginning service:

- The procedures in this manual should be performed only by a qualified service person.
- Read the *General safety summary*. (See page v.)
- Read the *Service safety summary*. (See page vii.)

When using this manual for servicing, be sure to follow all warnings, cautions, and notes.

Manual structure and conventions

This manual is divided into the following sections:

- *Theory of operation* contains circuit descriptions that support service to the module level.
- *Maintenance* contains information and procedures for performing preventive and corrective maintenance for the SPG8000 generator. These instructions include inspection and cleaning, remove and replace procedures, troubleshooting and fault isolation to the module level, and repackaging instructions.
- *Replaceable parts* includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers.

Manual conventions

This manual uses certain conventions with which you should become familiar.

Some sections of the manual contain procedures for you to perform. To keep those instructions clear and consistent, this manual uses the following conventions:

- Names of front panel controls and menus appear in the same case (initial capitals, all uppercase, etc.) in the manual as is used on the ECO8000 Series front panel and menus.
- Instruction steps are numbered unless there is only one step.
- **Bold** text refers to specific interface elements that you are instructed to select, click, or clear.
  - Example: Press the **ENTER** button to access the NETWORK CONFIG submenu.
- *Italic* text refers to document names or sections. Italics are also used in NOTES, CAUTIONS, and WARNINGS.
  - Example: The *Theory of operation* section includes a block diagram.

Modules. Throughout this manual, the term module appears. A module is composed of electrical and mechanical assemblies, circuit cards, and interconnecting cables.

Safety. Symbols and terms related to safety appear in the *General safety summary*.

Product documentation

The following product documentation is available on the Tektronix Web site (www.tektronix.com).

Product documentation

To read about	Use these documents
Product safety, installation, and operation	■ *ECO8000 Series User Manual* (Tektronix part number 071-3221-xx (English)) (Tektronix part number 077-0873-00 (Japanese)) (Tektronix part number 077-0874-00 (Russian)) ■ *ECO8000 Series Video System Integration Technical Reference* (Tektronix part number 077-0877-00)
Product specifications and performance verification	■ *ECO8000 Series Specifications and Performance Verification Technical Reference* (Tektronix part number 077-0876-00)
Servicing the product	■ *ECO8000 Series Service Manual* (Tektronix part number 077-0880-00)
Clearing or sanitizing the product	■ *ECO8000 Series Declassification and Security Instructions* (Tektronix part number 077-0879-00)
New features or known operational issues	■ *ECO8000 Series Release Notes* (Tektronix part number 077-0878-00)
Software licenses	The software licenses used by the ECO8000 Series are available for download from the Tektronix Web site. The licenses are bundled with the product firmware package.

Operating basics

Operating basics

Production description

The ECO8000 Series Automatic Changeover Unit is a highly versatile automatic sync and signal changeover unit with configurations and capabilities required to address modern master sync application and other advanced sync timing application. The ECO8000 Series offers exceptional reliability, stability, and is designed with optional high-bandwidth input changeover capabilities for HD/SD and/or 3G-SDI signal environments.

Each ECO8000 unit can be used with the following signal generators to form the complete sync generator system, which offers extra redundancy for the critical timing and synchronization system in the facilities.

- A pair of Tektronix Master Sync / Master Clock Reference Generators (SPG8000) for most broadcast facility timing applications.
- A pair of Tektronix Test Signal Generators (TG8000) for more advanced post production facility timing applications.

ECO8000 Series models

The ECO8000 Series consist of the following models:

- **ECO8000:** This model provides up to nine user-configurable BNC channels and four LTC channels. The base configuration has three 50 MHz Electronic Fast Switch (REF/ELSW) channels with options for six more 50 MHz Electronic Fast Switch or 3 GHz Relay Switch (HREF/Relay) channels in groups of three channels each, plus four optional LTC channels. Each channel consisting of primary and backup inputs, and an output.
- **ECO8020:** This model provides up to 20 user-configurable high-density BNC channels and four LTC channels. The base configuration has five 50 MHz Electronic Fast Switch (REF/ELSW) channels with options for 15 more 50 MHz Electronic Fast Switch or 3 GHz Relay Switch (HREF/Relay) channels in groups of five channels each, plus four optional LTC channels. Each channel consisting of primary and backup inputs, and an output.

Operation information

For detailed information about operating the ECO8000 Series, refer to the appropriate product manual. (See page xi, *Product documentation*.)

Power connection

The ECO8000 Series operates from a single-phase power source with the neutral conductor at or near earth ground. The line conductor is fused for over-current protection. A protective ground connection through the grounding conductor in the locking power cord is essential for safe operation.

CAUTION. *The instrument does not have a power switch. When you connect the power plug to one of the AC line connectors, and the Power Supply module for that slot is installed, the instrument powers on. If you have only one power supply installed, be sure to connect the power plug to the correct rear-panel power connector.*

Connect the power cable(s). Standard instruments are shipped with one Power Supply module installed in slot 1. If you ordered Option DPW, your instrument was shipped with two Power Supply modules installed.

Connect the power cable(s) to the instrument first, and then connect it to the AC power source. Connecting the power cable causes the instrument to power on.

After connecting the power, make sure that the fan in the instrument is working. If the fan is not working, turn off the power by disconnecting the power cable from the AC power source, and then contact your local Tektronix Field Office or representative.

A power-on self test is run when the instrument first boots up.

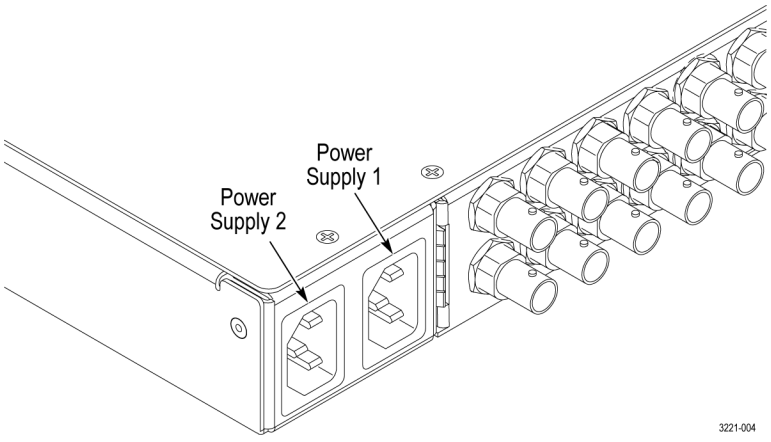


Figure 1-1: Location of rear panel power connectors (ECO8000 shown)

Overview of instrument operation

When operating the instrument from the front panel, there are three top-level menus. Pressing the BACK button several times will always return the instrument display to one of these menus. The top-level menus are: Status, System Config, and Channel. The Channel menu readout always displays one of the channels, such as "CH1 ELSW NTSC".

Press the up (▲) or down (▼) arrow buttons to cycle between the three top menus.

In the Channel menu, press the left (◄) or right (►) arrow button to cycle through the installed channels.

In the desired top-level menu or channel, press the ENTER button to go into that selection, then use the navigation arrows to browse to various items and to select options. Press the ENTER button to make a change, or to allow editing on Text strings and numeric fields.

Menu displays. The LCD display uses various symbols to help you navigate the menus and make selections:

- **Carriage return.** As shown below, when a carriage return symbol appears in the right bottom corner of a display, this indicates that you can either press the ENTER button to access a submenu or that you need to press the ENTER button to make a setting change.

3221-033

3221-034

- **Bullet.** As shown above, when a bullet symbol appears as the first character on the bottom line of the display, this indicates that there are multiple setting selections available and that the displayed selection is the currently selected setting. Press the left or right arrow buttons to view other possible selections and press the ENTER button to implement a setting change.
- **Left and right arrows.** As shown below, when left and right arrows appear on the far right side of the display, this indicates that you can view more diagnostic or event readouts using the left and right arrow buttons.

3221-035

- **Indentation.** As shown above, when right-arrow characters appear as the first characters on the top line of the display, this indicates that you have entered a submenu. The number of right-arrow characters represents the number of times you need to press the BACK button to return to the top-level menu.

Menu readout updates. Many of the menu readouts are static and do not update when instrument conditions change. To view the latest menu readout information, press the BACK button to exit the current menu and then press the ENTER button to reenter the menu and view the current readout information. This is especially useful when viewing items in the STATUS menu.

Web User Interface

The ECO8000 Series has a 10/100 BASE-T Ethernet port on the rear panel that allows you to use a PC to remotely control the instrument. When the Web Interface is enabled in the SYSTEM CONFIG menu, enter the IP address of the instrument in a supported Web browser to open the ECO8000 Web Interface.

Easy access and control. The Web-based interface allows quick access to most of the instrument settings and views. In most cases, it is easier to access and configure the instrument using the Web Interface. Examples of where this is especially true are:

- Viewing instrument status
- Viewing the Event Log
- Viewing diagnostic results
- Configuring event and email reporting
- Configuring channel settings such as threshold levels, labels, etc.

Operating limitations. All of the settings and functions that can configured using the front panel are available in the Web Interface except for the following:

- Configuring the SNMP settings
- Configuring the network settings
- Configuring the Web Interface level of control setting
- Performing a firmware upgrade

Upgrades

Hardware upgrade. There are no hardware upgrades available for the ECO8000 Series.

Firmware upgrade. Tektronix releases software and firmware updates for products to add new features and to fix product problems. You can find the latest firmware for your product at the Tektronix Web site (www.tektronix.com/downloads).

Be aware of the following upgrade considerations:

- It is recommended that the instrument be out of service to perform the upgrade
- You must perform the firmware upgrade using the instrument front panel (you cannot use the Web Interface)
- The instrument must be in Manual mode
- The instrument must be connected to the same Ethernet network as the computer you will use to perform the upgrade

Theory of operation

Theory of operation

This section describes the basic operation of the major circuit blocks or modules in the ECO8000 Series instruments. The block diagram shows the modules and functional blocks in the instrument. (See Figure 2-2.)

Instrument level

The ECO8000 and ECO8020 have three major subsystems which are essentially independent of each other:

- Channel Control system
- Configuration and Monitoring system
- Redundant Power system

These three subsystems are loosely coupled to achieve maximum reliability of the main ECO function, which is sensing faults on the input signals and switching to a backup if necessary.

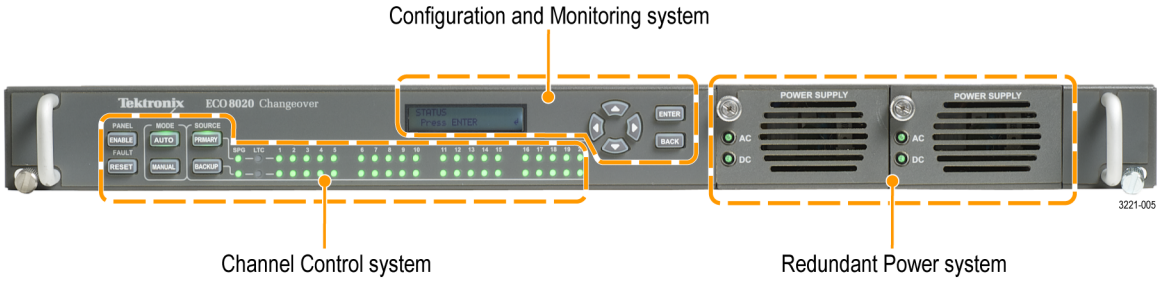


Figure 2-1: ECO8000 Series subsystems (ECO8020 with Option DPW shown)

Channel Control system

The Channel Control system monitors the signal level on each input, and switches to the other sync source if a fault occurs. This subsystem is implemented as a simple hardware state machine to maximize reliability. This portion of the instrument is accessed via the left keyboard, and the status is displayed on the button lights and the per-channel LEDs on the front panel.

When the instrument powers on, the Channel Control system restores all basic configuration settings that were in place when the instrument was powered off. This restoration is finished in a fraction of a second and is independent of the processor booting to run the display and the Configuration and Monitoring system. If the Configuration and Monitoring system is rebooted, the Channel Control system is unaffected.

Configuration and Monitoring system

The Configuration and Monitoring system is software-based and includes the user interface menus. This system is accessed via the right keyboard, the LCD, and the Web Interface.

MANUAL mode. When the instrument is in MANUAL mode, the Configuration and Monitoring system can program the settings in the Channel Control system. For example, it can set the level threshold on each channel or disable unused channels.

AUTO mode. When the instrument is in AUTO mode, most of the Configuration and Monitoring system is disabled and the subsystem is used for monitoring only.

Watchdog timer. If the Configuration and Monitoring system processor stops running, a 20 minute watchdog timer in the Channel Control System will automatically cause a processor reboot. If the watchdog timer causes a reboot, the event is entered in the Event Log.

Redundant Power system

The Redundant Power system monitors each Power Supply module (Option DPW provides a second supply as a backup supply) and switches to the backup supply if the preferred supply has a problem. This subsystem is independent of the other two systems. The Configuration and Monitoring system can set some parameters in the Redundant Power system and display its status.

Boards and modules

As indicated in the high-level block diagram (See Figure 2-2.), the ECO8000 Series implements these subsystems with the following boards and modules:

- Main board
- Processor board
- Channel modules, either REF/ELSW or HREF/Relay
- Front Panel module
- Power supply module(s)
- Combiner board

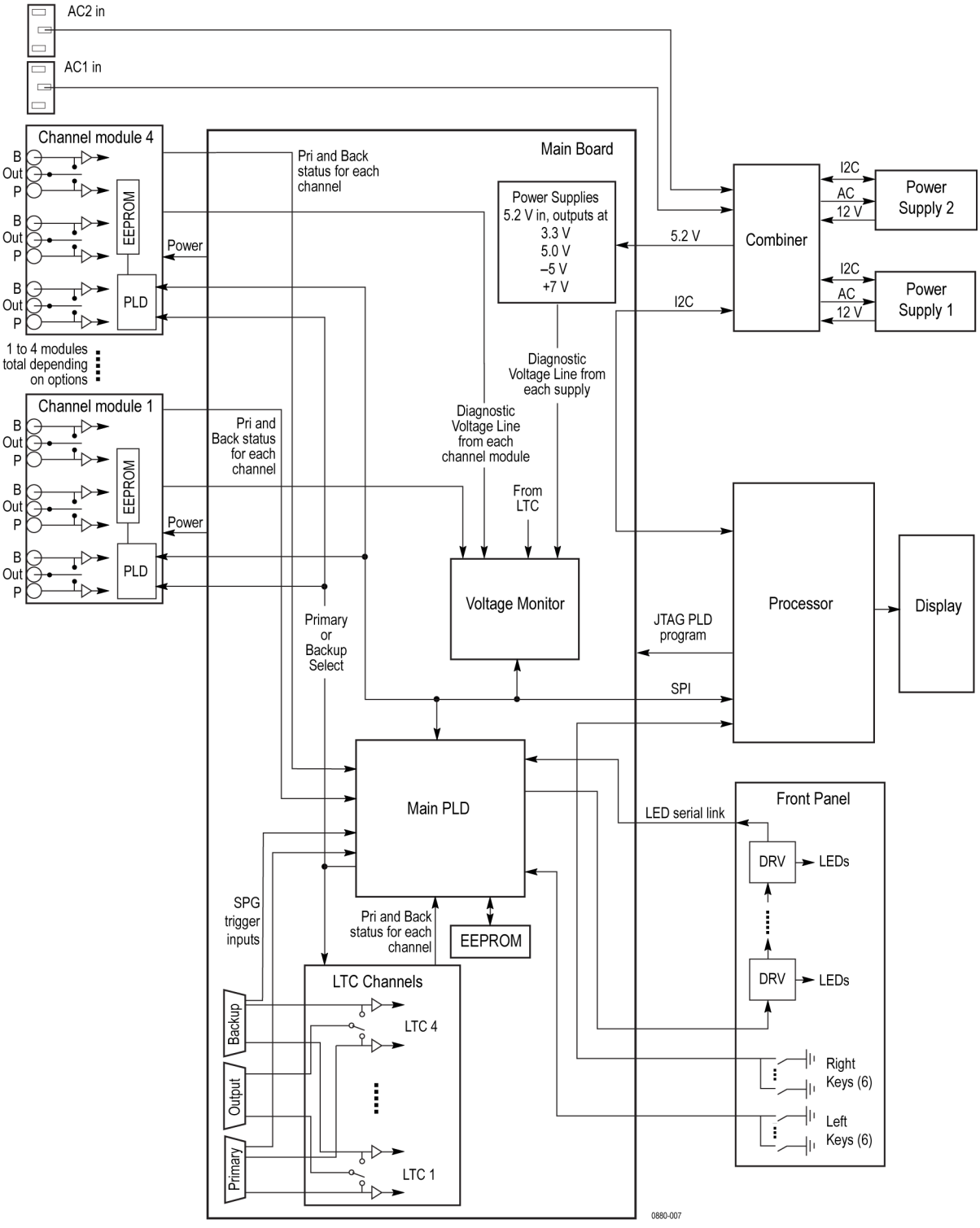


Figure 2-2: ECO8000 Series high-level block diagram

Main board

The Main board provides most of the interconnections to the other boards, modules, and secondary power supplies. The Main board houses the PLD, voltage monitor ADC, LTC channels, and the GPIO and Expansion ports.

PLD

The Main board contains the PLD, which has the logic for the Channel Control function. This PLD monitors the left-hand front panel buttons and the fault inputs from the modules to control the state of the ECO. The PLD also drives the per-channel fault LEDs. The PLD also restores settings from a small EEPROM on power up so that the primary function of the ECO can be functional before the processor boots.

Watchdog timer. The Main board PLD has a watchdog timer. If the processor stops communicating with the PLD for 20 minutes, then the PLD will reset the processor. The CPU reset can also be achieved by enabling the left panel (Channel Control system), and then pressing and holding both the ENABLE and RESET buttons for 6 seconds.

NOTE. *A CPU reset has no effect on the state or operation of the ECO relays, so it is safe to perform the reset during normal instrument operation.*

Reprogramming. The Main board PLD can be reprogrammed by the processor via a JTAG interface. A separate JTAG interface is multiplexed to each Channel module so that the Processor can update the PLDs on those modules.

