Product Manual
J85501E-1

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Lucent Technologies
Lineage® 2000
ECS-6U Controller

Notice:
Every effort was made to ensure that the information in this document was complete and accurate at the time of printing. However, information is subject to change.

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1 Introduction

General Information

This product manual, Select Code 167-790-045, describes the J85501E-1 ECS-6U Universal Rectifier Controller. The basic ECS-6U controller monitors and controls any combination of up to six Lucent Technologies switchmode (SR) or Lineage® 2000 ferroresonant rectifiers and provides a single interface point for power alarm and status reporting. When ordered with the optional microprocessor and datalogger features, it adds the latest technology in the product line to the battery plant.

When used with the optional Rectifier Adapter Board (RAB), the ECS-6U controller allows rectifiers of various technologies, vintages, and vendors to be tied together in the same battery plant and can be used for retrofit applications in older Lucent Technologies battery plants such as the 150 series, the 326 series, or the 111A. It can also be used to replace older technology controllers in other vendors' battery plants. Upgrading can be accomplished by placing the controller in a supplemental bay or in the same bay as the original equipment.

Appendix A is a list of the various Lucent Technologies rectifiers, both J- and KS-coded, that have the automatic restart feature and are compatible with the ECS-6U.

The ECS-6U demonstrates Lucent Technologies' continuing dedication to providing state-of-the-art energy systems management products for all battery plants, both old and new. The Lineage® 2000 Battery Plant product line is designed to provide battery-backed common system office voltages of +24Vdc, -24Vdc, or -48Vdc in telecommunications applications.

The ECS-6U controller is shown in Figure 1-1. A typical ECS controller application is shown in Figure 1-2.

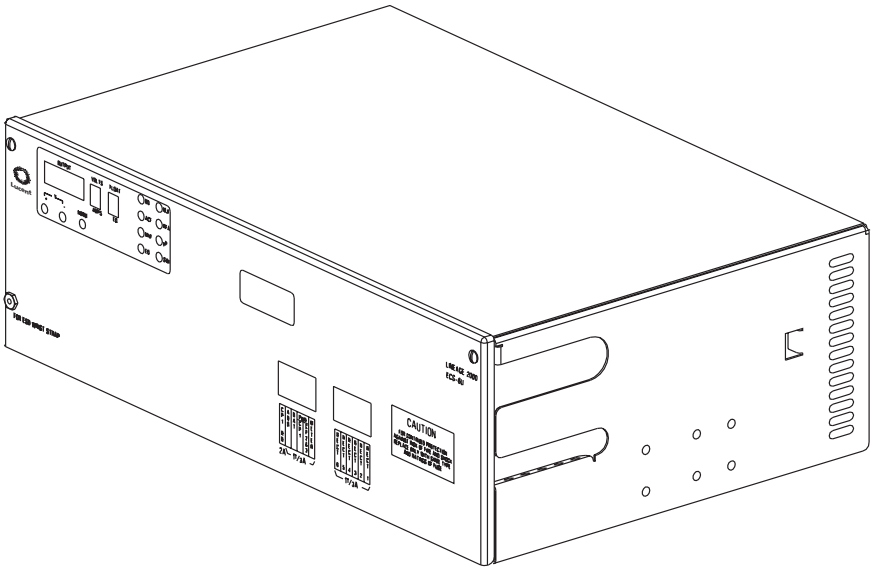


Figure 1-1: ECS-6U Controller

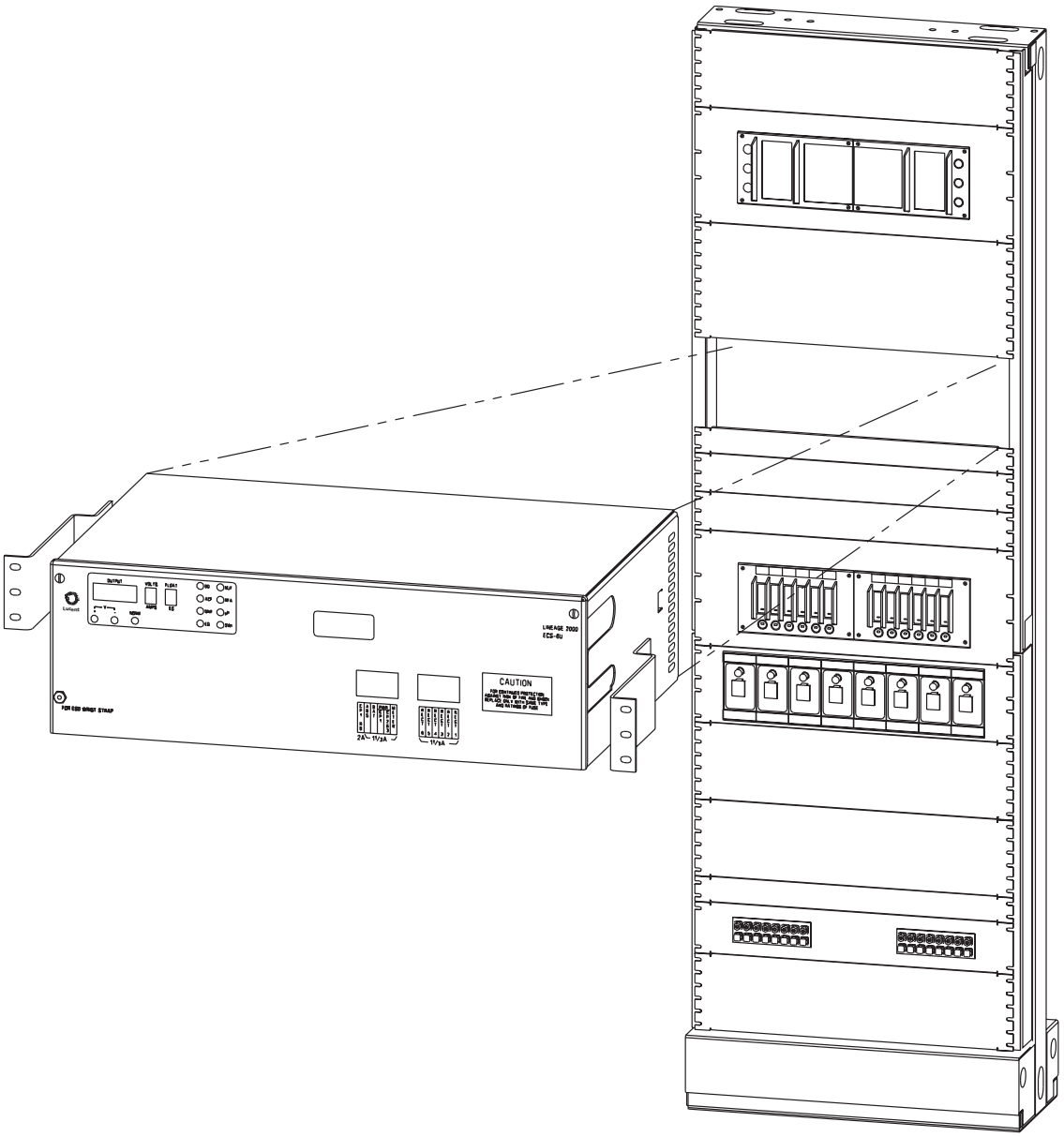


Figure 1-2: Typical ECS Controller Application

Customer Training

Lucent Technologies offers customer training on many Power Systems products. For information call 1-972-284-2163. This number is answered from 8:00 a.m. until 4:30 p.m., Central Time Zone (Zone 6), Monday through Friday.

Customer Service

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-THE-1PWR (1-800-843-1797). Services provided through this contact include initiating the spare parts procurement process for out of service emergencies, ordering Lucent Technologies documents, and providing other product and service information.

For other customers worldwide, call 001-972-840-0382. This number is answered from 8:00 a.m. until 4:30 p.m., Central Time Zone (Zone 6), Monday through Friday.

Technical Support

Technical support for Lucent Technologies customers is available around the world during the normal product warranty period and also while specific contractual agreements extend this service.

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-CAL-RTAC (1-800-225-7822) to contact a product specialist to answer your technical questions and assist in troubleshooting problems.

For other customers worldwide, contact your local field support center or your sales representative to discuss your specific needs.

Product Repair and Return

Repair and return service is provided for Lucent Technologies customers around the world. For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-255-1402 for information on returning of products for repair.

For other customers worldwide, contact your sales representative to discuss your particular circumstances.

Warranty Service

For warranty service worldwide, contact your Warranty Service Manager (WSM). The WSM serves specific customer-groups, who have taken ownership of the product. For product

conformance issues prior to customer ownership, contact your local customer service.

2 Product Description

Overview

The ECS-6U Controller consists of a chassis equipped with two slide-out trays. The upper tray is equipped with a standard analog control unit, 113A2, which consists of two circuit packs: the control board (CP1) and the display board (CP4). The control unit is plugged into a backplane with expansion slots for two optional circuit packs: the Microprocessor Board (CP2) and the Datalogger Board (CP3). See “Controller Options” for more information.

The lower tray is equipped with a standard Rectifier Interface Board (RIB) plugged into a backplane with one expansion slot for an optional Rectifier Adapter Board (RAB). See “Rectifier Adapter Board” for more information.

The lower tray also provides space for the optional Order Wire Board. Two other options may be added that are not part of the controller itself: the Boost Charge Circuit and the Shunt Isolator Circuit. See “Circuit Options” for more information.

A Fuse Alarm Board (CP5), which is mounted inside the front door, is always required to provide fusing for the controller and rectifier sense leads. See “Fuse Alarm Board” for more information.

A front view of the ECS-6U controller is shown in Figure 2-1. Figure 2-2 is a block diagram of the controller.

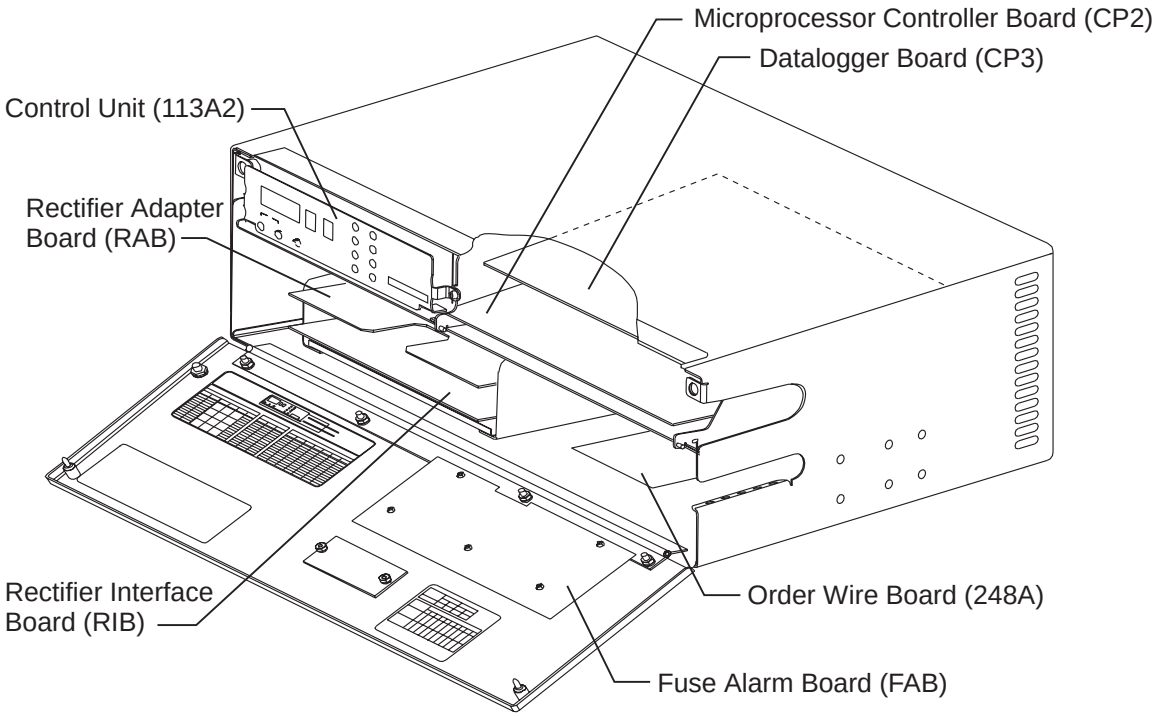
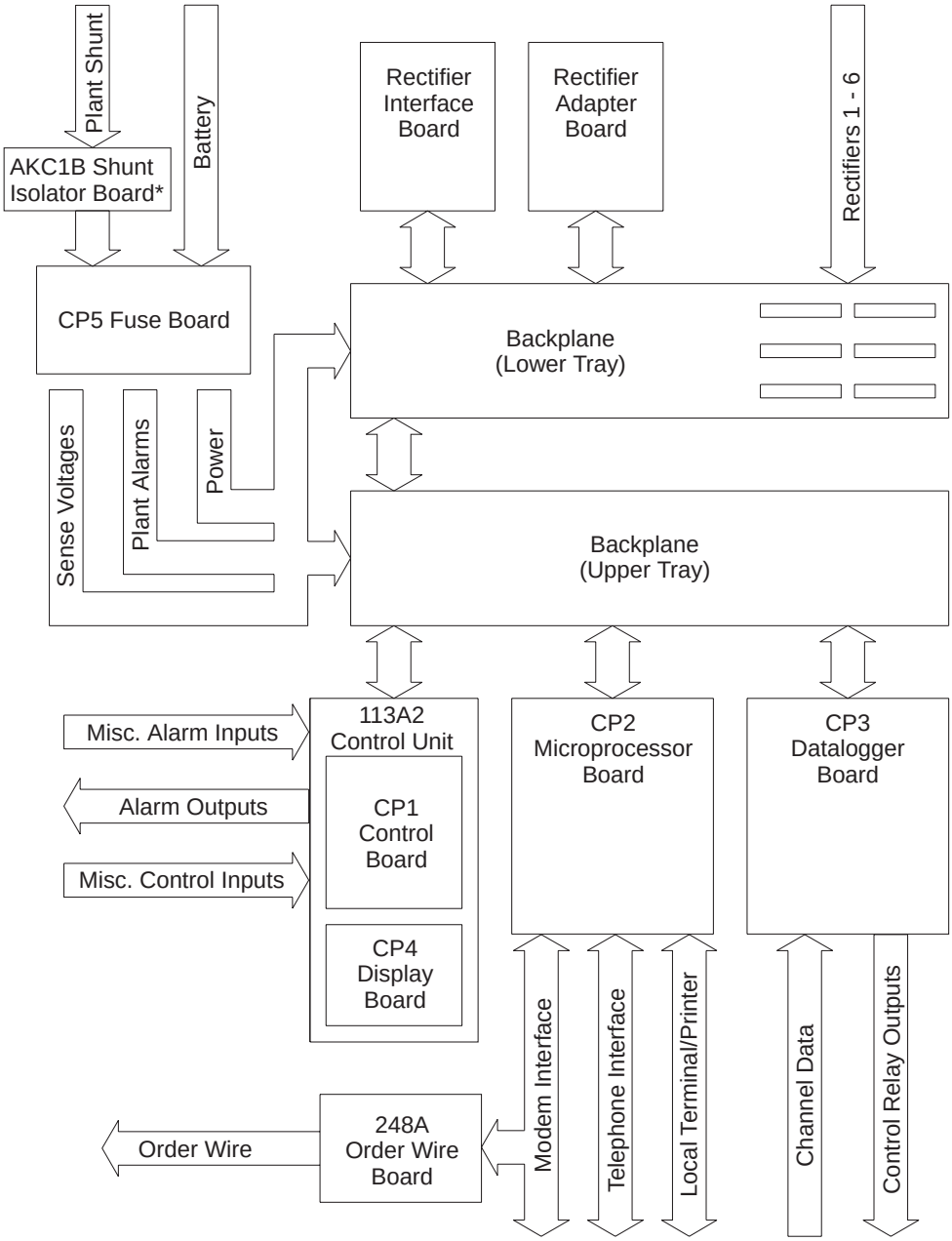


Figure 2-1: Front View of ECS-6U Controller (Door Shown in Full Open Position)

Throughout this manual the components of the ECS-6U controller are designated by the acronyms listed below:

Acronym	**Description**
113A2	Analog Control Unit
CP1	Control Board
CP2	Microprocessor Board
CP3	Datalogger Board
CP4	Display Board
CP5	Fuse Alarm Board (FAB)
RIB	Rectifier Interface Board (RIB)
RAB	Rectifier Adapter Board (RAB)
AKC1B	Shunt Isolator Circuit Pack
248A	Order Wire Board
BCP	Boost Charge Panel



*AKC1B Shunt Isolator Board is only required when the plant shunt is in the non-grounded (battery) path, or is not standard for ECS.

Figure 2-2: ECS-6U Controller Block Diagram

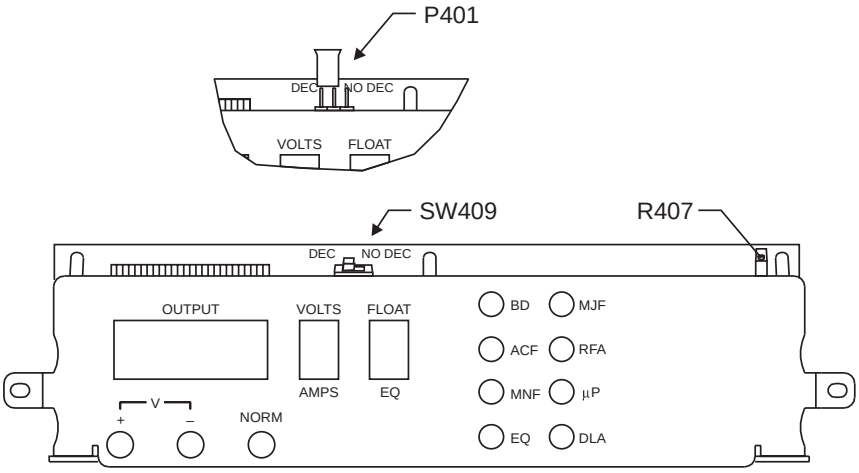


Figure 2-3: Detail of 113A2 Control Unit Display Panel

Basic Controller

The basic ECS-6U controller monitors and controls any combination of up to six Lucent Technologies switchmode or Lineage® 2000 ferroresonant rectifiers and provides a single interface point for power alarm and status reporting. Equipped with a 113A2 Control Unit, a RIB, and a Fuse Alarm Board, the basic controller performs traditional analog control functions. Each of these functions is described in detail in the paragraphs that follow.

Operating Voltage

The controller is powered by the plant dc voltage and may be used in 24V or 48V plants. It may be powered from either positive ground systems, e.g., -48V, or negative ground systems, e.g., +24V. Movable jumpers located on the upper tray backplane and DIP switches located on the 113A2 and the Rectifier Interface Board (RIB) must be positioned according to the plant voltage. The 113A2 may be plugged directly into the ECS-6U controller when the backplane is properly configured.

Batteryless Operation

The ECS-6U controller is suitable for telecommunications power plants with or without batteries. In batteryless plants, the loss of ac power causes an immediate loss of dc power to the controller. When ac power is restored, the ECS-6U controller, in an unpowered state, allows the rectifiers to automatically restart.

IMPORTANT

When the controller loses power, it also loses the ability to detect alarm conditions in the plant. To prevent the danger of unreported alarms, Power Major and Power Minor alarms are automatically issued when the controller is powered down.

IMPORTANT

Not all rectifiers will perform properly without a battery. Consult your rectifier manual.

Rectifier Sense Leads

Separately fused sense leads run from the fuse alarm board to the rectifiers via the controller backplane. These leads are not interrupted when the 113A2 is removed. The rectifiers use the sense leads to maintain the plant bus voltage independently of any load-dependent voltage drop between their output terminals and the bus.

Office Alarm Contacts and Alarm Battery Supply

Alarm contacts are provided on the 113A2 that may be connected to the office alarm system by the installer. (See Section 4, "Wiring.") Each set of contacts is a Form C or transfer type, i.e., a combination of normally open and normally closed contacts with one side of each in common. The normally open contact is referred to as O (other applications may call this the NO contact). The normally closed contact is referred to as C (other applications may call this the NC contact). The common or return contact is referred to as R (other applications may call this the C contact). Each Form C set is isolated. An alarm set is provided for each alarm condition, as follows:

AC Failure (ACF)
Major Fuse Failure (MJF)
Minor Fuse Failure (MNF)
High Voltage (HV)
Battery on Discharge (BD)

In addition, alarms that are classified as Major or Minor cause a group of general-purpose Major or Minor alarms, as follows:

Power Major - Visible (PMJV)
Power Major - Audible (PMJA)
Power Major - External (PMJE)
Power Minor - Visible (PMNV)
Power Minor - Audible (PMNA)
Power Minor - External (PMNE)

The de-energized or alarm state of a relay is its normal state, i.e., when an alarm condition exists, a closure exists between the "C" and "R" poles and an open exists between the "O" and "R" poles.

All alarms are in the non-alarm state only when the control unit is powered and the corresponding alarm is not present. When an alarm occurs, the corresponding closure occurs. When the control unit loses power, except for HV, all alarms are issued.

An Alarm Battery Supply (ABS) and a ground return are available on one of the terminal blocks (TB101). These pins may be wired by the installer to one or more alarms on the terminal blocks to drive alarm lamps, buzzers, or remote relays in the office alarm system. The ABS is the same voltage as the plant bus voltage and is separately fused on the FAB.

Battery on Discharge Alarm

If rectifier output is insufficient to supply the load current for any reason (such as an ac power failure), the battery reserve will provide the necessary current. Such a battery discharge can be detected by a drop in the plant bus voltage. Whenever the plant voltage drops below a preselected threshold, the controller issues a Battery on Discharge (BD) alarm and lights a red LED on the controller front panel. This alarm threshold is typically set to indicate the onset of battery discharge to allow enough time for maintenance personnel to respond before battery reserve is exhausted. When a BD alarm occurs, service is not usually affected immediately. However, since attention is required in a limited time, BD is considered a Major alarm, and all three Power Major alarm groups are issued to the office alarm system when a BD occurs.

