

Product Manual
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Lucent Technologies
Lineage[®] 2000
ECS-12U 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.

Table of Contents

1 Introduction

<i>General Information</i>	<i>1 - 1</i>
<i>Customer Training</i>	<i>1 - 4</i>
<i>Customer Service</i>	<i>1 - 4</i>
<i>Technical Support</i>	<i>1 - 4</i>
<i>Product Repair and Return</i>	<i>1 - 4</i>

2 Product Description

<i>Overview</i>	<i>2 - 1</i>
<i>Basic Controller</i>	<i>2 - 4</i>
<i>Operating Voltage</i>	<i>2 - 4</i>
<i>Batteryless Operation</i>	<i>2 - 4</i>
<i>Rectifier Sense Leads</i>	<i>2 - 5</i>
<i>Office Alarm Contacts and Alarm Battery Supply</i>	<i>2 - 5</i>
<i>Battery on Discharge Alarm</i>	<i>2 - 6</i>
<i>Selective High Voltage Shutdown</i>	<i>2 - 7</i>
<i>Automatic Rectifier Restart</i>	<i>2 - 9</i>
<i>Rectifier Fail Alarm</i>	<i>2 - 10</i>
<i>AC Fail Alarm</i>	<i>2 - 10</i>
<i>Major and Minor Fuse Alarms</i>	<i>2 - 11</i>
<i>Open Battery String Detection and Alarm</i>	<i>2 - 11</i>
<i>Front Panel Status Indicators</i>	<i>2 - 11</i>
<i>Front Panel Meter</i>	<i>2 - 12</i>
<i>Ammeter Scale</i>	<i>2 - 12</i>
<i>Front Panel Test Jacks</i>	<i>2 - 13</i>
<i>Rectifier Sequence Control Interface</i>	<i>2 - 13</i>
<i>Float and Equalize Control</i>	<i>2 - 14</i>
<i>Fuse Board</i>	<i>2 - 15</i>
<i>Power and Sense Voltage Fusing</i>	<i>2 - 17</i>
<i>Major and Minor Fuse Alarms</i>	<i>2 - 17</i>
<i>Low Power Distribution</i>	<i>2 - 17</i>
<i>Spare Fuses</i>	<i>2 - 18</i>
<i>Low Voltage Detection for Disconnect and Reconnect</i>	
<i>Contactor</i>	<i>2 - 18</i>
<i>Controller Options</i>	<i>2 - 19</i>
<i>Microprocessor Board</i>	<i>2 - 19</i>

<i>Datalogger Board</i>	2 - 19
<i>Rectifier Adapter Board</i>	2 - 19
<i>Circuit Options</i>	2 - 20
<i>Order Wire Board</i>	2 - 20
<i>Shunt Isolator Circuit</i>	2 - 20
<i>Mixed Types of Rectifiers in One Plant</i>	2 - 20
<i>Controller Specifications</i>	2 - 21
3 <i>Ordering</i>	
<i>ECS-12U</i>	3 - 1
<i>Rectifier Interface Cables</i>	3 - 3
<i>Documentation</i>	3 - 4
4 <i>Installation and Setup</i>	
<i>Introduction</i>	4 - 1
<i>Tools Required</i>	4 - 1
<i>Shipped-Loose Unit Installation</i>	4 - 1
<i>Preparation</i>	4 - 1
<i>Default Factory Settings</i>	4 - 2
<i>Frame Mounting</i>	4 - 3
<i>Connection to Frame Ground</i>	4 - 4
<i>Hardware Setup</i>	4 - 4
<i>Voltage Selection</i>	4 - 5
<i>Equalize Enable/Disable</i>	4 - 9
<i>Automatic Restart Enable/Disable</i>	4 - 10
<i>Ammeter Scale</i>	4 - 10
<i>Battery on Discharge Threshold</i>	4 - 11
<i>High Voltage Shutdown Thresholds</i>	4 - 11
<i>Rectifier Port Selection</i>	4 - 12
<i>Optional Rectifier Adapter Board (RAB)</i>	4 - 13
<i>Optional 248A Order Wire Board</i>	4 - 17
<i>Shunt Isolator Circuit</i>	4 - 18
<i>Low Voltage Disconnect Threshold (Optional)</i>	4 - 21
<i>Wiring</i>	4 - 22
<i>Basic Controller</i>	4 - 22
<i>Plant Alarms</i>	4 - 26
<i>External Wiring</i>	4 - 30
<i>Microprocessor and Datalogger Boards</i>	4 - 30
<i>Circuit Pack Installation</i>	4 - 30
<i>Replacement of Multiplexing Board</i>	4 - 30
5 <i>Acceptance Testing</i>	
<i>Test Procedures</i>	5 - 1

<i>Test Equipment</i>	5 - 1
<i>Meter Calibration</i>	5 - 2
<i>Battery on Discharge Alarm Test</i>	5 - 2
<i>Float and Equalize Control Test</i>	5 - 3
<i>High Voltage Shutdown and Restart Test</i>	5 - 4
<i>Fuse Alarm Test</i>	5 - 6
<i>Remote On/Off (TR Signal) Test</i>	5 - 8
<i>Bulk Ringer Alarm Test</i>	5 - 8
<i>Low Voltage Battery Disconnect Test</i>	5 - 9

6 Operation

<i>Front Panel Switches and Indicators</i>	6 - 1
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7 Troubleshooting

<i>Flowcharts</i>	7 - 1
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8 Product Warranty

Appendix Compatible Lucent A Technologies Rectifiers

List of Figures

<i>Figure 1-1: Lineage® 2000 ECS-12U Controller</i>	<i>1 - 2</i>
<i>Figure 1-2: Typical ECS Controller Application</i>	<i>1 - 3</i>
<i>Figure 2-1: Front View of ECS-12U Controller (Door Shown in Full Open Position)</i>	<i>2 - 2</i>
<i>Figure 2-2: ECS-12U Controller Block Diagram</i>	<i>2 - 3</i>
<i>Figure 2-3: Detail of 113B Control Unit Display Panel</i>	<i>2 - 4</i>
<i>Figure 2-4: Fuse Board Fuse Designations and Functions</i>	<i>2 - 16</i>
<i>Figure 4-1: 26-inch Frame Mounting</i>	<i>4 - 3</i>
<i>Figure 4-2: 23-inch Frame Mounting (List BA)</i>	<i>4 - 4</i>
<i>Figure 4-3: ECS-12U Controller Backplane (Upper)</i>	<i>4 - 5</i>
<i>Figure 4-4: 113B Jumper and Switch Locations</i>	<i>4 - 6</i>
<i>Figure 4-5: CP1 DIP Switch Settings</i>	<i>4 - 7</i>
<i>Figure 4-6: Rectifier Interface Board (RIB) Layout and Switch Locations</i>	<i>4 - 8</i>
<i>Figure 4-7: Rectifier Interface Board (RIB) DIP Switch Settings</i>	<i>4 - 8</i>
<i>Figure 4-8: ECS-12U Controller Backplane (Lower)</i>	<i>4 - 13</i>
<i>Figure 4-9: Rectifier Adapter Board (RAB) Layout and Switch Locations</i>	<i>4 - 14</i>
<i>Figure 4-10: RAB DIP Switch Settings</i>	<i>4 - 15</i>
<i>Figure 4-11: Control Cable for Non-Lucent Technologies Rectifier Connection</i>	<i>4 - 15</i>
<i>Figure 4-12: 248A Order Wire Board</i>	<i>4 - 17</i>

<i>Figure 4-13: Shunt Isolator Circuit</i>	4 - 20
<i>Figure 4-14: Typical Alarm Application Schematic</i>	4 - 28
<i>Figure 4-15: Typical Alarm Wiring Examples</i>	4 - 29
<i>Figure 4-16: Rectifier Multiplexing Circuit Pack</i>	4 - 31
<i>Figure 5-1: Fuse Alarm Test</i>	5 - 7
<i>Figure 6-1: Front Panel Location of Controls and Displays</i>	6 - 4
<i>Figure 7-1: Office Alarms Received</i>	7 - 2
<i>Figure 7-2.1: 113B Control Unit Has Lost Power</i>	7 - 3
<i>Figure 7-2.2: 113B Control Unit Has Lost Power (continued)</i>	7 - 4
<i>Figure 7-3.1: Verify Controller Alarms</i>	7 - 5
<i>Figure 7-3.2: Verify Controller Alarms (continued)</i>	7 - 6
<i>Figure 7-3.3: Verify Controller Alarms (continued)</i>	7 - 7
<i>Figure 7-3.4: Verify Controller Alarms (continued)</i>	7 - 8
<i>Figure 7-4: Display Is Not Lit</i>	7 - 9
<i>Figure 7-5: Meter Out of Calibration</i>	7 - 10