Voltage monitor ADC

The Main board houses the voltage monitor ADC, which is driven by a system of multiplexers that allow a variety of voltages to be measured. Each Channel module has a multiplexer to allow all power supply, peak detector and threshold voltages to be selected one at a time. The one selected signal from each Channel module, and selected signals from the Main board are again multiplexed to eventually drive one input to an ADC. The software and processor hardware step through all of the possible inputs to the ADC and measure each one. The results are displayed in the Diagnostic menu. This simple voltage monitor can give a significant view into the health of the instrument.

LTC channels

The LTC channels on the Main board are similar to the channels on the Channel modules. The 15-pin, high-density “VGA” style DSUBs connect the differential LTC inputs from the sync sources, and the output DSUB provides the selected source as an output. The pin-out of the DSUBs are compatible with the LTC outputs on the SPG8000 and GPS7 module of the TG8000, which allows the instruments to connect together with a standard cable.

Each LTC signal is switched with a double-pole relay. The unused input is not terminated. Each input has a level detector to drive the front-panel status LEDs and the ECO switching logic. Each Channel has a DAC to set the threshold for the fault detection.

GPIO and Expansion ports

The GPIO and Expansion ports on the Main board are basically interfaces to the PLD pins. The Expansion port can either drive or receive on each line, which allows each instrument to be configured either as a master or as a slave. Use a 1-1 RJ45 Ethernet-style cable to connect two instruments.

Processor board

The Processor monitors the right-hand keys (Configuration and Monitoring system) and drives the LCD, which together implement the local UI. The Processor is a small ARM-style running a Linux OS. It has NOR flash to store the program, DDR2 for program execution, and MRAM to store settings. The Processor also has a real time clock to provide time stamps for the log, and an Ethernet interface to provide remote configuration and monitoring. The Processor board uses the raw 5.25 V supply from the Main board and generates all the supplies it needs for the Processor functions with an integrated power management chip.

The Processor has two status LEDs (DS1 and DS2). DS1 is a heartbeat LED; it blinks if the Processor is running the normal application. If the blink rate is slower than 2-3 per socond, that indicates excessive loading on the Processor. DS2 indicates the 3.3 VA is present out of the power management chip.

The Processor uses I2C to communicate with the redundant power system on the Combiner board and Power Supply modules, and uses SPI to communicate with the channel control system on the Main board and Channel modules.

For SPI, the Processor board generates six separate chip selects to allow it to talk to the Main board PLD, each Channel module PLD, or the voltage monitor. The other SPI signals are buffered on the Main board.

The Ethernet signals from the Processor pass through the Main board to the connector on the rear panel (not shown in the block diagram).

The final sets of signals on the Processor interface are the JTAG chains. There are two JTAG chains: one to reprogram the Main board PLD and one for the Channel module PLDs. The chain for the Channel modules goes through a buffer/multiplexer to allow each module to be accessed independently.

The Processor board has a battery to power the real-time clock. No other functions are dependent on the battery. The battery voltage is nominally 3 V and can be checked from the Diagnostics menu, with threshold levels of >40%, between 20 and 40%, and less than 20%.

Channel modules

The Channel modules contain the relays and electronic switches, which connect either the primary or backup sync source to the output. There are two types of Channel modules: REF/ELSW (ELectronic SWitch) and HREF/Relay.

REF / ELSW modules

The REF/ELSW modules have a bandwidth of 50 MHz and normally use buffer amplifiers to isolate and switch the syncs. Since the switch is electronic, it creates very little disturbance to the sync signal. When power is lost, the REF/ELSW module reverts to a latching relay connection to maintain the last selected signal path.

HREF / Relay modules

The HREF/Relay module uses wide-band relays to provide a switch path with a bandwidth of 3 GHz. These relays are also latching so they retain state if the ECO loses power.

PLD

Both types of Channel modules have a PLD to house local logic and to restore state from a local EEPROM on power up. This restore is for the settings for each channel, such as the threshold.

Peak detectors

Both types of Channel modules have peak detectors that measure the low-frequency energy of the primary and backup inputs to monitor the signal level. This peak detector output is compared to a user-defined threshold to determine if the signal is present. The signal presence lines go back to the Main board PLD in order to drive the front-panel LEDs and to drive the logic that makes the AUTO mode source-switch decision.

The output of each peak detector also goes into the voltage monitoring system. This allows the diagnostic readout to provide level information on the input signal and to test the operation of the peak detector.

Interconnections

The interconnections to the Channel module are the inputs of power supplies, clocks, SPI, JTAG, reset and the source select. Outputs are the per-channel fault signals for both the primary and backup inputs. Additionally, there is a module-present line which gets grounded when a module is installed; the Main board uses this to detect that a module is present. Finally there are four module ID bits which have resistors to pull up or down to indicate the type of module (REF/ELSW or HREF/Relay) and the number of channels (three or five).

Sync source switching

Sync source switching is an interaction between the Main board and the Channel modules. The Main board PLD always asserts either the primary or backup select line. The modules PLDs convert that to the pulse or state needed to drive the relays and electronic switches. If a Channel module detects a low signal level, then it asserts the appropriate fault line back to the Main board PLD. If the instrument is in AUTO mode, that PLD will then see if the conditions are correct for a switch. If a switch is indicated, then it will swap which of the primary and backup lines are high and thus cause a sync source change on each Channel module.

Front Panel assembly

The Front Panel assembly includes both keypads and the channel-status LED indicators. One cable connects the Front Panel to the Main board. The display wires directly to the Processor board. All of the display signals come from the Processor board.

Buttons

The left-hand buttons and LEDs (Channel Control system) are connected to the PLD on the Main board. The connections for the right-hand buttons pass through the Main board and connect only to the Processor.

Each button signal is normally pulled up by a resistor and connected to ground when the button is pressed. The buttons are not in a matrix, each button connects to the destination directly. The buttons are backlit by LEDs. A small current is always supplied by a resistor. On the left keyboard, a larger current can be switched in to increase the illumination.

LED drivers

The channel-status LEDs and the larger button current are all driven from LED driver chips on the Front Panel board. These drivers are connected serially in one long chain, with the input and output of the serial chain connected to the PLD on the Main board. The PLD shifts the drive level for each LED into the drivers, then latches the levels in to drive each output.

Power Supply modules

The two Power Supply modules and the Combiner board are the main components of the redundant power subsystem. Operation with one supply module is also supported, but there is no redundancy.

The Power Supply modules contain the 100-240 VAC to 12 V supply, a fan, and the Power Module board, which adapts the cables to a board-to-board header. The Power Module board contains a temperature sensor to measure the power supply exit airflow, and an EEPROM to log hours of operation. Since the Power Module board tracks the use time on the other supply components, replacing components within the supply module is not allowed. The connector from the Power Module board to the Combiner board has the 12 V DC output, and the 100-240 VAC input, as well as I2C communication and fan drive signals.

The Power Module board passes the AC voltage going into the power supply, and the DC voltage from the supply to the instrument. The AC is carried on large pins with bigger spacing gaps in the board to board connector J1 as needed for safety on the line voltage. The AC pins are shorter on one side of the connector so that the GND connects first and disconnects last. The DC returning from the supply also uses large pins on J1, but that is to handle the current.

The Power Module board has an I2C bus for the memory and temperature sensor. The I2C pins in the connector are shorter so that ground and power are applied first when the module is installed.

Combiner board

The Combiner board routes the 100-240 VAC input from the rear-panel line filters to the Power Supply modules. The AC level detectors on the Combiner board indicate if the AC level is less than about 75 V. These AC-low lines drive the front-panel AC LEDs and the logic in the Combiner board and Main board PLD to prevent switching if the AC inputs are low.

The Combiner takes in the 12 V from the one or two supplies, and converts it to 5.2 V for the rest of the instrument. If there are two good supplies, the microcontroller in the Combiner chooses the preferred one. If either supply or AC input has an issue, the microcontroller chooses the best one.

There are two sets of 12 V storage capacitors. One set of capacitors allows time for the system to switch supplies without any disruption of the 5.2 V output. The second set of capacitors is used to flash the power-status LEDs for approximately 10 minutes after loss of power. During the boot up of the Combiner board microcontroller, the Combiner functions in diode mode and uses whichever supply has the higher voltage, or a mix of the two.

During operation, the Combiner board has a load that can be used to test the inactive supply. This happens when a new supply is plugged in and once a day to ensure that the backup supply can support the instrument if the primary supply fails.

The Combiner board also drives the fans and senses if they are not spinning. The fans are located in each Power Supply module.

Maintenance

Maintenance

This section contains the information needed to perform periodic and corrective maintenance on the instrument. The following subsections are included:

- *Preventing ESD* – General information on preventing damage by electrostatic discharge.
- *Inspection and cleaning* – Information and procedures for inspecting and cleaning the instrument.
- *Remove and replace procedures* – Information and procedures for removing and replacing modules in the instrument.
- *Troubleshooting* – Information for isolating and troubleshooting failed modules. Included are instructions for operating the diagnostic routines and troubleshooting trees. Most of the trees make use of the internal diagnostic routines to speed fault isolation to a module.
- *Repackaging instructions* – Information on returning an instrument for service.

Preventing ESD

Before servicing this product, read the *Important safety information* section at the front of the manual, and the ESD information below.

CAUTION. *Static discharge can damage any semiconductor component in the instrument.*

Electrostatic discharge (ESD) can damage components on the modules and mainframe. To prevent ESD or other component damage, follow the steps below when installing, removing, or handling modules:

- Work in an appropriate antistatic area with a properly grounded antistatic mat.
- Wear a grounded antistatic wrist strap to discharge the static voltage from your body while installing or removing modules from the mainframe.
- Minimize handling of static-sensitive circuit boards and components.
- Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive boards.
- Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Service static-sensitive modules only at a static-free work station.
- Do not use any devices capable of generating or holding a static charge in the work area where you remove, install, or handle modules.
- Handle circuit boards by the edges when possible. Do not touch module components or connector pins.
- Do not slide the circuit boards or modules over any surface.
- Avoid handling circuit boards in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and cleaning

Inspection and Cleaning describes how to inspect for dirt and damage. It also describes how to clean the exterior and interior of the instrument. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent malfunction and enhance reliability.

Preventive maintenance consists of visually inspecting and cleaning the instrument and using general care when operating it.

How often maintenance should be performed depends on the severity of the environment in which the instrument is used. A proper time to perform preventive maintenance is just before any instrument adjustment.

General care

The cabinet helps keep dust out and should normally be in place during operation.

There is no periodic lubrication required for the instrument.

WARNING. *To prevent injury or death, power off the instrument and disconnect it from line voltage before performing any procedure that follows.*

Exterior inspection

Inspect the outside of the instrument for damage, wear, and missing parts, using the following table as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

Table 3-1: External inspection checklist

Item	Inspect for	Repair action
Cabinet, front panel, and cover	Cracks, scratches, deformations, damaged hardware	Repair or replace defective module
Front-panel controls	Missing, damaged, or loose controls	Repair or replace missing or defective controls
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors	Repair or replace defective modules. Clear or wash out dirt
Carrying handle and cabinet feet	Correct operation	Repair or replace defective part
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors	Repair or replace damaged or missing items, frayed cables, and defective modules
LCD	Cracks	Replace the LCD assembly
	Dirty	Clean with glass cleaner

Exterior cleaning

Clean the exterior surfaces of the chassis with a dry lint-free cloth or a soft-bristle brush. If any dirt remains, use a cloth or swab dipped in a 75% isopropyl alcohol solution. Use a swab to clean narrow spaces around controls and connectors. Do not use abrasive compounds on any part of the instrument that may damaged by it.

CAUTION. *Avoid the use of chemical cleaning agents that might damage the plastics used in the instrument. Use only deionized water when cleaning the front-panel buttons. Use a glass cleaner to clean the LCD. For the rest of the instrument, use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

Interior inspection

To access the inside of the instrument for inspection and cleaning, you must remove the top cover.

Inspect the internal portions of the instrument for damage and wear, using Table 4-2 as a guide. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, check to see if it is necessary to adjust the instrument. (See Table 3-2 on page 3-4.)

CAUTION. *To prevent damage from electrical arcing, make sure that circuit boards and components are dry before applying power to the instrument.*

Table 3-2: Internal inspection checklist

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove and replace damaged circuit board.
Resistors	Burned, cracked, broken, blistered condition.	Remove and replace damaged circuit board.
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove and replace damaged circuit board.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Interior cleaning

Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle, non-static-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution and rinse with deionized water.

To clean the instrument interior, perform the following steps:

1. Blow off dust with dry, low-pressure, deionized air (approximately 9 psi).
2. Remove any remaining dust with a lint-free cloth dampened in isopropyl alcohol (75% solution) and rinse with warm deionized water. (A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.)

   STOP. *If, after doing steps* 1 *and* 2 *, a module is clean upon inspection, skip the remaining steps.*
3. If steps 1 and 2 do not remove all the dust or dirt, the instrument may be spray washed using a solution of 75% isopropyl alcohol by doing steps 4 through 6.
4. Gain access to the parts to be cleaned by removing easily accessible shields and panels.
5. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
6. Dry all parts with low-pressure, deionized air.

Remove and replace procedures

This section contains procedures for removal and installation of customer-replaceable modules in the ECO8000. Any electrical or mechanical module, assembly, or part listed in the Replaceable parts list section of this manual is a module.

Preparation

WARNING. *To prevent serious injury or death, disconnect the power cord from the line voltage source before performing any remove or replace procedures.*

Before performing this or any other procedure in this manual, read the General safety summary and the Service safety summary found at the beginning of this manual.

CAUTION. *To prevent possible damage to the instrument components, read the information on preventing ESD in this section. (See page 3-3, Electrostatic damage prevention.)*

Required equipment

Most disassembly is done using a #2 Phillips (P2) screwdriver tip. Use a P2 tip whenever a procedure step instructs you to remove or install a screw unless a different size screwdriver is specified in that step.

Table 3-3: Required tools

Name	Description
Anti-static wrist strap	
Screwdriver handle	Accepts driver bits
P1 and P2 driver bit	Driver bit for P1 and P2 screw heads
T15 TORX bit	Driver bit for T15 TORX screw heads
6 mm nut driver	A 7/32 inch may also be used
9/16 inch deep socket	Deep socket to fit over BNC connectors
Needle nose pliers	To remove or install light pipes
Cable tie	To replace a removed cable tie
Diagonal cutters	To clip cable ties
ECO8000 Series Specifications and Performance Verification manual (Tektronix part number 077-0876-XX) and all test equipment listed within Available for download from the Tektronix Web site at www.tektronix.com/manuals	To perform the verification checks after reassembling

Remove instrument from rack and remove top cover

1. Disconnect any power cords and signal cables from the instrument.
2. If applicable, remove the instrument from the equipment rack:

WARNING. *To prevent injury when removing the product from the rack, do not forcefully and abruptly pull the product from the rack. Pull with a consistent, even motion, with the minimum force required to move the instrument.*

   a. Loosen the knob screws, if present, that attach the front of the instrument to the rack.

   b. Gently pull the instrument toward you until you can reach the levers at the rear of the instrument.

   c. Tilt both lever handles upward simultaneously to allow them to clear the stops.

   d. Pull the instrument past the stops and out of the rack.

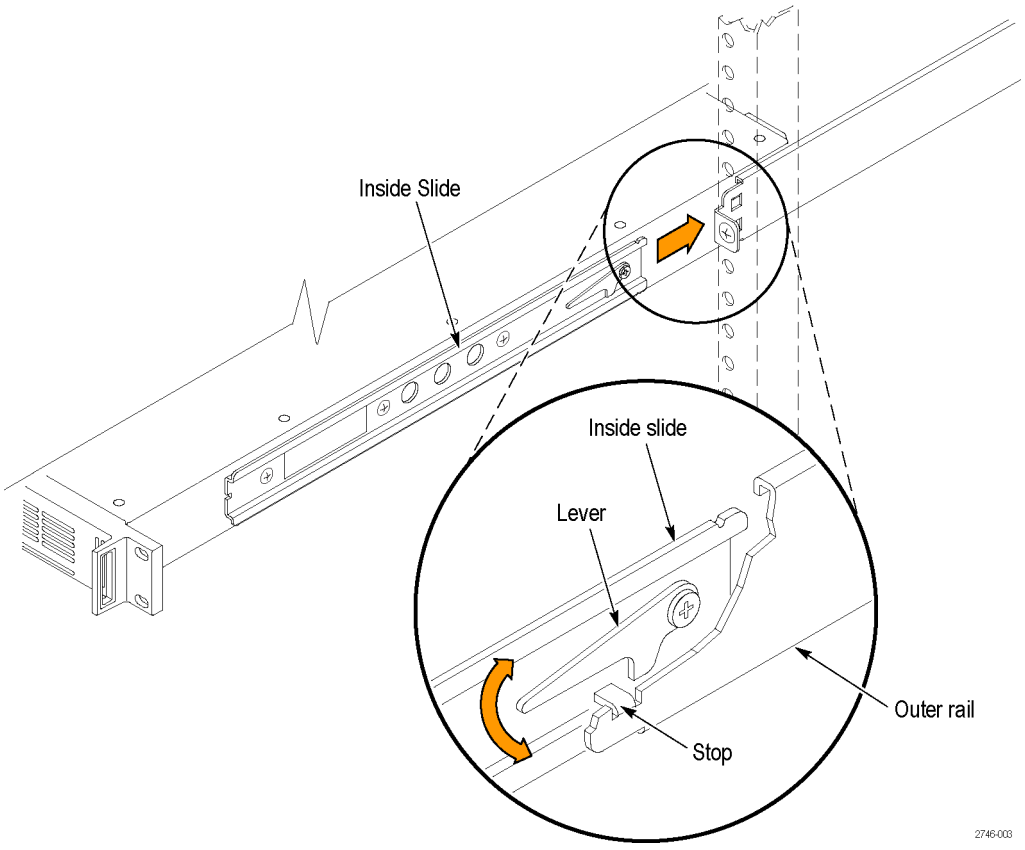


Figure 3-1: Installing or removing the instrument into or from the rack

3. Move the instrument to an appropriate antistatic work area. Wear a correctly grounded antistatic wrist strap when disassembling or assembling the instrument.