It should be noted here that a BD alarm does not necessarily indicate that rectifier output current has been lost or reduced. A BD alarm can be caused by misadjusted rectifier output voltage during otherwise normal operation. It can also be caused by current overload on normally functioning rectifiers.

The voltage threshold for the BD alarm is selected by the user by setting a group of DIP switches on the 113A2. The setpoint is typically at least 1 volt below the plant float voltage for nominal 48V plants or 0.5 volts below the float voltage in 24V systems. This threshold avoids nuisance alarms due to component tolerances, variations in load, and other transient conditions.

The actual BD threshold settings that may be selected are listed on Figure 4-6 and on a label on the controller itself. The range of available settings is based on the most common battery float voltages for 24V and 48V systems. The shutdown level can be adjusted in 0.5 volt increments.

Selective High Voltage Shutdown

The controller is equipped to detect a high voltage condition on the plant bus. Such a high voltage condition is typically caused by lightning-induced transients on the commercial ac power lines. A rectifier failure might, however, cause an individual rectifier to increase its output voltage. To prevent high voltage from damaging the connected telecommunications load, the controller will send a signal for the rectifiers to shut down if the plant voltage goes high.

When the controller detects an increase in the plant voltage above a preset threshold, it immediately issues an HV alarm to

the external alarm system. HV is considered a Major alarm, so all Power Major alarm groups are also issued.

When reporting the alarm, the controller sends a simultaneous shutdown signal to all rectifiers. Since the outputs of all rectifiers are paralleled in the plant, their output voltages are forced to be the same. Their output currents, however, may vary widely. In a high voltage condition caused by an individual rectifier failure, the failed rectifier will be supplying more current than any other rectifier. When the high voltage shutdown signal is sent by the controller, the rectifier supplying the most current, i.e., the failed rectifier, will shut down, causing the plant voltage to drop to normal and the HV alarm to retire. All other rectifiers will remain on. If a high voltage condition exists without an individual rectifier failure, e.g., because of incorrect setting of the HV-threshold DIP switches or lightning-induced high voltage, the rectifier with the highest output current will shut down, but the HV condition will remain. The rectifier with the highest output current of those remaining on will shut down next, but again the HV condition will remain. This will continue until all rectifiers have shut down. Note that although it is a sequential shutdown of rectifiers, the timing is very fast, and it will appear as if all rectifiers have shut down simultaneously. The detection of the high voltage condition and sending of the shutdown signal are functions of the controller, while the selection of the rectifier with the highest output current for shutdown is a function of the rectifiers.

If the rectifiers have load sharing, the HV shutdown operates differently. In this case, if a single rectifier fails, its output current will try to increase and the HV signal will shut down only that rectifier. If the entire bus goes high, the rectifiers will still share current equally and no shutdown will occur unless the bus voltage reaches the backup high voltage shutdown.

CAUTION **Do not use the load share option for a single rectifier.**

The high voltage shutdown threshold voltage should be set by the user to a prescribed margin above the plant float voltage. (See Section 4, “High Voltage Shutdown Thresholds.”) This margin is typically 1.0 volts for nominal 48V battery plants and 0.5 volts for nominal 24V battery plants. Since voltage fluctuations are greater in batteryless plants, the shutdown margin is typically set at 3 volts above float in 48V batteryless plants or 1.5 volts for 24V batteryless plants. The actual threshold voltage is set with a group of DIP switches on the

113A2. DIP switches provide a visual verification of the shutdown set point at all times.

For plants configured with the float/equalize feature, a separate high voltage shutdown threshold is used when the plant is in equalize mode. A separate group of DIP switches is used to select the HV shutdown threshold for equalize mode. When the plant is switched from float to equalize, the equalize high voltage shutdown threshold becomes effective immediately. When the plant is switched from equalize to float, the equalize high voltage shutdown threshold remains effective for 2-4 minutes, after which the float high voltage shutdown threshold becomes effective. This delay is necessary to avoid nuisance HV alarms and shutdowns that would occur if the float threshold became effective while the battery voltage was slowly dropping from the equalize voltage to the float voltage. This feature is basically transparent in normal plant operation, but could be misinterpreted as a failure in the HV detection circuit if not taken into account during acceptance testing or troubleshooting.

For FT-Series G applications of the boost charge panel, the HV float and equalize thresholds should have the same setting (see "Boost Charge Circuit" in this section and Section 4, "Optional Boost Charge Panel").

The available threshold settings correspond with the range of float and equalize voltages that might be encountered in nominal 24V and 48V applications. A listing of the actual settings appears on Figure 4-6 and on a label on the controller itself.

Automatic Rectifier Restart

A high voltage shutdown from the controller is typically followed by an automatic restart signal. When the controller detects that one or more rectifiers have responded to its HV signal by shutting down, there is a 3 to 5 second delay, after which the controller issues a restart signal to all rectifiers. Rectifiers that have shut down may or may not respond to the restart signal, depending on the nature of the failure and whether or not the rectifier can accommodate the restart signal. The restart signal consists of six sets of isolated contact closures, one set of closures for each rectifier.

After the controller issues the restart closures, they stay in effect for the next 4 to 6 minutes and then they reopen. The controller does not issue a new restart signal in response to any additional high voltage events in that 4-6 minute period. The timeout period

is intended to prevent multiple shutdown/restart cycles during heavy lightning storms that would otherwise stress the power equipment.

Rectifiers that have not shut down are not affected by the restart signal from the controller and continue to run normally. Rectifiers that have restarted in response to the signal will resume normal operation unless lightning activity continues or they are actually faulty units. In either case, if the plant voltage goes high again during the 4-6 minute timeout, the shutdown signal (see previous section) will be reissued but will not be followed by an automatic restart.

The 4-6 minute timer may be reset manually before it times out. This may be desirable during testing of the restart circuit. See also Section 5, *Acceptance Testing*. The timer will also reset and a restart will be issued if the controller loses power for any reason, e.g., if controller fuses are removed.

The automatic restart function may be disabled by the user or installer by moving a jumper strap on the basic controller. (See Section 4, *Installation and Setup,* for this procedure.) **This function should be disabled only for batteryless plants equipped with only one rectifier.** In such an application, the controller loses power if the rectifier is shut down and, in the process, issues a restart. If the one rectifier shuts down again, the cycle will repeat since the controller will again lose power. To prevent a possible infinite cycle of shutdown and restart, the automatic restart function should be disabled for batteryless plants with only one rectifier.

Rectifier Fail Alarm

There are various types of failure conditions in different types of rectifiers that result in a rectifier failure signal. Refer to the appropriate rectifier manuals for details. Whenever a rectifier fail signal is received by the controller from any rectifier, the controller issues a Power Minor alarm (PMN) to the office alarm system. A yellow RFA LED on the controller front panel also lights.

The loss of one or more rectifiers is not necessarily a Major alarm, unless the plant voltage drops and the batteries begin to discharge. Rectifier Fail is, therefore, treated as a Minor alarm by the controller, which issues three sets of Power Minor office alarms. If loss of rectifier output is such that the plant voltage drops significantly, a BD alarm is issued, which is a Major alarm

condition. If the controller is equipped with CP2, the alarm can also be issued remotely. If it is equipped with CP3, the controller can be programmed to provide a hardware RFA alarm.

If a failed rectifier is successfully restarted, either manually or automatically, or if it disconnected from the controller interface, the RFA LED will extinguish and the associated alarms will retire.

AC Fail Alarm

The AC Fail Alarm is intended to indicate that ac input power to at least one rectifier has failed or dropped below a minimum voltage. This alarm is provided as an isolated transfer contact for the office alarm systems. An ACF alarm also lights a yellow LED on the front panel of the controller.

ACF does not automatically result in a Power Major or Power Minor alarm because users or installers may classify the loss of ac power as either a Major, Minor, or no alarm condition. The user or installer may hard wire parallel the ACF alarm to the desired Power Alarm to give loss of ac the proper priority. See Section 4, “Wiring” for alarm wiring details.

Major and Minor Fuse Alarms

The controller monitors all fuse and circuit breaker protection devices in the plant. Each blown fuse or tripped circuit breaker is classified as either a Major or Minor alarm. Major fuses or circuit breakers protect service-affecting circuits, basic controller circuits, and alarm circuits that report Major alarms. Loss of any other circuit protectors are treated as Minor Fuse Alarms. Examples of Major “fuses” include load circuit breakers and the Alarm Battery Supply (ABS) fuse. Rectifier regulation fuses are Minor “fuses.”

A red MJF LED on the controller front panel will light in the event of a Major Fuse Alarm. Similarly, a yellow MNF LED lights following a Minor Fuse Alarm. Fuse alarms cause the associated Power Major and Power Minor alarms to be issued to the office alarm system. In addition, separate Major Fuse Alarm and Minor Fuse Alarm transfer contacts are provided to the office alarm system. Refer to Table 4-I for a list of contacts.

Open Battery String Detection and Alarm

In a plant equipped with battery string disconnects, the disconnect switch on each battery string may be wired to the controller to indicate when they are open. The open string signal

occurs when a battery string disconnect switch is turned off manually or electronically. The Open String alarm (OS) is passed as a separate alarm to the microprocessor board.

If the OS signal is wired directly to the controller alarm terminal blocks, it will generate a Minor Fuse Alarm whenever a battery string is open. Alternatively, OS may be hard-wired to the auxiliary Major Fuse Alarm input on the fuse alarm board.

Front Panel Status Indicators

Light-emitting diodes (LEDs) are located on the controller front panel to indicate the alarm status of the battery plant.

Yellow LEDs indicate the following conditions, including (but not restricted to) Power Minor alarms:

Minor Fuse Alarm (MNF)
Rectifier Fail Alarm (RFA)
AC Fail (ACF)
Equalize On (EQ)
Microprocessor Alarm (μP)
Datalogger Alarm (DLA)

Red LEDs indicate the following Power Major alarms:

Battery on Discharge (BD)
Major Fuse Alarm (MJF)

When no alarms are present and the controller is powered, the green NORM LED lights to indicate normal operation. The EQ (Equalize) LED may be lit when the NORM LED is on since equalize is not considered an alarm condition. See Sections 4 and Section 5 for more information on the equalize function.

Front Panel Meter

A four-digit, backlit liquid-crystal display is located on the front panel. A toggle switch next to the display selects either the plant voltage or the plant load current to be shown. A calibration potentiometer (R407) on the CP4 display board is used for fine adjustment of the plant voltmeter. See Figure 2-3.

When the meter select switch on the front panel is set in the AMPS position, the display indicates the plant load current in amperes. This current is measured with a calibrated shunt located in the dc distribution return bus or from the AKC1B shunt isolator circuit pack.

A slide switch (SW409) or jumper (P401) is available on the CP4 display board to set a decimal point after the third digit. For maximum plant currents of 999A or less, place the jumper or slide switch in the decimal position (DEC); for currents over 999A, place the jumper or slide switch to the no decimal position (NO DEC). See Figure 2-3.

Ammeter Scale

Plant shunts are available with standard full-scale dc output voltages for a variety of full-scale dc currents. The signal from the shunt in any Lineage® 2000 battery plant is a 0 to 50 mV dc voltage proportional to the load current. The controller may also be used in a plant that is equipped with other than a 50 mV shunt, e.g., 100 mV, as long as the shunt is located in the distribution return bus. A shunt isolator circuit is required in applications where the plant shunt is located in the distribution power bus (hot lead), or if the shunt size is not compatible with the controller (see "Shunt Isolator Circuit" in Sections 2 and 4). See Table 4-C for a listing of compatible shunts.

The ammeter scale for the particular plant shunt size is selected by DIP switches on the 113A2. Scales are provided for the most common shunt ratings and range from 6 amperes per millivolt to 160 amperes per millivolt (See Section 4, "Hardware Setup" for details.)

Front Panel Test Jacks

Test points are provided on the front panel so that the plant voltage may be checked with the user's meter. The accuracy of the LCD voltmeter on the front panel, at 0.05%, is better than that available with most hand-held meters. The test points are current-limited against accidental short-circuits by test probes.

Rectifier Sequence Control Interface

When the battery plant's ac power is backed up by an engine alternator of limited capacity, it is often necessary to control the number of rectifiers on line during a commercial ac outage. To avoid stalling the engine during start up or overloading it at steady-state, it may be necessary to turn off rectifiers temporarily until the engine comes up to speed. This operation of turning rectifiers off and back on during engine start up is called rectifier sequence control.

The ECS-6U controller may be connected to the four output signals (TR1, TR2, TR3, and TR4) provided by a Rectifier Sequence Controller, such as Lucent Technologies model

J87339A-1. These signals are used to turn off rectifiers or groups of rectifiers.

Since sequence control is typically part of the ac engine system rather than part of the dc battery plant system, the rectifier sequence controller is often outside the battery plant and interfaces with the rectifiers through the battery plant controller.

The controller equipped with CP2 is capable of rectifier sequence control without an external sequence controller. However, a signal to indicate that the plant is being powered by the reserve system is still required. (See ECS Controller Options Product Manual, Select Code 167-790-109.)

The TR signal input to the controller may also be used for other on/off control of rectifiers by an external control device. (See ECS Controller Options Product Manual, Select Code 167-790-109.)

Float and Equalize Control

Some Lineage® 2000 rectifiers are capable of battery equalize charging in addition to normal float charging. The equalize feature may be used to recharge flooded type, i.e., non-sealed, batteries in less time than when the float voltage is used. Some battery manufacturers recommend equalize charging after a discharge; others recommend periodic equalizing of batteries.

NOTE **Use of equalize on sealed lead acid batteries is NOT recommended.**

The ECS-6U controller has several methods of controlling the equalize function in plants that are so equipped:

Hardware Disable: A movable jumper strap on the 113A2 may be used to disable the equalize function and lock the plant in float mode. This is especially important for plants equipped with sealed-type or valve-regulated batteries and for plants powering equipment sensitive to high voltages. Batteryless plants also have no need for the equalize function. The controller is always shipped with equalize disabled by this jumper to prevent accidental misapplication of the equalize feature. (See Section 4, “Hardware Setup” for details.)

Local Manual Control: A momentary toggle switch on the controller front panel may be used to switch the

rectifiers in the plant from float mode to equalize mode and back again. This control is disabled when equalize is hardware disabled with the jumper described above.

External Timer Panel: The 113A2 may interface with an external equalize control panel. Since the basic controller with the 113A2 and RIB boards has no built-in on/off timer (see Section 4, "Wiring") CP1 may be connected to a timer panel to automatically terminate equalize without manual intervention. For example, use of the control relays on the datalogger board in conjunction with the logic functions provided for the datalogger board will enable an automatic equalize function. Note that this control method is overridden when equalize is hardware disabled.

Microprocessor Control: The microprocessor is equipped with a variety of software features for float/equalize control. These features are also disabled by the hardware strap on the 113A2. (See ECS Controller Options Product Manual, Select Code 167-790-109.)

These control methods may be used interchangeably. For example, the front panel switch may be used to initiate equalize, while an external timer may turn it off.

Fuse Alarm Board (FAB)

The BAD8 FAB provides fused power and voltage sense distribution for the ECS-6U controller and the rectifiers in the plant containing the controller. Major and Minor Fuse Alarms are generated by the fuses on the board, as well as for plant distribution circuit breakers and user selectable interfaces.

Power and Sense Voltage Fusing

The fuse alarm board has 12 fuses to distribute power and sense voltages:

- F501-F506 provide battery sense voltage to the regulation leads of the rectifiers.
- F507 provides power and plant voltage sensing to the meter circuits of the 113A2 and optional microprocessor circuit pack.
- F508 provides power to the optional microprocessor and datalogger circuit packs.

- F509 provides power to the rectifier interface circuits on the 113A2.
- F510 provides power to the controller interface circuits on the rectifiers.
- F511 provides power to the ABS leads of the 113A2.
- F512 provides power to the circuitry on the 113A2 not powered by F507 or F509.

Major and Minor Fuse Alarms

The fuse alarm board provides Major and Minor Fuse Alarms to the controller. A Major Fuse Alarm is generated when F510, F511, or F512 opens, when a plant distribution circuit breaker trips open for overcurrent (but not when manually turned off), or when E502 is connected to the plant voltage. A Minor Fuse Alarm is generated when any of the fuses F501-F509 opens or when E503 is connected to the plant voltage.

Controller Options

A separate product manual, Lineage® 2000 ECS Controller Options (Select Code 167-790-109), provides additional information on the Microprocessor Board and the Datalogger Board.

Microprocessor Board

The Microprocessor Board adds sophisticated firmware features such as remote communications, optional voice response, diagnostics, and statistics to the controller. The Voice Response Option provides high-quality voice reporting of plant information and access to plant functions from a remote location.

Datalogger Board

The Datalogger Board may be used together with the microprocessor option to provide general purpose ac and dc voltage, current and transducer monitoring, and relay control.

Rectifier Adapter Board

The Rectifier Adapter Board may be added to the basic ECS-6U controller to permit non-Lineage® rectifiers, whether manufactured by Lucent Technologies or not, to be used in any combination in the battery plant. This permits the user to obtain the latest technology features of the ECS controller in a variety of battery plants. Standard cables are available for all Lucent

Technologies manufactured ferroresonant or switched mode technology rectifiers. All other rectifiers require field termination to either a screw or wire wrap terminal.

Order Wire Board

The Order Wire Interface feature provides a means to access the microprocessor board without the use of a dedicated telephone line. This feature is a field installation kit ordered per J85501E-2 List H. It should be ordered when the controller will be monitored over the FT-Series G embedded maintenance system or a similar order wire system. The Microprocessor Board (CP2) must be used along with the Order Wire Interface feature to allow the interface between the modem and the FT-Series G order wire circuit.

Additional equipment and connections are required outside the controller to establish the communication link over the FT-Series G embedded telemetry system (see Section 4, "Optional 248A Order Wire Board").

Circuit Options

Two other options, the Boost Charge Circuit and the Shunt Isolator Circuit, are not part of the controller but can be used with it in certain applications.

Boost Charge Circuit

This circuit is approved for use only with Lucent Technologies 50 ampere or 25 ampere ferroresonant rectifiers in an FT-Series G plant configuration of two or three rectifiers. This circuit provides a feature that closely resembles the equalize function. When used with the ECS-6U, the HV and EQ/HV must be set to the same level on the 113A2. The BD must be at least 2.5 volts below float in order to prevent false BD alarms.

The ED-83215-30 boost charge panel is designed to be used with the ECS-6U controller in -48 volt applications. Its purpose is to allow connected rectifiers to raise their output voltage so that connected batteries can be charged at a voltage higher than their normal float voltage. It is intended for use with rectifiers that do not have the equalize feature.

The boost charge can be initiated or removed in three ways: manually, by Switch S1 on the boost charge panel; manually, by the Float/EQ switch on the front panel of the ECS-6U controller; or remotely, via the microprocessor board of the ECS-6U. A yellow LED lights on the front panel only when boost charge is

activated via the microprocessor board or by the FLOAT/EQ switch on the front panel of the ECS-6U controller.

Shunt Isolator Circuit

The Lucent Technologies ECS-6U controller was designed for operation in a battery plant that has the plant shunt in the return (ground) lead. If the plant shunt is in the battery lead, the shunt isolator circuit is required. The AKC1 shunt isolator circuit (List 5) was replaced by the AKC1B (List 6 or 7) to also interface non-standard shunts to the ECS controller. (Non-standard shunts are shunt sizes other than those listed in Table 4-C as compatible with the ECS controller.)

The AKC1B is not mounted in the controller. List 6 provides a field installation kit to mount the AKC1B in a frame with 24-5/16 inch mounting centers. List 7 provides a field installation kit to mount the AKC1B in a frame with 22-5/16 inch mounting centers. See Figure 4-15.

Mixed Types of Rectifiers in One Plant

The ECS-6U controller may be used to control a total of six rectifiers. There are six rectifier interface ports on the backplane of the lower tray in the controller. Rectifiers may be of different types with each requiring different cable types. Cables for each rectifier type are available; however, only cables for rectifiers other than those made by Lucent Technologies will require termination in the field. If Lucent Technologies Lineage® 2000 SR-series rectifiers and Lineage® 2000 J855-series ferroresonant rectifiers are used, only the rectifier interface board (RIB) is required. All other rectifiers require the RIB and the rectifier adapter board (RAB). See wiring options in Table 4-D and Table 4-E.

A moveable jumper, P108, is provided on the 113A2 to connect (jumper across pins 1 and 2 of P108) or isolate (jumper across pins 2 and 3 of P108) the return leads of the two isolated restart contacts. In the Universal Rectifier Controller, the connection jumper, P108, can be placed across either pins 1 and 2 or pins 2 and 3. The controller is shipped with the jumpers across pins 1 and 2 of P108.

Controller Specifications

Table 2-A gives the electrical specifications of the ECS-6U Controller. Battery plant alarm voltage ranges are shown in Table 2-B. Table 2-C lists the physical specifications of the ECS-6U Controller.