List of Tables

<i>Table 2-A: ECS-12U Controller Electrical Specifications</i>	<i>2 - 21</i>
<i>Table 2-B: Battery Plant Alarm Voltage Ranges</i>	<i>2 - 22</i>
<i>Table 2-C: ECS-12U Controller Physical Specifications</i>	<i>2 - 22</i>
<i>Table 3-A: ECS-12U Controller Ordering Information</i>	<i>3 - 1</i>
<i>Table 3-B: Available Rectifier Interface Cables</i>	<i>3 - 3</i>
<i>Table 4-A: Default Factory Settings for Circuit Boards</i>	<i>4 - 2</i>
<i>Table 4-B: SW109 DIP Switch Settings</i>	<i>4 - 11</i>
<i>Table 4-C: Non-Lucent Technologies Rectifier Control Signals</i>	<i>4 - 16</i>
<i>Table 4-D: External Connections Required to Establish a Communication Link Over the FT-Series G Embedded Telemetry System</i>	<i>4 - 18</i>
<i>Table 4-E: LVD/Fuse Board Terminal Block Pin Assignments</i>	<i>4 - 21</i>
<i>Table 4-F: CPI Terminal Block Pin Assignments for 113B Control Unit</i>	<i>4 - 24</i>
<i>Table 4-G: Shunt Isolator Circuit Pack Shunt Voltage Programming Table</i>	<i>4 - 26</i>
<i>Table 4-H: AKC1B Shunt Isolator Circuit Pack Shunt Current Programming Table</i>	<i>4 - 27</i>

1 Introduction

General Information

This product manual, Select Code 167-790-056, describes the J85501E-2 ECS-12U Universal Rectifier Controller. The basic ECS-12U controller monitors and controls any combination of up to 12 Lucent Technologies switchmode (SR) or 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-12U 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 302 series or the 326 series. 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-12U.

The ECS-12U 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-12U controller is shown in Figure 1-1. A view of a typical ECS controller application is shown in Figure 1-2.

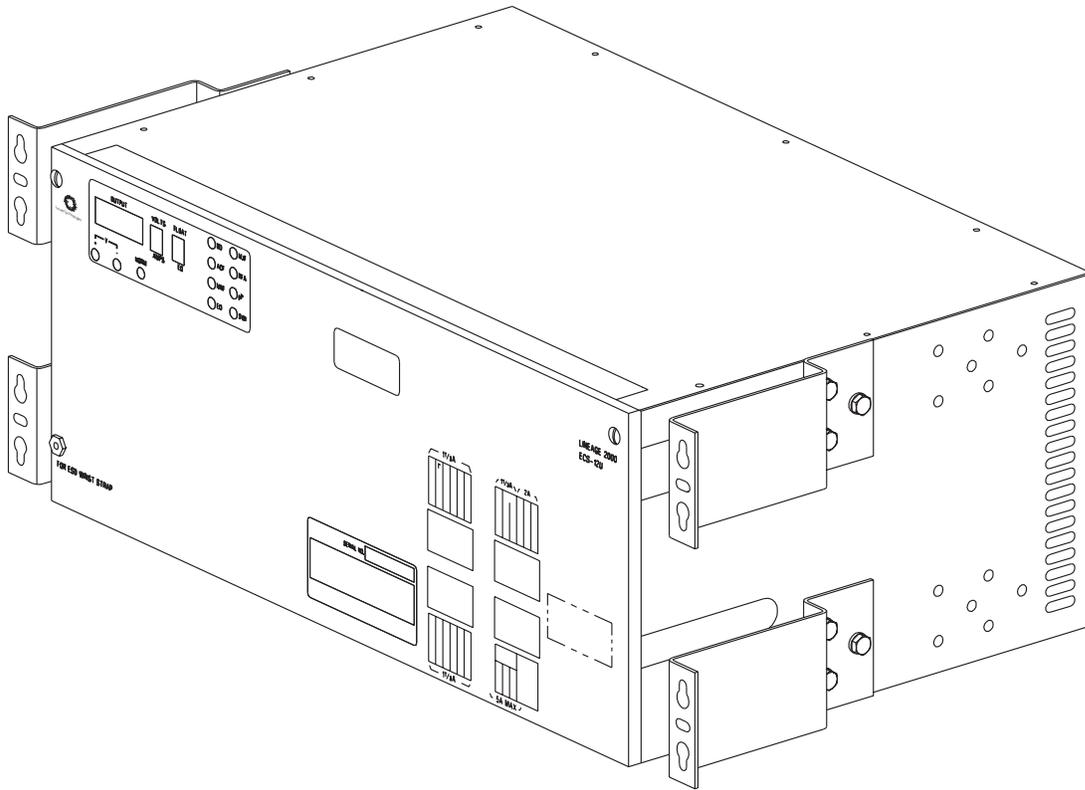


Figure 1-1: Lineage[®] 2000 ECS-12U Controller

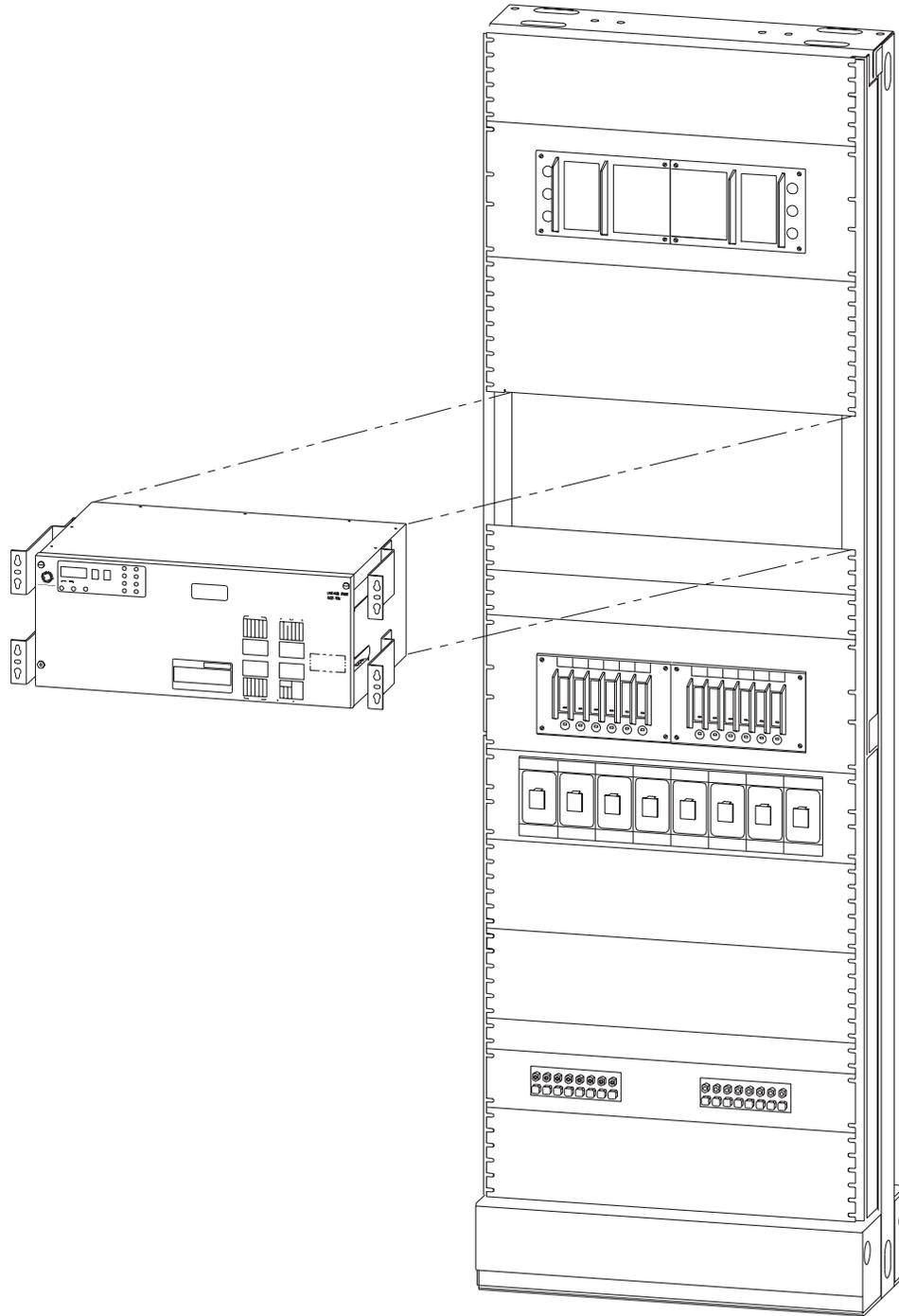


Figure 1-2: Typical ECS Controller Application

Customer Training

Lucent Technologies offers customer training on this and other power 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.

2 *Product Description*

Overview

The ECS-12U Controller consists of a chassis equipped with two slide-out trays. The upper tray is equipped with a standard analog control unit, the 113B, which consists of two circuit boards, 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.