4. Use the screwdriver handle with a P2 driver bit to remove the instrument top cover (reassembly torque: 4.0 in/lb.)

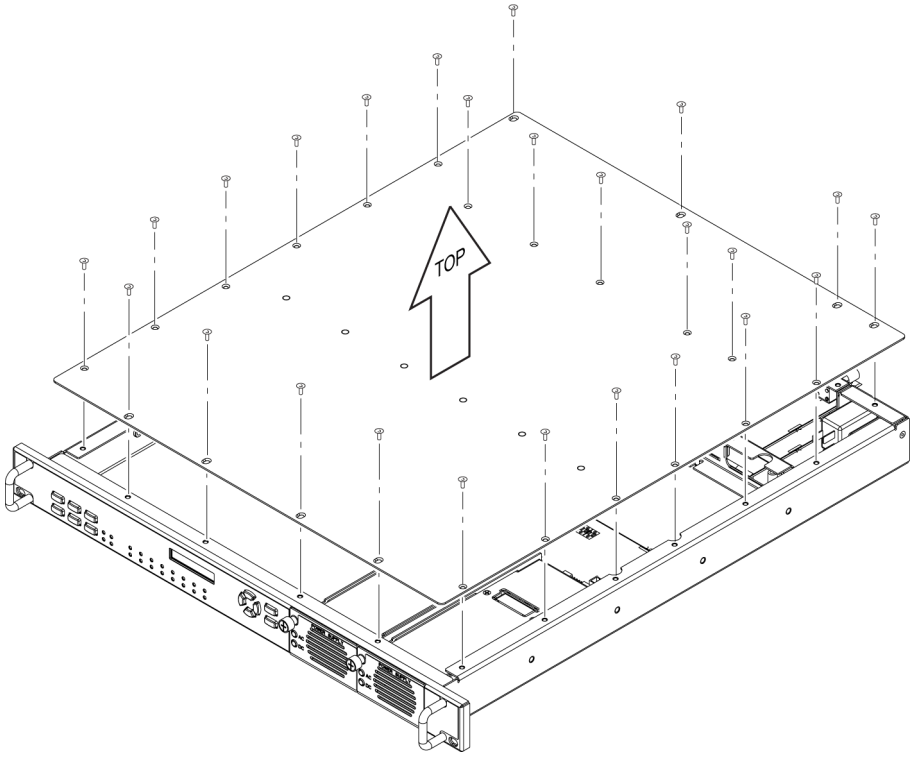
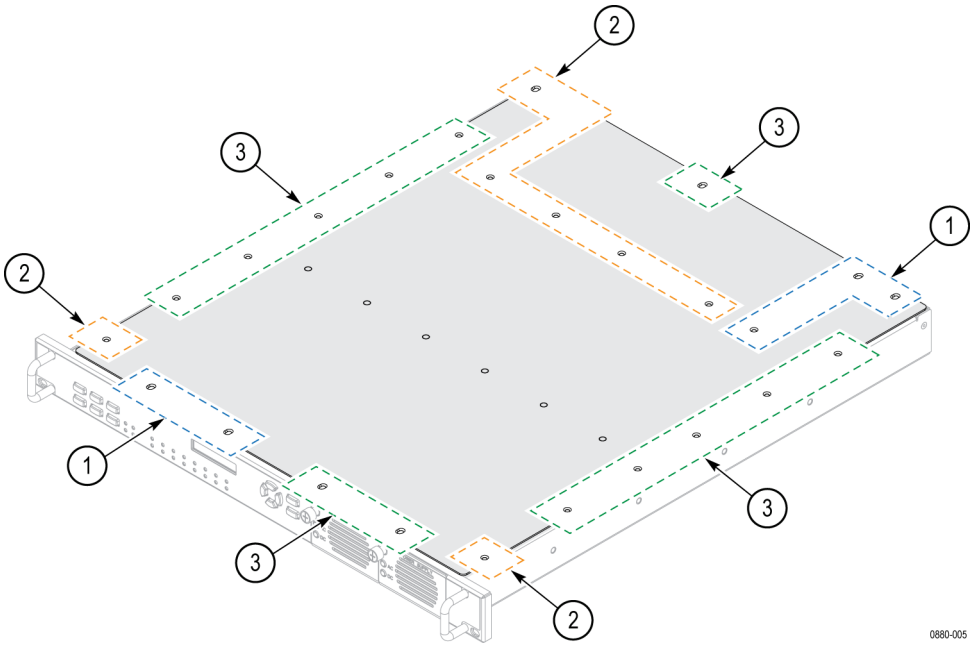


Figure 3-2: Removing the top cover

Reassembly. Reassemble in the reverse order of the disassembly procedure. The following areas require attention while reassembling:

- **Installing the top cover**: Install the top cover screws in the following order: install group one screws, then group two screws, then group three screws. Do not tighten the screws until all are installed. Torque: 4.0 in/lb.



Board locator and cable type/routing

Use the following to identify instrument board locations and cables, and to correctly route cables when assembling.

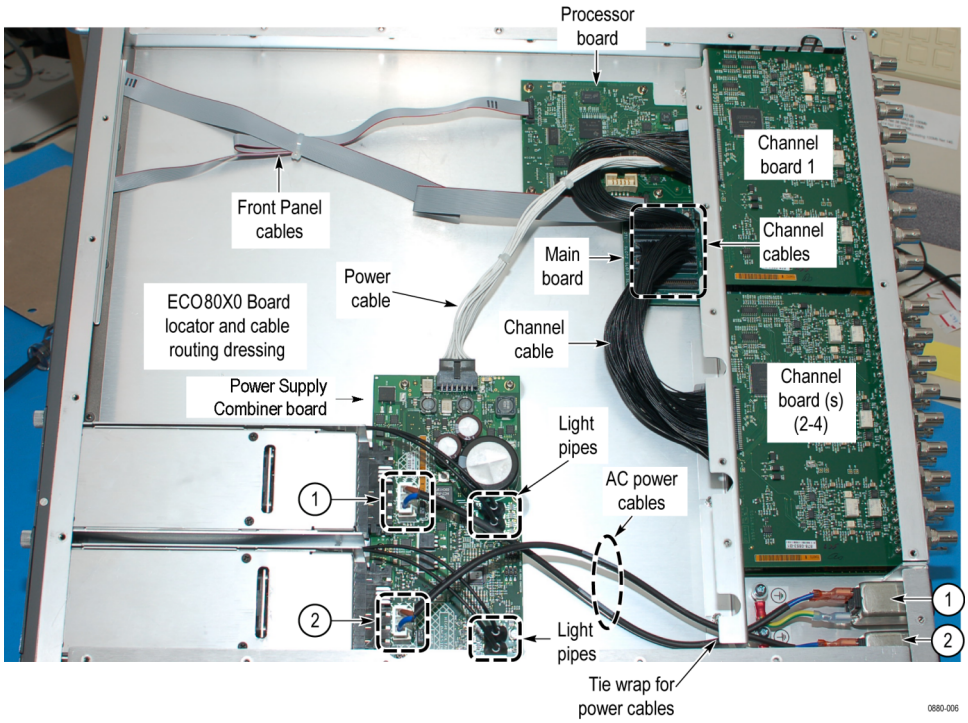


Figure 3-3: Board locator and cable routing diagram

Remove the Processor board

1. Disconnect the narrow ribbon display cable from J1 of the Processor board.
2. Remove the 4 screws on the Processor board (reassembly torque: 4.0 in/lb.).
3. Lift the back edge of the Processor board slightly and carefully pull away from the rear panel to disconnect the Processor board from the main board.

Reassembly. Reassemble in the reverse order of the disassembly procedure.

Remove the Channel modules

1. Clip or cut the cable-tie that is securing the two power cables from the rear-panel line filters.

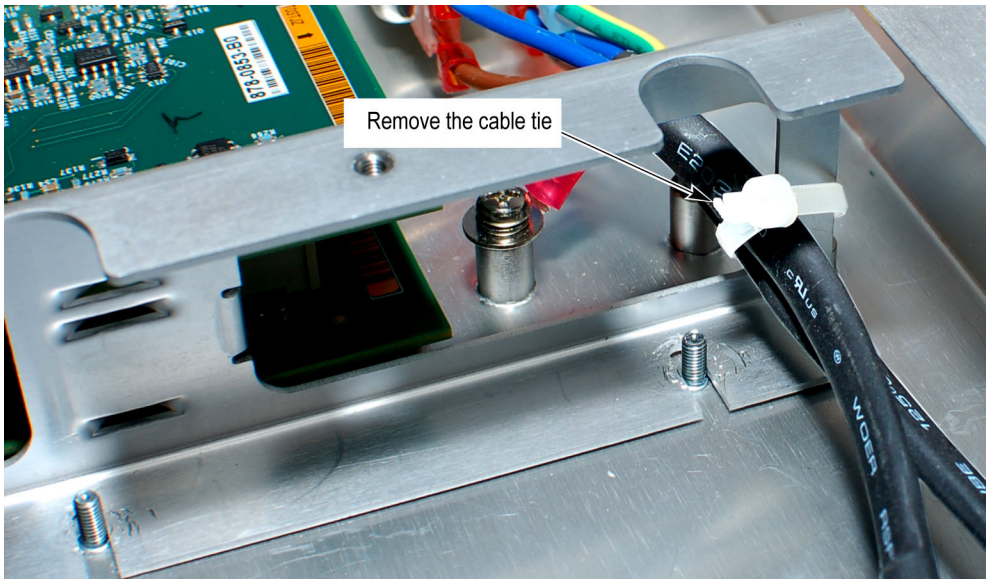


Figure 3-4: Removing the cable tie

2. Disconnect the black multi-wire cables between the Main board and any channel modules.

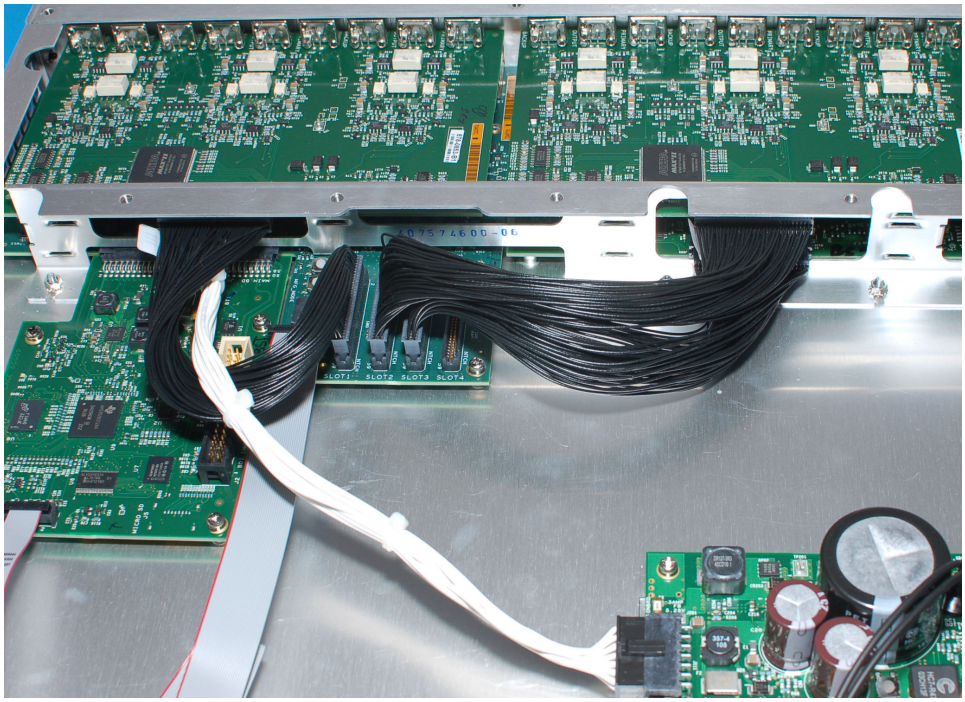


Figure 3-5: Removing the multi-wire channel cables

3. Disconnect the Main board power cable from the Combiner board. (See Figure 3-10 on page 3-16.)
4. Disconnect the two power cables from J10 and J20 on the Combiner board. (See Figure 3-14 on page 3-20.)
5. Use a 6 mm nut driver (7/32 inch may also work) to remove the four nuts securing the support bracket to the bottom of the chassis (reassembly torque: 4.0 in/lb.).

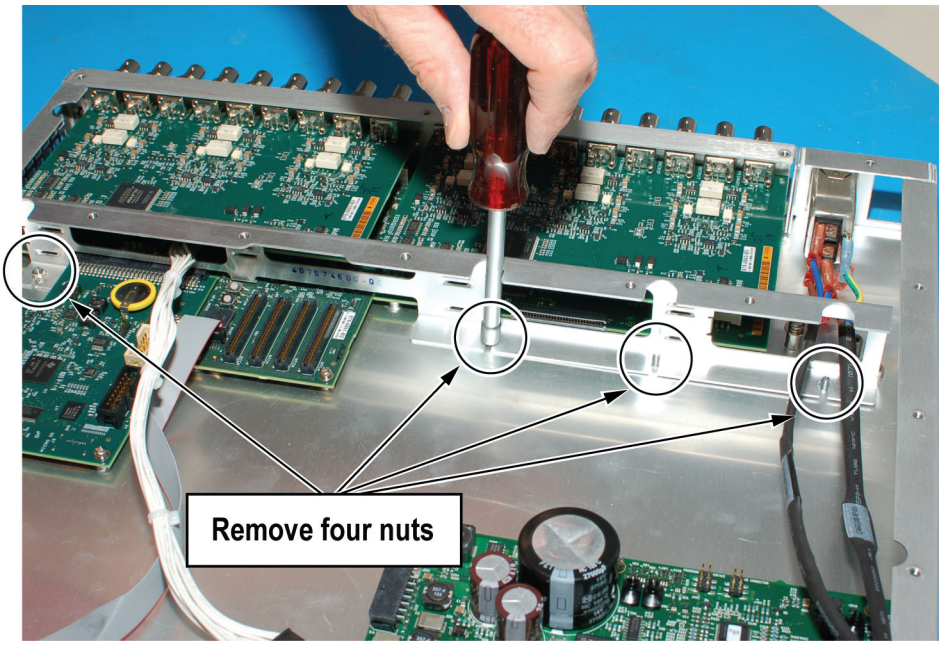


Figure 3-6: Removing the circuit board support bracket

6. Lift the bracket up and away from the chassis while carefully sliding the three power cables through the slots in the bracket. Move the bracket so that it is out of the way of accessing the channel modules, and is not sitting on any circuit boards.
7. Use the appropriate tool (see table below) to remove the nut/lock washers or screws from the rear-panel of the channel module that you are removing.

NOTE. *You do not need to remove upper channel modules to remove a lower channel module. You can remove each module individually.*

Channel module	Connector type	Connector removal tool
ECO8000: REF/ELSW, HREF/Relay	BNC	9/16 inch deep nut driver Reassembly torque: 14 in/lb.
ECO8020: REF/ELSW, HREF/Relay	HD BNC	P2 screwdriver Reassembly torque: 4.0 in/lb.

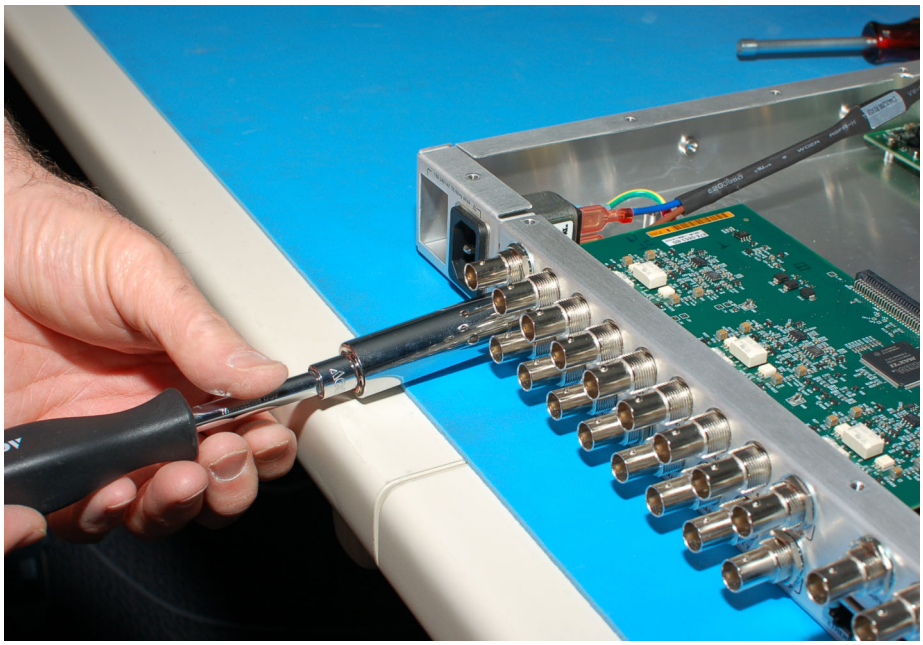


Figure 3-7: Removing the BNC nuts from a channel module

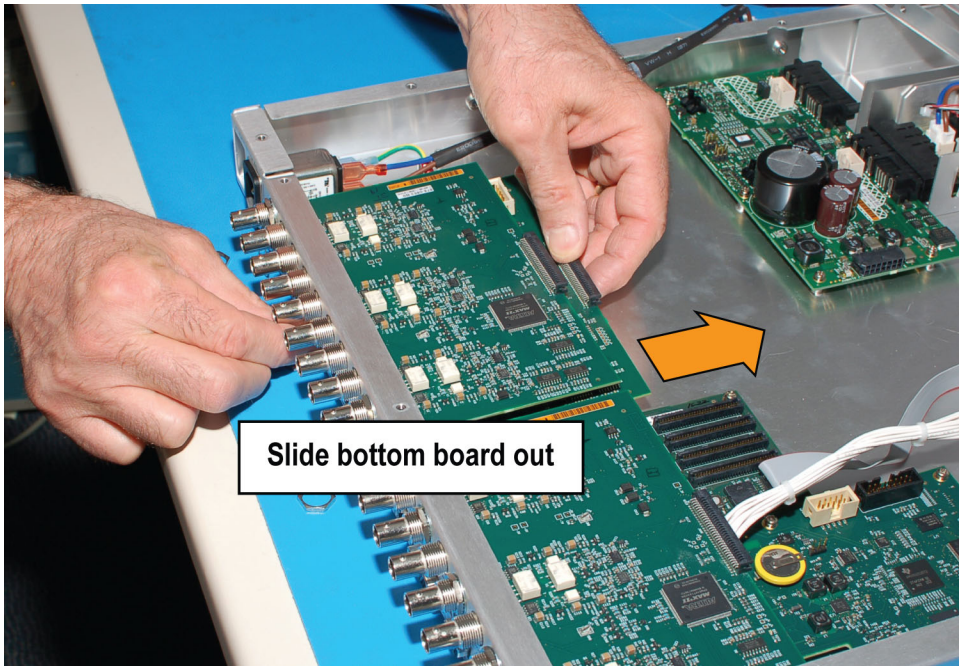


Figure 3-8: Removing a channel module

Reassembly. Assemble in the reverse order of the disassembly procedure. The following areas require attention while reassembling:

- **Seating modules in the bracket support tabs**: Position the bracket so that the Channel modules are aligned with the correct support tabs. The bottom level modules sit on the top edge of the lower support tabs. Upper modules sit between the bracket support tabs. (See Figure 3-12 on page 3-18.)
- **Secure the AC power lines**: Install a new cable tie to secure the two line filter power cables to the support bracket. (See Figure 3-4 on page 3-11.)
- **Connecting channel module cables**: Install a cable from the Slot 1 connector on the Main board to the channel 1 module (above the Main board). Route the channel 1 cable below the white power cable. Repeat for any other Channel modules: Slot 2 cable connects to the Channel 2 module (top), and so on.(See Figure 3-5 on page 3-11.)