Table 2-A: ECS-6U Controller Electrical Specifications

Float Voltage	47.0 - 58.5 volts dc (48 volts dc nominal) 23.5 - 29.0 volts dc (24 volts dc nominal)
Operating Voltage	40.0 - 60.0 volts dc (48 volts dc nominal) 20.0 - 30.0 volts dc (24 volts dc nominal)
Input Power	8 - 16 watts, depending on options provided
Display Meter	4-digit backlit LCD Range: 0.00 to +/-60.00 V (voltmeter) 0.0 to 8000.0 A(ammeter) Accuracy: +/-0.5% of full scale reading (ammeter) +/-0.05% of full scale reading (voltmeter) Resolution: +/-0.1 ampere < 1000 amperes +/- 1 ampere for ≥ 1000 amperes
Plant Shunt	50 millivolts at 300, 600, 1200, 2000, 2600, 4000, 6000 or 8000 amperes
Alarm Contact Rating	60 volts dc, 1.0 ampere, Form C
Temperature	32 to 122° F (0 to 50° C)
Altitude	-200 to 13,000 feet (-61 to 3962 meters) For altitudes of 5000 to 13,000 feet, derate maximum temperature by 3.6° F per 1000 feet above 5000 feet. For altitudes of 1524 to 3962 meters, derate maximum temperature by 0.656° C per 100 meters above 1524 meters.
Humidity	10% to 95% noncondensing
Electrostatic Discharge	IEC 801-2 Level 5 (15kV) at 40% relative humidity
Radiated and Conducted Emissions	FCC Level A
Electromagnetic Immunity	10 V/m over the range of 20 to 2000 MHz

Table 2-B: Battery Plant Alarm Voltage Ranges

48-volt Plant	Range	Accuracy
High Voltage Shutdown Thresholds (adjustable in 0.5V increments)	49.0V to 60.0V	+/-0.5V
Equalize High Voltage Shutdown Thresholds (adjustable in 0.5V increments)	51.0V to 60.0V	+/-0.5V
Battery on Discharge Thresholds (adjustable in 0.5V increments)	46.0V to 57.5V	+/-0.5V
24-volt Plant	**Range**	**Accuracy**
High Voltage Shutdown Thresholds (adjustable in 0.5V increments)	24.75V to 29.75V	+/-0.25V
Equalize High Voltage Shutdown Thresholds (adjustable in 0.5V increments)	25.75V to 30.75V	+/-0.25V
Battery on Discharge Thresholds (adjustable in 0.5V increments)	23.0V to 28.50V	+/-0.25V

Table 2-C: ECS-6U Controller Physical Specifications

Dimensions	Width 21.5" (546 mm) Depth 15.0" (381 mm) Height 7.0" (178 mm)
Frame Mounting Requirements	Standard 23" and 26" relay racks Vertical mounting centers: 1.00" (25 mm) Horizontal mounting centers: 22.32" (567 mm) for 23" rack-mount 24.32" (618 mm) for alternate 26" rack-mount
Weight	14 pounds (6.4 kilograms) Includes 113A2, EAT1, and BAD8

3 Ordering Information

Controller

Table 3-A is a summary of the J85501E-1 List Structure. Microprocessor Board and Datalogger Board options (Lists A through F and K through N and KA) are discussed in the Controller Options Product Manual (167-790-109). Note that all options except List BA are shipped separately from the controller for connection by installers. Section 2 presents detailed descriptions of controller features.

Table 3-A: ECS-6U Controller Ordering Information

List	Description
1	ECS-6U Controller for -48 volt plants. Provides interface to 6 Lucent Technologies Lineage® 2000 rectifiers
2	ECS-6U Controller for +24 volt plants. Provides interface to 6 Lucent Technologies Lineage®2000 rectifiers
3	ECS-6U Controller for -24 volt plants. Provides interface to 6 Lucent Technologies Lineage® 2000 rectifiers
6	Kit for one AKC1B shunt isolator circuit pack and associated mounting hardware for outboard retrofit in a frame with 24-5/16 inch mounting centers. Replaces AKC1 (List 5)
7	Same as List 6 except for mounting in a frame with 22-5/16 inch mounting centers
A	Optional -48 volt microprocessor circuit pack (CP2) to provide local or remote monitoring and control functions
B	Same as List A, except with voice response feature

Table 3-A: ECS-6U Controller Ordering Information

List	Description
C	Optional +24 volt microprocessor circuit pack (CP2) to provide local or remote monitoring and control functions
D	Same as List C, except with voice response feature
E	Optional Datalogger circuit pack (CP3) for data acquisition features
F	Same as List E, except with a remote termination panel
G	Optional Rectifier Adapter Board (RAB) to interface with up to six non-Lineage rectifiers (Lucent Technologies or non-Lucent Technologies)
H	Optional 248A Order Wire Board and mounting hardware when the controller will be monitored over the FT-Series G embedded maintenance system
J	Power cable to connect one Lucent Technologies boost charge panel (ED83108-30) to a List 1 or 3 controller
K	Same as List A (CP2), with X.25/TL1 features
L	Same as List B (CP2), with X.25/TL1 features
M	Same as List C (CP2), with X.25/TL1 features
N	Same as List D (CP2), with X.25/TL1 features
KA	Kit to add voice response feature to List A, C, K, or M CP2 circuit pack
BA	Optional mounting hardware for mounting controller in a frame with 22-5/16 inch mounting centers

Kits

Table 3-B: Kits

Comcode	Description	Upgrades for Pack Version
847074507	48V Pad Kit	---
847074515	24V Pad Kit	---
847074531	Digital Service Unit Kit	---
847074549	Shelf Kit (GA 3/93)	---
847101565	ECS CP2/Software Upgrade Kit	MC80041A1B-A4B Issue 1:1 or later

Spare Parts

Table 3-C lists the recommended spare parts for the ECS-6U Controller.

Table 3-C: Recommended Spare Parts

Comcode	Description
106671746	113A2 Control Unit
J85501E-1 List A	48V Microprocessor Board without voice response
J85501E-1 List C	24V Microprocessor Board without voice response
J85501E-1 List B	48V Microprocessor Board with voice response
J85501E-1 List D	24V Microprocessor Board with voice response
106615610	BAC1 Datalogger Board
106615628	Datalogger Circuit Pack
106593007	Rectifier Interface Board (RIB)
J85501E-1 List G	Rectifier Adapter Board (RAB)
106592397	BAD8 Fuse Alarm Board (FAB)
J85501E-1 List H	248A Circuit Module (FT Series G Order Wire)
406281428	Replacement Battery for CP2 (CR-1/3N)
405673146	1-1/3A Fuse (WP90247 L7)
405181983	2A Fuse (WP90247 L9)
J85501E-1 List K	48V Microprocessor Board with X.25/TL1 features but without voice response
J85501E-1 List M	24V Microprocessor Board with X.25/TL1 features but without voice response
J85501E-1 List L	48V Microprocessor Board with X.25/TL1 features and voice response
J85501E-1 List N	24V Microprocessor Board with X.25/TL1 features and voice response

Documentation

This document is part of a set of documents developed to assist equipment engineering and installation.

Document No.	Document Description
J85501E-1	Assembly, Ordering, and Installation Drawing for ECS-6 Controller
T-83122-30	Wiring Drawing for ECS-6U Controller
SD-83122-01	Schematic Drawing for ECS-6U Controller
167-790-045	ECS-6U Controller Product Manual
167-790-109	ECS Controller Options Product Manual (provided when Microprocessor Board, CP2, is ordered)

4 Installation and Setup

Introduction

This section covers the installation and setup procedures for all configurations of the ECS-6U controller. Follow all the applicable steps in the following sections in the order they are presented.

NOTE **If the ECS-6U is installed in a UL listed bay, the UL certification on the bay may no longer be valid.**

Tools Required

The tools required in this section are the following.

- Flat-blade screwdriver (for shipped-loose mounting only)
- Cutters (for wire and for plastic wire ties)
- Jeweler's screwdriver (for alarm wiring)
- Wire strippers (22 to 26-gauge)

Shipped-Loose Unit Installation

Controllers are typically factory wired and assembled to a battery plant. For custom-engineered applications or as a replacement, however, the ECS-6U controller may be shipped as a loose unit. The user must assemble and wire a shipped-loose unit to the plant.

The ECS-6U controller is shipped equipped with a 113A2, RIB, and FAB. If the ECS-6U is received factory assembled as part of a Lineage® 2000 Battery Plant, skip to "Basic Hardware Setup."

Preparation

On delivery, immediately inspect the shipping carton for damage. If the crate is damaged, unpack and inspect for damage to the controller. If the controller was damaged in transit, contact the carrier for instructions for filing a damage claim. If the unit

must be returned to the factory due to damage, reuse the crate and packing material.

Check the contents against the shipping bill for completeness.

- Assembled ECS-6U Controller J85501E-1
- Self-tapping mounting screws (#12-24 size)
- Wire ties
- ECS-6U Controller product manual, Select Code 167-790-045
- ECS-6U Controller schematic, wiring, and assembly drawings: SD-83122-01, T-83122-30, and J85501E-1
- Mounting brackets
- Trim panels

Default Factory Settings

Optional circuit boards are shipped loose. Table 4-A lists the default settings for the boards shipped from the factory.

Table 4-A: Default Factory Settings for Circuit Boards

Feature	List 1 Factory Setting	List 2 or 3 Factory Setting
Auto Restart, P108 on 113A2	1 and 2 (Enable)	1 and 2 (Enable)
BD Alarm	51V	25.5V
HV Alarm	55V	26.25V
EQ-HV Alarm	57V	27.25V
FL/EQ (Enable/Disable)	1 and 2 (Disable)	1 and 2 (Disable)
Ammeter Scale, SW109 and J104	300A	300A
Ammeter Scale, CP2, if provided	300A	300A

Frame Mounting

The controller is designed for 23-inch or 26-inch frame mounting. Two mounting brackets (standard) are shipped loose and should be assembled as shown in Figure 4-1. Brackets shown in Figures 4-2 and 4-3 are ordered per List BA to provide alternative mounting positions.

After assembling the mounting brackets, proceed with the controller hardware setup.

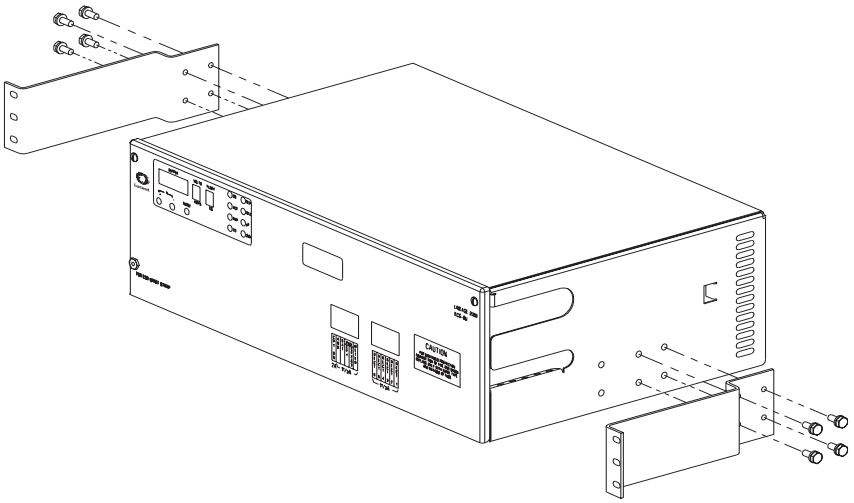


Figure 4-1: 26-inch Frame with Flush Mounting

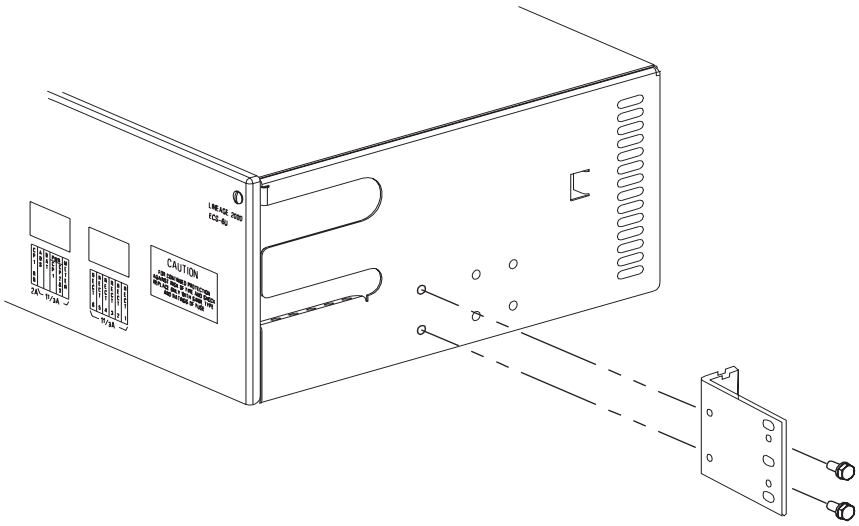


Figure 4-2: 26-inch Frame with 5-inch Non-Flush Mounting (List BA)

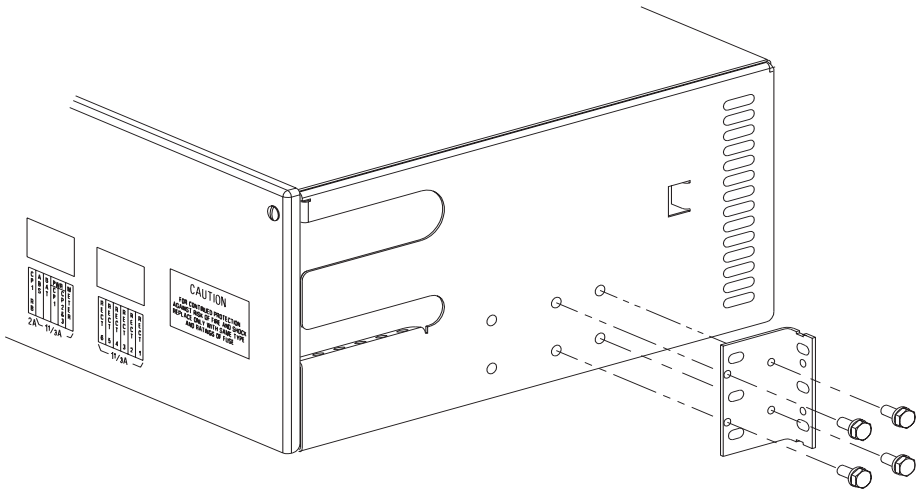


Figure 4-3: 23-inch Frame with 9-inch Flush Front Mounting (List BA)

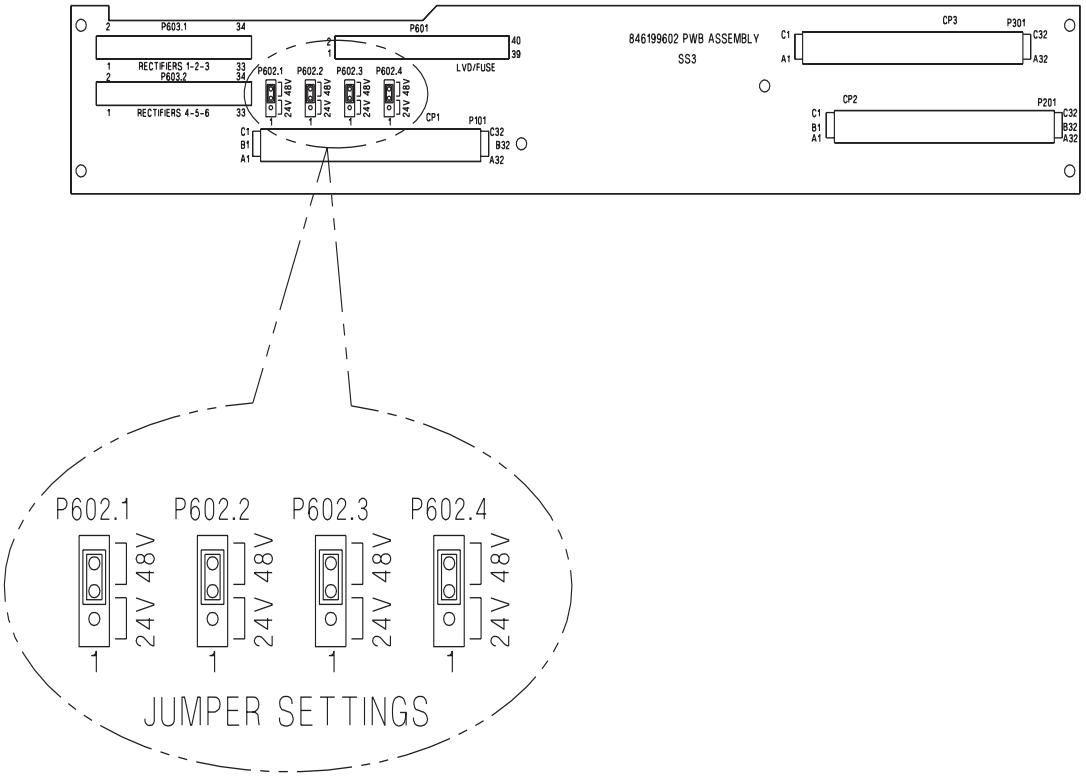


Figure 4-4: ECS-6U Controller Backplane (Upper)

Hardware Setup

Jumper straps are located on the upper tray backplane, and a combination of jumper straps and DIP switches are located on the control unit and the rectifier interface board (RIB). These jumpers and switches must be set properly before powering the controller. Proper settings are made at the factory for the plant in which the controller is shipped. In shipped-loose controllers, the jumpers and switches are factory configured for -48 volt operation.

CAUTION **Applying power to the controller when jumper straps and DIP switches are improperly set may damage the controller circuit packs or provide extraneous alarms.**

Voltage Selection

As shown in Figure 4-4, there are four jumpers on the controller backplane for voltage selection: P602.1, P602.2, P602.3, and P602.4. Verify that all four of the jumpers are in the correct positions. Factory-mounted controllers are typically preset for the proper plant voltage. The installer, however, should check these settings.

CAUTION **Circuit packs can be damaged by static electricity. Operators should always wear a grounded wrist strap plugged into the controller front panel when touching or handling circuit packs.**

DIP switches SW101, SW102, and SW103 on CP1, and S1 and S2 on the RIB (EAT1), must be set to the proper plant voltage. DIP switch position 6 on SW101, SW102, and SW103, and positions 1 through 10 on S1 and S2 must be set for either 24 or 48 volts and all of these switches must be set to the same voltage.

Refer to Figures 4-5 and 4-8 for the location of switches on CP1 and the RIB.

Figure 4-6 shows the CP1 DIP Switch Settings and Figure 4-9 shows the RIB DIP Switch Settings. These two figures are replications of actual labels that appear on the controller.

Input power may be connected only after the installer has set and verified the voltage selection jumpers and DIP switches. The input power and plant shunt connections are made through the wire set connected to the Fuse Alarm Board (BAD8), which is mounted on the inside of the front door. The wire set exits the unit on the right side as the user faces the unit. Each wire is

terminated with a connector. The proper connectors are shipped with each unit. Table 4-B describes the wires and their functions.

Table 4-B: Wire Descriptions and Functions

Wire Color	Name	Connecting Point to FAB	Function
Blue	DG	P506-1	"Discharge ground" from plant bus
Brown	RG	P506-2	"Reg ground" from plant bus
Yellow	DB	P504-1	"Discharge battery" from plant bus
Brown	RB	P504-2	"Reg battery" from plant bus
Orange	RB	P504-3	"Reg battery" from plant bus
Orange/black	BS-	P506-3	Plant shunt connection (negative)
Orange	BS+	P506-4	Plant shunt connection (positive)
White/orange	CBA	E501	Connection for major fuse alarm
White/brown	MJF	E502	Connection for major fuse alarm
White/blue	MNF	E503	Connection for minor fuse alarm

Equalize Enable/Disable

The equalize jumper, P106 on the 113A2, is factory set in the DISABLE position (pins 1 and 2). If the plant is equipped with equalize-type rectifiers and flooded-type batteries, this jumper may be moved to the ENABLE position (pins 2 and 3). When equalize is enabled, the front panel switch and other equalize control methods can be used to initiate equalize charging. If the jumper is removed or misplaced, equalize is DISABLED.

CAUTION **Use of Equalize is not recommended for sealed cells.**

Not all Lucent Technologies rectifiers are equipped with the equalize feature. Use equalize only if all the rectifiers have the equalize feature. The following is a list of Lucent Technologies rectifiers that have the equalize feature:

24 and 48 volt, 125 ampere, **J85502C-1**
24 and 48 volt, 200 ampere, **J85503B-2**
48 volt, 400 ampere, **J85503C-2**
48 volt, 400 ampere, **J85503C-3**
24 volt, 100 ampere, **SR364B** series
48 volt, 50 ampere, **SR364A** series

Automatic Restart Enable/Disable

The restart jumper, P105 on the 113A2, is factory set in the ENABLE position (pins 1 and 2). This setting allows the controller to attempt to restart rectifiers after a high voltage shutdown. For a one-rectifier plant without battery reserve, the jumper should be moved to the DISABLE position (pins 2 and 3). Manual intervention will be required to restart the rectifier in such an application.

CAUTION **If the P105 jumper is removed or lost, the automatic restart function is DISABLED.**

Ammeter Scale

Use DIP switch SW109 on the 113A2 and P401 on the CP4 display board to select the scale for the plant current meter. Factory-mounted controllers in bays equipped with plant shunts are preset to the proper ammeter scale. Use the label on the cover plate of the 113A2 to check the DIP switch settings versus the plant shunt rating. If the plant shunt rating is not known and is not directly indicated in the plant manual, check the plant assembly drawing. If the optional CP2 is provided, be sure that its switch settings correspond to those of the 113A2.

Table 4-C shows how to set DIP switch SW109 on the 113A2 controller for various size plant shunts. The CP4 display board on this unit, shown in Figure 2-3, has a jumper (P401) or slide switch (SW409) that is used to show or not show a decimal point. Settings marked with an asterisk (*) require the decimal point to be present. To turn on the decimal point for items marked with (*), place the jumper or set the slide switch in the "DEC" position.

Table 4-C: SW109 DIP Switch Settings

Use These Switch Settings						For These Plant Shunt Sizes		
						Shunt	**Full Scale**	**Millivolts**
1	**2**	**3**	**4**	**5**	**6**	**25mV**	**50mV**	**100mV**
c	o	o	o	c	c	150A*	300A*	600A*
c	o	o	o	o	o	300A*	600A*	not usable
o	c	o	o	o	o	600A*	1200A	2400A
o	o	c	o	c	c	1000A	2000A	4000A
o	o	o	c	o	o	1300A	2600A	5200A
o	o	c	o	o	o	2000A	4000A	8000A
c	o	o	o	o	o	3000A	6000A	not usable
o	o	o	o	o	o	4000A	8000A	not usable

"o" = open, "c" = closed

*Decimal point must be used in these settings.

The controller works only with the shunt sizes listed in Table 4-C. In battery plants with other shunt sizes, replace the shunt or use an AKC1B circuit pack. If an AKC1B is used, configure SW109 according to Table 4-H instead of Table 4-C.