Located behind the tray is a rectifier multiplexing circuit board (BCC1) that allows signals to pass between the lower and upper backplanes.

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

The lower tray also provides space for the optional Order Wire Board and the AKC1B Shunt Isolator Circuit Board. See “Circuit Options” for more information.

A Fuse Board (CP5), which is mounted inside the front door, is always required to provide fusing for the controller and rectifier sense leads. An optional CP5, the LVD/Fuse Board, also provides the low voltage disconnect function for plants with this feature. See “Fuse Board” for more information.

A front view of the ECS-12U controller is shown in Figure 2-1. Figure 2-2 is a block diagram of the controller.

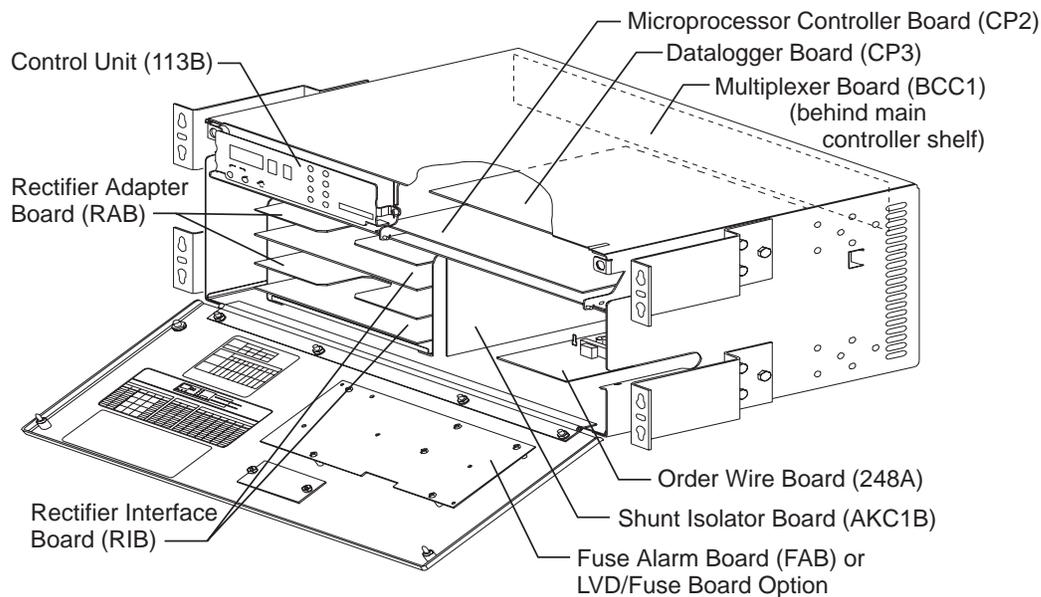


Figure 2-1: Front View of ECS-12U Controller (Door Shown in Full Open Position)

Throughout this manual the components of the ECS-12U controller are designated by the acronyms listed below:

Acronym	Description	Product Code
113B	Analog Control Unit	113B
CP1	Control Board	(part of 113B)
CP2	Microprocessor Board	BAB1B
CP3	Datalogger Board	BAC1
CP4	Display Board	(part of 113B)
CP5	Fuse Alarm Board or optional LVD/Fuse Board	BCB5 (-48V), BCB6 (+24V), or BCB2 (-48V with LVD)
RIB	Rectifier Interface Board	EAT1
RAB	Rectifier Adapter Board	EAT2
MUX	Multiplexer Board	BCC1
AKC1B	Shunt Isolator Circuit Pack	AKC1B
248A	Order Wire Board	248A

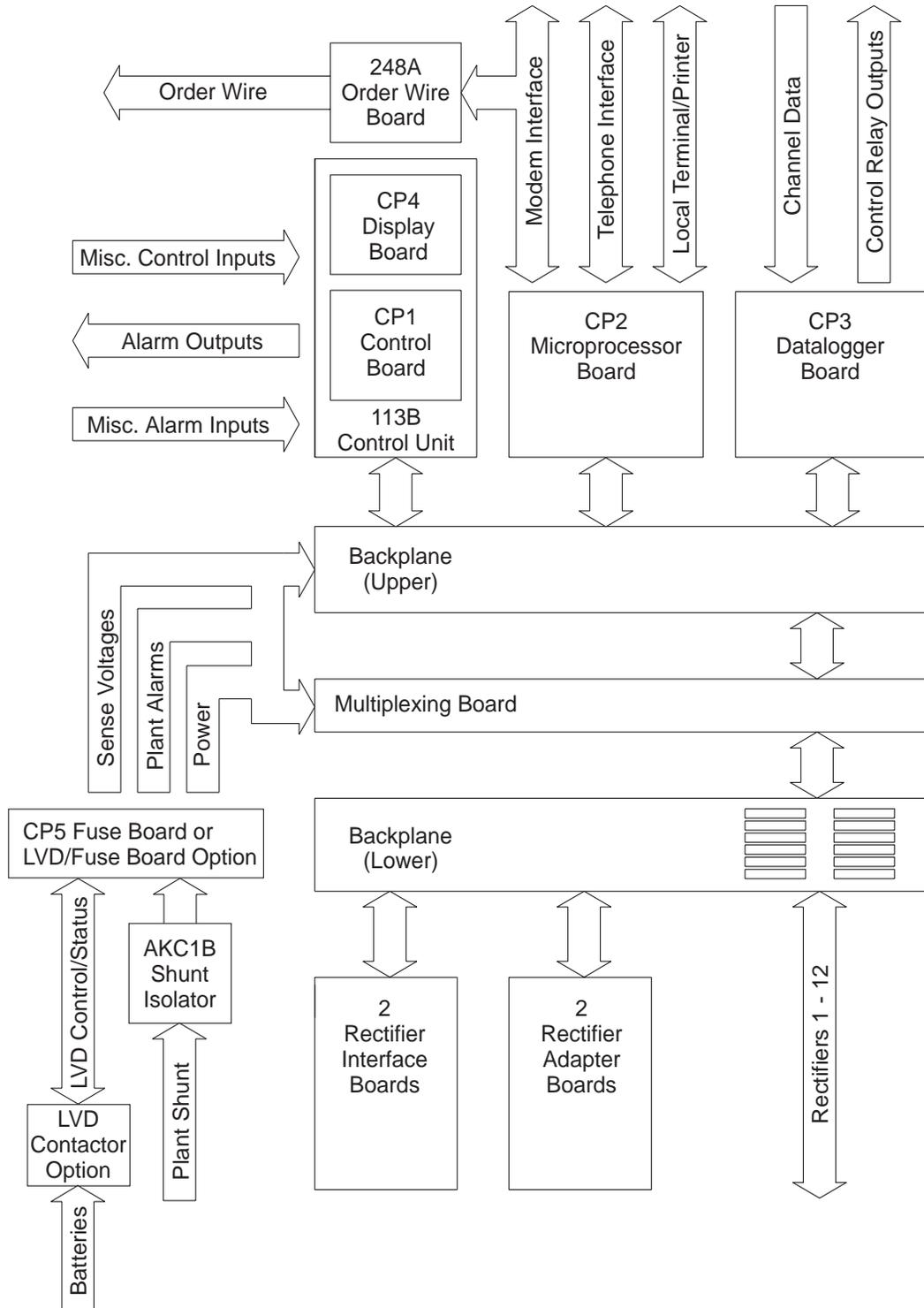


Figure 2-2: ECS-12U Controller Block Diagram

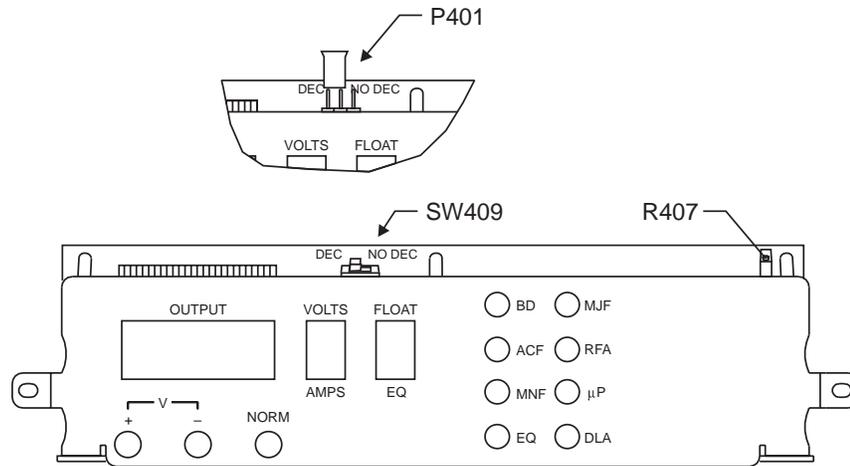


Figure 2-3: Detail of 113B Control Unit Display Panel

Basic Controller

The basic ECS-12U controller monitors and controls any combination of up to twelve Lucent Technologies switchmode (SR) or ferroresonant rectifiers and provides a single interface point for power alarm and status reporting. Equipped with a 113B Control Unit, two RIBs, and an LVD/Fuse Board or Fuse Alarm Board, the basic controller performs the traditional analog control functions of the MCS, CCS, or XCS controllers. 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 backplane and DIP switches located on the 113B and the Rectifier Interface Boards (RIB) must be positioned according to the plant voltage. The 113B may be plugged directly into the ECS-12U controller when the backplane is properly configured.