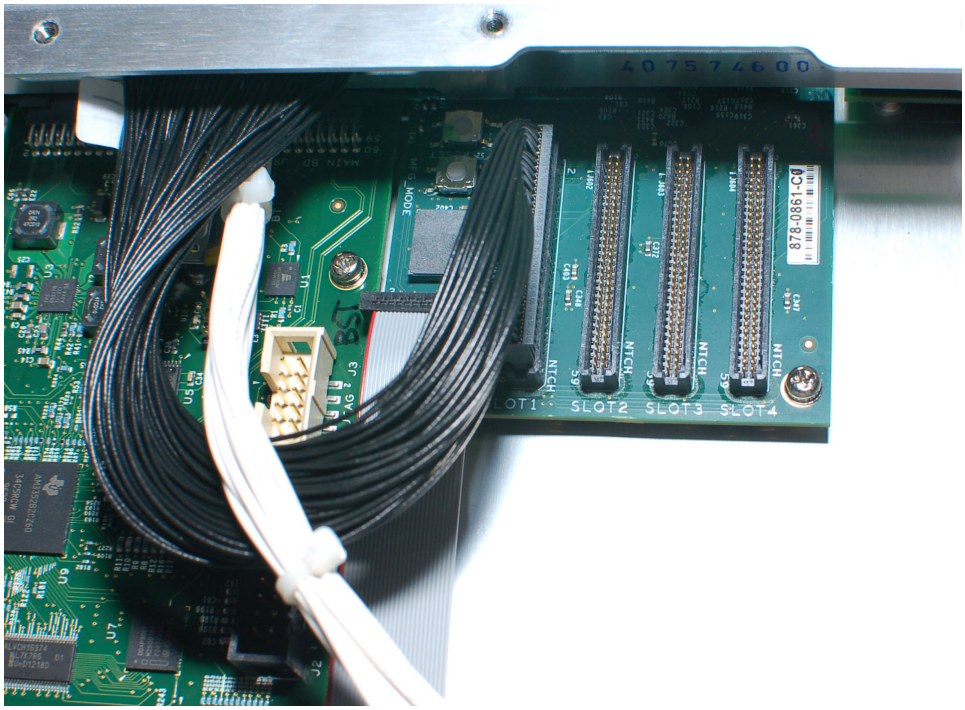


Figure 3-9: Installing channel cable example: Slot 1 on the Main board to the channel 1 module

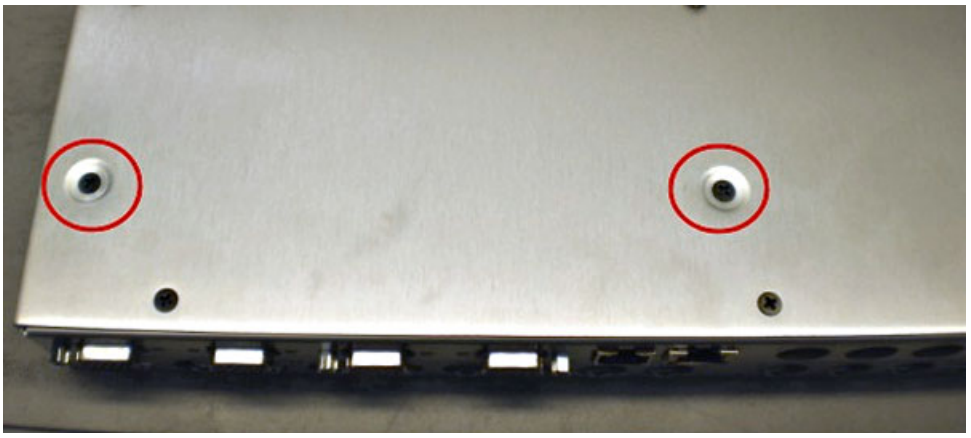
The channel cables are directional, with the connector key positioned toward the front of the instrument on the Main board connectors, and to the right where it plugs into the channel modules. The key is near pin 60 on the cable, so be sure to align the cable correctly on both ends.

CAUTION. *The channel modules will be damaged when power is applied if the cables are installed backwards in the connector.*

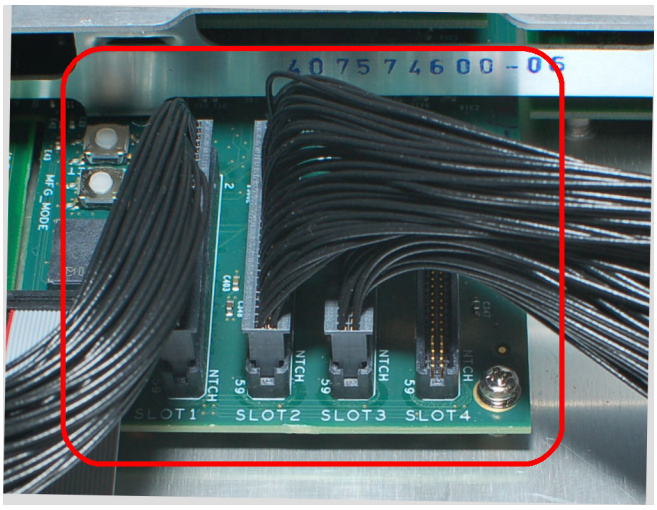
Remove the Main board

NOTE. *You do not need to remove the channel board above the Main board to remove the Main board.*

1. Turn the chassis over and remove the two Main board screws on the bottom of the chassis near the rear panel with a P1 tip (reassembly torque: 4.0 in/lb.). Turn the chassis back over.



2. Disconnect the black multi-wire cables from the Main board.



3. Remove the Processor board. (See page 3-10, *Remove the Processor board*.)
4. Disconnect the ribbon cable from J1210 on the main board.
5. Clip or cut the cable-tie that secures the two power cables from the rear-panel line filters. (See Figure 3-4.)
6. Disconnect the two power cables from J10 and J20 on the Combiner board. (See Figure 3-14 on page 3-20.)

7. Disconnect the white multi-wire power cable from J111 on the Combiner board (See Figure 3-10.) by pushing down on the lock tab and pulling back with a very slight side-to-side rocking motion. This connector is a snug fit, so it will take a bit of effort to disconnect.

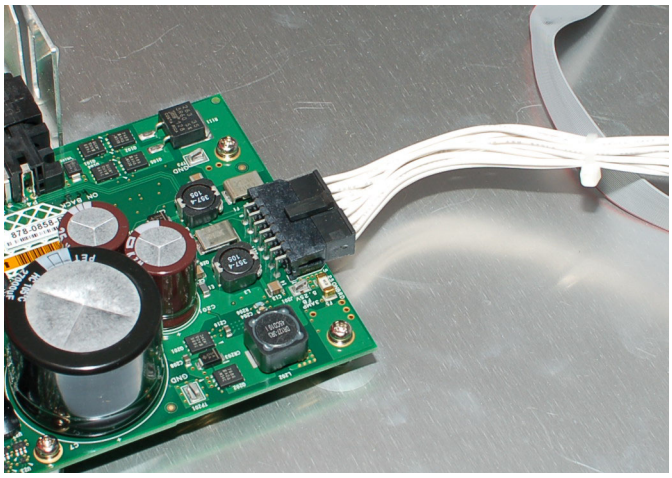


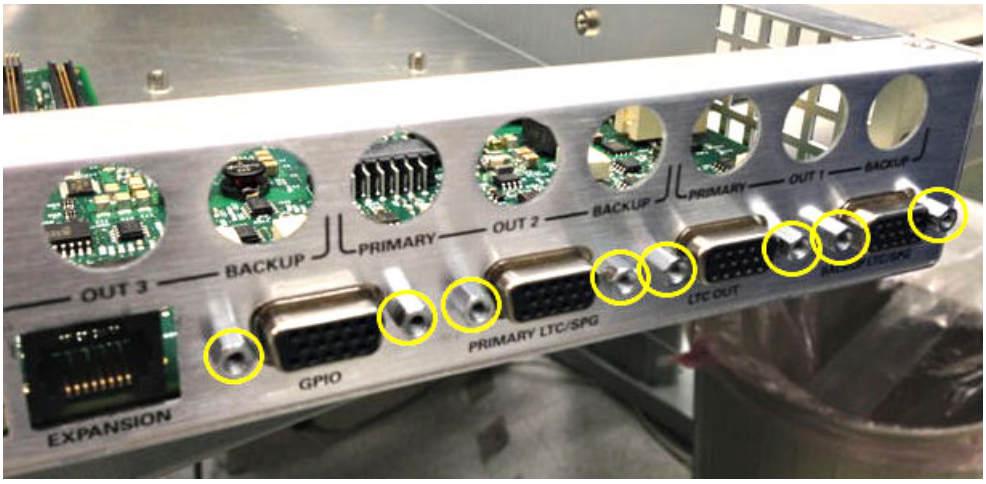
Figure 3-10: Disconnecting the Main board power cable from the Combiner board

8. Use a 6 mm nut driver (7/32 inch may also work) to remove the four nuts securing the circuit board support bracket to the bottom of the chassis (reassembly torque: 4.0 in/lb). (See Figure 3-6.)

9. Lift the board support bracket up and away from the chassis while carefully sliding the three power cables through the slots in the bracket. Remove the bracket.

10. Disconnect the white power cable from the Main board.

11. On the rear panel, use a 3/16 inch nut driver to remove the eight Main board connector post screws (reassembly torque: 4.0 in/lb.).



12. Remove the two screws from the Main board, near the channel cable connectors (reassembly torque: 4.0 in/lb.).

13. Lift the rear edge of the Main board slightly while pulling it away from the rear panel. Do not drag the board across the chassis standoffs. Place the board on a static-free work surface.

Reassembly. Assemble in the reverse order of the disassembly procedure. The following areas require attention while reassembling:

- **Main board power cable**: Be sure to connect the white power cable to the Main board before you install the Main board into the chassis. This cable mounts in the center of the board and cannot be accessed once the Main board is installed under the slot 1 Channel board.
- **Cable routing**: Route the three power cables through the slots in the support bracket.

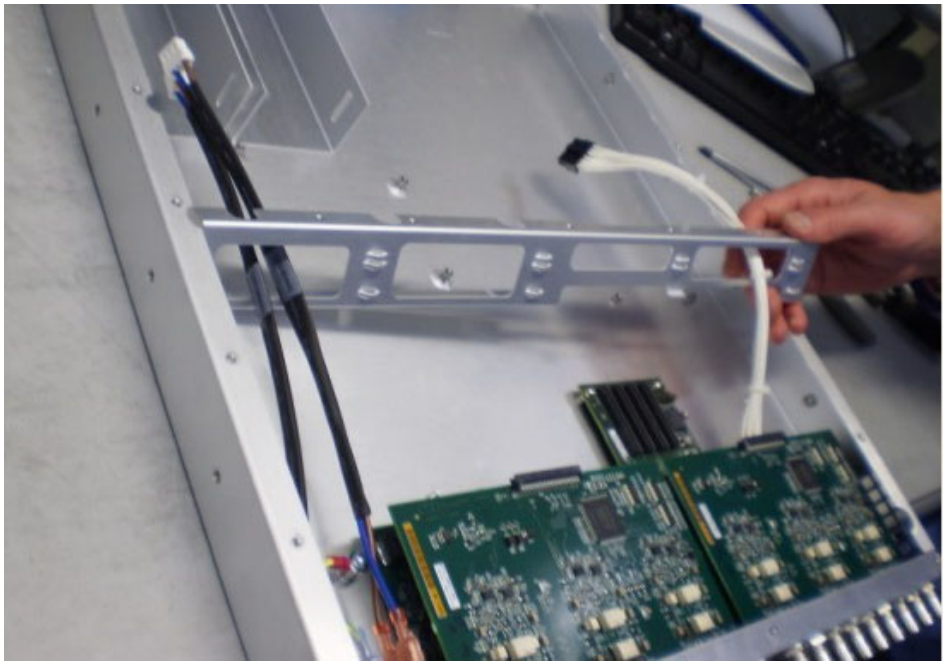


Figure 3-11: Threading the power cables through the circuit board support bracket

- **Seating boards in the bracket support tabs**: Position the bracket so that the boards are aligned with the correct support tabs. The bottom level boards sit on the top edge of the lower support tabs. Upper boards sit between the bracket support tabs. Hold the bracket in place and use a 6 mm nut driver (7/32 inch may also work) to install the four nuts securing the support bracket to the chassis. Torque the nuts to 4.0 in./lb.

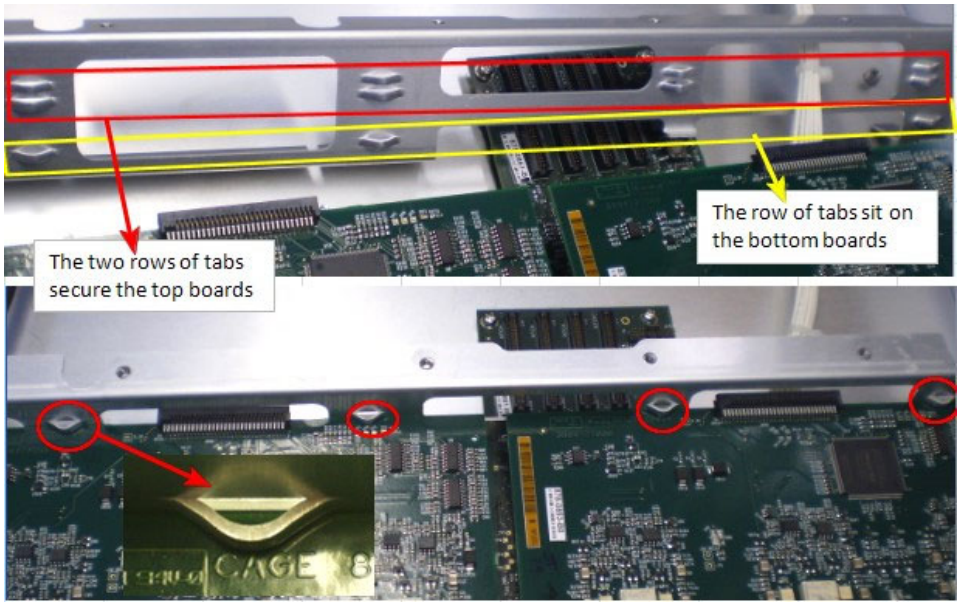


Figure 3-12: Positioning the support bracket tabs with the circuit boards

- **Secure the AC power lines**: Install a new cable tie to secure the two line filter power cables to the support bracket. (See Figure 3-4 on page 3-11.)
- **Connecting channel board cables**: Install a cable from the Slot 1 connector on the Main board to the channel 1 board (above the Main board), routing the channel 1 cable below the white power cable. Install any other channel board cables: Slot 2 cable connects to the channel 2 board, and so on.(See Figure 3-5 on page 3-11.)

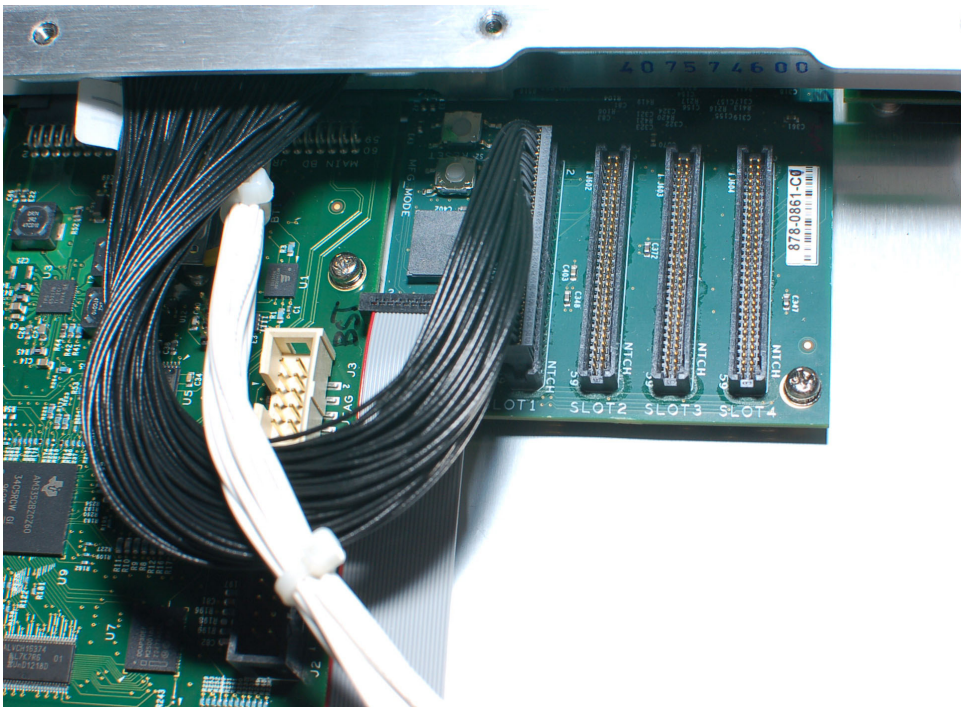


Figure 3-13: Installing the channel 1 board cable (Slot 1 to channel 1 board)

The channel cables are directional, with the connector key positioned toward the front of the instrument on the Main board connectors, and to the right where it plugs into the channel boards. The key is near pin 60 on the cable, so be sure to align the cable correctly on both ends.