Battery on Discharge Threshold

The voltage threshold for the BD alarms is set with DIP switch SW103. Refer to Figure 4-6 or the label on the 113A2 cover plate for the DIP switch settings for the desired alarm threshold. The same table of settings also appears on the schematic drawing SD-83122-01 and on the assembly drawing J85501E-1. The recommended threshold is approximately 1.0 volt below the float voltage for nominal 48 volt plants or approximately 0.5 volt below float for nominal 24 volt plants.

Be sure also to set DIP switch 6 of SW103 for the proper operating voltage.

High Voltage Shutdown Thresholds

The controller is equipped with two separate high voltage shutdown thresholds. The first is used during normal float operation. The second threshold is used when the plant is in equalize mode. The float shutdown is set with DIP switch SW102 on CP1. (See Figure 4-5.) The equalize shutdown is controlled by settings on DIP switch SW101 on CP1. The equalize shutdown level does not need to be set if equalize is hardware disabled (see "Equalize Enable/Disable"). The recommended shutdown levels are approximately 1.0 volt above

operating voltage for nominal 48 volt plants or approximately 0.5 volt above operating voltage for nominal 24 volt plants. The actual operating voltages in float and equalize modes are determined by the battery manufacturer's recommendations and by any restrictions imposed by the load equipment.

DIP switches must be set for the proper plant operating voltage (24 or 48 volts). All DIP switches must be set for the same operating voltage. The switch settings may be done as part of the BD and HV level setting procedure in "Battery on Discharge Threshold" and "High Voltage Shutdown Thresholds," respectively. See the DIP switch setting instructions in "Controller Setup." For batteryless plants, disable equalize and use a 3-volt margin for the HV setting on 48 volt plants and a 1.5 volt margin for the HV setting on 24 volt plants.

If a battery plant has the boost charge feature, set both the HV and EQ/HV DIP switches to the same voltage.

Rectifier Port Selection

The ECS-6U controller is factory configured for use with Lucent Technologies Lineage® 2000 J855-series ferroresonant rectifiers. Rectifier connections should be made to the respective ports (Rectifier 1, etc.) on the lower tray backplane. These ports correspond to the S3 positions on the RIB. (See Figure 4-8.)

To connect Lucent Technologies J855-series ferroresonant rectifiers to the controller, set the S3 respective positions on the RIB to On (closed).

To connect Lucent Technologies switch mode (SR) rectifiers or non-Lucent rectifiers, or if no rectifier is connected, open the S3 respective positions on the RIB.

The same table of settings shown in Figure 4-9 also appears as a label on the inside of the door of the controller. Standard interface cables are listed in Table 4-D.

Table 4-D: Available Rectifier Interface Cables

Cable Description	Cable Assembly
Control cable required to connect one Lucent Technologies switch mode rectifier shelf with one, two or three switch mode rectifiers	H285-226, L42
Control cable required to connect one Lucent Technologies 24-volt Lineage® single phase ferroresonant rectifier (J85502 series)	H285-226, L43
Control cable required to connect one Lucent Technologies 48-volt Lineage® single phase ferroresonant rectifier (J85502 series)	H285-226, L44
Control cable required to connect one non-Lucent Technologies rectifier or one Lucent Technologies rectifier not listed on this table	H285-226, L45
Control cable required to connect one Lucent Technologies rectifier J87434 or J87435 equipped with SP3	H285-226, L46
Control cable required to connect one Lucent Technologies rectifier J87434 equipped with SP8, or J87436 or J87438 equipped with SP7 (24 volt only)	H285-226, L47
Control cable required to connect one Lucent Technologies rectifier J87435 equipped with SP8, or J87437 or J87439 equipped with SP7 (48 volt only)	H285-226, L48
Control cable required to connect one Lucent Technologies rectifier J87436 or J87438 equipped with SP1 (24 volt only)	H285-226, L49
Control cable required to connect one Lucent Technologies rectifier J87437 or J87439 equipped with SP1 (48 volt only)	H285-226, L50
Control cable required to connect one Lucent Technologies 24-volt Lineage® three phase ferroresonant rectifier (J85503A or B1)	H285-226, L51
Control cable required to connect one 48-volt Lucent Technologies Lineage® three phase ferroresonant rectifier (J85503A, B1, C1, and J85503C2 not e/w List 5)	H285-226, L52

Table 4-D: Available Rectifier Interface Cables

Cable Description	Cable Assembly
Control cable required to connect one Lucent Technologies 24-volt Lineage® three phase ferroresonant rectifier (J85503B2)	H285-226, L53
Control cable required to connect one 48-volt Lucent Technologies Lineage® three phase ferroresonant rectifier (J85503B2, J85503C2 e/w List 5, J85503C3, or J85603C2)	H285-226, L54
Control cable required to connect one Lucent Technologies 150-ampere switch mode rectifier	H285-226, L56

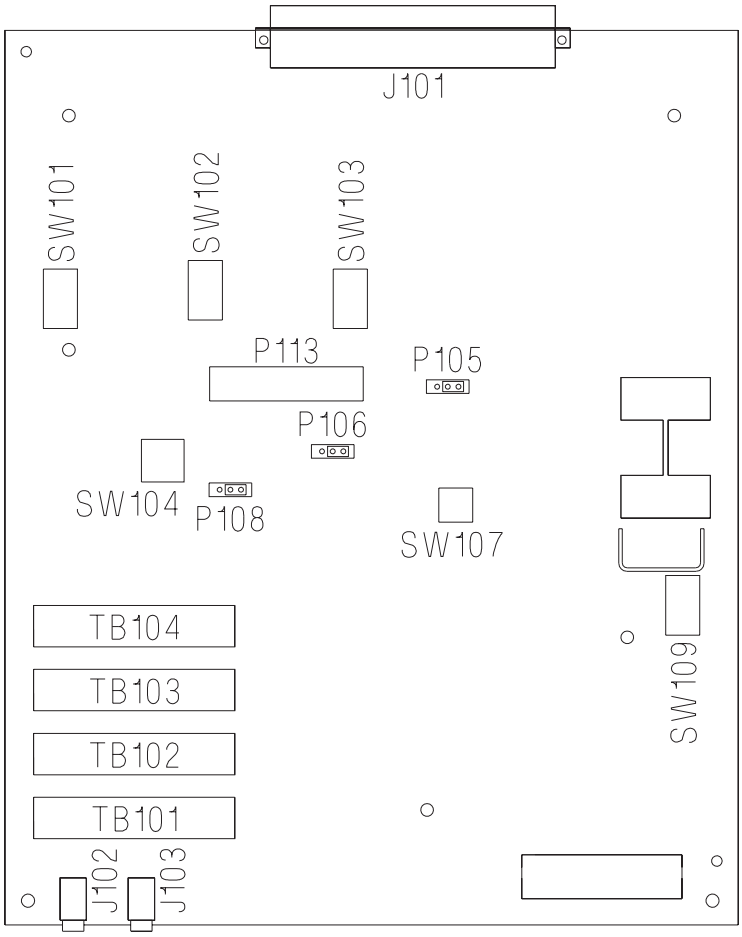


Figure 4-5: CP1 Jumper and Switch Locations

CP1 DIP SWITCH SETTINGS

VOLTS						SWITCH POSITION (0=OPEN , 1=CLOSED)						
SW 101- HV/EQ		SW 102- HV/FL		SW 103- BD		-1	-2	-3	-4	-5	-6	
24V	48V	24V	48V	24V	48V						24V	48V
	51.00		49.00	23.00	46.00	1	1	1	1	1	1	0
	51.50		49.50	23.50	46.50	0	1	1	1	1	1	0
25.75	52.00	24.75	50.00	24.00	47.00	1	0	1	1	1	1	0
26.25	52.50	25.25	50.50	24.50	47.50	0	0	1	1	1	1	0
26.75	53.00	25.75	51.00	25.00	48.00	1	1	0	1	1	1	0
27.25	53.50	26.25	51.50	25.50	48.50	0	1	0	1	1	1	0
27.75	54.00	26.75	52.00	26.00	49.00	1	0	0	1	1	1	0
28.25	54.50	27.25	52.50	26.50	49.50	0	0	0	1	1	1	0
28.75	55.00	27.75	53.00	27.00	50.00	1	1	1	0	1	1	0
29.25	55.50	28.25	53.50	27.50	50.50	0	1	1	0	1	1	0
29.75	56.00	28.75	54.00	28.00	51.00	1	0	1	0	1	1	0
30.25	56.50	29.25	54.50	28.50	51.50	0	0	1	0	1	1	0
30.75	57.00	29.75	55.00		52.00	1	1	0	0	1	1	0
	57.50		55.50		52.50	0	1	0	0	1	1	0
	58.00		56.00		53.00	1	0	0	0	1	1	0
	58.50		56.50		53.50	0	0	0	0	1	1	0
	59.00		57.00		54.00	1	1	1	1	0	1	0
	59.50		57.50		54.50	0	1	1	1	0	1	0
	60.00		58.00		55.00	1	0	1	1	0	1	0
			58.50		55.50	0	0	1	1	0	1	0
			59.00		56.00	1	1	0	1	0	1	0
			59.50		56.50	0	1	0	1	0	1	0
			60.00		57.00	1	0	0	1	0	1	0
					57.50	0	0	0	1	0	1	0

AMPERES SW 109- METER SHUNT			SWITCH POSITION (0=OPEN , 1=CLOSED)					
25mV	50mV*	100mV	-1	-2	-3	-4	-5	-6
150 A	300 A	600 A	1	0	0	0	1	1
300 A	600 A	N/A	1	0	0	0	0	0
600 A	1200 A	2400 A	0	1	0	0	0	0
1000 A	2000 A	4000 A	0	0	1	0	1	1
1300 A	2600 A	5200 A	0	0	0	1	0	0
2000 A	4000 A	8000 A	0	0	1	0	0	0
3000 A	6000 A	N/A	1	0	0	0	0	0
4000 A	8000 A	N/A	0	0	0	0	0	0

* ECS BATTERY PLANTS USE A 50mV SHUNT

CAUTION

THIS PRODUCT CONTAINS ELECTROSTATIC SENSITIVE DEVICES. INSTALLATION AND MAINTENANCE PERSONNEL SHALL USE AN ESD GROUNDING STRAP TO PREVENT DAMAGE.

846885804

Figure 4-6: CP1 DIP Switch Settings

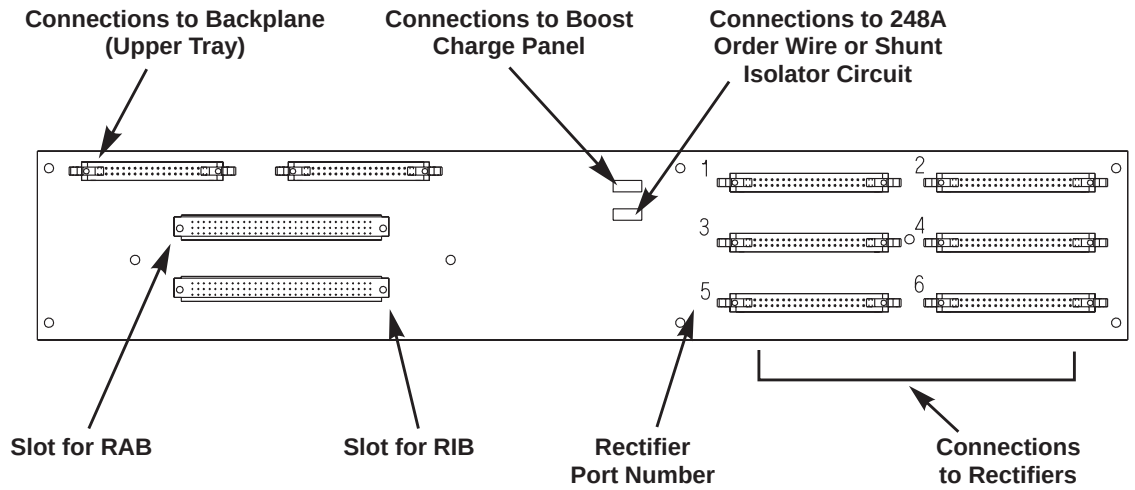


Figure 4-7: ECS-6U Controller Backplane (Lower)

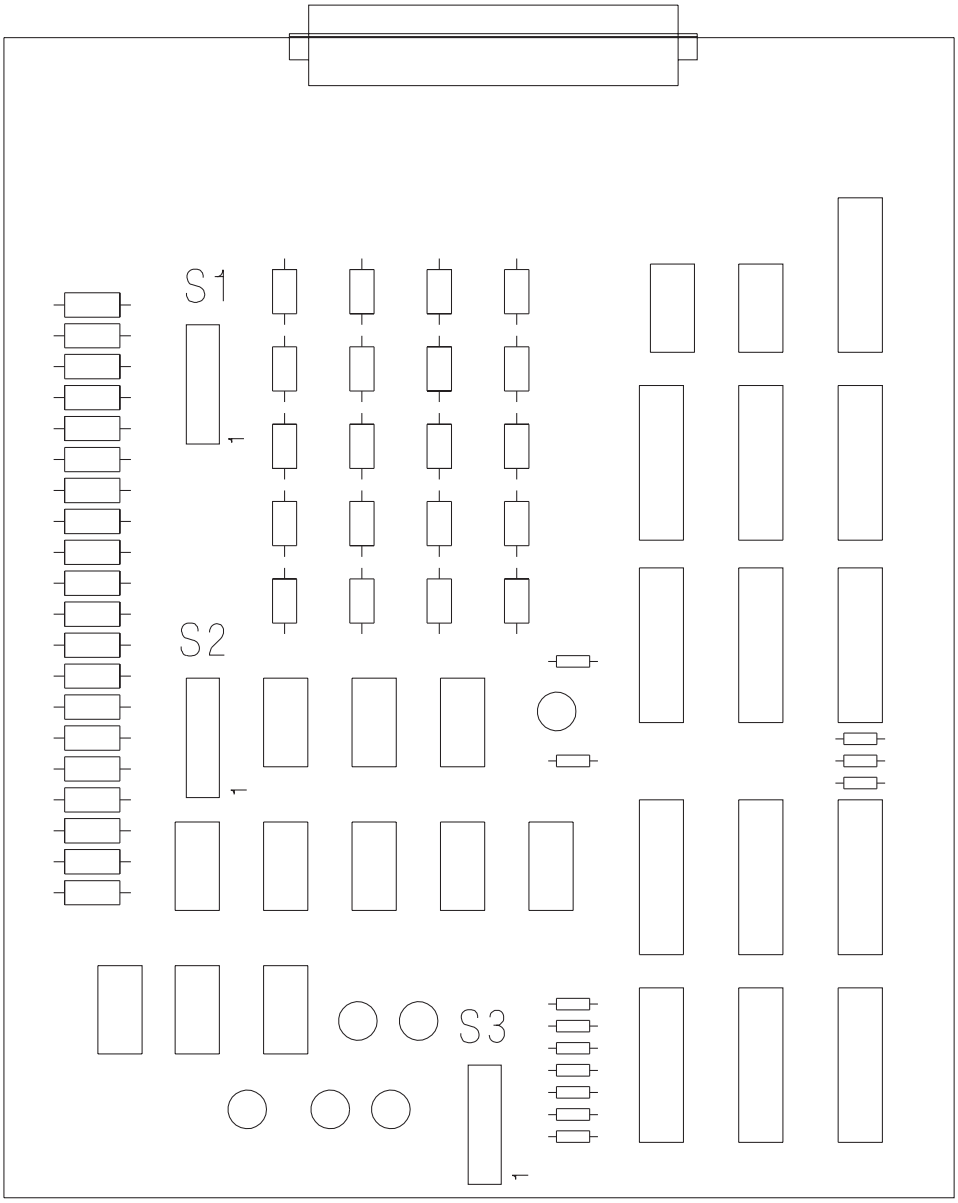


Figure 4-8: Rectifier Interface Board (RIB) Layout and Switch Locations

EAT1 DIP SWITCH SETTINGS

SWITCH POSITION	SW 1		SW 2	
	24V	48V	24V	48V
1 THRU 10	ON	OFF	ON	OFF

NOTE:
OFF=OPEN
ON=CLOSED

	SW 3 – SWITCH POSITION									
	1	2	3	4	5	6	7	8	9	10
RECTIFIER PORT NO.	1	2	3	4	5	6	–	–	–	–

OPEN RESPECTIVE SWITCH POSITION IF NO RECTIFIER OR IF A LUCENT SWITCH MODE (SMR) RECTIFIER IS CONNECTED TO THAT PORT.

Figure 4-9: RIB DIP Switch Settings

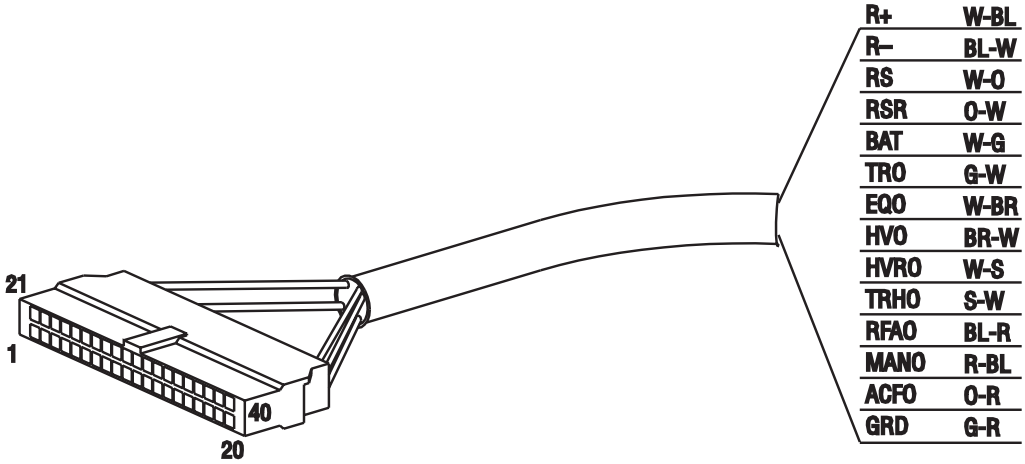


Figure 4-10: Control Cable for Non-Lucent Technologies Rectifier Connection

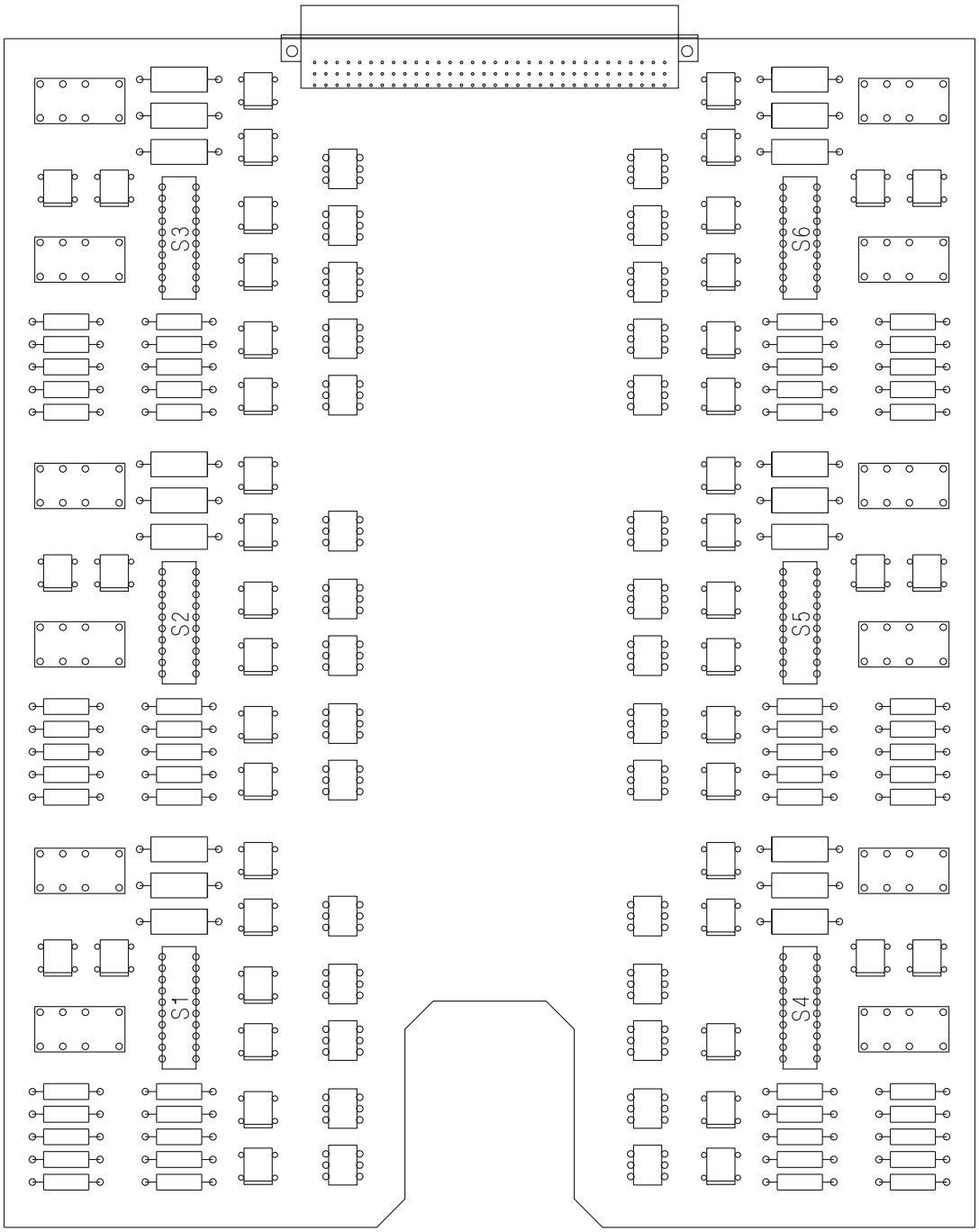


Figure 4-11: Rectifier Adapter Board (RAB) Layout and Switch Locations

EAT2 DIP SWITCH SETTINGS - S1 THRU S6

RECTIFIER OPTIONS (NON-LUCENT RECTIFIERS ONLY)		SWITCH POSITION *		
		1 THRU 8	9	10
VOLTAGE	24V	ON	-	-
	48V	OFF	-	-
MAN ALARM	ALARM = OPEN	-	ON	OFF
	ALARM = CLOSURE	-	OFF	ON
	ALARM NOT PROVIDED	-	OFF	ON
	NO RECTIFIER **	-	ON	OFF

* - ALL SWITCHES MUST BE SET ACCORDING TO THIS TABLE.