Batteryless Operation

The ECS-12U 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-12U 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 LVD/Fuse Board to the rectifiers via the controller backplanes. These leads are not interrupted when the 113B 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 113B 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 type of alarm condition, as follows:

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

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 the relay is its normal state, i.e., 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, 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. ABS is the same voltage as the plant bus voltage and is separately fused on the fuse board.

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 113B. 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 4-5 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.

If the rectifiers do not have load sharing, the controller sends a simultaneous shutdown signal to all rectifiers while reporting the alarm. Since the output 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, any Lucent Technologies rectifier supplying more than 10% of its rating, 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, all Lucent Technologies rectifiers supplying more than 10% of their rated current will shut down. The detection of the high voltage condition and sending of the shutdown signal are functions of the controller, while the selection of the rectifier(s) with more than 10% rated current for shutdown is a function of the rectifiers.

If the rectifiers have load sharing, the HV shutdown may operate differently. In the Lucent Technologies SR series, 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 shutdown may not 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 113B. DIP switches provide a visual verification of the shutdown set point at all times.

The high voltage alarm contacts are tested by pressing SW104 on the 113B (see Figure 4-4 for location). Pressing SW104 activates the HV, PMJA, PMJE, and PMJV alarms on the office alarm terminal blocks, extinguishes the NORM LED on the front panel, and sends an HV signal to the CP2 microprocessor if the controller is so equipped. The alarms remain as long as the switch is held. Normal operation resumes when the switch is released. This test switch does NOT send an HV signal to the rectifiers, so no rectifiers will be shut down, and the rectifier restart signal will NOT be issued.

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 on the 113B 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.

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 both in Figure 4-5 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 12 sets of isolated contact closures, one set of closures for each rectifier. The isolation is provided by the Rectifier Interface Board (RIB).

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- to 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 they are actually faulty units. If the plant voltage goes high again during the 4- to 6-minute timeout, the shutdown signal (see previous section) will be reissued but will not be followed by an automatic restart.

The 4- to 6-minute timer may be reset manually before it times out by pressing SW107 (see Figure 4-4 for location). 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*, 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, however, 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. In plants with any

Lucent Technologies J874 series three-phase ferroresonant rectifiers connected, a phase alarm is treated as an ac fail. The J874 series does not provide an ACF alarm for total loss of ac. For J85503 or J85603 series rectifiers, a phase fail provides both an RFA and ACF, and total loss of ac generates only an ACF alarm.

***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. Examples of Minor “fuses” include regulation fuses of each rectifier.

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-E 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 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 (RFA)
AC Fail (ACF)
Equalize On (EQ)
Microprocessor Alarm (μ P)
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 Equalize LED (EQ) may light when the NORM LED is on, since equalize is not considered an alarm condition. See Sections 4 and 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 or 25 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 Section 4, "Shunt Isolator Circuit"). See Table 4-B for a listing of compatible shunts.

The ammeter scale for the particular plant shunt size is selected by DIP switches on the 113B. 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," and Figure 4-5 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. However, 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. This operation of turning rectifiers off and back on during engine start up is called rectifier sequence control.

The controller may be connected to the four output signals (TR1, TR2, TR3, and TR4) provided by an external rectifier sequence controller. 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 rectifier 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-12U controller has several methods of controlling the equalize function in plants that are so equipped:

Hardware Disable: A movable jumper (P106) on the 113B 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 113B may interface with an external equalize control panel. Since the basic controller with the 113B and RIB boards has no built-in on/off timer (see Section 4, “Basic Controller Wiring”) the 113B 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 (CP3) in conjunction with the logic functions provided for the CP3

will enable an automatic equalize function. Note that this control method is overridden when equalize is hardware disabled.

Microprocessor Control: The microprocessor board (CP2) is equipped with a variety of software features for float/equalize control. These features are also disabled by the hardware strap on the 113B. (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.

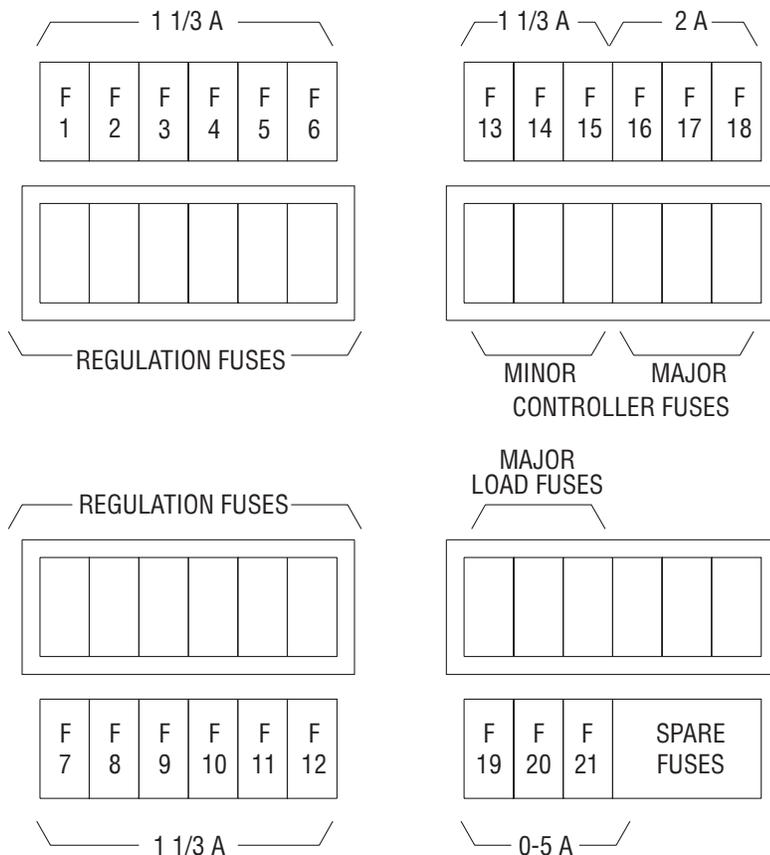
Fuse Board

Major and Minor Fuse Alarms are generated by the fuses on the board, as well as for plant distribution fuses, circuit breakers and user-selectable interfaces.

The fuse board contains six fuses for power and sense voltage distribution in the controller, 12 fuses for battery sense voltage to the regulation leads of the rectifiers, three fuses for user defined low power distribution, and three spare fuse holders.

A 12-position terminal block is also available for connection to external Major and Minor Fuse Alarm inputs and for connection to the three low power distribution fuses. See Table 4-E for terminal block (TB501) designations.

There are three fuse board codes: BCB2 for -48V applications (Low Voltage Disconnect option), BCB5 for -48V applications, and BCB6 for +24V applications.



FUSE DESIGNATIONS	
F1	REG LEAD RECTIFIER 1
F2	REG LEAD RECTIFIER 2
F3	REG LEAD RECTIFIER 3
F4	REG LEAD RECTIFIER 4
F5	REG LEAD RECTIFIER 5
F6	REG LEAD RECTIFIER 6
F7	REG LEAD RECTIFIER 7
F8	REG LEAD RECTIFIER 8
F9	REG LEAD RECTIFIER 9
F10	REG LEAD RECTIFIER 10
F11	REG LEAD RECTIFIER 11
F12	REG LEAD RECTIFIER 12

FUSE DESIGNATIONS	
F13	113B METER
F14	CP2 AND CP3
F15	CP1 - DB POWER
F16	BAT
F17	ALARM BATTERY SUPPLY (ABS)
F18	CP1 - RB POWER
F19	LOW POWER DISTRIBUTION
F20	LOW POWER DISTRIBUTION
F21	LOW POWER DISTRIBUTION

Figure 2-4: Fuse Board Fuse Designations and Functions

***Power and Sense
Voltage Fusing***

Figure 2-4 shows the fuse designations on the fuse board. The fuse board has 18 fuses to distribute power and sense voltages:

- F1-F12 provide battery sense voltage to the regulation leads of the rectifiers.
- F13 provides power and plant voltage sensing to the meter circuits of the 113B and optional circuit pack CP2.
- F14 provides power to the optional circuit packs CP2 and CP3.
- F15 provides power to the rectifier interface circuits on the 113B.
- F16 provides power to the controller interface circuits on the rectifiers.
- F17 provides power to the ABS leads of the 113B.
- F18 provides regulation battery (Reg Bat) power to the circuitry on the 113B not powered by F13 or F15.