⚠ ***CAUTION.*** *The channel circuit boards will be damaged when power is applied if the cables are installed backwards in the connector.*

Remove the Combiner board

1. Remove power supply module(s) from the instrument.
2. Disconnect the two power cables from J10 and J20 on the Combiner board.

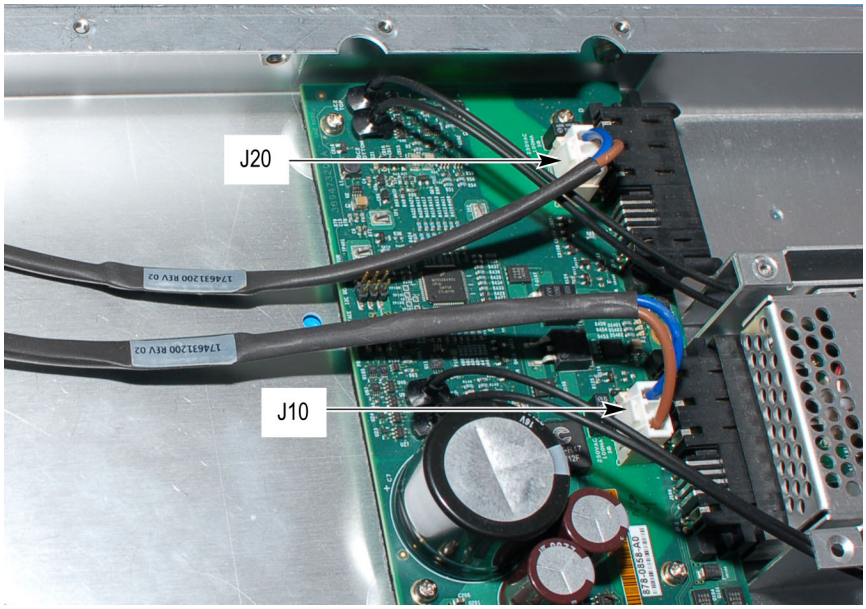


Figure 3-14: Disconnecting the line filter power cables from the Combiner board

3. Disconnect the white multi-wire power cable from J111 on the Combiner board by pushing down on the lock tab and pulling back with a very slight side-to-side rocking motion. This connector is a snug fit, so it will take a bit of effort to disconnect. (See Figure 3-10.)
4. Disconnect all four fiber-optic light pipes from the light pipe housings on the board. Use needle nose pliers to firmly hold each light pipe near the light pipe housing on the board and pull straight up.
5. Remove the six screws holding the board to the chassis (reassembly torque: 4.0 in/lb.). Remove the board by lifting slightly and disconnecting from the power supply bay, and remove the board shield.

Reassembly. Assemble in the reverse order of the disassembly procedure. The following areas require attention while reassembling:

- **Board shield**: Do not forget to install the shield under the Combiner board.
- **Cables from AC power filter(s)**: Connect the AC filter cable 1 to J10. Connect the AC filter cable 2 to J20. (See Figure 3-3.)
- **Install light pipes**: Install the light pipe ends in the Combiner board. Use the following illustrations to determine where to install each light pipe. Use needle nose pliers to hold the light pipe near the end and push it firmly into the connector on the board. Route the light pipes under the tabs located on the side of the power supply bays.

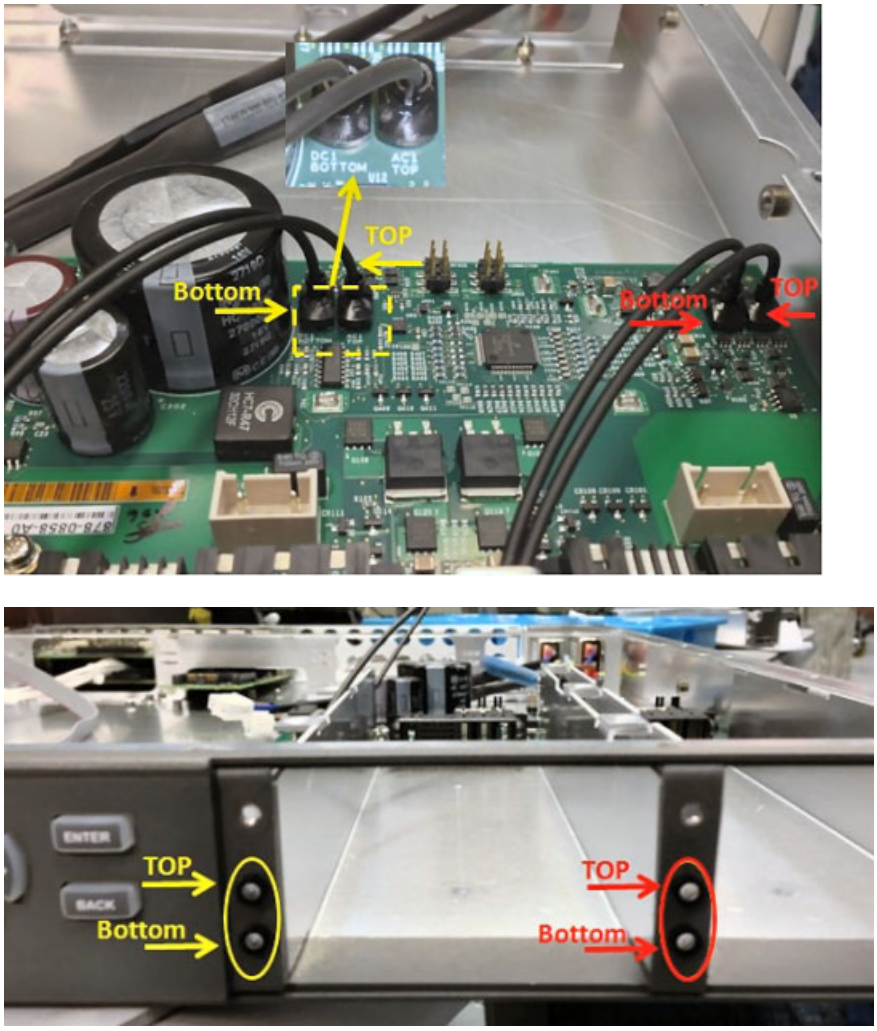


Figure 3-15: Light pipe connections

Remove the Front Panel assembly

1. Turn instrument over and remove the four screws from the bottom front edge of the instrument (reassembly torque: 4.0 in/lb.).

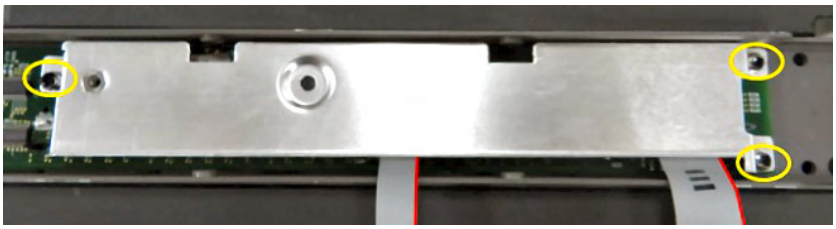
2. Turn the instrument back over.
3. Remove the Power Supply module(s) and/or power supply bay cover from the instrument.
4. Disconnect the flat display panel cables from the Display and Front Panel boards. You do not need to cut the cable tie on the cable unless you are replacing one of the cables.
5. Disconnect all four fiber-optic light pipes from the Combiner board. Use needle nose pliers to firmly hold a light pipe near the light pipe housing on the board and pull straight up.

CAUTION. *Do not rest your hand on the large capacitor or use it as a leverage point while removing the adjacent light pipes.*

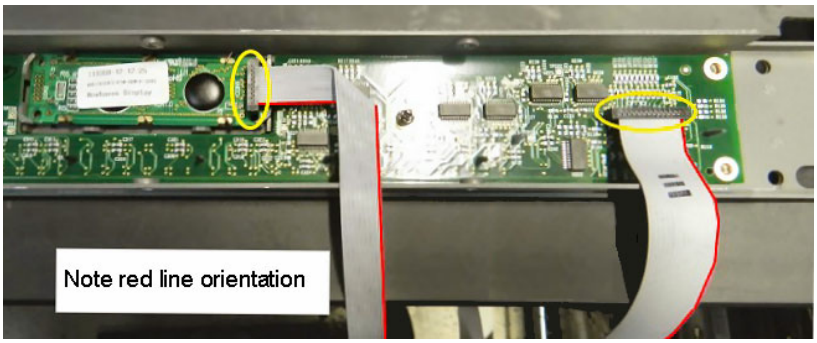
6. Remove the four T15 screws securing the two front-panel handles (reassembly torque: 4.0 in/lb.).
7. Pull the Front Panel assembly away from chassis. Place face down on a static-free work area.

Remove the Front Panel board and button mats.

8. Remove the three screws from the cable retaining bracket and remove the bracket (reassembly torque: 4.0 in/lb.).

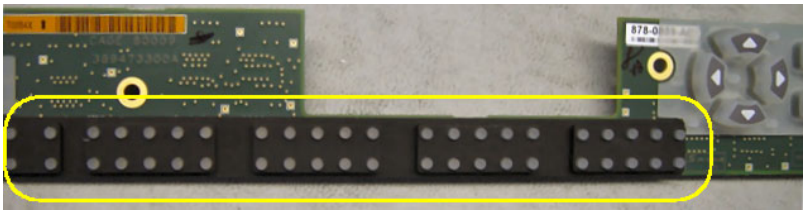


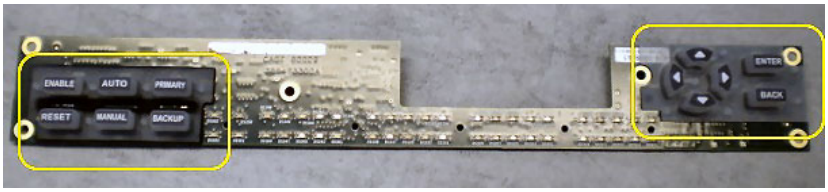
9. Disconnect the flat cables from the Display and Front Panel boards.



10. Remove the three screws from the front panel board and remove the front panel board (reassembly torque: 4.0 in/lb.).

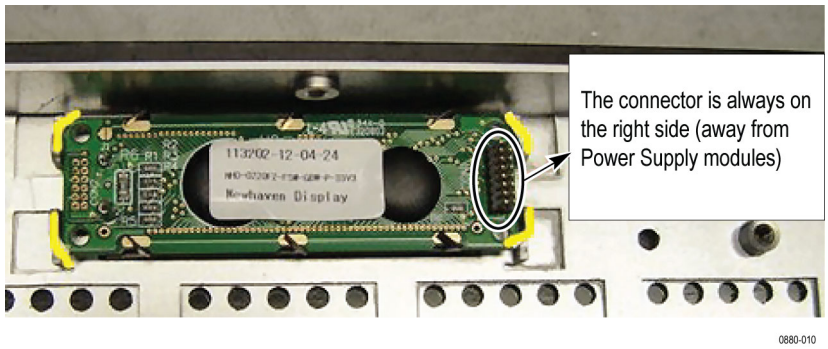
11. Remove the button mats. Do not touch the circuit board or contact areas of the button mats.





Remove the Display board.

12. Carefully bend back the corner tabs on the display just enough to remove the Display board.



13. Remove the Display board.

Reassembly. Assemble in the reverse order of the disassembly procedure. The following areas require attention while reassembling:

- **Install light pipes**: Install the light pipe ends in the Combiner board. Use needle nose pliers to hold the light pipe near the end and push it firmly into the connector on the board. (See page 3-21, *Reassembly*.) Route the light pipes under the tabs located on the side of each power supply bay.

Verify product operation

After you reassemble the instrument, perform the performance verification procedure for the ECO8000 as listed in the *ECO8000 Series Specifications and Performance Verification* manual (See page xi, *Product documentation*.).

Repackaging instructions

Use the following instructions to prepare your instrument for shipment to a Tektronix, Inc., Service Center:

1. Attach a tag to the instrument showing: the owner, complete address and phone number of someone at your firm who can be contacted, the instrument serial number, and a description of the required service.
2. Package the instrument in the original packaging materials. If the original packaging materials are not available, follow these directions:
   a. Obtain a carton of corrugated cardboard having inside dimensions six or more inches greater than the dimensions of the instrument. Use a shipping carton that has a test strength of at least 250 pounds (113.5 kg).
   b. Surround the module with a protective (anti-static) bag.
   c. Pack dunnage or urethane foam between the instrument and the carton. If using Styrofoam kernels, overfill the box and compress the kernels by closing the lid. There should be three inches of tightly packed cushioning on all sides of the instrument.
3. Seal the carton with shipping tape, industrial stapler, or both.

Troubleshooting

Troubleshooting

This section contains information about how to troubleshoot instrument problems in order to isolate faulty modules in the ECO8000 Series.

General troubleshooting strategy

Use the following guidelines as a general troubleshooting strategy:

- When troubleshooting an unknown instrument problem, first perform the performance verification procedures. (See the *ECO8000 Series Specifications and Performance Verification Technical Reference* manual.)
- When troubleshooting a known instrument problem, run only the diagnostic portion of the performance verification procedures to gain information about the subsystems.
- Try to determine which of the three main subsystems are affected. These subsystems are largely independent and knowing which system is affected will help isolate the problem to certain boards.
  - Channel Control system (left keyboard, channel status LEDs, Main board and channel module boards)
  - Configuration and Monitoring system (right keyboard, LCD display, and Processor board)
  - Redundant Power system (Power Supply modules and Combiner board).
- Verify all of the internal connections to power and user signals.

Solutions to common problems

For the common instrument problems listed below, perform the indicated troubleshooting procedure(s).

Table 4-1: Troubleshooting common problems

Symptom	Troubleshooting procedures
No lights on the instrument	■ Check the AC power connection ■ Swap in a replacement Power Supply module ■ Check the Combiner board voltages (See page 4-16.)
Power Supplies are running but the rest of the instrument is not running	■ Check the Power Supply module LEDs (See page 4-5.) ■ Check the 16-pin and 26-pin ribbon cables to the front panel (See page 4-15.) ■ Check the 14-pin power cable between the Combiner board and the Main board (See page 4-15.) ■ Check the Combiner board voltages (See page 4-16.)
Keyboard is illuminated but is not responding	■ Check that the Main board 3.3 V supply is OK (See page 4-18.) ■ Verify that the Main board PLD is programmed (See page 4-18.)
Display is running but the keyboards are not running	■ Check the 26-pin ribbon cable to the Front Panel board (See page 4-15.) ■ Check that the Main board 3.3 V supply is OK (See page 4-18.) ■ Verify that the Main board PLD is programmed (See page 4-18.)
Keyboard is running but the LCD display is not running	■ Check the 16-pin ribbon cable to the LCD display (See page 4-15.) ■ Check the Processor board (See page 4-19.)
No channels are switching between Primary and Backup sources	■ Verify that the AC power LEDs are green (See page 4-5.)
Only some channels are switching between Primary and Backup sources	■ Check the 60-pin cables to the channel modules (See page 4-15.) ■ Check the power-on self test (See page 4-4.)
Fault LEDs are green with no signal attached	■ Check the 60-pin cables to the channel modules (verify that all cables go to the correct connector on the Main board) (See page 4-15.) ■ Check the power-on self test (See page 4-4.) ■ Check the diagnostics for miss-connected modules (See page 4-16.)

Table 4-1: Troubleshooting common problems (cont.)

Symptom	Troubleshooting procedures
Channel LED shows signal as a fault when level is correct	■ Check that the channel threshold level is correct (See page 4-19.)
Relay Check function is buzzing the HREF/Relay channel relay when not needed	■ Check that the HREF/Relay channel is correctly terminated (See page 4-19.) ■ Disable the Relay Check for that HREF/Relay channel (See page 4-22.)
Front panel status LEDs are not on for a given channel	■ Check that the channel is enabled (See page 4-21.) ■ Execute the Initialize Hardware function (See page 4-23.)
Status screen indicates a Power Supply module has a temperature weighted hour warning	This status indicates that the supply has exceeded its recommended life. ■ Replace the supply to ensure maximum reliability
Status screen indicates that the Backup Test is due ***NOTE.*** *Preventative testing will improve the reliability of the changeover system if an actual fault occurs and the ECO changes to the backup source.*	This status Indicates that the channel relays have not switched for at least 6 months. ■ If possible, arrange to manually switch to backup and ensure the signals are all present and working

Troubleshooting procedures

This section contains procedures for troubleshooting problems.

Check the power-on self test

The power-on self test is run when the Configuration and Monitoring system first boots up (See page 2-2, *Configuration and Monitoring system*.). The test is run regardless of whether the reboot is caused by cycling power or by other means, such as a watchdog timeout or by pressing and holding the ENABLE and RESET keys.

If any failure occurs, it will be reported in the following ways:

- An error message is written on the LCD display and is visible for 2 seconds.
- The STATUS menu FAULT display will indicate that the self-test has failed and display the event code. This display will not be erased until instrument power is cycled.
- A similar message, which includes the event code, is entered in the Event Log.
- If the user-configurable event reporting methods (SNMP trap, e-mail, GPI signal, instrument beeper) are enabled to notify in the event of a voltage error, then a message is sent using the enabled method(s).

The self-test event code is a bit-wise value with each fault type assigned a bit. The following table lists the possible error codes.

Table 4-2: Self test error codes

Test type	Code
Front panel communications	0 (LSB)
Main board communications	1
Module 1 communications	2
Module 2 communications (if installed)	3
Module 3 communications (if installed)	4
Module 4 communications (if installed)	5
Power Supply combiner communications	6
MRAM communications	7
RTC communications	8 (MSB)

Check the state of the Power Supply module LEDs

When the instrument is running, the power supply LEDs indicate the status of the supplies, including the internal fans and which of the supplies is currently powering the instrument.