** - SETTINGS TO BE USED WHEN NO RECTIFIER OR A LUCENT RECTIFIER IS CONNECTED TO THE CORRESPONDING PORT.

NOTE: OFF=OPEN
ON=CLOSED

Figure 4-12: RAB DIP Switch Settings

Optional Rectifier Adapter Board (RAB)

The Rectifier Adapter Board (RAB) may be added to the controller to extend the features described in this manual to pre-Lineage® rectifiers either manufactured by Lucent Technologies or manufactured for Lucent Technologies to a J or KS specification. (See Figure 4-11.) DIP switches S1 through S6 on the RAB must be set corresponding to the port used for each non-Lineage® rectifier connected to the controller. (See Figure 4-12.) Table 4-D lists the cables required for the various rectifiers. Those rectifiers not listed will require a termination either to a screw or wire wrap terminal at the rectifier end. See Table 4-E and Figure 4-10.

The RAB also permits non-Lucent Technologies rectifiers to be used with the controller. DIP switches S1 through S6 on the RAB must be set corresponding to the port used for each of the non-Lineage® rectifiers connected to the controller. For rectifiers not manufactured by Lucent Technologies, the cable will always require field termination to a wire wrap or screw terminal. See “Mixed Types of Rectifiers in One Plant” in Section 2.

A rectifier must have a feature in order for the ECS-6U to extend that feature to the system. For example, if a rectifier is not capable of acting upon an automatic restart signal, the rectifier will not restart even though the controller sends the signal to the rectifier.

The RAB is required for all Lucent Technologies non-Lineage® 2000 rectifiers and all rectifiers not manufactured by Lucent Technologies.

Table 4-E: Non-Lucent Technologies Rectifier Control Signals

Signal Designation	Signal Description
R+	Positive voltage from point of regulation
R-	Negative voltage from point of regulation
RSRSR	Restart, Restart Return: An isolated contact closure that is sent from the controller to the rectifier to attempt to restart the rectifier after a HV shutdown
BAT	Battery Plant Voltage: Sent from the controller to the rectifier (if needed) to operate alarm and control relays
TRO	A contact closure to HVRO sent from the controller to the rectifier to shut the rectifier down remotely
EQO	A contact closure to HVRO sent from the controller to the rectifier to activate the equalize circuit in the rectifier
HVO	A contact closure to HVRO sent from the controller to the rectifier during a high voltage condition
HVRO	Return for all alarm leads. This lead should be connected to ground at the rectifier
TRHO	TR Handshake. A closure to ground provided by the rectifier after receipt of a TR signal from the controller
RFAO	Rectifier failure alarm. A closure to rectifier ground provided by the rectifier upon failure of the rectifier
MANO	Manual. An open or closed contact to rectifier ground provided by the rectifier upon being turned off manually
ACFO	AC input failure. A closed contact to rectifier ground provided by the rectifier upon loss of AC input voltage

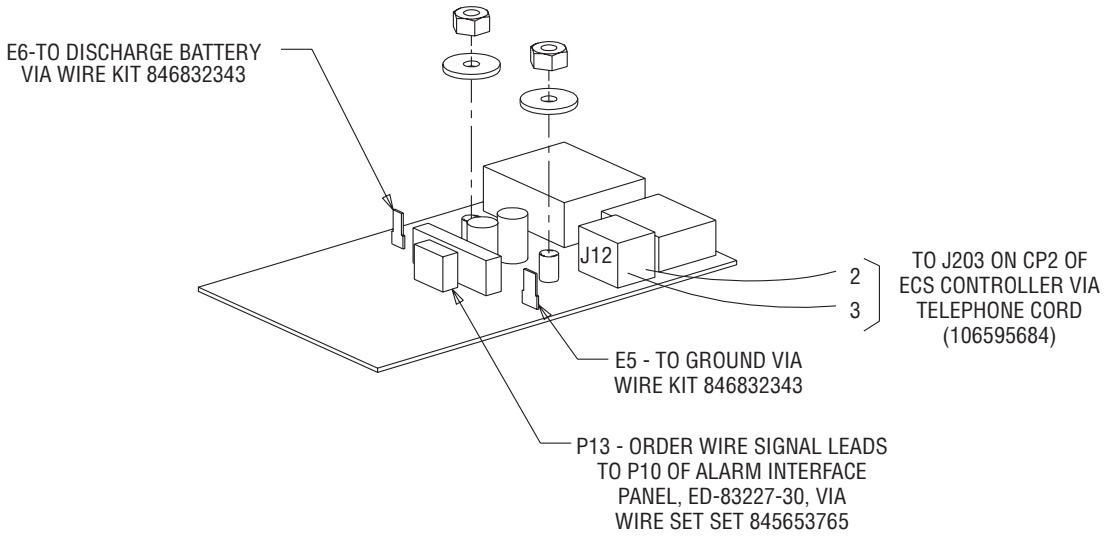


Figure 4-13: 248A Order Wire Board

Optional 248A Order Wire Board

The Order Wire Board shown in Figure 4-13 is optional for the plant. This feature should be ordered when the plant will be monitored over the FT-Series G embedded maintenance system.

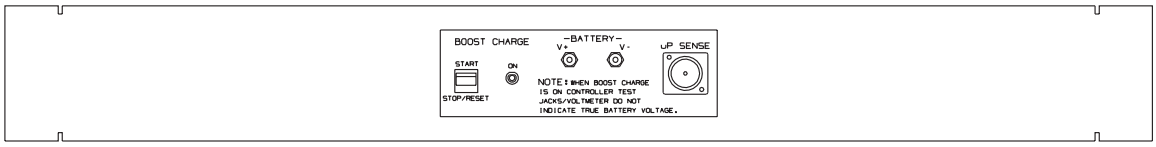
Additional equipment and connections are required outside the power bay to establish the communication link over the FT-Series G embedded telemetry system.

For each repeater site, an SM535 circuit pack (J98764R-1, L45) is required for order wire slot 4 of the LRBC. An SM534 (J98764T-1, L15) circuit pack is also required at the terminal site(s) of each route.

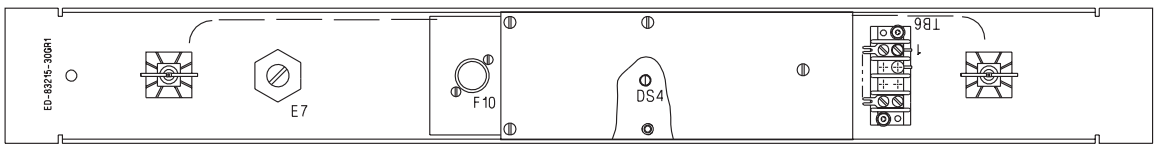
The external connections in Table 4-F are required at the back of the LRBC and TCC (slot 4 is most commonly used) in order to establish a communication link with the ECS-6U Controller over the FT-Series G embedded maintenance system.

Table 4-F: External Connections Required to Establish a Communication Link over the FT-Series G Embedded Telemetry System

		SD-7C441-01		417 Repeater T-96654-32		1.7 Repeater T-96654-37		Terminal T-96653-32	
Connection	**For Site**	**Fig.**	**Note**	**Fig.**	**Note**	**Fig.**	**Note**	**Fig.**	**Note**
2 A25C cables (from alarm interface panel)	Repeater	CAD 5	307	8.7		13, 14		23 through 26	71
Call, TL	Repeater Terminal	CAD 6 CAD 7	311, 321	3		3		7	66
2 or 3 digit dialing address	Repeater Terminal	CAD 6 CAD 7	315	3	55	3	55	7	62
GND	Repeater Terminal	CAD 6	309	3	60	3	60	7	69
DDD EN	Terminal	CAD 7	312, 313					7	64
Line	Terminal	CAD 7							



Front



Rear

Figure 4-14: Boost Charge Panel (Front and Rear Views)

Optional Boost Charge Panel (FT Series G Only)

The Boost Charge Panel shown in Figure 4-14 is optional for the plant.

All three of the following criteria must be satisfied to insure that a Boost Charge Panel is suitable for a particular battery plant.

1. The total plant drain (I_{Load}) must be between 10% and 80% of the plant charge capacity (I_{Cap}).

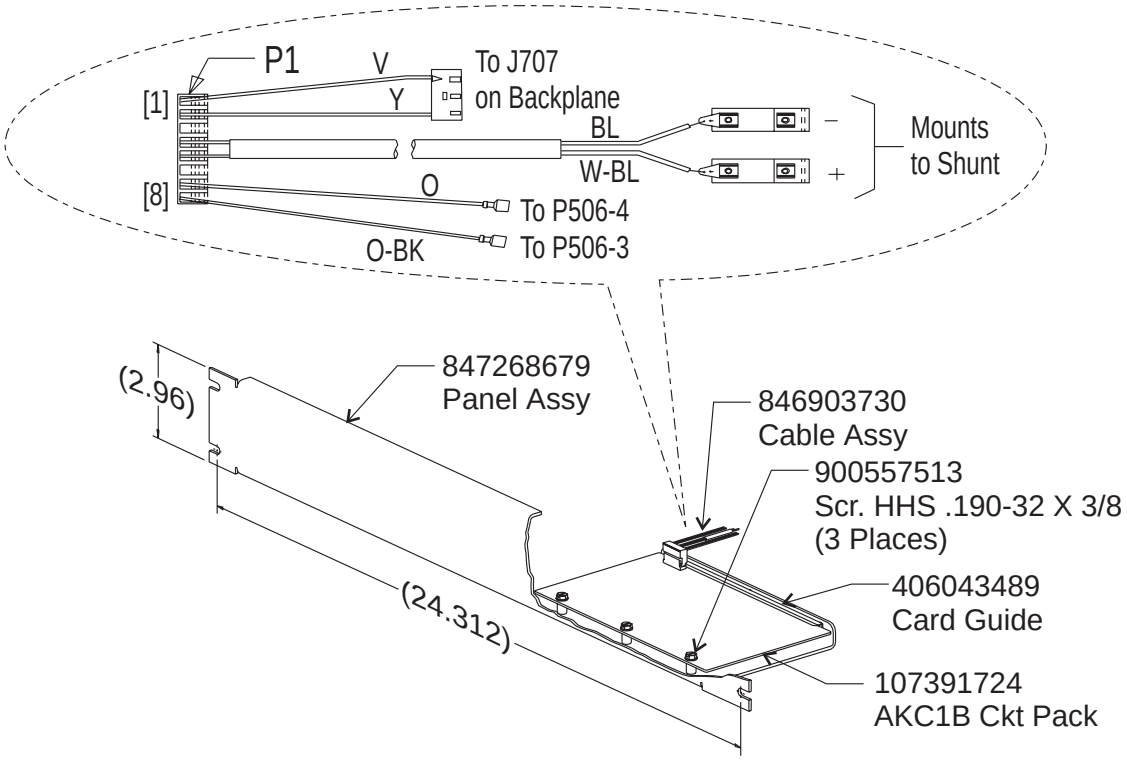
$$0.10 \leq \frac{(I\text{Load})}{(I\text{Cap})} \leq 0.80$$

2. The total plant drain (ILoad) must be between 5% and 40% of the Ampere-Hour capacity (A-HR) of the entire battery string.

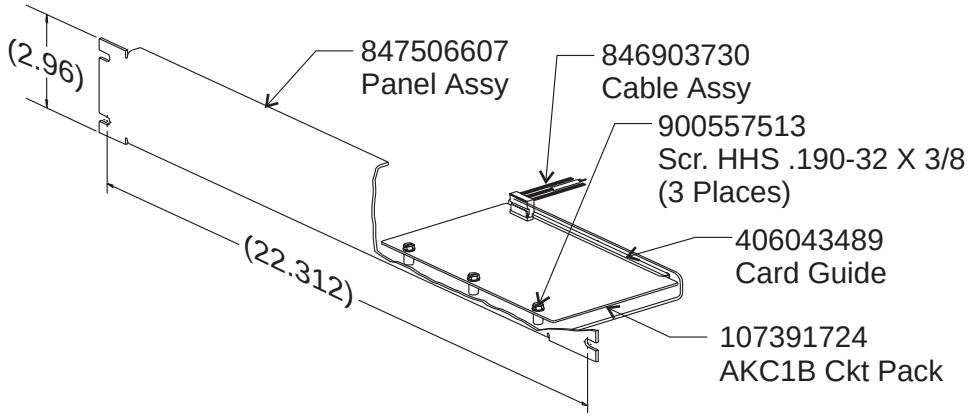
$$0.05 \leq \frac{(I\text{Load})}{(A-HR)} \leq 0.40$$

3. The plant charge capacity must be between 28% and 55% of the Ampere-Hour (A-HR) capacity of the entire battery string.

$$0.28 \leq \frac{(I\text{Cap})}{(A-HR)} \leq 0.55$$



List 6 - AKC1B Ckt Pack Assy (for 24 5/16 Inch Mounting Centers)



List 7 - AKC1B Ckt Pack Assy (for 22 5/16 Inch Mounting Centers)

Figure 4-15: Shunt Isolator Circuit

Shunt Isolator Circuit

When a plant whose shunt is located in the "Batt" lead is connected to the ECS-6U, or the shunt size is not compatible with the ECS-6U (i.e., not listed in Table 4-C), the AKC1B Shunt Isolator Circuit must be used. This circuit, along with the mounting hardware, 846903730 wire set, and four 403929219 shunt fuses (two are spares), is provided per J85501E-2 List 6 field installation kit when mounted in a frame with 24-5/16 inch mounting centers or List 7 when mounted in a frame with 22-5/16 inch mounting centers. Figure 4-15 shows the installation of the circuit.

A shunt isolator is required when retrofitting the originating bay of 152A-155A power plants. A 259A terminal strip and associated mounting is also included with this kit to provide a common fuse alarm (FAJ) connection point for distribution panels and the controller. Mount this terminal strip in the originating bay framework. Refer to wiring drawing T-82603-31, Figure H19.

The 846903730 wire set consists of a 5-foot cable with fused shunt leads for bolting directly to the shunt, an isolated shunt signal to the BAD8 Fuse Alarm Board at P506-4 and -3, and power for the circuit from the lower backplane connector J707 on the controller. If the wire set is not long enough, splice 22-gauge wire as required.

When the P707 and P1 plugs of the 846903730 wire set are connected, the green LED of the AKC1B should activate, indicating proper power polarity to the AKC1B. If the red LED activates, polarity into P1-1 and P1-2 has been reversed. Reverse the faston connectors of the yellow and violet wires of the wire set.

The DIP switch settings required to configure the AKC1B board are listed in Tables 4-G and 4-H. **When the AKC1B isolator circuit is used, the DIP switch settings on CP1 (SW109) and CP2 (SW202) must be reconfigured to conform to these tables for the type and size of shunt required.**

For non-standard shunts that do not match the settings in Tables 4-G and 4-H, use this recommended procedure:

1. Set the DIP switches on Table 4-H to the next higher shunt current rating.

2. For shunts with voltage ratings other than those listed in Table 4-G, select the next lower voltage rating for SW1.

3. Measure plant shunt voltage with voltmeter and record the reading.

4. Calculate the desired reading on the ECS controller using the following formula: Display = (MSV/SVR) SCR

   Where: MSV = Measured Shunt Voltage
   SVR = Shunt Voltage Rating
   SCR = Shunt Current Rating

5. Close SW2-9 and adjust potentiometer R45 (calibration) on AKC1B to display the number calculated in Step 4 on the ECS ammeter.

If the expected plant load reading is not obtained through the AKC1B, adjust the gain (R29) potentiometer of the AKC1B. First, verify the plant shunt current and voltage ratings and use Tables 4-G and 4-H DIP switch settings. Use the following procedure to reset R48 and R29:

1. With sensing inputs J1-4 and J1-5 either open or shorted together, verify that the output at J1-7 and J1-8 reads 0.0X mV (X can be from 1 to 5). If it does not, you may need to readjust the factory settings of the offset (R48) potentiometer.

2. Connect the sensing outputs to the shunt, observing proper polarity (J1-4 to the most negative and J1-5 to the most positive). Measure the shunt mV drop and calculate the plant load with the formula: (Full Scale Shunt Amps / Full Scale Shunt mV) X Shunt mV Reading. Adjust R29 to obtain this reading on the plant ammeter. Verify a second time.

Table 4-G: Shunt Isolator Circuit Pack Shunt Voltage Programming

Shunt Voltage Rating	AKC1B, SW1		
	1	**2**	**3**
25mV	1	1	1
50mV	1	1	0
100mV	1	0	0
150mV	0	0	0

Table 4-H: AKC1B Shunt Isolator Circuit Pack Shunt Current Programming

Shunt Current Rating (Amps)	AKC1B, SW2										ECS CP1, SW109 (see Note 1)						ECS CP2, SW202		
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	2	3	4
50	1	1	1	1	1	1	1	0	0	1	1	0	0	0	1	1	1	0	1
75	1	0	1	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1
100	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1
150	0	1	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1
200	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1
250	0	0	0	1	1	1	1	1	0	1	1	0	0	0	1	1	1	0	1
300	0	0	0	1	1	1	1	0	0	1	1	0	0	0	1	1	1	0	1
400	0	0	0	0	1	1	1	0	0	1	1	0	0	0	1	1	1	0	1
500	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	1	1	0	1
600	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1
800	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0
1000	0	0	0	1	1	1	1	1	0	1	0	1	0	0	0	0	1	1	0
1200	0	0	0	1	1	1	1	0	0	1	0	1	0	0	0	0	1	1	0
1300	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0
1500	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	1	1	0
2000	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	1	1	0
2400	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0
2600	0	0	0	1	1	1	1	0	0	1	0	0	0	1	0	0	1	0	0
3000	0	0	0	0	0	1	1	0	0	1	0	0	1	0	1	1	0	1	0
4000	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	1	0
5000	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0
5200	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0
6000	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	0
8000	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
10000*	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	1	1
15000*	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1
*Actual load should not exceed 8000 amperes.																			

Wiring

Each circuit pack in the controller may require connection to systems outside the power plant or to other parts of the power system. The user must provide these connections.

Basic Controller

The installer wiring associated with the basic controller is connected to four removable terminal blocks on the 113A2. The types of signals on these terminal blocks fall into four categories:

- Alarm Outputs (BD, HV, ACF, MJF, MNF, PMJs and PMNs)
- Alarm Inputs (RMJ, RMN, OS, MJF and MNF from EMJF and EMNF)
- Control Inputs (TEQ, TEL, TF/ER and TRs)
- Miscellaneous Outputs (ABS and DG)

Three of the four terminal blocks (TB102, TB103 and TB104) are assigned to the various office alarm outputs from the controller. Terminal block TB101 has the connection points for the remaining three categories of office interfaces. The signal on each terminal is indicated on the label inside the controller front panel.

Table 4-I provides the Terminal Block Pin Assignments for the 113A2 control unit.

Table 4-I: Terminal Block Pin Assignments for 113A2 Control Unit

Pin No.	Designation	Definition
TB101-1	DG	Discharge Ground
TB101-2	TF/ER	Timer Float/Equalize Return
TB101-3	OS	Open String Alarm
TB101-4	RMJ	Ringer Major Alarm
TB101-5	RMN	Ringer Minor Alarm
TB101-6	TEQ	Timer Equalize
TB101-7	TFL	Timer Float
TB101-8	ABS	Alarm Battery Supply
TB101-9	TR1	Transfer Shutdown from Engine
TB101-10	TR2	Transfer Shutdown from Engine

Table 4-I: Terminal Block Pin Assignments for 113A2 Control Unit

Pin No.	Designation	Definition
TB101-11	TR3	Transfer Shutdown from Engine
TB101-12	TR4	Transfer Shutdown from Engine
TB102-1	BDEC	Battery on Discharge External, alarm causes closure
TB102-2	BDER	Battery on Discharge External, return
TB102-3	BDEO	Battery on Discharge External, alarm causes open
TB102-4	HVEC	High Voltage External, alarm causes closure
TB102-5	HVER	High Voltage External, return
TB102-6	HVEO	High Voltage External, alarm causes open
TB102-7	ACFEC	AC Fail External, alarm causes closure
TB102-8	ACFER	AC Fail External, return
TB102-9	ACFEO	AC Fail External, alarm causes open
TB103-1	PMNAC	Power Minor Audible, alarm causes closure
TB103-2	PMNAR	Power Minor Audible, return
TB103-3	PMNAO	Power Minor Audible, alarm causes open
TB103-4	PMNEC	Power Minor External, alarm causes closure
TB103-5	PMNER	Power Minor External, return
TB103-6	PMNEO	Power Minor External, alarm causes open
TB103-7	MNFEC	Fuse Alarm Minor, External, alarm causes closure
TB103-8	MNFER	Fuse Alarm Minor, External, return
TB103-9	MNFEO	Fuse Alarm Minor, External, alarm causes open
TB103-10	PMNVC	Power Minor Visual, alarm causes closure
TB103-11	PMNVR	Power Minor Visual, return
TB103-12	PMNVO	Power Minor Visual, alarm causes open

Table 4-I: Terminal Block Pin Assignments for 113A2 Control Unit

Pin No.	Designation	Definition
TB104-1	PMJAC	Power Major Audible, alarm causes closure
TB104-2	PMJAR	Power Major Audible, return
TB104-3	PMJAO	Power Major Audible, alarm causes open
TB104-4	PMJEC	Power Major External, alarm causes closure
TB104-5	PMJER	Power Major External, return
TB104-6	PMJEO	Power Major External, alarm causes open
TB104-7	PMJVC	Power Major Visual, alarm causes closure
TB104-8	PMJVR	Power Major Visual, return
TB104-9	PMJVO	Power Major Visual, alarm causes open
TB104-10	MJFEC	Fuse Alarm Major, External, alarm causes closure
TB104-11	MJFER	Fuse Alarm Major, External, return
TB104-12	MJFEO	Fuse Alarm Major, External, alarm causes open

Alarm Outputs: The alarm outputs (BD, HV, ACF, PMNA, PMNV, PMNE, PMJA, PMJV, PMJE, MNF and MJF) are isolated transfer contacts and are described functionally in Section 2. Office alarm systems are designed for EITHER closure-on-alarm or open-on-alarm, requiring two wires from each controller alarm that is used.