***Major and Minor
Fuse Alarms***

The fuse board provides Major and Minor Fuse Alarms to the controller. A Major Fuse Alarm is generated when any of fuses F16-F21 open, when a plant distribution circuit breaker trips open for overcurrent (but not when manually turned off), or when TB501-2 or TB501-4 is tied to the plant voltage. A Minor Fuse Alarm is generated when any of fuses F1-F15 open or when TB501-3 or TB501-5 is connected to plant voltage. TB501-1 is also a Major Fuse Alarm equipped with a 1000 ohm dropping resistor for distribution panels that are not so equipped.

***Low Power
Distribution***

The fuse board may provide low power distribution for customer applications. Plant voltage is supplied to TB501, pins 6, 7, and 8 via fuses F19, F20, and F21 respectively. These three fuses come factory equipped with 5-ampere ratings. Lower ampacity fuses may be used to suit particular applications. Typical applications include remote monitoring systems, alarm indicator panels, temperature transducers, or any other equipment that requires plant voltage at low ampacities. If any of these fuses opens, a Major Fuse Alarm is generated.

Spare Fuses

The fuse board may also provide holders for three spare fuses. These fuses are labeled F22, F23, and F24. The holders come equipped from the factory with 1-1/3 ampere-rated fuses. These may be replaced with any ampere-rating fuses the customer prefers for a particular application. Note that these fuse holders are not connected to plant power or to the controller's alarm circuitry.

***Low Voltage
Detection for
Disconnect and
Reconnect
Contactor***

The List 3 controller also includes a low voltage disconnect/reconnect circuit as part of the fuse board. The List 3 is intended for use with the J85500S-1 and J85500T-1 Battery Plants that have an optional LVD contactor.

The LVD/Fuse board provides sensing of the plant voltage for use in controlling the Low Voltage Disconnect/Reconnect Contactor in the battery plant. Although the actual Contactor is an optional feature of the battery plant, the sensing circuits and associated alarms are standard on all List 3 controllers. There are two sense circuits on the LVD/Fuse board, configured in a redundant fashion so that both circuits must sense a low voltage before opening the Contactor. P505.1 and P505.2 provide the user with a choice of two disconnect voltages. Placing jumpers across pins 1 and 2 of 505.1 and 505.2 provides a disconnect voltage of 42.5V, while placing the jumpers across pins 2 and 3 provides a disconnect voltage of 40.5V.

CAUTION

The two jumpers must be set for the same threshold. Each jumper sets the threshold for one of the two redundant sense circuits. If the jumpers are set for different thresholds, the lower threshold will actually control the Contactor since both circuits must sense a low voltage before opening the Contactor.

Information on the state of the detection circuits is provided via two LEDs, connections to the controller's Minor Fuse Alarm circuits, and a Form-C contact closure available on the 113B. When one or both of the detection circuits senses a low voltage, or if one of the detection circuits fails such that it appears to have detected a low voltage, the yellow LVD/FAIL LED will illuminate and a Minor Fuse Alarm will be sent to the controller. If the battery plant is equipped with the LVD Disconnect/Reconnect Contactor, the red LVD/OPEN"LED will illuminate when the Contactor is open either during normal operation when a low voltage is detected, or in the unlikely event of a Contactor failure. A Form C contact closure on the 113B

will also show the status of the Contactor. The red LVD/OPEN LED and Form C contact closure are powered from the battery side of the Contactor, while the yellow LVD/FAIL LED is powered from the load side of the Contactor. If the rectifiers are powered down and the Contactor is open, the red LVD/OPEN LED will be illuminated, the Form C contact closure will show the Contactor as open, and a Minor Fuse Alarm will be given because the 113B sends all alarms when it loses power.

In battery plants without a Contactor, the red LVD/OPEN LED will never illuminate, and the Form C contact closure will always show the non-existent Contactor as open.

Controller Options

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

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

One or two Rectifier Adapter Boards (RAB) may be added to the basic ECS-12U controller to permit non-Lineage[®] 2000 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. The bottom RAB is associated with rectifiers 1-6. The upper RAB is associated with rectifiers 7-12. See Figure 2-2 and Section 4, "Rectifier Port Selection," for more details.

Circuit Options

Order Wire Board

The Order Wire Interface feature is optional for the ECS-12U Controller. 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”).

Shunt Isolator Circuit

The ECS-12U 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 shunt isolator circuit can also be used to interface non-standard shunts to the ECS controller. (Non-standard shunts are shunt sizes other than those listed as compatible with the ECS controller.)

The AKC1B shunt isolator circuit uses DIP switch selectable programming to marry a wide range of shunt and current combinations to the standard values accepted by the controller. If the plant shunt is in the battery lead, the AKC1B provides the required isolation of the shunt signal and references it to ground. The AKC1B shunt isolator circuit is provided with J85501E-2, List P. It replaced the AKC1B provided with J85501E-1, List J, to provide a more rugged power supply with reverse polarity protection and voltage transient protection.

Mixed Types of Rectifiers in One Plant

The ECS-12U controller may be used to control a total of 12 rectifiers. There are 12 rectifier interface ports on the lower backplane of the controller. Rectifiers may be of different types with each requiring different cable types. Cables for each rectifier type are available; however, cables for rectifiers other than those made by Lucent Technologies will require termination to either a screw or wire wrap terminal at the rectifier end of the control cable. If Lineage[®] 2000 SR series and J855 series ferroresonant rectifiers are used, only the rectifier interface boards (RIB) are required. All other rectifiers require

the RIB and the rectifier adapter board (RAB). See “Rectifier Adapter Board (RAB)” in this section.

Controller Specifications

Table 2-A: ECS-12U 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-12U Controller Physical Specifications

Dimensions	Width 21.5" (546 mm) Depth 15.0" (381 mm) Height 9.0" (229 mm)
Frame Mounting	Standard 23" and 26" relay rack
Requirements	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	38 pounds (17.3 kilograms) Includes 113B, two RIBs, and LVD/Fuse Board

3 *Ordering*

ECS-12U

Table 3-A provides a summary of the J85501E-2 List structure. Microprocessor board (CP2) and Datalogger board (CP3) options (Lists A through F and K through KB) are discussed in the Controller Options Product Manual (167-790-109). Please note that all lettered options except List BA are shipped separately from the controller for connection by installers. Section 2 presents a detailed description of controller features.

Table 3-A: ECS-12U Controller Ordering Information

Description	List
ECS-12U Controller for -48 volt plants. Provides interface to 12 Lucent Technologies Lineage [®] 2000 rectifiers.	1
ECS-12U Controller for +24 volt plants. Provides interface to 12 Lucent Technologies Lineage [®] 2000 rectifiers.	2
Same as List 1, except includes low voltage disconnect circuit for J85500S-1 and J85500T-1 plants.	3
Optional -48 volt microprocessor circuit pack (CP2) to provide local or remote monitoring and control functions.	A
Same as List A, except with voice response feature.	B
Optional +24 volt microprocessor circuit pack (CP2) to provide local or remote monitoring and control functions.	C

Table 3-A: ECS-12U Controller Ordering Information

Description	List
Same as List C, except with voice response feature.	D
Optional Datalogger circuit pack (CP3) for data acquisition features.	E
Same as List E, except with a remote termination panel.	F
Optional Rectifier Adapter Board (RAB) to interface up to six non-Lineage® rectifiers (Lucent Technologies or non-Lucent Technologies). Note: A maximum of two RABs can be installed with each controller.	G
Optional 248A Order Wire Board and mounting hardware when the controller will be monitored over the FT-Series G embedded maintenance system.	H
Optional AKC1B shunt isolator circuit pack and mounting hardware for a battery plant with the plant load shunt in the “hot” (ungrounded) lead or with a plant load shunt not compatible with the basic ECS-12U controller. Replaces AKC1 (List J)	P
Same as List A (CP2), with X.25/TL1 features.	K
Same as List B (CP2), with X.25/TL1 features.	L
Same as List C (CP2), with X.25/TL1 features.	M
Same as List D (CP2), with X.25/TL1 features.	N
Kit to add voice response feature to List A, C, K or M CP2 circuit pack.	KA
Kit to add X.25/TL1 feature to List A, B, C or D CP2 circuit pack.	KB
Optional mounting hardware for mounting controller in a 23 inch framework.	BA

**Rectifier
Interface
Cables**

Table 3-B: Available Rectifier Interface Cables

Cable Description	Cable Assembly
Control cable required to connect one Lucent Technologies switchmode 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

Table 3-B: Available Rectifier Interface Cables

Cable Description	Cable Assembly
Control cable required to connect one Lucent Technologies 24-volt Lineage® three phase ferroresonant rectifier (J85503 A or B1 series)	H285-226, L51
Control cable required to connect one 48-volt Lucent Technologies Lineage® three phase ferroresonant rectifier (J85503 A, B1, C1, and J85503C2 not e/w List 5)	H285-226, L52
Control cable required to connect one Lucent Technologies 24-volt Lineage® three phase ferroresonant rectifier (J85503B-2)	H285-226, L53
Control cable required to connect one 48-volt Lucent Technologies Lineage® three phase ferroresonant rectifier (J85503B-2, J85503C2 e/w List 5, J85503C3, or J85603C2)	H285-226, L54
Control cable required to connect one Lucent Technologies 150-ampere switchmode rectifier	H285-226, L56

Documentation

This document (Lucent Technologies Select Code 167-790-056) is part of a set of documents developed to assist engineering and installers. The following documents are provided with each controller:

Document No.	Document Description
J85501E-2	Assembly, Ordering, and Installation Drawing for ECS-12U Controller
T-83181-30	Wiring Drawing
SD-83181-01	Schematic Drawing
167-790-056	Product Manual
167-790-109	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-12U controller. Follow all the applicable steps in the following sections in the order they are presented.