If the instrument loses power from both supplies, the LEDs continue to provide status to help troubleshoot the root of the problem. In this mode, the LEDs flash to conserve the power in the storage capacitor. Typically the LED flashing should last for 10 minutes after the loss of power.

If both of the supplies are good, the system will use the supply that is configured to be the preferred (active) supply. If one power supply has a problem, the system will switch to the other supply. If either supply can support the instrument load, even if it has a non-fatal problem, the system will choose the best supply and attempt to continue to operate.

The following table shows the states of the AC and DC LEDs on a Power Supply module when the power is on.

Table 4-3: Power on LED states for a Power Supply module

Power Supply state	AC LED state	DC LED state
Normal, Active	Green	Green
Normal, Backup	Green	Dim Green
AC < 75 V, DC supply running	Red	Green
AC < 75 V, DC supply failed	Red	Red
AC OK, DC supply failed	Green	Red
Marginal Low or High DC, Active		Orange
Marginal Low or High DC, Backup		Yellow
Load Test Fail - Backup		Red
Load Test Fail – Active		Orange
Fan Fail - Active		Orange
Fan Fail - Backup		Red
Supply not installed, AC present	Green	Off
Supply not installed, AC absent	Off	Off

The following table shows the states of the AC and DC LEDs on a Power Supply module when the power is off. The LEDs will blink for several minutes after power is removed from the instrument to help troubleshoot power problems.

Table 4-4: Power off LED states for a Power Supply module

Power Supply state	AC LED state	DC LED state
AC present, DC bad	Flash green	Flash red
AC missing, DC missing	Flash red	Off
AC present, supply not installed	Flash green	Off
AC missing, supply not installed	Off	Off
AC present, DC present, on-board converter failure	Flash green	Flash green

Troubleshooting power supply problems. For troubleshooting power supply problems, take these steps:

- If the AC LED is red, verify the power source connecting to the instrument.
- If the DC LED is red, replace the supply module.
- If both the AC and DC lights are flashing green, replace the Combiner board.
- Examine the STATUS menu display and the Event Log readouts to locate details on the nature of the faults.

Check the diagnostic readouts

The diagnostic readouts include temperatures, input signal levels, supply voltages, threshold voltages, fan operation, power supply usage hours, RTC battery level, LED operation, and the power supply load test result. Perform the following steps to check the diagnostic readouts:

1. Press **BACK** as necessary to access the top-level menu.
2. Press the up (▲) or down (▼) arrow to select **SYSTEM CONFIG**, and then press **ENTER** to access the SYSTEM CONFIG menu.
3. Press the up (▲) arrow to select **DIAGNOSTICS**, and then press **ENTER** to access the DIAGNOSITCS submenu.
4. Check the temperature readouts:
   a. If necessary, use the up (▲) or down (▼) arrow to select **TEMPERATURE**.
   b. Press the right (►) arrow to scroll through the Main (CPU) and Power Supply temperature readouts. Check that each temperature is **OK**.

NOTE. *The Power Supply temperatures (PS1 and PS2) are usually within 5 °C of the ambient. The Main (CPU) temp is usually 10 °C above ambient. If Option DPW is not installed, the PS2 temperature readout is "not installed."*

5. Check the Primary and Backup signal levels versus the threshold settings:
   a. Press the down (▼) arrow to select **CHx PRI vs THRES**.

NOTE. *The signal levels for each channel are displayed as dB relative to the threshold that is set for that channel. This is mainly an operational display rather than a true diagnostic.*

If the input is normal and the threshold is set for that signal type, then the readout should be about +3 dB. If the signal input is absent, then the level will be lower, such as -10 dB or -50 dB. Any level below 0 dB will cause the front-panel LED for that input to turn red. The detected input and threshold voltages that make up this dB ratio are available in other diagnostics that follow below.

   b. Press the right (►) arrow to scroll through each available Primary channel, verifying that each signal level readout is appropriate for the selected channel.
   c. Press the down (▼) arrow to select **CHx BACK vs THRES**.
   d. Press the right (►) arrow to scroll through each available Backup channel, verifying that each signal level readout is appropriate for the selected channel.

6. Check the Main board readouts:

   a. Press the down (▼) arrow to select **MAIN BOARD**.

   b. Press the right (►) arrow to scroll through each of the voltage readouts (+5.0 V, +3.3 V, –5.0 V, +5.2 V raw, +7.0 V). If a voltage is good, **OK** is displayed.

NOTE. *If the +5.2 V voltage is bad, check the Combiner board. If any of the other voltages are bad, replace the Main board.*

   c. Press the right (►) arrow to scroll through each of the detected peak levels for the LTC Primary and Backup inputs. For example, the LTC1 Primary input is indicated by **LTC1 P PK** and the Backup input is indicated by **LTC1 B PK**.

   If no signal is present, the levels will be near 0 V. If a signal is applied, then a detected level will be present. The gain of the detector is about 0.7, so a 5 V input will result in a detected peak level of about 3.5 V on the display.

NOTE. *If a signal is applied to a LTC input and the detected peak level is not correct, then replace the Main board.*

   d. Press the right (►) arrow to scroll through each of the threshold voltages for the LTC inputs. For example, the threshold for the LTC1 input is indicated by **LTC1 NEG**.

   For a 1 V threshold, expect a readout of about 0.4 V on the display. For a 2 V threshold, expect a readout of about 0.85 V. For a 5 V threshold, expect a readout of about 2.15 V on the display.

NOTE. *If the LTC thresholds are not as expected, replace the Main board.*

7. Check the Module 1 and REF/ELSW optional module readouts:

NOTE. *Module 1 is always installed and always contains REF/ELSW channels. For the ECO8000, each channel module has three channels per module. For the ECO8020, each channel module has five channels per module.*

a. Press the down (▼) arrow to select **MODULE 1**.

b. Press the right (►) arrow to scroll through each of the voltage readouts (+5.2 V raw, +3.3 V, +5.0 V, –5.0 V, +4.0 V, +7.0 V). If a voltage is good, **OK** is displayed.

NOTE. *If the +4.0 V voltage is bad, replace the module board. If any of the other voltages are bad, replace the Main board.*

c. Press the right (►) arrow to scroll through each of the channel threshold readouts.

The voltage displayed is a function of the threshold that is set. A readout of 0.69 V is nominal for an NTSC threshold. Other signals have different thresholds as a function of their level and bandwidth. It is very useful to compare levels from different channels that have the same threshold setting.

NOTE. *If the channel threshold levels are not correct, replace the module.*

d. Press the right (►) arrow to scroll through each of the detected peak levels for the Module 1 Primary and Backup inputs. For example, the Channel 1 Primary input is indicated by **CH1 P PK** and the Backup input is indicated by **CH1 B PK**.

If no signal is present, the readout will be near 0 V. If a signal is applied, then a detected level will be present. For an NTSC signal, the detected level will be about 1 V. Other signals have different detected levels as a function of their level and bandwidth. It is very useful to compare levels from different channels with the same signal applied.

NOTE. *If the channel peak levels are not correct, replace the module.*

e. Press the down (▼) arrow to select **MODULE 2**. If the module is not installed, the message "No module present" is displayed. In this case, proceed to step 9.

f. Depending on the type of channel module installed, proceed as follows:

- If module 2 has REF/ELSW channels, then perform steps b through d for module 2.

NOTE. *For module 2, the channel number readout is the number within the module, not the channel number on the rear or front panel. For example, channel 1 of module 2 is either channel 4 on an ECO8000 or channel 6 on an ECO8020.*

- If module 2 has HREF/Relay channels, then proceed to step 8.

NOTE. *If module 2 has HREF/Relay channels, then modules 3–4 (if installed) are also HREF/Relay channels.*

g. Press the down (▼) arrow to select **MODULE 3**. If the module is not installed, the message "No module present" is displayed. In this case, proceed to step 9.

h. Depending on the type of channel module installed, proceed as follows:

- If module 3 has REF/ELSW channels, then perform steps b through d for module 3.

NOTE. *For module 3, the channel number readout is the number within the module, not the channel number on the rear or front panel. For example, channel 1 of module 3 is either channel 7 on an ECO8000 or channel 11 on an ECO8020.*

- If module 3 has HREF/Relay channels, then proceed to step 8.

NOTE. *If module 3 has HREF/Relay channels, then module 4 (if installed) also has HREF/Relay channels.*

i. ECO8020 only: Press the down (▼) arrow to select **MODULE 4**. If the module is not installed, the message "No module present" is displayed. In this case, proceed to step 9.

j. Depending on the type of channel module installed, proceed as follows:

- If module 4 has REF/ELSW channels, then perform steps b through d for module 4.

NOTE. *For module 4, the channel number readout is the number within the module, not the channel number on the rear or front panel. For example, channel 1 of module 4 is channel 16 on an ECO8020.*

- If module 4 has HREF/Relay channels, then proceed to step 8.

8. Check the module readouts for each HREF/Relay optional channel module that is installed in your instrument:

NOTE. *The ECO8000 can have up to two optional channel modules installed. Modules 2–3 are optional modules and can be any combination of REF/ELSW and HREF/Relay channels. Each channel module has three channels per module.*

The ECO8020 can have up to three optional channel modules installed. Modules 2–4 are optional modules and can be any combination of REF/ELSW and HREF/Relay channels. Each channel module has five channels per module.

a. Press the down (▼) arrow to select **MODULE 2**. If the module is not installed, the message "No module present" is displayed. In this case, proceed to step 9.

b. If module 2 is installed and has HREF/Relay channels, press the right (►) arrow to scroll through each of the voltage readouts (+5.2 V raw, +3.3 V, +5.0 V, –5.0 V, +4.0 V, +7.0 V, +3.1 V raw). If a voltage is good, **OK** is displayed.

NOTE. *If the +4.0 V or +3.1 V raw voltage is bad, replace the module board. If any of the other voltages are bad, replace the Main board.*

c. Press the right (►) arrow to scroll through each of the channel threshold readouts.

NOTE. *For modules 2–4, the channel number readout is the number within the module, not the channel number on the rear or front panel. For example, channel 1 of module 2 is either channel 4 on an ECO8000 or channel 6 on an ECO8020.*

The voltage displayed is a function of the threshold that is set. A readout of 0.73 V is nominal for an NTSC threshold. Other signals have different thresholds as a function of their level and bandwidth. It is very useful to compare levels from different channels that have the same threshold setting.

NOTE. *If the channel threshold levels are not correct, replace the module.*

d. Press the right (►) arrow to scroll through each of the detected peak levels for the Module 2 Primary and Backup inputs. For example, the Channel 1 Primary input is indicated by **CH1 P PK** and the Backup input is indicated by **CH1 B PK**.

If no signal is present, the readout will be near 0 V. If a signal is applied, then a detected level will be present. For an NTSC signal, the detected level will be about 1.1 V. Other signals have different detected levels as a function of their level and bandwidth. It is very useful to compare levels from different channels with the same signal applied.

NOTE. *If the channel peak levels are not correct, replace the module.*

e. Press the down (▼) arrow to select **MODULE 3**. Proceed as follows:

- If module 3 is not installed, the message “No module present” is displayed. In this case, proceed to step 9.
- If module 3 is installed and has HREF/Relay channels, then perform steps b through d for module 3.

f. Press the down (▼) arrow to select **MODULE 4**. Proceed as follows:

- If module 4 is not installed, the message “No module present” is displayed. In this case, proceed to step 9.
- If module 4 is installed and has HREF/Relay channels, then perform steps b through d for module 4.

9. Check the Power Supply 1 and Power Supply 2 fan status:

   a. Press the down (▼) arrow to select **FAN STATUS**.

   b. Press the left (◄) or right (►) arrow button to toggle the readout between Power Supply 1 and Power Supply 2. The possible readouts are Fan running, Not installed, or Fan stopped. If a fan is stopped, then replace the associated Power Supply module.

NOTE. *If two Power Supply modules are installed but only one supply is connected to power, the fan on both supplies should be running.*

10. Check the Power Supply 1 and Power Supply 2 status:

   a. Press the down (▼) arrow to select **PS1 HOURS**.

   b. If the message **PS1 is not installed** appears, press the down (▼) arrow to select **PS2 HOURS**.

   c. Press the right (►) arrow button to scroll through the readouts: Active Hours, Standby Hours, Temperature Weighted Hours, +12 V Output Voltage. The Temperature Weighted Hours and +12 V Output Voltage readouts should read **OK**.

NOTE. *If a Power Supply module is installed but does not have an AC input, the +12 V readout will be between 1 and 2 V and will display the message WARN UV (under voltage).*

If a Power Supply module has AC input and the +12 V readout out is bad, then replace the supply. If a Power Supply module has a temperature weighted hour readout above 43200 hours, then replace the supply.

   d. If Power Supply 1 was installed , press the down (▼) arrow to select **PS2 HOURS**.

   e. Repeat step c for Power Supply 2.

11. Press the down (▼) arrow to select **RTC BATTERY LEVEL**. This diagnostic indicates the level of charge in the Real Time Controller (RTC) battery on the Processor board. The following readouts may appear:

   - **More than 40% (OK)** indicates the battery power is good.
   - **20% to 40% (WARN)** indicates the battery power is getting low and should be replaced soon.
   - **Less than 20% (LOW)** indicates that the battery should be replaced immediately.

12. Check the front-panel LEDs:

a. Press the down (▼) arrow to select **FP LED TEST**.

b. Press **ENTER** to start the test. The test first turns on each LED individually in green and red and then turns them all on together in green, red, and then yellow.

c. During the test, check for the following:

- When the LEDs are tested individually, only one LED is on at a time.
- When the LEDs are tested together, each LED should turn on for each color (green, red, yellow) with the colors and intensity being well matched.

NOTE. *If there is a bad LED or if two adjacent LEDs are shorted, replace the Front Panel board.*

13. Press the down (▼) arrow to select **PS1 LOAD TEST** or **PS2 LOAD TEST**. The readout will show PS1 or PS2, depending on which supply is configured as the primary supply.

The readout displays the status of the most recent load test of the backup power supply. The instrument automatically runs a load test on the backup supply every 24 hours when Option DPW is installed. **Load test not run** is displayed when only one supply is installed. When the test is run, the top line of the display lists whether the test passed or not and the second line lists the date and time of the test.

NOTE. *You can use the* ***SYSTEM CONFIG > PS LOAD TEST*** *menu selection to force a load test of the backup supply. After a load test, the load resistor must cool off for 30 seconds before a new test can be initiated. If the backup supply shows a load test failure, replace the backup supply.*

14. Press **BACK** to exit the DIAGNOSTICS submenu.

Check the cable connections

Refer to the figures in the *Remove and replace procedures* section to see the proper routing for the cables. (See page 3-6.)

AC input cables. The AC input cables go from the line filters to the J10 and J20 on the Combiner board. The line filter nearest to the side of the instrument should go to J20 to preserve the left and right association between supplies and AC inputs. (See Figure 3-14 on page 3-20.)

Light pipes for AC and DC LEDs. There are four light pipes that carry light from LEDs on the Combiner board to lenses for the power supply AC and DC LEDs on the front panel. It is important that the top and bottom light pipes route to the correct receptacle on the Combiner board. Each is receptacle on the board is labeled as “top” or “bot” (bottom) to assist in making correct connections. (See Figure 3-15 on page 3-21.)

14-pin white power cable. The 14-pin white power cable between the Combiner board and the Main board carries +5.2 V power to the Main board, +3.3 V power from the Main board to the Combiner board, and carries the I2C control, power fault and AC power low signals. The cable latches in place.

16-pin Display board ribbon cable. The 16-pin ribbon cable from the Processor board to the Display board has a polarized header on the Processor board. On the Display board, the pin-1 red wire should be on the bottom.

26-pin Front Panel board ribbon cable. The 26-pin ribbon cable from the Main board to the Front Panel board carries +3.3 V and +5 V power, the button signals, and the LED serial chain. Both ends of the cable are polarized.

60-pin channel board cables. Each installed channel board has a 60-pin cable that connects to the Main board. Depending on the installed options, an instrument may have from 1 to 4 of these large wire cables. Correct connectivity and polarity are two important items to check with these cables.

The four connectors on the Main board are labeled slot 1 to slot 4. The channel board that mounts above the Main board must connect to the Slot 1 connector on the Main board. The Slot 2 connector on the Main board must connect to the top channel board installed near the AC connectors. Each subsequent slot connector goes to the next channel board that is installed lower in the stack. It is important not to skip a slot connector on the Main board or to reverse the order of channel board connections.

The 60-pin cables and connectors are polarized, but it is possible to force them in wrong direction and it can be difficult to tell if the cables are fully seated. The polarization is a small tab on the pin 60 end of the connector. The polarization tab goes toward the front of the instrument on the Main board and to the top and toward the AC line filters on the channel boards.

Check the Diagnostics for miss-connected modules.

1. Press **BACK** as necessary to access the top-level menu.
2. Press the up (▲) or down (▼) arrow to select **SYSTEM CONFIG**, and then press **ENTER** to access the SYSTEM CONFIG menu.
3. Press the up (▲) arrow to select **DIAGNOSTICS**, and then press **ENTER** to access the DIAGNOSITCS submenu.
4. Press the down (▼) arrow several times to select **MAIN BOARD**.
5. Press the down (▼) arrow to select **MODULE 1**.
6. Press the down (▼) arrow three more times to see which slots have modules installed.
7. You should see the same number of modules that are installed in the instrument, and they should all be consecutive. You should not see a slot without a module followed by a slot that does have a module installed. For example, if the readout for Module 2 is "No module present," then there should be no modules installed in slots 3-4.

Check the Combiner board voltages

1. Leave the instrument powered on and remove the instrument top cover. (See Figure 3-2 on page 3-8.)

CAUTION. *Line voltages of 100 to 240 VAC are present on the Combiner board. Although most of the line voltage circuits are on the back side of the circuit board, be careful to avoid contact with these voltages.*

Additionally, C7 stores a charge from the 12 V supply to power the front-panel power supply LEDs for up to 10 minutes after the instrument is powered off. If you need to remove the Combiner board, you should press and hold S1 for 5 seconds to discharge C7 before removing the board. (See Figure 4-1.)