Alarm Inputs: The alarm inputs cited above are compatible with battery voltage on alarm signals, current-limited by resistors. These alarm inputs are general purpose. They can be used to detect alarm conditions from any auxiliary plant equipment, such as ringer, converter, inverter, etc. The subsystems generating those alarms must be powered off the same battery and ground system as the controller (i.e., the dc distribution bus bars). A typical application is shown schematically in Figure 4-16. Note that the resistor value for OS is 1000 ohms and the values for RMN and RMJ are 4640 ohms.

Control Inputs: The control inputs from an external equalize timer panel (TEQ, TFL and TF/ER) must be connected to

isolated contacts with a common return (TF/ER). A momentary closure between TEQ and the common return starts equalize. A momentary closure between TFL and the return stops equalize.

The TR inputs from the external rectifier sequence controller should be contact closures to discharge ground (DG) to turn off rectifier groups. In the ECS-6U system, TR1 controls rectifiers G1 and G5, TR2 controls rectifiers G2 and G6, TR3 controls rectifier G3, and TR4 controls rectifier G4.

Miscellaneous Outputs: The miscellaneous signals are basically power (ABS) and ground (DG) to drive the office alarm system and some of the control inputs to the controller.

The terminal blocks accept 22 to 24-gauge stranded wire. Wire terminals are not used. The wire ends are stripped and clamped directly in the terminal blocks. Multiconductor 24-gauge jacketed cable or 22-gauge twisted pair wire is recommended.

1. Select the desired alarms and other signals. Thus determine the total number of wires to be connected to the terminal blocks.

2. Select the configurations of cable and/or twisted pairs based on the number of signals that are to be directed as a group to different locations in the office.

3. Route the total wire bundle for the 113A2 through the opening on the left side of the chassis.

4. Allow for slack in the cable loop outside of the controller, so that the controller drawer will slide out freely to its full extent. Approximately 8 inches (200 mm) of cable will be needed.

5. Strip back the cable jacket(s), if present, approximately eight inches (200 mm) so that the individual wires reach their terminal block positions with no tension on any wire.

6. Tape the ends of all extra (spare) wires which are not to be connected during the initial installation.

7. Strip the remaining wires approximately 1/4-inch (5mm), insert in their respective terminal positions, and tighten the terminal block screws. Terminal blocks may be removed from the control unit for this step, if desired. Note that the

terminal blocks are each polarized differently and are therefore not interchangeable.

8. Slide the drawer in and out to ensure that the amount of cable slack is adequate. When the desired length is found, tie off the cable bundle with the wire ties and tie.

9. Connect Alarm Battery Supply and Discharge Ground to alarm contacts as required to power the office alarms. Alarms, such as ACF, may be combined with other alarms, as required, at this point. If closure-on-alarm contacts are used, alarms should be wired in parallel. If open-on-alarm contacts are used, the alarms should be wired in series. Figure 4-17 shows some examples of typical alarm wiring.

Microprocessor and Datalogger Boards

See Product Manual 167-790-109, Lineage® 2000 ECS Controller Options, for installation, wiring and use of the optional expansion boards.

Circuit Pack Installation

WARNING

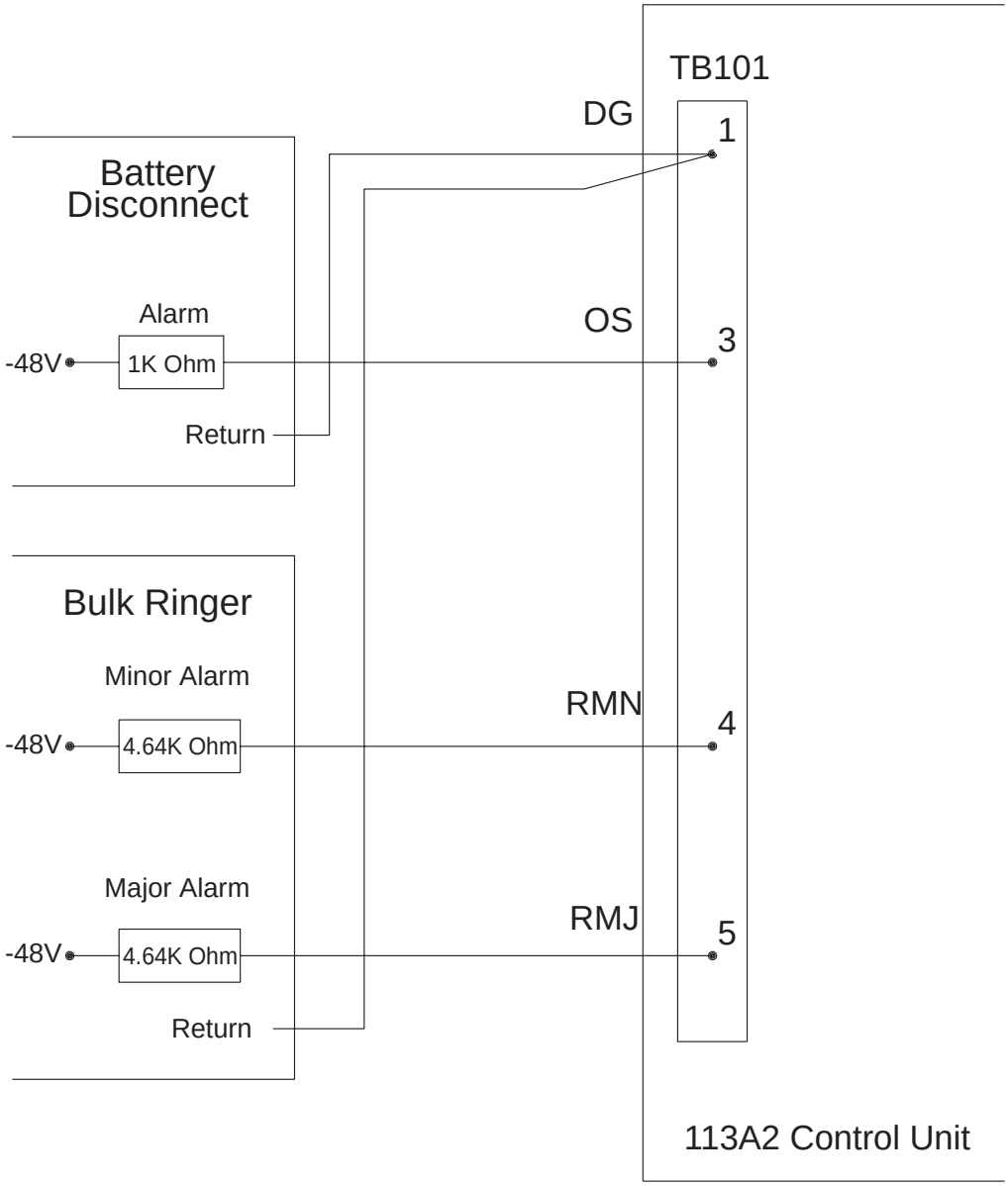
Circuit packs can be damaged by static electricity. Operators should always be grounded when handling circuit packs. Connect the grounding wrist strap to the ESD ground plug on the controller front panel.

When replacing a circuit pack or adding a new circuit pack to a controller which is in service, the circuit pack hardware must first be set up as described in "Basic Hardware Setup." It is not necessary to pull fuses or power down the plant or controller in any manner to remove or add any circuit packs in the controller.

To install a circuit pack, simply open the controller front panel, pull out the drawer and slide the board along its guide rails into the proper slot. Backplane connectors are arranged so that circuit packs cannot be inserted in the wrong slots.

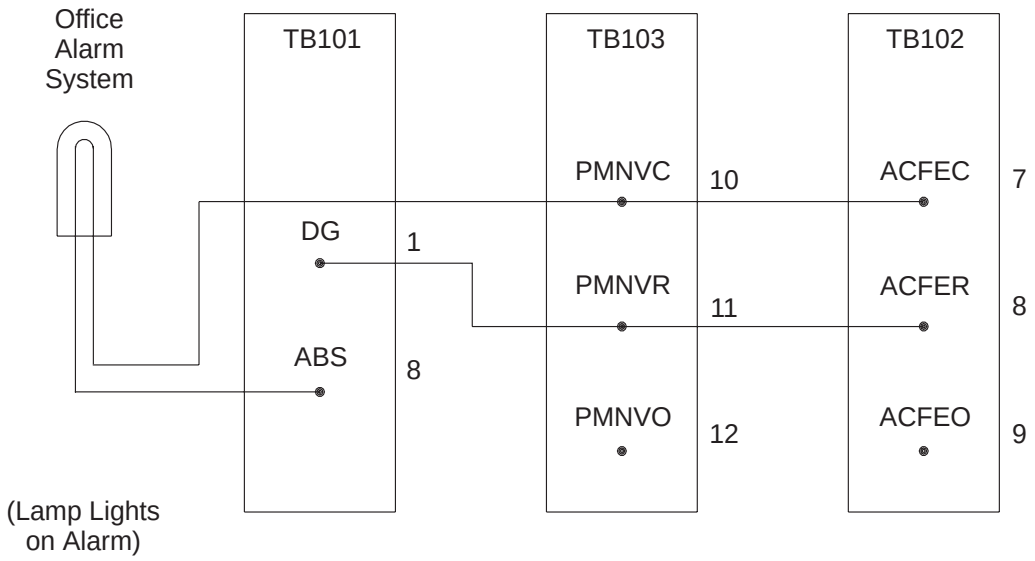
External Wiring

Note: The ECS-6U Controller may provide false alarms if rectifier interface cables are connected to the controller and are not connected to the respective rectifier.

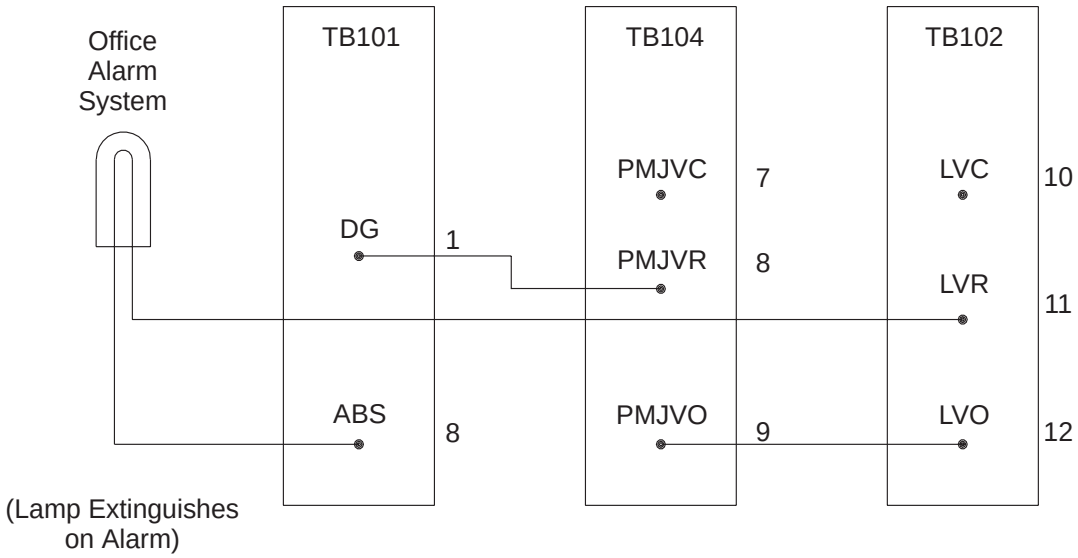


RMN and RMJ are general purpose alarm inputs that can be used for auxiliary equipment.

Figure 4-16: Typical Alarm Application Schematic



(A) AC Fail Paralleled with Power Minor Visual Alarm
for Closure-on-Alarm Type System



(B) Low-Voltage Disconnect Open Alarm in Series with Power Major
Visual Alarm for Open-on-Alarm Type System

Figure 4-17: Typical Alarm Wiring Examples

5 Acceptance Testing

Test Procedures

The ECS-6U controller is tested as a unit and as a part of a battery plant system in the factory. This section of the manual is provided for those users who wish to repeat some of those test procedures as part of the installation and turn-up process. Most of these tests should not be performed while the plant is powering active loads.

The test procedures in this section are listed below.

- Meter Calibration
- Battery on Discharge Alarm*
- Float and Equalize Control
- High Voltage Shutdown and Restart*
- Fuse Alarm
- Remote On/Off (TR signal)
- Bulk Ringer Alarm*

***These tests are not suitable for plants in service.**

Test equipment required:

- Test load - greater than the capacity of the largest rectifier by 20% (60V minimum for 48V plants; 30V minimum for 24V plants)
- Multimeter
- Jeweler’s screwdriver
- Flat-blade screwdriver
- Paper clip with insulated handle or equivalent
- Resistor, 4.64K ohm, 1/4W minimum
- Short length of 22 to 26-gauge wire, 4" (100 mm) maximum
- Power supply, adjustable 0-60 volts dc, 1 ampere, with clip leads

NOTE **Unless otherwise indicated in the test procedures, at least one rectifier must be on line in batteryless plants.**

Meter Calibration

The controller voltmeter has an accuracy of 0.05% and a resolution of one digit. To verify the calibration of the voltmeter, an external meter with better than 0.05% accuracy is needed. If such a meter is not available, only a rough assessment of the controller meter calibration can be achieved. The controller meter is factory calibrated and should not be adjusted in the field unless it is obviously outside the tolerance of the external meter.

If calibration is needed, set the meter select switch to the VOLTS position. Adjust Potentiometer R407 on CP4.

Battery on Discharge Alarm Test

NOTE **The Battery on Discharge Alarm test procedure is to be performed *without an office load*.**

If the test must be performed on a live plant (*with office load*), first notify the alarm center, then shut off rectifiers one at a time. Observe the BD alarm, then restore all rectifiers to normal as quickly as possible.

1. Identify the BD threshold level set on DIP switch SW103.

2. Set the controller meter select switch to the VOLTS position and verify that the plant voltage is above the BD threshold.

3. Turn off all but one rectifier until rectifier capacity is less than plant load.

4. Adjust the test load to draw 5-10% of the rectifier rating.

5. Adjust the rectifier output voltage down until the BD LED on the controller lights. This should occur at the set threshold within the tolerance specified in Table 2-B.

   If Step 5 fails to produce the desired result, more load may be required if a large capacity battery string is connected. Recheck the SW103 setting, raise the plant voltage back to

normal, and repeat Step 5 by adjusting the rectifier voltage down slowly. Refer to the rectifier product manual for voltage adjustment procedures.

6. With the BD alarm present, check with a multimeter or with the office alarm system (if connected) that the following alarms are present on the controller terminal blocks:

   BDE, PMJE, PMJV, and PMJA

   The terminal block positions are listed on a label inside the controller.

7. Slowly adjust the rectifier output voltage back up to normal, or turn the rectifier back on (i.e., reverse Step 5). Observe that the BD LED extinguishes at the correct voltage level, within the specified tolerance. The green NORM LED should light when the BD LED goes out.

8. Check the office alarms on the 113A2 terminal blocks to verify that no alarms are present.

9. If the test fails, replace the 113A2.

10. Restore the plant to normal service. Allow approximately the same amount of time as required for the above test to recharge the batteries before proceeding.

Float and Equalize Control Test

If the equalize function is disabled on the 113A2 or if the plant is not equipped with equalize-capable rectifiers, skip this test. Before beginning, verify that the office load can operate satisfactorily at the higher voltage.

1. Use the front panel switch to put the plant in equalize mode. Verify that the equalize LED lights on the controller and that the rectifiers change to their equalize voltage settings. Readjust the equalize voltage of each rectifier, as required. (Refer to the rectifier product manual for voltage adjustment procedures.)

2. Return plant to float mode with the front panel switch. The equalize LED should extinguish.

3. Momentarily short together pins 2 and 6 on TB101 on CP1 with a piece of wire. This simulates an equalize initiation signal from an external timer panel. Verify that the equalize LED lights and the rectifiers change to equalize mode.

4. Momentarily short pins 2 and 7 on TB101 with a piece of wire. This should stop equalize and return the plant to float mode.

   If the plant is equipped with a CP2, initiate the equalize mode from a terminal. After verifying proper operation, return the plant to the float mode.

High Voltage Shutdown and Restart Test

NOTE **This test cannot be performed on a live plant powering active loads. If possible, batteries should be disconnected from the plant to allow the plant voltage to be reduced easily.**

1. Identify the high voltage shutdown threshold for float operation on DIP switch SW102.

2. Set all rectifiers to non-load share mode.

3. Turn on two rectifiers and adjust the test load so that each rectifier delivers more than 10% of its full load current. Do not load plant more than 90% of the capacity of one rectifier.

4. Set the controller meter to read VOLTS, and verify that the green NORM indicator is the only LED that is lit on the controller.

5. At any one rectifier, slowly adjust its output voltage up until a shutdown occurs. This should occur at the specified HV shutdown threshold within the tolerance indicated in Table 2-B. Verify that the rectifier being adjusted has shut down.

6. Note that the NORM LED goes out and the yellow RFA LED lights on the controller. If enough rectifier capacity is

not still available to maintain the load, the red BD LED may also light.

7. Within ten (10) seconds of rectifier shutdown, the controller should automatically restart all rectifiers. The RFA LED should extinguish and the NORM LED should come on.

8. Since one rectifier is adjusted high, the controller should issue another shutdown signal when the plant voltage again reaches the HV shutdown threshold. Verify that the rectifier shuts down again.

9. After the second shutdown, the controller should NOT automatically attempt to restart rectifiers.

NOTE The automatic restart function may be disabled by the user or installer by moving a jumper strap on the basic controller. (See Section 4, *Installation and Setup,* for this procedure.) **This function should be disabled only for batteryless plants equipped with only one rectifier.** In such an application, the controller loses power if the rectifier is shut down and, in the process, issues a restart. If the one rectifier shuts down again, the cycle will repeat since the controller will again lose power. To prevent a possible infinite cycle of shutdown and restart, the automatic restart function should be disabled for batteryless plants with only one rectifier.

10. With the rectifier(s) shut down, check the office alarm terminal blocks to verify that the following alarms are present:

    PMNE, PMNA, and PMNV

    If the BD LED is also lit, the following alarms should also be present on the terminal blocks:

    BDE, PMJE, PMJA, and PMJV

11. Readjust the rectifier output voltage back down and restart any failed rectifiers manually (i.e., toggle the On/Off switch). Once all rectifiers are back on line, perform the fine adjustment of the rectifier output voltage. (Refer to the rectifier product manual for voltage adjustment procedures.)

12. Verify that only the NORM LED is lit on the controller. Reset the restart timer in the controller by pressing switch SW107, shown on Figure 4-5. This will prevent the controller from ignoring any HV shutdown that might occur in the next ten minutes.

13. If the Float/Equalize function is disabled on CP1, this test is complete. If Float/Equalize is enabled, proceed with Step 14.

NOTE **If the optional Microprocessor Controller Board CP2 is installed, disconnect it temporarily to complete this test. If equipped with a CP2 that has not been disconnected, the controller will default back to the normal float mode when it sees the EQ HV fault, and the HVSD/R test will not work properly.**

14. Identify the HV shutdown threshold for equalize operation on DIP switch SW101.

15. Use the front panel switch to put the plant in equalize mode and verify that the EQ LED lights. This LED should stay lit through the end of the test. The NORM LED is also lit at this point.

16. Repeat Steps 2 through 12 with the plant in equalize mode.

17. Return the plant to float mode using the front panel switch on the controller.

18. Reinstall the CP2.

19. Reset rectifiers to load share mode.

Fuse Alarm Test This test may be performed with or without load on the plant.

1. Insert a paper clip or equivalent as shown in Figure 5-1 to connect the battery lead of the fuse to the alarm lead of the fuse in F501. Insulate the part of the paper clip in contact with the hand. The MNF (Minor Fuse Alarm) LED on the controller front panel should light, and the NORM LED should go out. With a multimeter, verify that the following office alarms are present on the appropriate terminal blocks on the 113A2:

PMNE, PMNV, PMN, MNF

2. Remove the paper clip. The alarms should retire and the MNF LED extinguish. The PMN and MNF alarms in the terminal block should clear.

3. Repeat Steps 1 and 2 for all minor fuses, including F502 through F509.

4. Place a paper clip or equivalent to connect the battery lead of the fuse to the alarm lead of the fuse F510. The MJF (Major Fuse Alarm) LED should light, and the NORM LED should go out. Check the terminal blocks for the following major alarms:

   MJFE, PMJE, PMJA and PMJV

5. Remove the paper clip, and note that the alarms retire and that LEDs return to normal.

6. Repeat Steps 4 and 5 for major fuses F511 and F512.

7. For plants equipped with Battery String Disconnect Breakers Only: The Open String Alarm (OS) is hardwired from the controller terminal blocks to an auxiliary fuse alarm input on the FAB. If OS is wired into the FAB, turn one disconnect breaker off to verify that the desired MJF or MNF alarm and associated power alarms are issued. Turn the breaker back on and note that the alarms retire.