NOTE **If the ECS-12U 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)
- Cutter (for wire and for plastic wire ties)
- Jeweler's screwdriver (for alarm wiring)
- Wire strippers (22-26 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-12U controller may be shipped as a loose unit. The user must mount and wire a shipped-loose unit to the plant.

If the ECS-12U controller is received factory assembled as part of a Lineage[®] 2000 battery plant, skip to “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-12U Controller (J85501E-2)
- Self-tapping mounting screws (#12-24 size)
- Wire ties
- ECS-12U Controller product manual, Select Code 167-790-056
- Controller schematic, wiring, and assembly drawings: SD-83181-01, T-83181-30, and J85501E-2
- Trim panels (not furnished with List BA)
- Lockwasher (for grounding)

Default Factory Settings

The ECS-12U controller is shipped equipped with a 113B, two RIBs, and FAB. Default settings for the boards shipped from the factory are listed below:

Table 4-A: Default Factory Settings for Circuit Boards

Feature	List 1 or 3 Factory Setting	List 2 Factory Setting
(1) Auto Restart, P105 on 113B	1 and 2 (Enable)	1 and 2 (Enable)
(2) BD Alarm, SW103 on 113B	51V	25.5V
(3) HV Alarm, SW102 on 113B	53V	26.25V
(4) EQ-HV Alarm, SW101 on 113B	55V	27.25V
(5) FL/EQ, P106 on 113B	1 and 2 (Disable)	1 and 2 (Disable)
(6) Ammeter Scale, SW109 and P401 or SW409	300A	300A

Jumper straps are located on the upper tray backplane, and a combination of jumper straps and DIP switches are located on the 113B 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 for List 1 or 3 and +24 volt operation for List 2.

Frame Mounting

The controller is equipped with four mounting brackets for installation in battery plants with a 26-inch framework. Refer to Figure 4-1. The brackets position the controller flush with the front of the framework. Extra mounting holes allow installers to move the brackets back 3-1/2 or 5 inches for applications where equipment extends 3-1/2 or 5 inches from the framework.

Alternative mounting brackets are provided per J85501E-2 List BA for installation in a 23-inch framework. Refer to Figure 4-2. These brackets may be also relocated in the field.

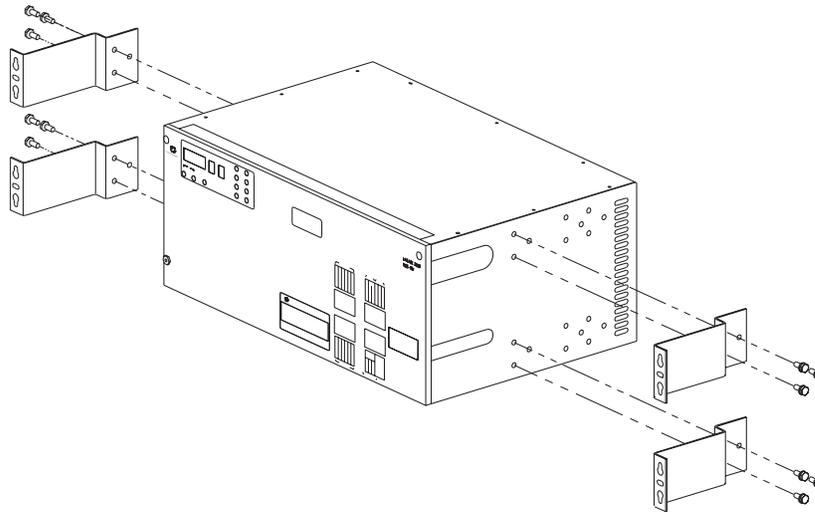


Figure 4-1: 26-inch Frame Mounting

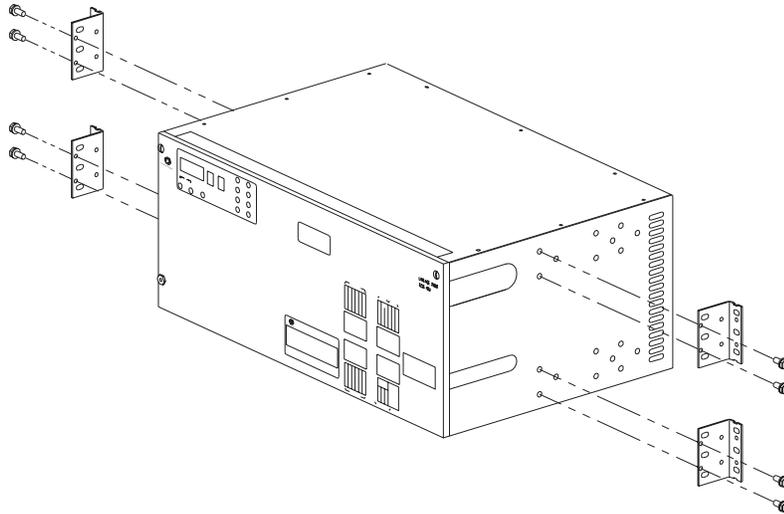


Figure 4-2: 23-inch Frame Mounting (List BA)

***Connection to
Frame Ground***

To ensure that the ECS-12U controller is grounded to the framework, use the lockwasher provided with the #12-24 self-tapping mounting screws. Place the lockwasher under the middle mounting screw of the top left mounting bracket. The lockwasher will break through the paint on the bracket and the screw threads will contact the frame to form the ground point. Make sure the framework is properly grounded.

Hardware Setup

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.

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.

Voltage Selection

As shown in Figure 4-3, there are four jumpers for voltage selection. Verify that all of the jumpers are in the correct positions. DIP switches SW101, SW102, and SW103 on the 113B, and S1 and S2 on the RIB, must be set to the proper plant voltage. (See Figures 4-4 through 4-7.) DIP switch position 6 on SW101, SW102 and SW103, and positions 1 thru 10 on S1 and S2 must be set for either 24 or 48 volts. All of these switches must be set to the same voltage.

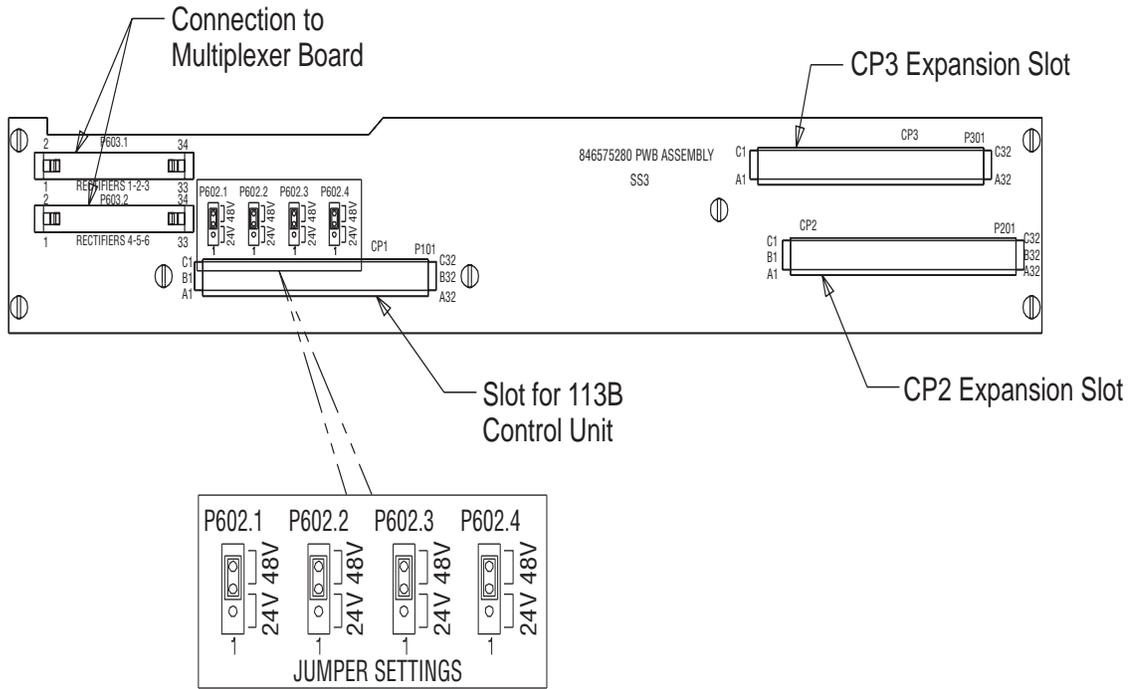


Figure 4-3: ECS-12U Controller Backplane (Upper)