2. Locate the Combiner board. (See Figure 3-3 on page 3-10.)
3. On the Power Combiner board, measure the output of the DC supply on pin P4 on both J100 and J200. (See Figure 4-1.) The voltage should be 12 V for a supply that is running or about 1.5 V on the second supply if only one supply is running.
4. If the 12 V supply voltages are bad, check the 110-240 VAC input on J100 and J200 pins P2 and P3. If the voltage is good, replace the supply module.

5. Measure the 5.2 V output on J111 pin 10. This connector has pins 8-14 on the outside row, so pin 10 is the third from the bottom (when facing the front of the instrument. If the 5.2 V is bad, replace the Combiner board.

6. Check the 3.3 V supply on J111 pin 8. This is actually the I2C SDA line, but should be pulled up to 3.3 V. If not, then check the 3.3 V supply on the Main board. (See page 4-18, *Check the Main board 3.3 V supply and that the PLD is programmed*.)

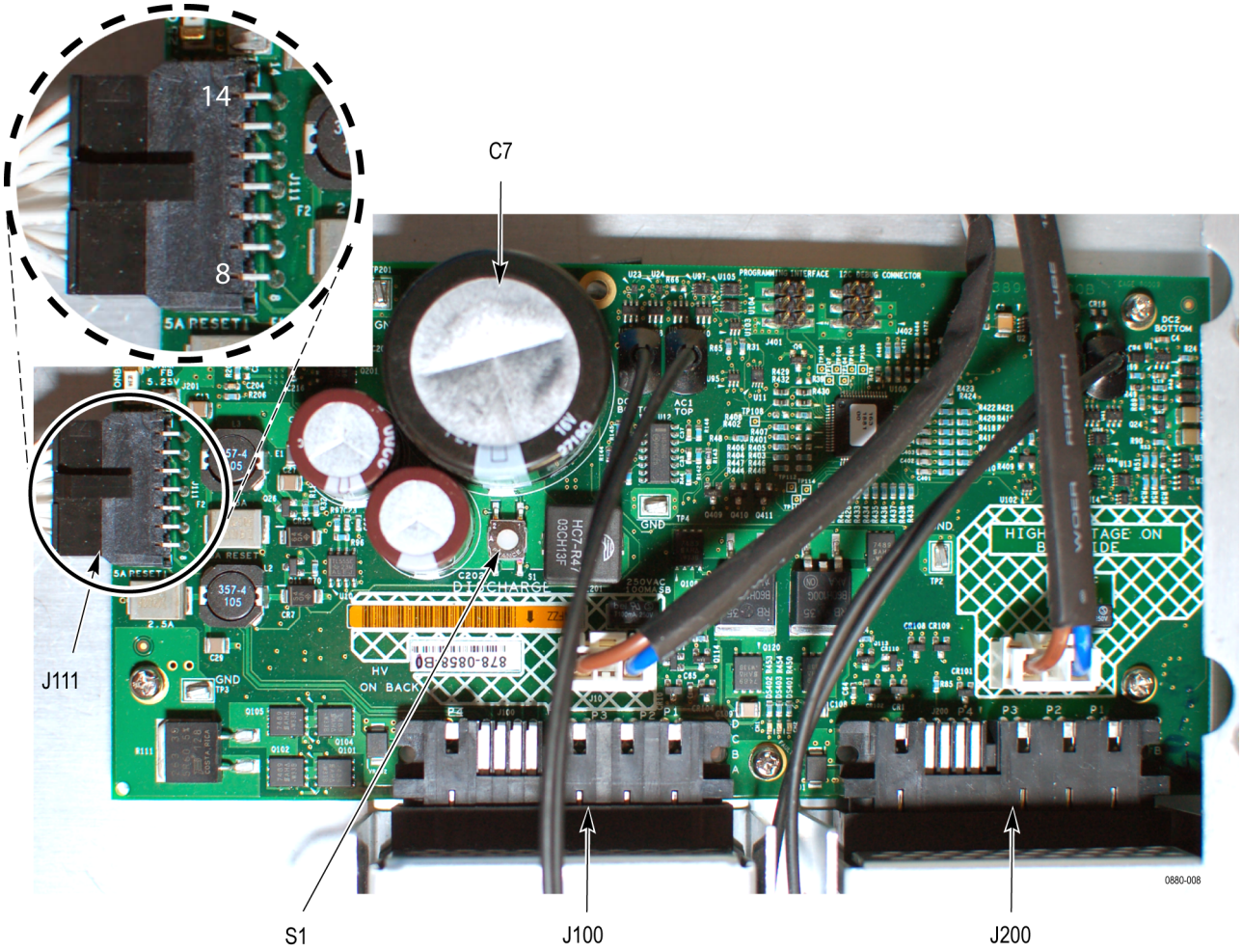


Figure 4-1: Component locations on the Combiner board

Check the Main board 3.3 V supply and that the PLD is programmed

1. Check the 3.3 V supply on the Main board. This is accessible on pin 2 of the connector to the Processor board (JR1). (See Figure 4-2.) This supply is generated on the Main board from the 5.2 V input and must be present for the PLD to work.
2. Locate S1 on the Main board (it is labeled “MFG_MODE”).
3. Press S1 and some of the channel relays should switch. Also, a small red LED should come on just behind the support bracket. This function should toggle on and off as repeatedly press S1.
4. If the MFG mode is not working, then the PLD is not running. Replace the Main board.

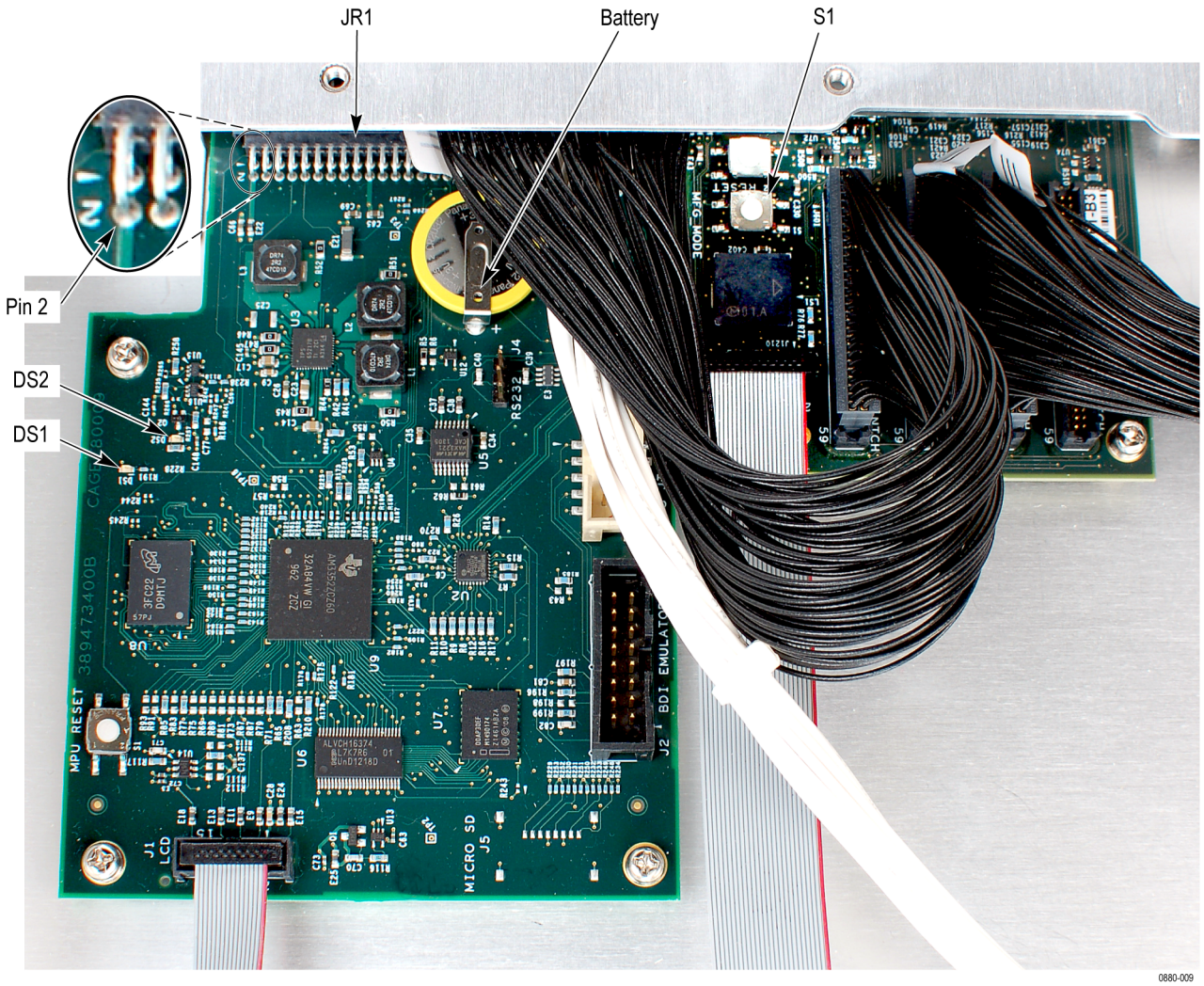


Figure 4-2: Component locations on the Processor and Main boards

Check the Processor board

1. The Processor board drives the display and reads the right side buttons (ENTER, BACK, and the four navigation arrows). If the display is working and responding to buttons, then the CPU is at least partially working.
2. Check the 5 V input on pin 20 of JR1, the large connector from the Main board. If the 5 V is bad or not present, then check the Main board and the Combiner board.
3. Check the voltage on the battery. The voltage should be 3 V nominal.
4. During the power-on process, both DS1 and DS2 should light up as follows:
   - DS2 is the power status LED. If all of the rails on the power management chip are nominal, then the chip turns on the 3.3 VA and drives the DS2 LED on. If the DS2 LED is off, replace the Processor board.
   - DS1 is the processor heartbeat. After a power cycle, the DS1 LED should be on steady for about 13 seconds, then go off for about 12 seconds, then start flashing at about 2x per second. The completion of this sequence indicates that the processor has booted and is running normally. If DS1 flashes slowly, or does not follow the normal power-on pattern, replace the Processor board.
5. The instrument display should show messages during the boot up process. If the power is there but the display is not running, then replace the Processor board.

Check a channel threshold level

For each channel, the threshold setting must match the type of signal that is connected to that channel.

1. If necessary, set the instrument to Manual mode:
   a. Press and hold the **PANEL ENABLE** button to enable the front-panel control buttons. The instrument beeps when the control buttons are enabled.
   b. Press the **MANUAL MODE** button to put the ECO8000 Series in Manual mode.
2. Press **BACK** as necessary to access the top-level menu.
3. Press the up (▲) or down (▼) arrow to select the Channel menu. The top line will begin with “LTC” or “CH”.
4. Press the left (◄) or right (►) arrow button to select the channel that has a problem, and then press **ENTER** to enter the submenu for that channel.
5. Verify that the channel is enabled. If the channel is disabled, press the left (◄) or right (►) arrow button to select **Enabled**, and then press **ENTER** to make the change.
6. Press the down (▼) arrow twice to select **THRESHOLD**.

7. Verify that the threshold setting matches the type of signal that is connected to the selected channel. If necessary, press the left (◄) or right (►) arrow button to select the correct threshold setting, and then press **ENTER** to make the change.
8. If the channel status LED is still indicating an error, then swap the input signal with one from another channel that is working. If necessary, reconfigure the threshold setting for the new signal.
9. If this channel still does not work with a known good signal, then replace the associated channel module board.

Check an HREF/Relay channel termination

Only the optional 3 GHz HREF/Relay channel boards are sensitive to missing terminations. On these boards, the detected level on the active source will increase if the output is not terminated. The 50 MHz REF/ELSW channel boards in the base unit and the Option REF channel boards are not susceptible to this.

1. Apply the same type of signal to the Primary and Backup inputs for the channel you are testing. Use a signal that is supported by the channel, such as NTSC, SDI, or AES.
2. If necessary, set the instrument to Manual mode:
   a. Press and hold the **PANEL ENABLE** button to enable the front-panel control buttons. The instrument beeps when the control buttons are enabled.
   b. Press the **MANUAL MODE** button to put the ECO8000 Series in Manual mode.
3. Press **BACK** as necessary to access the top-level menu.
4. Press the up (▲) or down (▼) arrow to select the Channel menu. The top line will begin with “LTC” or “CH”.
5. Press the left (◄) or right (►) arrow button to select the channel you are testing, and then press **ENTER** to enter the submenu for that channel.
6. Check that the channel is enabled. If the channel is disabled, press the left (◄) or right (►) arrow button to select **Enabled**, and then press **ENTER** to make the change.
7. Press the down (▼) arrow twice to select **THRESHOLD**.
8. If necessary, press the left (◄) or right (►) arrow button to select **CUSTOM**, and then press **ENTER** to make the change.
9. The top line of the menu will show the Primary and Backup levels relative to the threshold setting. Press the left (◄) or right (►) arrow button to set the custom DAC level to **40**.

10. Check that the signal levels on the top line indicate that a signal is present. If they indicate a very low level, such as -13 dB then connect a bigger signal to the Primary and Backup inputs.
11. If necessary, press and hold the **PANEL ENABLE** button to enable the front-panel control buttons. The instrument beeps when the control buttons are enabled.
12. Press the **PRIMARY SOURCE** and **BACKUP SOURCE** buttons to change the active source. Watch the level readouts on the display as you make the switch. If the levels change more than 1 dB, then the output is not terminated.
13. Add a termination to the output signal for the channel you are testing, and then repeat this test.

Check that the channel is enabled

Each Channel can be enable or disabled, and it can be selected to trigger a source switch or not. See the Operators manual for more information.

1. If necessary, set the instrument to Manual mode:
   a. Press and hold the **PANEL ENABLE** button to enable the front-panel control buttons. The instrument beeps when the control buttons are enabled.
   b. Press the **MANUAL MODE** button to put the ECO8000 Series in Manual mode.
2. Press **BACK** as necessary to access the top-level menu.
3. Press the up (▲) or down (▼) arrow to select the Channel menu. The top line will begin with “LTC” or “CH”.
4. Press the left (◄) or right (►) arrow button to select the channel you are checking, and then press **ENTER** to enter the submenu for that channel.
5. Check that the channel is enabled. If the channel is disabled, press the left (◄) or right (►) arrow button to select **Enabled**, and then press **ENTER** to make the change.

Disable the Relay Check function for an HREF/Relay channel

The optional 3 GHz HREF/Relay channels can detect an open relay contact after a source switch. If the output is unterminated, this detection will be falsely triggered. Therefore, the relay check function should be turned off on unterminated output signals. This function does not apply to the 50 MHz REF/ELSW channels.

1. If necessary, set the instrument to Manual mode:
   a. Press and hold the **PANEL ENABLE** button to enable the front-panel control buttons. The instrument beeps when the control buttons are enabled.
   b. Press the **MANUAL MODE** button to put the ECO8000 Series in Manual mode.
2. Press **BACK** as necessary to access the top-level menu.
3. Press the up (▲) or down (▼) arrow to select the Channel menu. The top line will begin with “LTC” or “CH”.
4. Press the left (◄) or right (►) arrow button to select the HREF/Relay channel you are checking, and then press **ENTER** to enter the submenu for that channel.
5. Check that the channel is enabled. If the channel is disabled, press the left (◄) or right (►) arrow button to select **Enabled**, and then press **ENTER** to make the change.
6. Press the down (▼) arrow to select **RELAY CHECK**.
7. Press the left (◄) or right (►) arrow button to select **Disabled**, and then press **ENTER** to make the change.
8. Press **BACK** to exit the channel submenu.

Execute the Initialize Hardware function

There are multiple settings that can affect the operation of each channel. In the event that it is unclear why a channel is not working, it is possible to restore many settings back to a factory default state. The Initialize Hardware function is intended for use only during the manufacturing and service of the instrument.

CAUTION. *To prevent a loss of instrument configuration and a disruption in the output signals, do not perform the Initialize Hardware function while the instrument is in service. Executing the Hardware Initialization function will override many user settings. Only perform this function if you are sure it is necessary.*

When this function is activated, the CPU determines which hardware and software options are installed and then configures the following system parameters to a default state:

- Enables all of the installed channels including the LTC channels if Option LTC is installed
- Arms all of the installed BNC channels as switchover triggers (but not the LTC channels if Option LTC is installed)
- Sets all thresholds to the default values (NTSC for BNC channels, 2 V for LTC channels if Option LTC is installed)
- Disables the Relay Check function
- Disables the SPG input trigger function
- Sets the Startup Delay setting to 15 seconds

Procedure.

1. If necessary, set the instrument to Manual mode:
   a. Press and hold the **PANEL ENABLE** button to enable the front-panel control buttons. The instrument beeps when the control buttons are enabled.
   b. Press the **MANUAL MODE** button to put the ECO8000 Series in Manual mode.
2. Press **BACK** as necessary to access the top-level menu.
3. Press the up (▲) or down (▼) arrow to select **SYSTEM CONFIG**, and then press **ENTER** to enter the SYSTEM CONFIG menu.
4. Press the up (▲) or down (▼) arrow to select **INITIALIZE HW**, and then press **ENTER** to start initialization process.
5. A confirmation message is displayed. Press **ENTER** again to perform the initialization of the hardware or press **BACK** to exit without performing the function.

Replaceable Parts

Replaceable parts

This section contains a list of the replaceable modules for your instrument. Use this list to identify and order replacement parts. Note that not all parts listed in this section are present on every model. The parts present will depend on the model and options installed.

Parts ordering information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest 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 you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Module servicing

Modules can be serviced by selecting one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module exchange. In some cases, you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-833-9200. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix Web site for a list of offices: www.tektronix.com.

Module repair and return. You may ship your module to us for repair, after which we will return it to you.

New modules. You may purchase replacement modules in the same way as other replacement parts.

Using the replaceable parts lists

This section contains lists of the mechanical and/or electrical components that are replaceable for your instrument. Use this list to identify and order replacement parts. The following table describes the columns in the parts list.

Parts list column descriptions

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the illustrations that follow. Orderable modules show the figure number without an index number.
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entry indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & description	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.