8. Repeat Step 7 for each battery string disconnect switch.

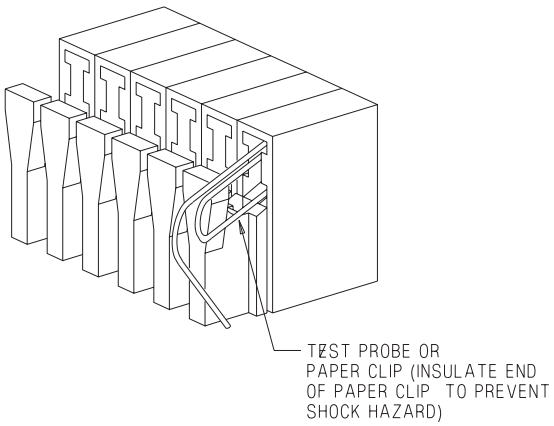


Figure 5-1: Fuse Alarm Test

Remote On/Off (TR Signal) Test

1. Attach one end of a piece of wire to Discharge Ground (DG) on pin 1 of TB101 on CP1. This wire will be used to ground the TR input signals to simulate a Rectifier Sequence Controller or other remote on/off device for controlling rectifiers.

2. Touch the free end of the wire, in turn, to each of the TR inputs on the terminal block pins listed below.

	TB101 Pin #	Rectifier(s)
TR1	9	1, 5
TR2	10	2, 6
TR3	11	3
TR4	12	4

3. Verify that the listed rectifier or rectifiers turn off. When the wire is removed, the rectifier(s) should restart automatically.

4. Disconnect the lead from both ends when finished.

Bulk Ringer Alarm Test

This test involves connecting a lead with plant voltage from one point to another on the controller terminal blocks. Although this voltage is protected by the ABS fuse on the external fuse board, care should be taken to avoid touching and damaging components or printed wiring on CP1.

1. Connect one end of a 4640 ohm resistor to the Ringer Major Alarm input (RMJ) on pin 4 of TB101. Bend the free end clear of any metal parts (e.g., the chassis).

2. Attach one end of a piece of wire to Alarm Battery Supply (ABS) on pin 8 of TB101.

3. Touch the free end of the wire to the free end of the 4640 ohm resistor. The NORM LED on the controller front panel should go out. With a multimeter or the office alarm system, if connected, verify that the following major alarms are issued.

   PMJE, PMJA, and PMJV

4. Disconnect the lead from the resistor, and note that the alarms retire and the NORM LED turns on.

5. Remove the resistor from TB101 pin 4, and connect it to the Ringer Minor Alarm input (RMN) on pin 5 of TB101.

6. Touch the wire to the free end of the resistor. Again, the NORM LED should extinguish and the following power minor alarms should appear on the controller terminal blocks or office alarm system.

   PMNE, PMNA, and PMNV

7. When finished, disconnect the lead and the resistor from both ends. Close the controller front panel.

6 Operation

Front Panel Switches and Indicators

The front panel switches and indicators provide the only operator interaction in a basic controller which is functioning normally. In the event of a controller malfunction, refer to Section 7, *Troubleshooting*. The front panel controls and displays are shown, as numbered and described below, in Figure 6-1.

Table 6-A: Front Panel Switches and Indicators

1.	OUTPUT display	Four-digit LCD display shows the plant dc voltage or load dc current. (See 2.)
2.	VOLTS AMPS switch	Two-position switch selects either plant dc voltage or load current for display. The switch may be left in either position. (See 1.)
3.	FLOAT EQ switch	Three-position, momentary, center-off switch selects either float mode or equalize mode of rectifier operation.
4.	ACF indicator	Yellow LED, when lit, indicates one or more rectifiers have reported a loss of ac input power. This may be treated as a major or minor alarm, at the user's discretion.
5.	BD indicator	Red LED, when lit, indicates the plant voltage is below the preset threshold. This is a MAJOR alarm condition.

Table 6-A: Front Panel Switches and Indicators

6.	MJF indicator	Red LED, when lit, indicates an overcurrent protector on a critical circuit has operated. Such protectors include load circuit breakers/fuses, some controller fuses, and may also include auxiliary devices such as battery disconnects. This is a MAJOR alarm condition.
7.	RFA indicator	Yellow LED, when lit, indicates one or more rectifiers have failed for reasons other than loss of input ac power. This is a MINOR alarm condition.
8.	µP indicator	Yellow LED lights under certain conditions dictated by the CP2 microprocessor board to indicate a microprocessor alarm.
9.	DLA indicator	Yellow Datalogger Alarm LED lights as a warning indication from CP2 and/or the CP3 datalogger board.
10.	EQ indicator	Yellow LED, when lit, indicates that plant is in equalize charge mode. This is not an alarm condition.
11.	MNF indicator	Yellow LED, when lit, indicates that a non-critical overcurrent protector has operated. Such protectors include some controller fuses and may also include battery disconnect circuit breakers. This is a MINOR alarm condition.
12.	NORM indicator	Green LED is lit whenever there are no alarms present, to indicate normal operation. The only other LED that may be lit when the NORM LED is lit is the EQ indicator.
13.	V+ and V- jacks	Test jacks are available for monitoring the plant charge bus voltage with an external meter.
14.	Local terminal port	Opening in the front panel reserved for the local terminal port on the CP2 microprocessor board.
15.	ESD connector	Jack provided for electrostatic discharge grounding with a wrist strap. The operator should be grounded to this point before opening the controller front panel.

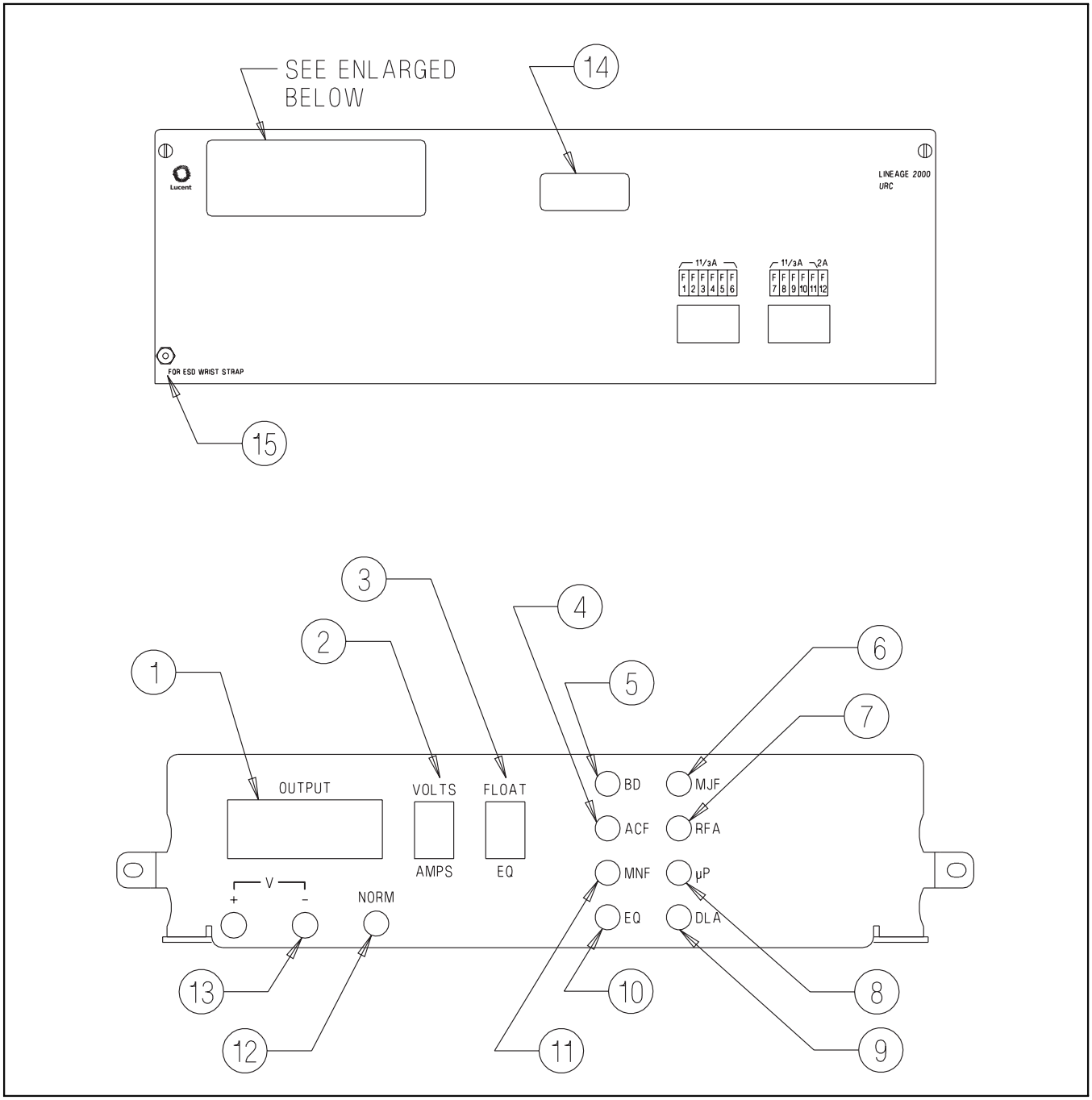


Figure 6-1: Front Panel Location of Controls and Displays

7 Troubleshooting

Flowcharts

This section contains five flowcharts for the purpose of troubleshooting the ECS-6U Controller, verifying controller alarms, and meter calibration.

The flowcharts are listed below.

A. OFFICE ALARMS RECEIVED SHEET 1 OF 1

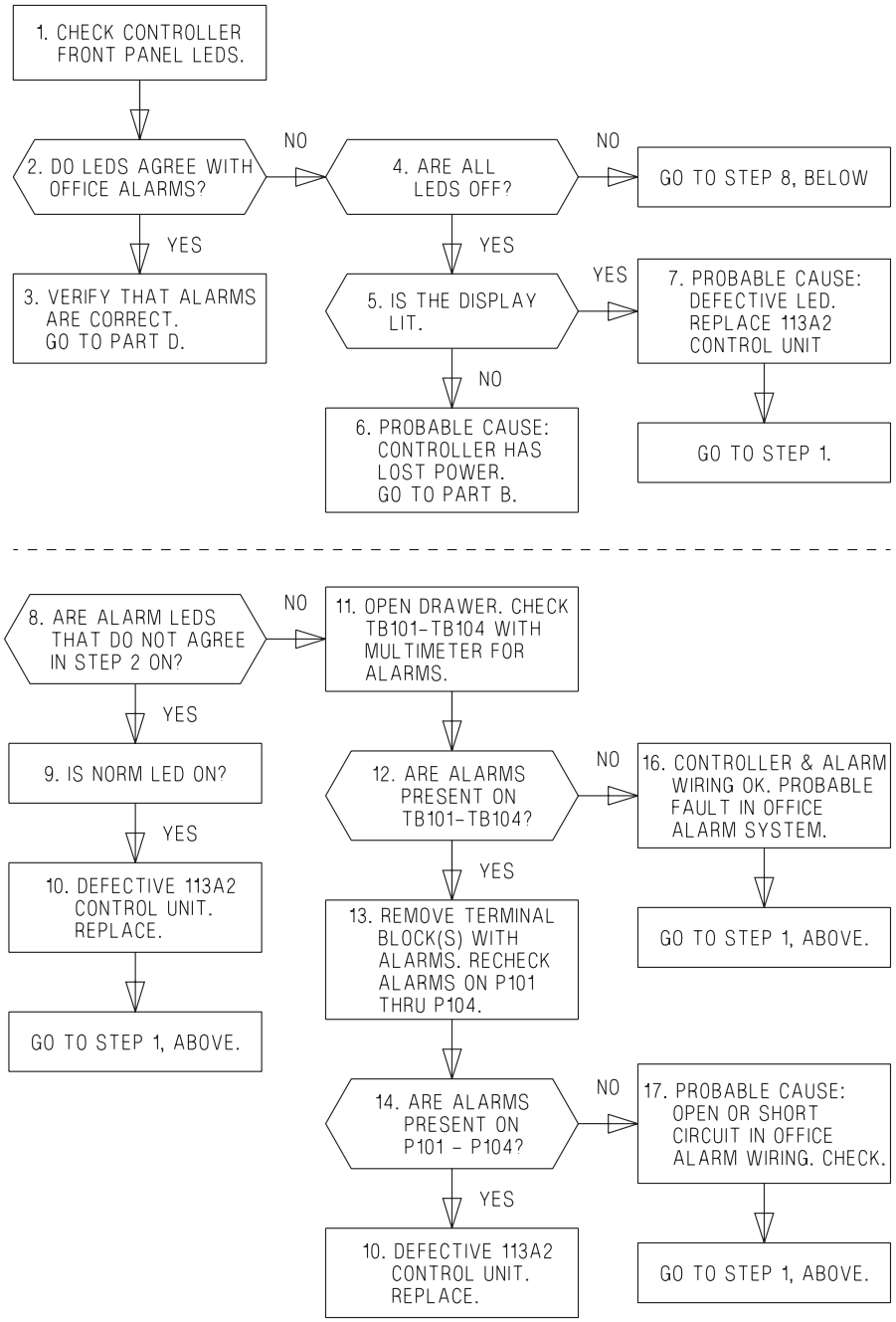


Figure 7-1: Office Alarms Received

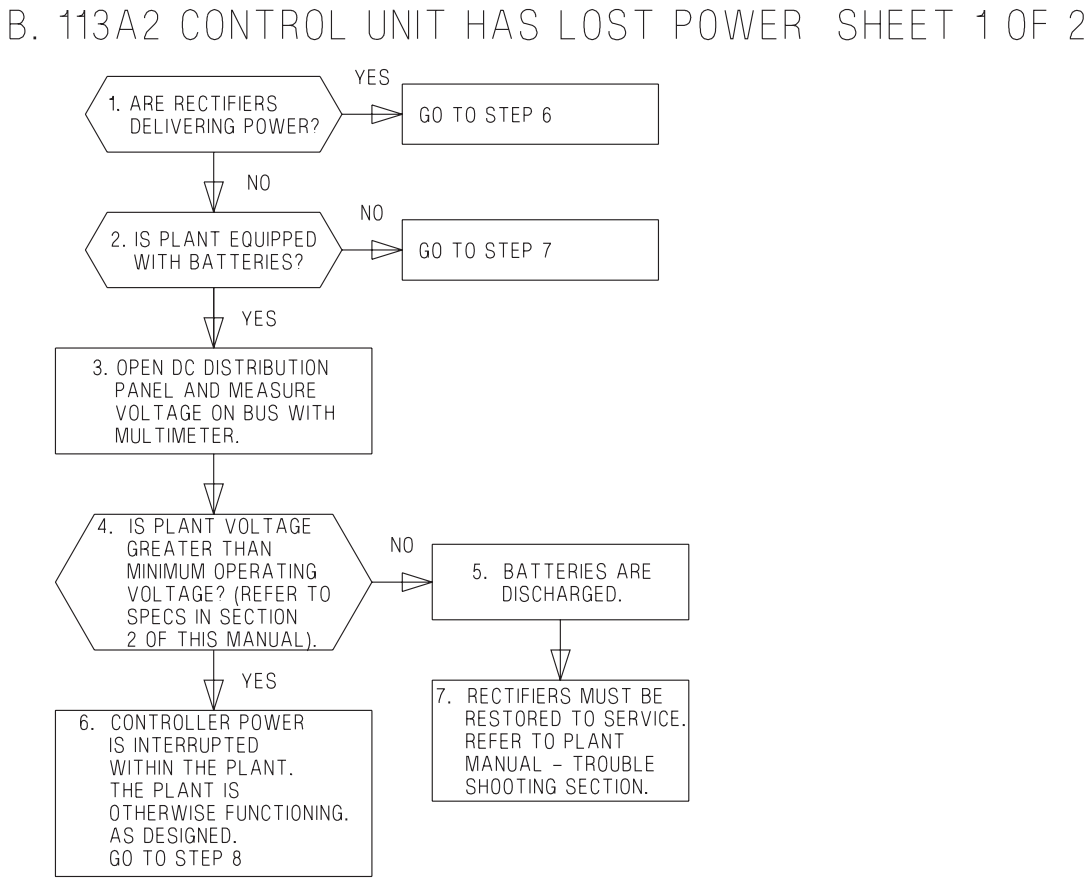


Figure 7-2.1: 113A2 Control Unit Has Lost Power

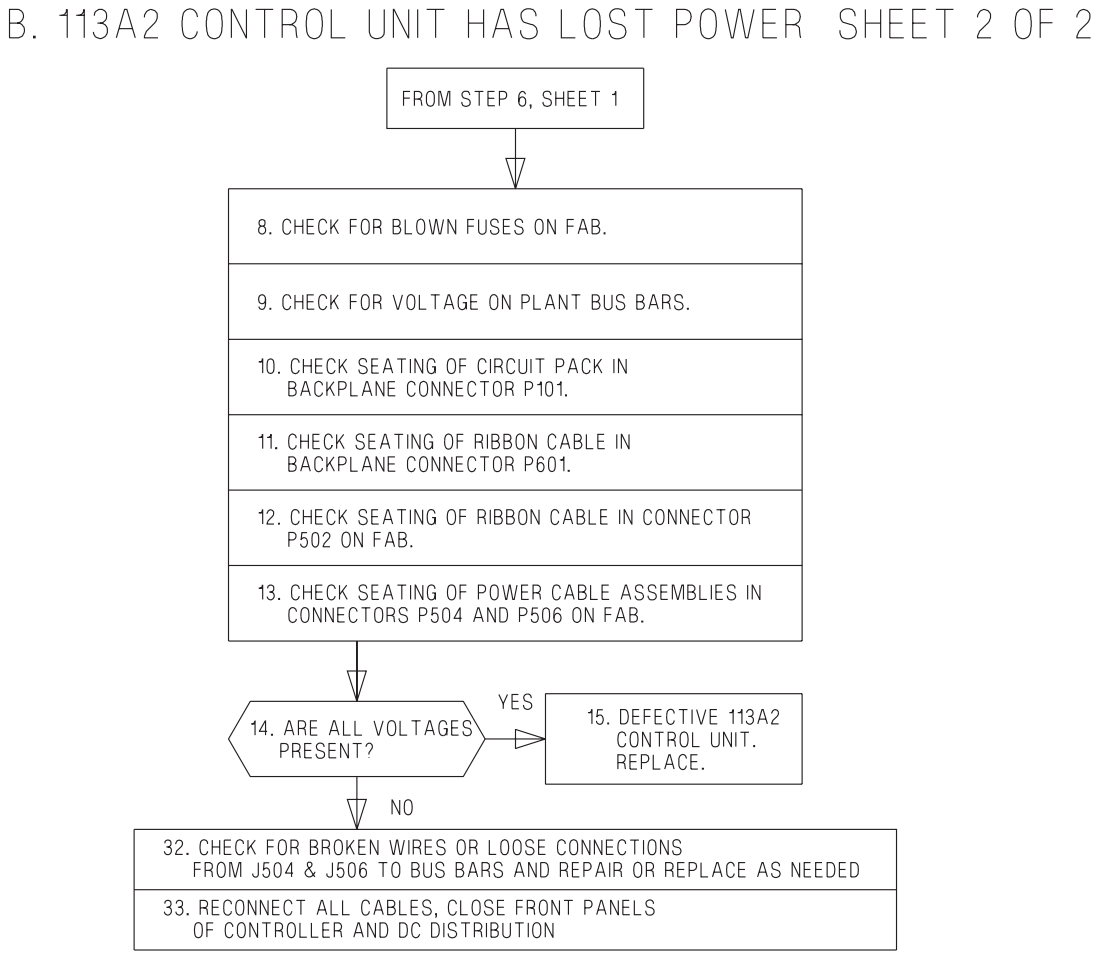


Figure 7-2.2: 113A2 Control Unit Has Lost Power (continued)