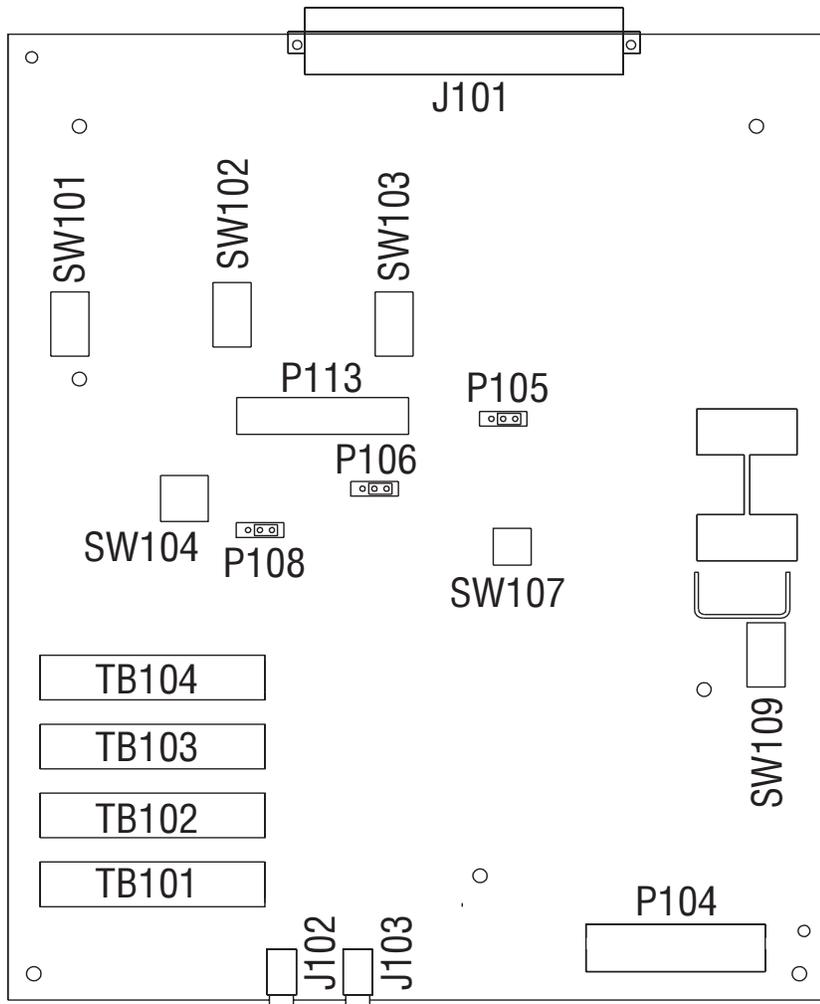
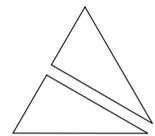


Figure 4-4: 113B Jumper and Switch Locations

CP1 DIP SWITCH SETTINGS																					
VOLTS						SWITCH POSITION (0=OPEN, 1=CLOSED)						AMPERES			SWITCH POSITION						
SW 101- HV/EQ		SW 102- HV/FL		SW 103- BD		-1	-2	-3	-4	-5	-6		SW 109- METER SHUNT			-1	-2	-3	-4	-5	-6
24V	48V	24V	48V	24V	48V						24V	48V	25mV	50mV*	100mV						
	51.00		49.00	23.00	46.00	1	1	1	1	1	1	0	150	300	600	1	0	0	0	1	1
	51.50		49.50	23.50	46.50	0	1	1	1	1	1	0	300	600	N/A	1	0	0	0	0	0
25.75	52.00	24.75	50.00	24.00	47.00	1	0	1	1	1	1	0	600	1200	2400	0	1	0	0	0	0
26.25	52.50	25.25	50.50	24.50	47.50	0	0	1	1	1	1	0	1000	2000	4000	0	0	1	0	1	1
26.75	53.00	25.75	51.00	25.00	48.00	1	1	0	1	1	1	0	1300	2600	5200	0	0	0	1	0	0
27.25	53.50	26.25	51.50	25.50	48.50	0	1	0	1	1	1	0	2000	4000	8000	0	0	1	0	0	0
27.75	54.00	26.75	52.00	26.00	49.00	1	0	0	1	1	1	0	3000	6000	N/A	1	0	0	0	0	0
28.25	54.50	27.25	52.50	26.50	49.50	0	0	0	1	1	1	0	4000	8000	N/A	0	0	0	0	0	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									

* 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 4-5: CP1 DIP Switch Settings

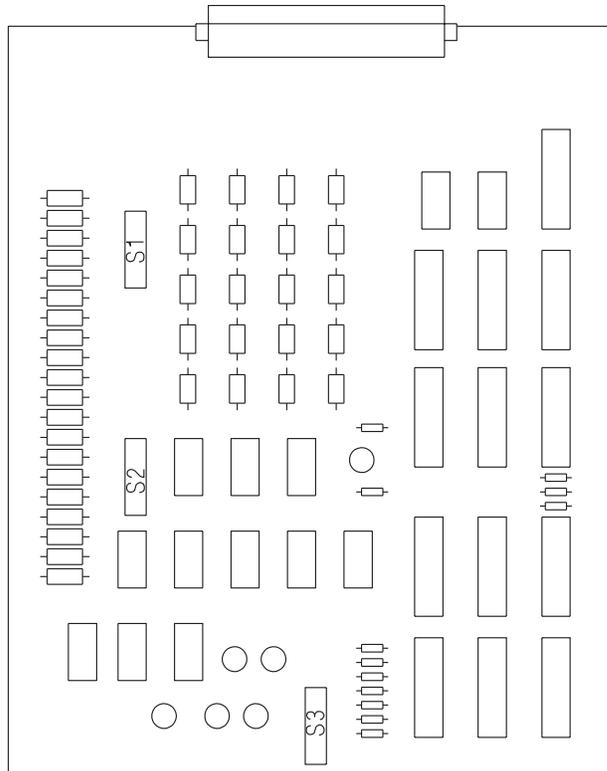


Figure 4-6: Rectifier Interface Board (RIB) Layout and Switch Locations

EAT1 DIP SWITCH SETTINGS										
SWITCH POSITION	S1		S2		NOTE: OFF=OPEN ON=CLOSED					
	24V	48V	24V	48V						
1 THRU 10	ON	OFF	ON	OFF						
	S3 - SWITCH POSITION									
	1	2	3	4	5	6	7	8	9	10
UPPER EAT 1 RECTIFIER PORT NO.	7	8	9	10	11	12	-	-	-	-
LOWER EAT 1 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

847218351 ISS: 1

Figure 4-7: Rectifier Interface Board (RIB) DIP Switch Settings

Figures 4-5 and 4-7 are the same table of settings that appear as labels within the controller.

The installer may connect input power only after setting and verifying the voltage selection jumpers and DIP switches. Six input leads from the plant bus bars and shunt are terminated to terminal block TB1, mounted on the right side of the controller. The following list describes each wire and its function:

Connecting Point TB1	Name	Function
5	DG	“Discharge ground” from plant bus
4	RG	“Reg ground” from plant bus
8	DB	“Discharge battery” from plant bus
7	RB	“Reg battery” from plant bus
2	BS-	Plant shunt connection (negative)
1	BS+	Plant shunt connection (positive)

Wire size for these six leads should be 18 gauge minimum, 10 gauge maximum. Terminate wires to the terminal block with insulated .250 Fast-on type connectors provided with the controller.

Equalize Enable/Disable

The equalize jumper, P106, shown in Figure 4-4, 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. Not all Lucent Technologies rectifiers are equipped with the equalize feature. Use equalize only if all the rectifiers have the equalize feature.

The following Lucent Technologies rectifiers have equalize:

24 and 48 volt, 125 amp, J85502C
48 volt, 400 amp, J85503C-2
24 volt, 100 amp, SR 364B series
48 volt, 50 amp, SR 364A2 series

CAUTION Use of equalize is not recommended for sealed cells.

Automatic Restart Enable/Disable The restart jumper, P105, is factory set in the ENABLE position (pins 1 and 2). (See Figure 4-4.) 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.

In the ECS-12U, the RIB boards have isolated contact closures for each rectifier. Therefore, the moveable jumper P108 on the 113B is deactivated. In some controllers this connects (jumper across pins 1 and 2 of P108) or isolates (jumper across pins 2 and 3 of P108) the return leads of the two isolated restart contacts. The controller is shipped with the jumper pins across pins 1 and 2 of P108.