Abbreviations

Abbreviations conform to American National Standard ANSI Y1.1-1972.

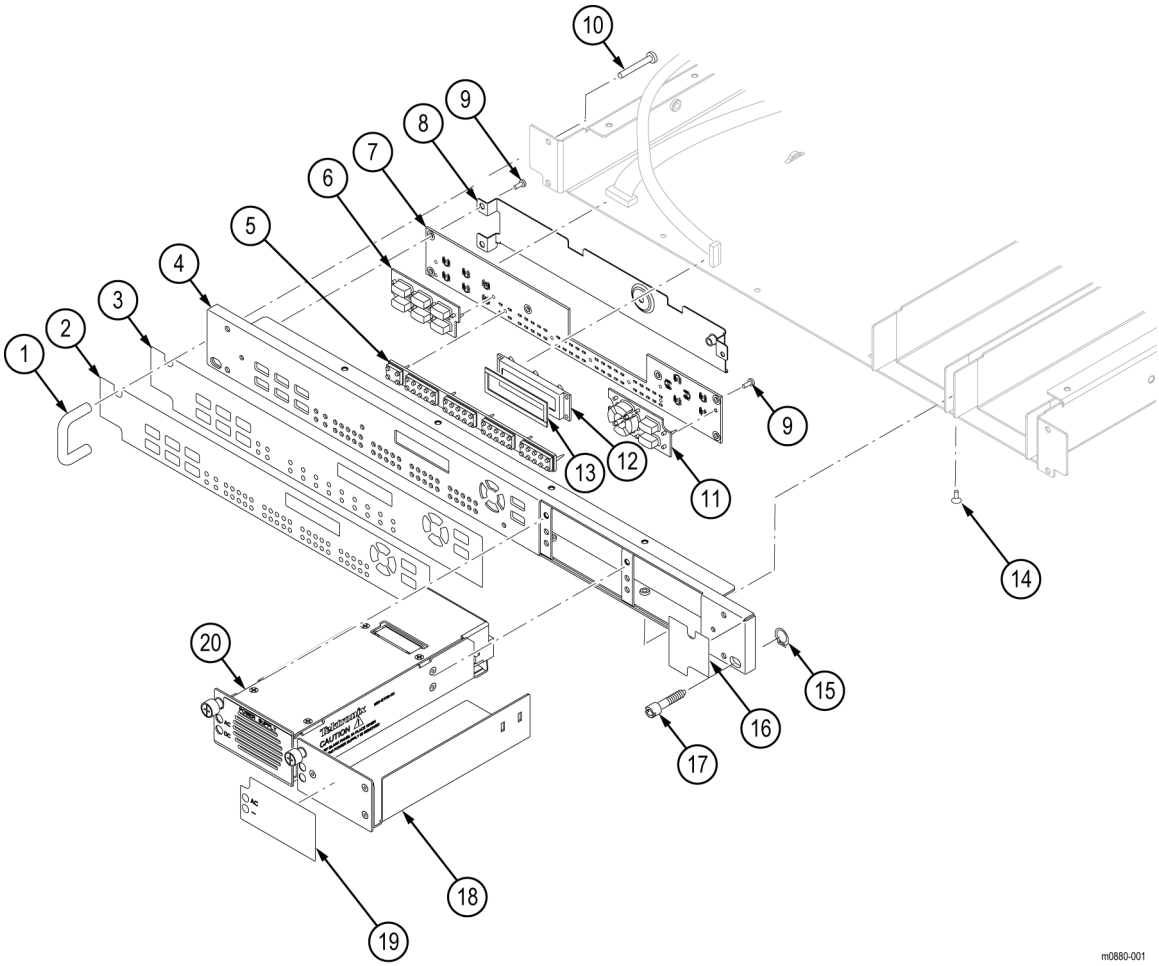


Figure 5-1: Front panel assembly and Power Supply module

Table 5-1: Front panel assembly and Power Supply module replaceable parts list

Fig. & index number	Tektronix part number	Qty	Name & description
5-1			**Front panel assembly and Power Supply module**
-1	367-0530-xx	2	HANDLE, BOW; AL,1.0 X 1.25, STAIN FINISH, SAFETY CONTROLLED
-2	335-3105-xx	1	LABEL, FRONT PANEL, SAFETY CONTROLLED, ECO8020
-3	335-3088-00	1	LABEL, FRONT PANEL, SAFETY CONTROLLED, ECO8000
-4	333-4709-xx	1	PANEL, FRONT
-5	260-2979-xx	1	LIGHT PIPE, FRONT PANEL EMAT
-6	260-2976-xx	1	SWITCH KEYPAD (ELASTOMERIC MAT, SET)
-7	878-0859-xx	1	CIRCUIT BOARD ASSY; ECO FRONT PANEL
-8	407-5779-xx	1	BRACKET, FRONT PANEL CONNECTOR RETAINER
-9	211-A245-xx	6	SCREW, MACHINE; M3 X 6 MM L, PNH, STL, NI PL, CROSS REC, W/PLAIN & SPLIT LOCK WASHER
-10	211-1276-xx	2	SCREW, MACHINE; 6-32 X 0.375, PNH, STL, ZNPL, T-15 TORX DR
-11	260-2976-xx	1	SWITCH KEYPAD (ELASTOMERIC MAT, SET)
-12	119-8090-xx	1	DISPLAY MODULE; LCD; 20 CHARACTERS X 2 LINES, TRANSFLECTIVE, 6:00 VIEW, STN, WHITE LED BACKLIGHT
-13	348-2080-xx	1	GASKET, DISPLAY DUST SEAL
-14	211-1194-xx	4	SCREW, MACHINE; M3 X 6MM, FLH BLACK, CROSS REC
-15	354-0025-xx	2	RING, RETAINING; EXTERNAL,U/O 0.187 DIA SFT, ZINC PLATED STEEL
-16	335-3117-xx	1	LABEL, FRONT PANEL LEXAN RIGHT SIDE, NO TEXT
-17	213-0216-xx	2	THUMBSCREW; 10-32 X 0.85,0.375 OD HD, ZINC PLATED STEEL, W/SLOT
-18	333-4724-xx	1	PANEL, BLANK POWER SUPPLY (not included when Option DPW is installed)
-19	335-3259-xx	1	LABEL, BLANK POWER SUPPLY (not included when Option DPW is installed)
-20	650-5708-xx	1	POWER SUPPLY MODULE ASSEMBLY (quantity is two when Option DPW is installed)

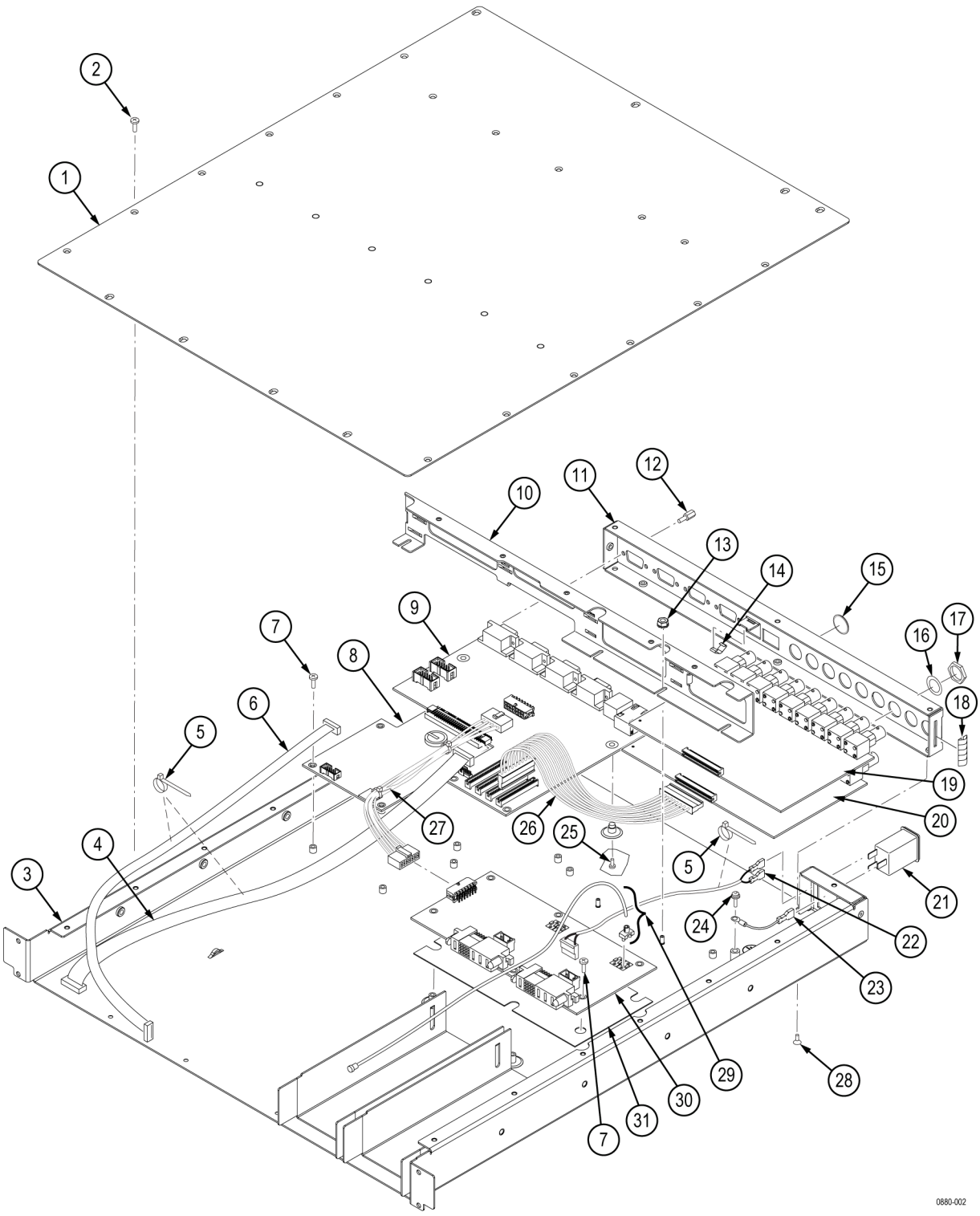


Figure 5-2: Main chassis and ECO8000 rear panel

Table 5-2: Main chassis and ECO8000 rear panel replaceable parts list

Fig. & index number	Tektronix part number	Qty	Name & description
5–2			**Main chassis and ECO8000 rear panel**
-1	200-5294-xx	1	CABINET, TOP MAIN CHASSIS, SAFETY CONTROLLED
-2	211-1194-xx	25	SCREW, MACHINE; M3 X 6MM, FLH BLACK, CROSS REC
-3	441-2743-xx	1	CHASSIS, MAIN BASE, SAFETY CONTROLLED
-4	174-6301-xx	1	FRONT PANEL TO MAIN BOARD CABLE
-5	346-0120-xx	2	STRAP, TIEDOWN; 5.5 L MIN, PLASTIC, WHITE
-6	174-6303-xx	1	CABLE, RIBBON, LCD, 2X8, 0.050 P DISPLAY TO PROCESSOR FEMALE TO FEMALE
-7	211-A245-xx	12	SCREW, MACHINE; M3 X 6 MM L, PNH, STL, NI PL, CROSS REC, W/NUT & LOCK WASHER
-8	878-0860-xx	1	CIRCUIT BOARD ASSY; ECO PROCESSOR
-9	878-0861-xx	1	CIRCUIT BOARD ASSY; ECO MAIN LOGIC
-10	407-5746-x	1	BRACKET, PCB RETAINER, SD MODULE, ECO8000
-11	333-4708-xx	1	REAR PANEL, ECO8000
-12	214-3903-xx	8	SCREW, JACK; 4-40 X 0.312 EXT THD, 4-40 INT THD, 0.188 HEX, ZINC PLATED STEEL
-13	220-A095-xx	4	NUT, PLAIN, HEX: M3, STL, NI PL, W/EXT TOOHED WASHER
-14	131-6643-xx	1	CONTACT, ELEC; GROUNDING, 0.169 L, 0.320 DEEP, ELECTROLESS NICKEL
-15	134-0273-x	0–18	PLUG, HOLE COVER; BUTTON PLUG, DOUBLE-D HOLE, ECO8000 (quantity depends on product options; nine for each uninstalled channel module)
-16	210-1039-xx	9–27	WASHER, LOCK; 0.521 ID, INT, 0.025 THK, STEEL, ZINC FINISH, ECO8000 (quantity depends on product options; nine for each installed channel module)
-17	220-0497-xx	9–27	NUT, PLAIN, HEX; 0.5-28 X 0.562 HEX, BRS, NI (NICKEL) PLATE, ECO8000 (quantity depends on product options; nine for each uninstalled channel module)
-18	348-A156-01	1	GASKET, SHIELD; FINGER TYPE, BE-CU, 8.13MM W X 2.79MM H X 406.4MM L
-19	878-0853-xx	1–3	CIRCUIT BOARD ASSY; ECO ANALOG CHANNEL MODULE (OPTION REF), UNTESTED, ECO8000 (quantity depends on product options; one for each installed REF/ELSW channel module)
-20	878-0855-xx	0–2	CIRCUIT BOARD ASSY; ECO SDI CHANNEL MODULE (OPTION HREF), UNTESTED, ECO8000 (quantity depends on product options; one for each installed HREF channel module)
-21	119-7929-xx	2	FILTER, EMI; AC LINE FILTER; 4.0A, 115-250VAC, 50/60HZ, IEC INPUT, LOCKING CORD, FAST-ON/SOLDER LUG OUTPUT
-22	174-6312-xx	2	AC LINE TO COMBINER CABLE, SAFETY CONTROLLED
-23	174-6151-xx	2	CABLE ASSEMBLY (LINE FILTER TO GROUND, 16 AWG), SAFETY CONTROLLED
-24	212-A041-xx	2	SCREW, MACHINE; M4 X 8MM L, PNH, STL, NI PL, CROSS REC, W/NUT & LOCK WASHER
-25	211-1194-xx	2	SCREW, MACHINE; M3 X 6MM, FLH BLACK, CROSS REC
-26	174-6302-xx	1–4	CABLE ASSEMBLY 60 PIN, PCB MAIN TO PCB MODULE (quantity depends on product model and options; one for each installed channel module)
-27	174-6045-xx	1	CABLE ASSEMBLY, BRIDGE-MARKER-CLOCK (14 POS MICRO-FIT, 12 INCH)
-28	211-1194-xx	4	SCREW, MACHINE; M3 X 6MM, FLH BLACK, CROSS REC
-29	352-1134-xx	4	LIGHT PIPE AND HOUSING, PWR SUPPLY SPG 8000, SAFETY CONTROLLED

Table 5-2: Main chassis and ECO8000 rear panel replaceable parts list (cont.)

Fig. & index number	Tektronix part number	Qty	Name & description
-30	878-0858-xx	1	CIRCUIT BOARD ASSY; ECO POWER COMBINER
-31	337-4615-00	1	SHIELD, COMBINER BOARD, SAFETY CONTROLLED

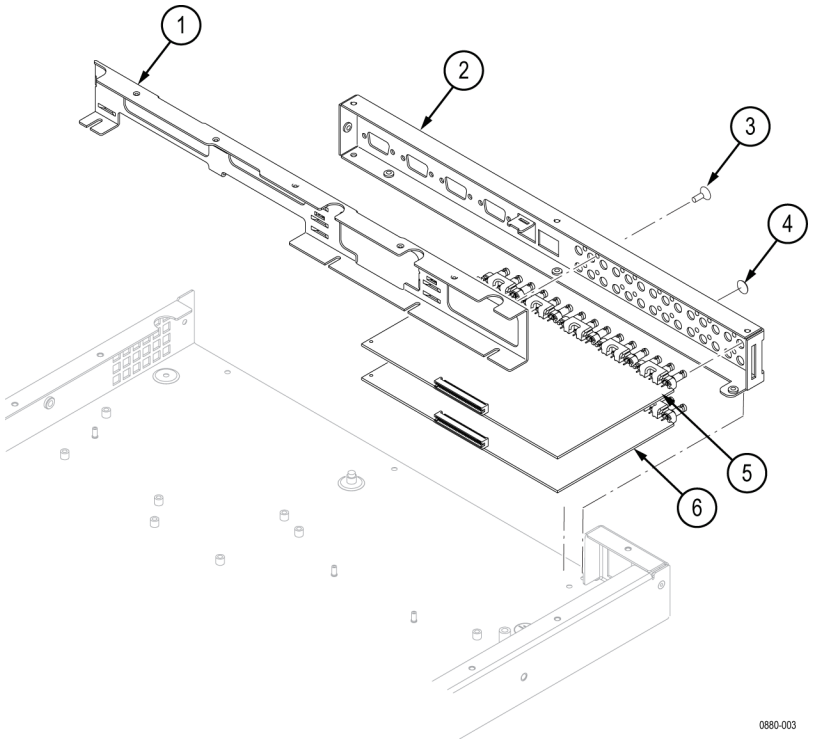


Figure 5-3: ECO8020 rear panel

Table 5-3: ECO8020 rear panel replaceable parts list

Fig. & index number	Tektronix part number	Qty	Name & description
5-3			**ECO8020 rear panel**
-1	407-5745-xx	1	PCB RETAINER, ECO8020
-2	333-4710-xx	1	REAR PANEL, ECO8020
-3	211-1194-01	10–40	SCREW, MACHINE; M3 X 6MM, FLH BLACK, CROSS REC (quantity depends on product options; 10 for each installed channel module)
-4	134-0277-xx	0–45	PLUG, HOLE COVER; BUTTON PLUG, 0.312 HEAD DIA X 0.312 THK, ACCOM 0.250 DIA D HOLE, ECO8020 (quantity depends on product options; 15 for each uninstalled channel module)
-5	878-0854-xx	1–4	CIRCUIT BOARD ASSY; ECO ANALOG HD BNC CHANNEL MODULE (OPTION REF), ECO8020 (quantity depends on product options; one for each installed REF/ELSW channel module)
-6	878-0856-xx	0–3	CIRCUIT BOARD ASSY; ECO SDI HD BNC CHANNEL MODULE (OPTION HREF), ECO8020 (quantity depends on product options; one for each installed HREF channel module)

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