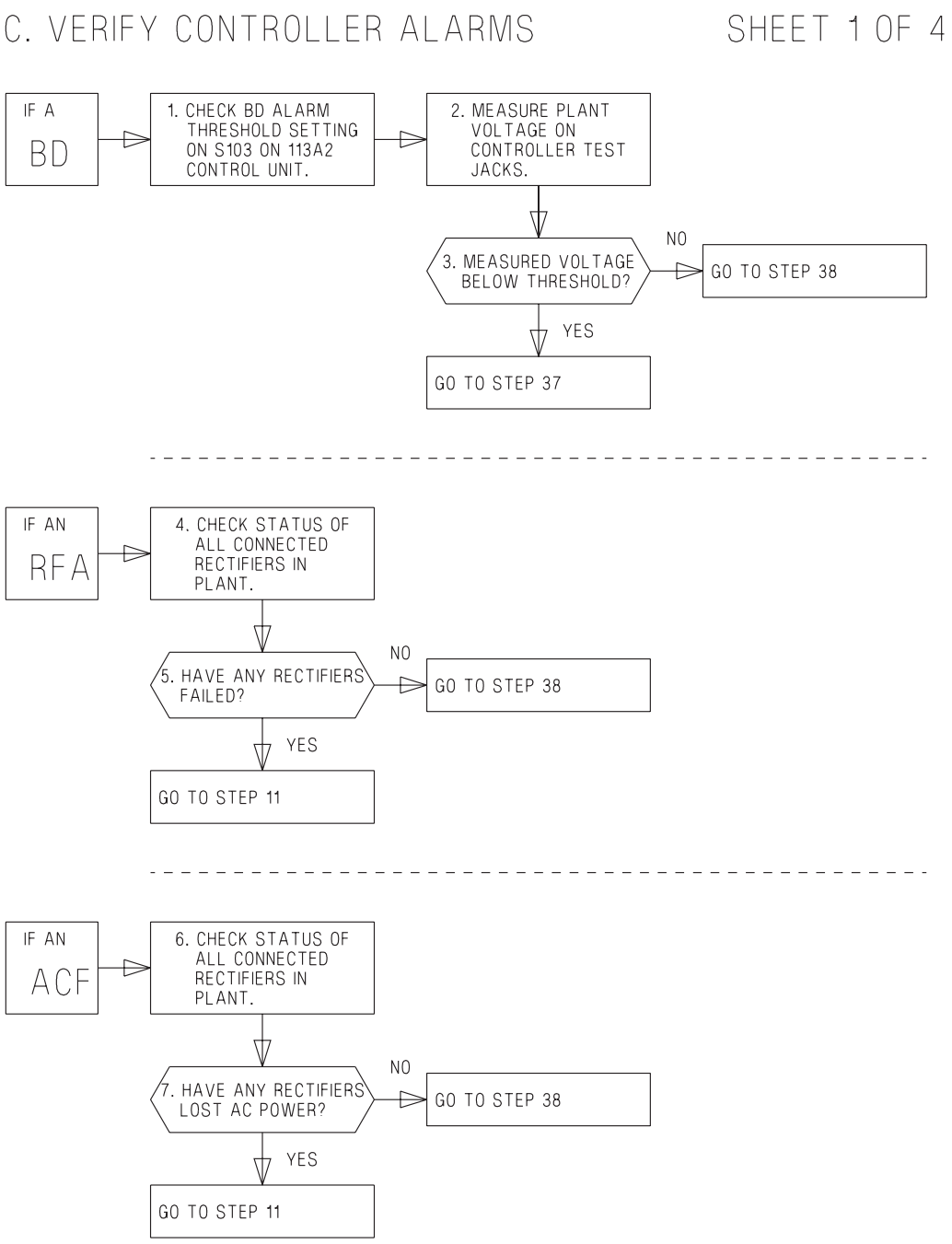
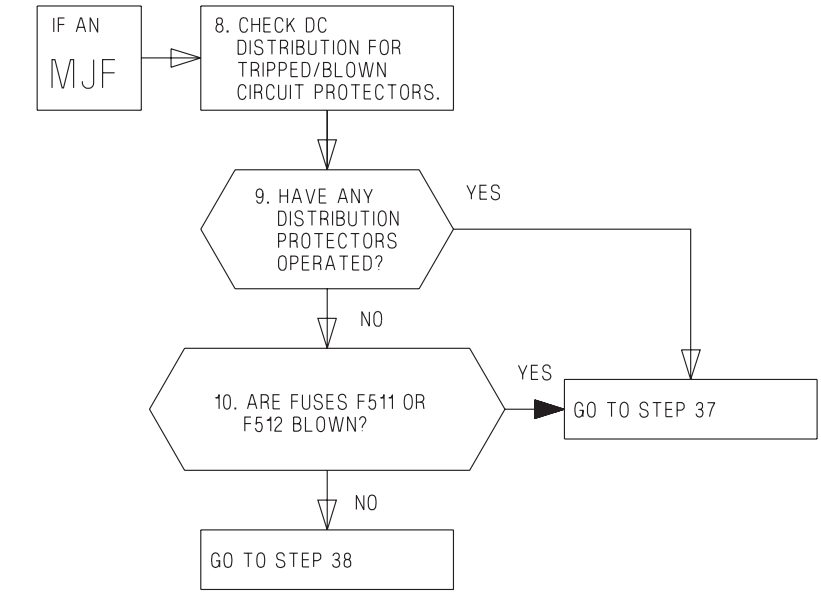


Figure 7-3.1: Verify Controller Alarms

C. VERIFY CONTROLLER ALARMS SHEET 2 OF 4



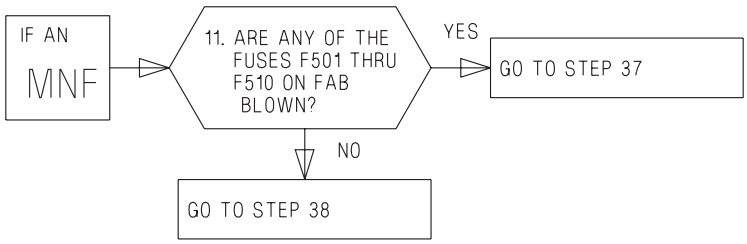


Figure 7-3.2: Verify Controller Alarms (continued)

C. VERIFY CONTROLLER ALARMS SHEET 3 OF 4

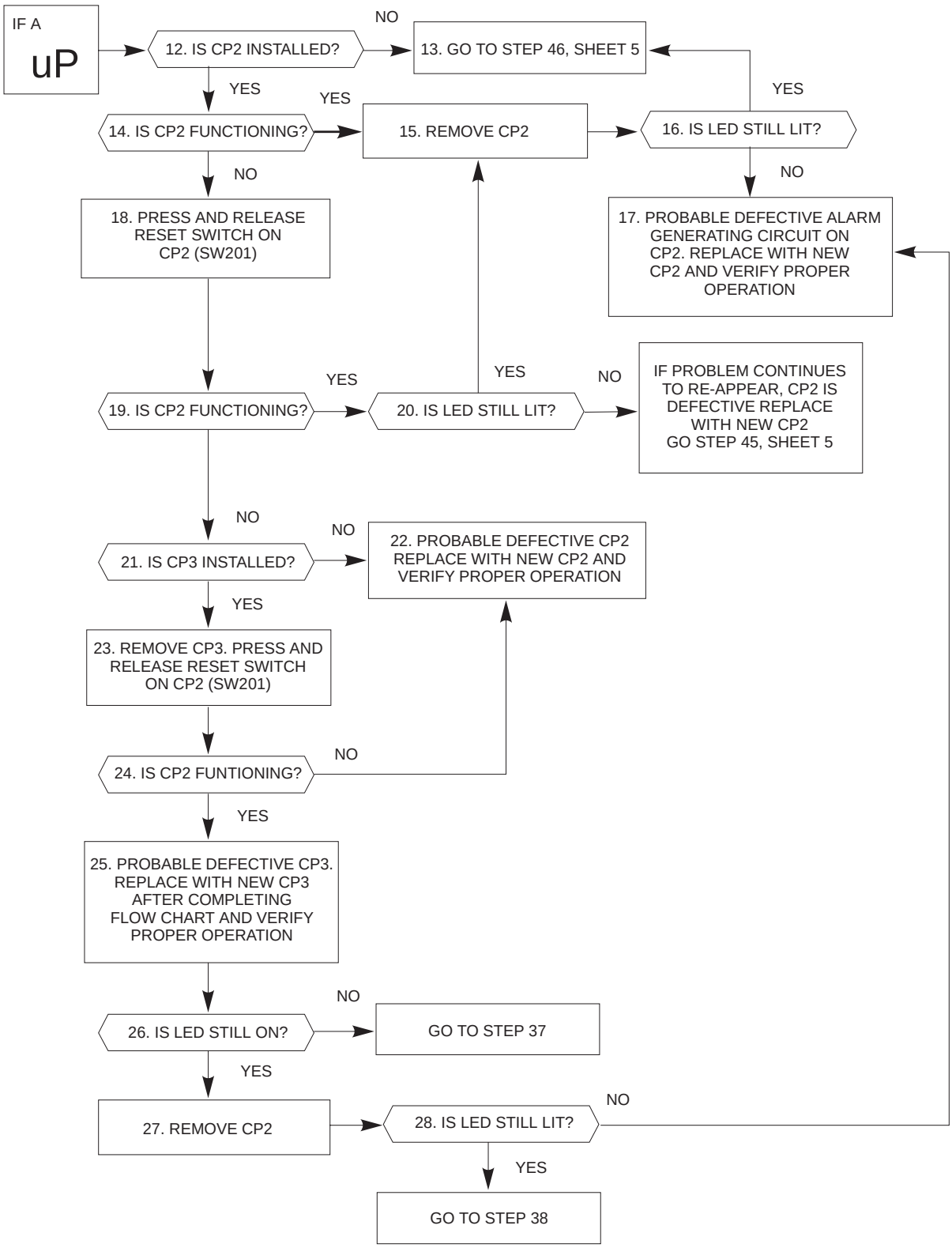


Figure 7-3.3: Verify Controller Alarms (continued)

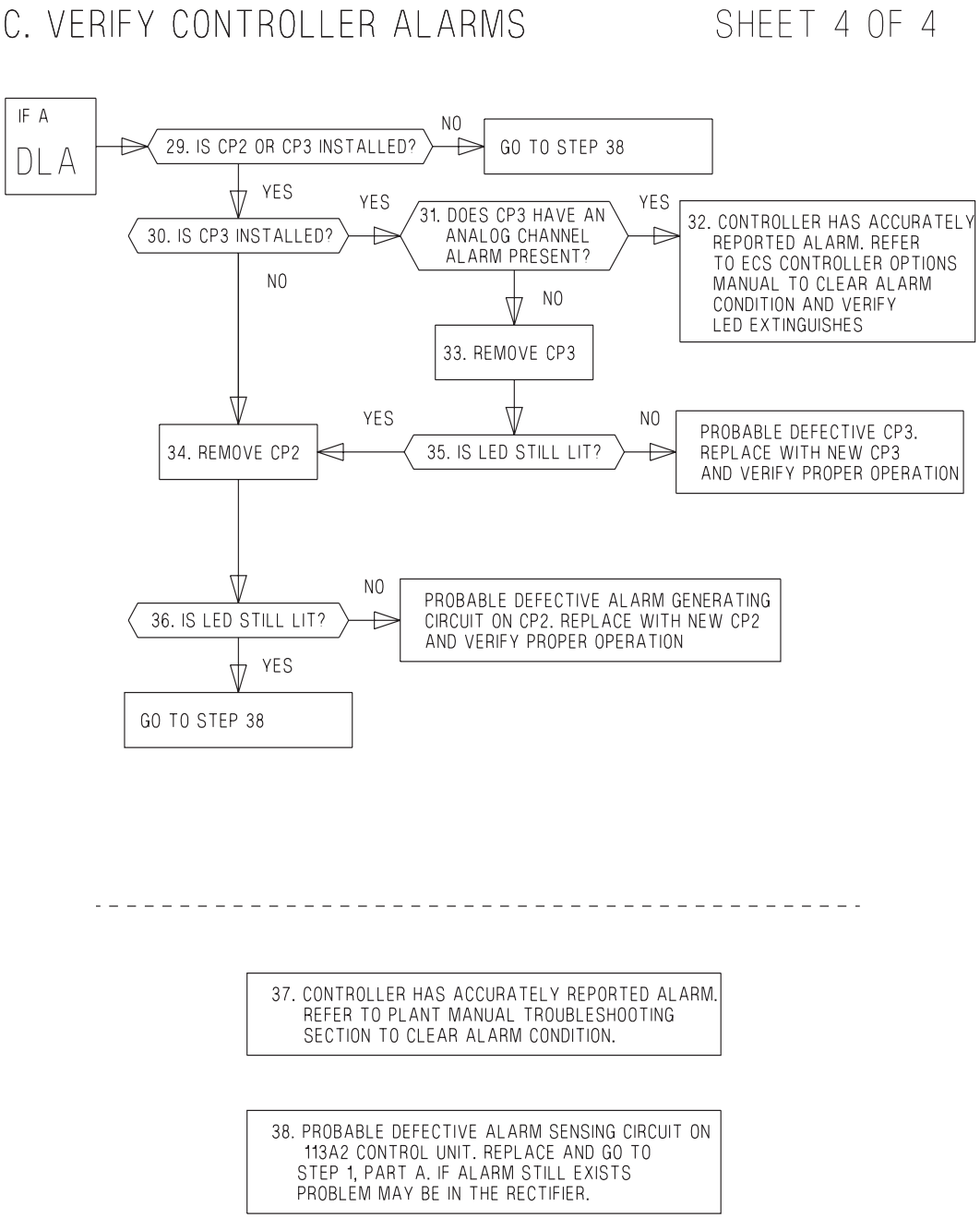


Figure 7-3.4: Verify Controller Alarms (continued)

D. DISPLAY IS NOT LIT SHEET 1 OF 1

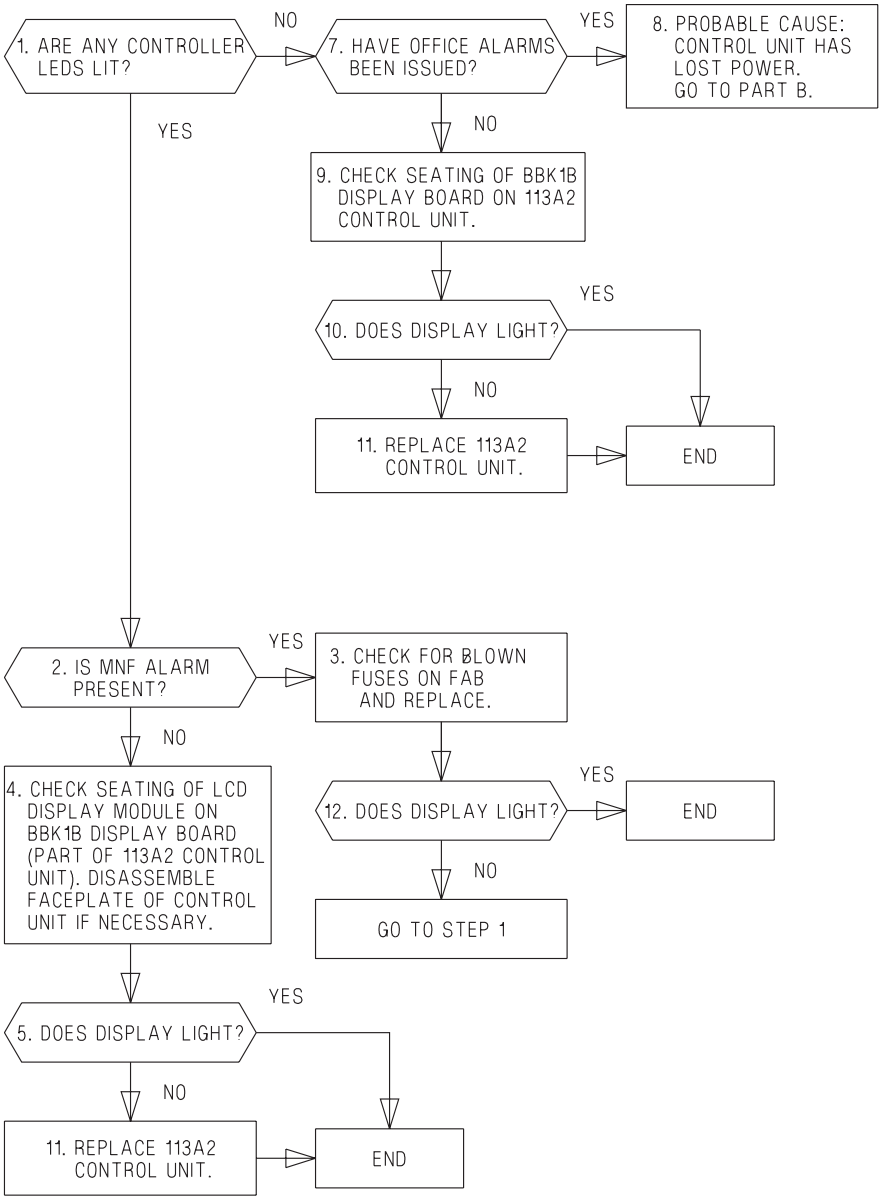


Figure 7-4: Display Is Not Lit

E. METER OUT OF CALIBRATION SHEET 1 OF 1

ASSUMPTIONS: - DISPLAY IS LIT

- PLANT IS OPERATING NORMALLY WITH NO ALARMS

- VOLTAGE DISPLAY DISAGREES WITH THAT MEASURED AT FRONT PANEL TEST JACKS BY MORE THAN THE COMBINED TOLERANCES OF THE EXTERNAL METER AND 0.05 PERCENT.

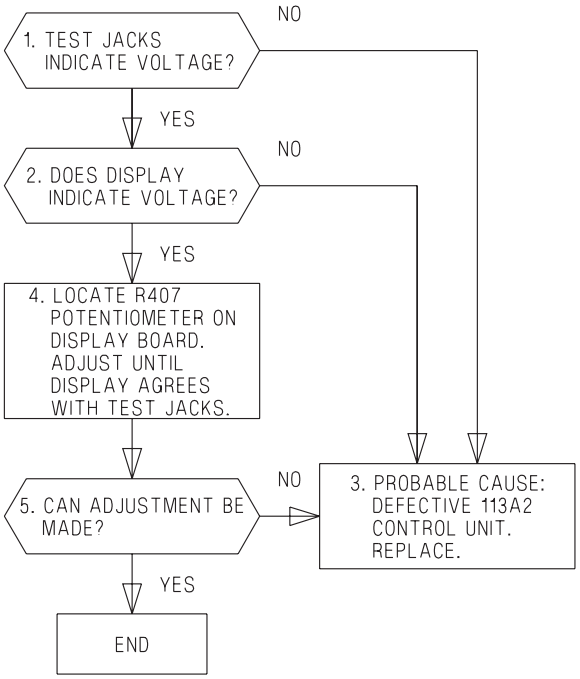


Figure 7-5: Meter Out of Calibration

8 Product Warranty

A. Seller warrants to Customer only, that:

1. As of the date title to Products passes, Seller will have the right to sell, transfer, and assign such Products and the title conveyed by Seller shall be good;
2. Upon shipment, Seller's Manufactured Products will be free from defects in material and workmanship, and will conform to Seller's specifications or any other agreed-upon specification referenced in the order for such Product;
3. With respect to Vendor items, Seller, to the extent permitted, does hereby assign to Customer the warranties given to Seller by its vendor of such Vendor Items, such assignment to be effective upon Customer's acceptance of such Vendor Items. With respect to Vendor items recommended by Seller in its specifications for which the vendor's warranty cannot be assigned to Customer, or if assigned, less than Sixty (60) days remain of the vendor's warranty or warranty period when the Vendor's items are shipped to Customer or when Seller submits its notice of completion of installation if installed by Seller, Seller warrants that such Vendor's Items will be free from defects in material and workmanship on the date of shipment to Customer. In such an event, the applicable Warranty Period will be sixty (60) days.

B. The Warranty Period listed below is applicable to Seller's Manufactured Products furnished pursuant to this Agreement, unless otherwise stated:

Warranty Period

Product Type	New Product	Repaired Product or Part
Central Office Power Equipment	24 Months	6 Months

*The Warranty Period for a repaired Product or part thereof is as listed or, in the case of Products under Warranty, is the period listed or the unexpired term of the new Product Warranty Period, whichever is longer.

**The Warranty Period for Products ordered for Use in Systems or equipment Manufactured by and furnished by Seller is that of the initial Systems or equipment.

C. If, under normal and proper use during the applicable Warranty Period, a defect or nonconformity is identified in a Product and Customer notifies Seller in writing of such defect or nonconformity promptly after Customer discovers such defect or nonconformity, and follows Seller's instructions regarding return of defective or nonconforming Products, Seller shall, at its option attempt first to repair or replace such Product without charge at its facility or, if not feasible, provide a refund or credit based on the original purchase price and installation charges if installed by Seller. Where Seller has elected to repair a Seller's Manufactured Product (other than Cable and Wire Products) which has been installed by Seller and Seller ascertains that the Product is not readily returnable for repair, Seller will repair the Product at Customer's site.

   With respect to Cable and Wire Products manufactured by Seller which Seller elects to repair but which are not readily returnable for repair, whether or not installed by Seller, Seller at its option, may repair the cable and Wire Products at Customer's site.

D. If Seller has elected to repair or replace a defective Product, Customer shall have the option of removing and reinstalling or having Seller remove and reinstall the defective or nonconforming Product. The cost of the removal and the reinstallation shall be borne by Customer. With respect to Cable and Wire Products, Customer has the further responsibility, at its expense, to make the Cable and Wire Products accessible for repair or replacement and to restore

the site. Products returned for repair or replacement will be accepted by Seller only in accordance with its instructions and procedures for such returns. The transportation expense associated with returning such Product to Seller shall be borne by Customer. Seller shall pay the cost of transportation of the repair or replacing Product to the destination designated by Customer within the Territory.

E. The defective or nonconforming Products or parts which are replaced shall become Seller's property.

F. If Seller determines that a Product for which warranty service is claimed is not defective or nonconforming, Customer shall pay Seller all costs of handling, inspecting, testing, and transportation and, if applicable, traveling and related expenses.

G. Seller makes no warranty with respect to defective conditions or nonconformities resulting from actions of anyone other than Seller or its subcontractors, caused by any of the following: modifications, misuse, neglect, accident, or abuse; improper wiring, repairing, splicing, alteration, installation, storage, or maintenance; use in a manner not in accordance with Seller's or vendor's specifications or operating instructions, or failure of Customer to apply previously applicable Seller modifications and corrections. In addition, Seller makes no warranty with respect to Products which have had their serial numbers or month and year of manufacture removed, altered, or with respect to expendable items, including, without limitation, fuses, light bulbs, motor brushes, and the like.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. CUSTOMER'S SOLE AND EXCLUSIVE REMEDY SHALL BE SELLER'S OBLIGATION TO REPAIR, REPLACE, CREDIT, OR REFUND AS SET FORTH ABOVE IN THIS WARRANTY

Appendix A Compatible Lucent Technologies Rectifiers

The following rectifiers have the restart feature and are fully functional when used with the ECS-6U Universal Rectifier Controller, J85501E-1.

25A			**35A**		
24V and 48V			J87434*	SD-82395-01	24V
J85502A	SD-82604-01		J87435*	SD-83296-01	48V
			*Must be equipped with SP3 or SP8 Circuit Pack		
50A			**100A**		
24V and 48V			24V and 48V		
J85502B	SD-82604-01		J85503A-1	SD-82605-01	
364A	SD-82668-01	48V	J87437A-1	SD-82398-01	48V
			KS20493	SD-81999-01	48V
				SD-81999-02	48V
				SD-82401-01	48V
				SD-82401-02	48V
			KS20491	SD-81997-01	24V
				SD-81997-02	24V
				SD-82462-01	24V
				SD-82462-02	24V
			J87436A-1	SD-82397-01	24V
			364B2	SD-82668-01	24V
			364A	SD-82668-01	24V

125A

24V and 48V	
J85502C-1	SD-82659-01

200A

24V and 48V		
J85503B-1	SD-82605-01	
J85503B-2	SD-83281-01	
J87438A-1	SD-82399-01	24V
J87439A-1	SD-82400-01	48V

400A

24V and 48V		
J85503C-1	SD-83102-01	48V
J85503C-2	SD-83102-02	48V
J85503C-3	SD-83103-03	48V
KS21520	SD-82409-01	48V
	SD-82410-01	48V
KS21521	SD-None	24V

800A

48V	
KS21522	SD2412-01