Ammeter Scale DIP switch SW109 on the 113B and P401 or SW409 on the CP4 display board are used 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. 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 113B.

Table 4-B or the label on the cover plate of the 113B shows how to set DIP switch SW109 on the 113B controller for various size plant shunts. The CP4 display board on this unit, shown in Figure 2-3, has a jumper (P401) or switch (SW409) that is used to show or not show a decimal point. 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).

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

Table 4-B: 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

*Decimal point must be used in these settings.

Battery on Discharge Threshold

The voltage threshold for the BD alarms is set with DIP switch SW103. (See Figure 4-4.) Refer to Figure 4-5 or the label on the 113B cover plate for the DIP switch settings for the desired alarm threshold. The same table of settings also appears on schematic drawing SD83181-01 and on the assembly drawing J85501E-2. 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 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 the 113B. (See Figure 4-4.) The equalize shutdown is controlled by DIP switch SW101 on the 113B. 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 procedures in this section, 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.

***Rectifier Port
Selection***

The ECS-12U controller is factory configured for use with Lucent Technologies Lineage[®] 2000 ferroresonant rectifiers, J855 series. Rectifier connections should be made to the respective ports on the lower backplane. (See Figure 4-8.) Two Rectifier Interface Boards (RIBs) are provided with the controller. The lower RIB is associated with rectifier ports 1-6. The upper RIB is associated with rectifier ports 7-12.

To connect rectifiers to the controller, set switch S3 on the two Rectifier Interface Boards (RIBs). (See Figures 4-6 and 4-7.) Following the table shown in Figure 4-7, set the switch at the position corresponding to each rectifier port to ON (closed) for each ferroresonant rectifier connected to the ECS-12U controller. For each port not used or where a Lucent Technologies switchmode rectifier (SR) is used, set the respective switch position to OFF (open) on switch S3. The same table of settings shown in Figure 4-7 also appears as a label on the inside of the door of the controller. Table 3-B lists standard interface cables. These control cables are ordered separately from the controller with individual cable length specified in job specifications.

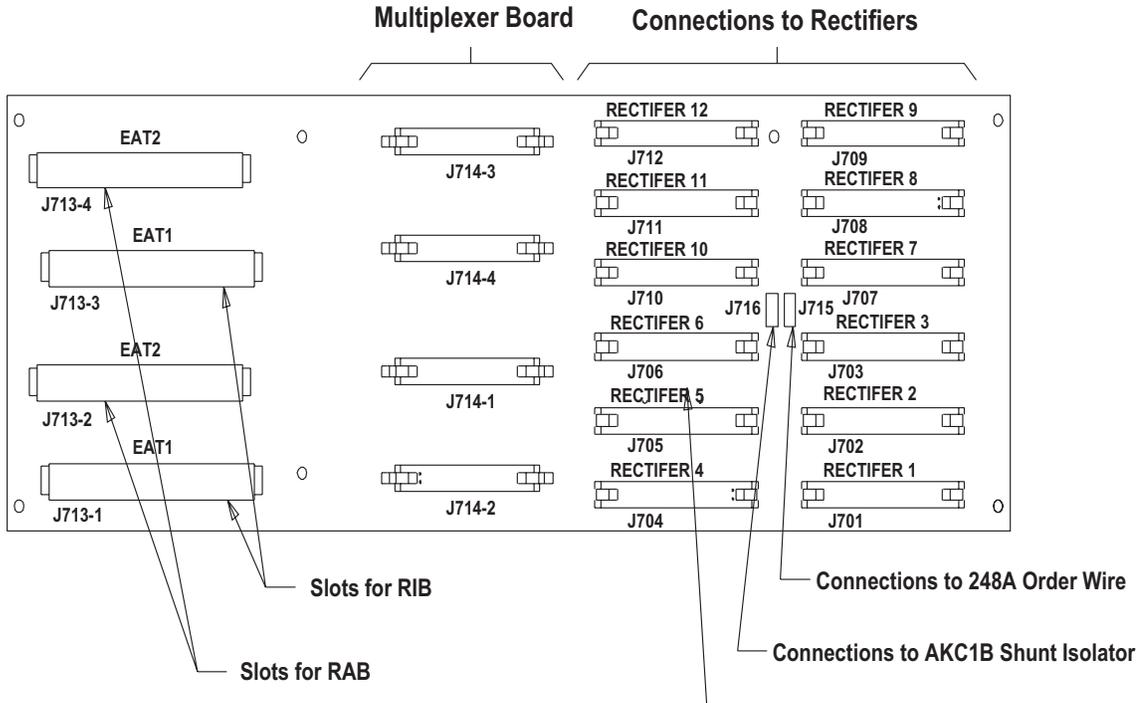


Figure 4-8: ECS-12U Controller Backplane (Lower)

**Optional
Rectifier Adapter
Board (RAB)**

Adding the Rectifier Adapter Board (RAB) to the controller extends the features described in this manual to non-Lineage rectifiers either manufactured by Lucent Technologies or manufactured for Lucent Technologies to a J or KS specification. The RAB also enables the use of non-Lucent Technologies rectifiers. DIP switches S1 through S6 on the RAB must be set corresponding to rectifier ports 1-6 for the lower RAB and rectifier ports 7-12 for the upper RAB for each non-Lineage rectifier connected to the controller. Figure 4-10 shows this table of settings. These settings are also on a label on the inside of the controller door. If a rectifier is added after initial installation, it may be necessary to remove the RAB to access DIP switches. Alarms to rectifiers requiring the RAB will not function properly until the RAB is reinstalled. **Always notify the Alarm Center before working on the controller.**

Table 3-B 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 of control cable H285-226, L45. See Table 4-C and Figure 4-11.

NOTES The rectifier must have a feature in order for the ECS-12U 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 non-Lineage rectifiers, Lucent Technologies or non-Lucent Technologies. In plants with any Lucent Technologies J874 series ferroresonant rectifiers connected, a phase alarm is treated as an AC Fail. The J874 series does not provide an AC Fail alarm for total loss of ac. For J85503 or J85603 series rectifiers, a phase alarm will provide both an RFA and AC Fail. For total loss of ac, only an AC Fail alarm is issued.

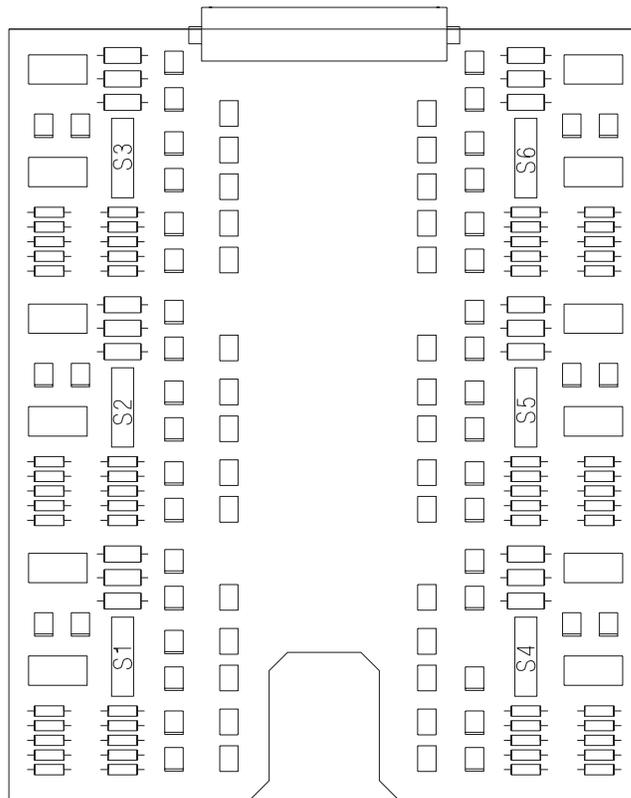


Figure 4-9: Rectifier Adapter Board (RAB) Layout and Switch Locations

RECTIFIER OPTIONS		SWITCH POSITION*		
		1 THRU 8	9	10
VOLTAGE	24 VOLT PLANT	CLOSED	-	-
	48 VOLT PLANT	OPEN	-	-
R T Y P E	NON-LUCENT RECTIFIER	-	CLOSED	OPEN
	MAN ALARMS=CLOSED CONTACTS	-	OPEN	CLOSED
	MANUAL ALARM NOT PROVIDED	-	OPEN	CLOSED
	LUCENT RECTIFIER	ALL TYPES	-	CLOSED
	NO RECTIFIER CONNECTED TO THIS POINT	-	CLOSED	OPEN

EAT2 DIP SWITCH SETTINGS (S1 THRU S6)

* ALL SWITCHES MUST BE SET ACCORDING TO THIS TABLE

NOTE: OFF=OPEN
ON=CLOSED

Figure 4-10: RAB DIP Switch Settings

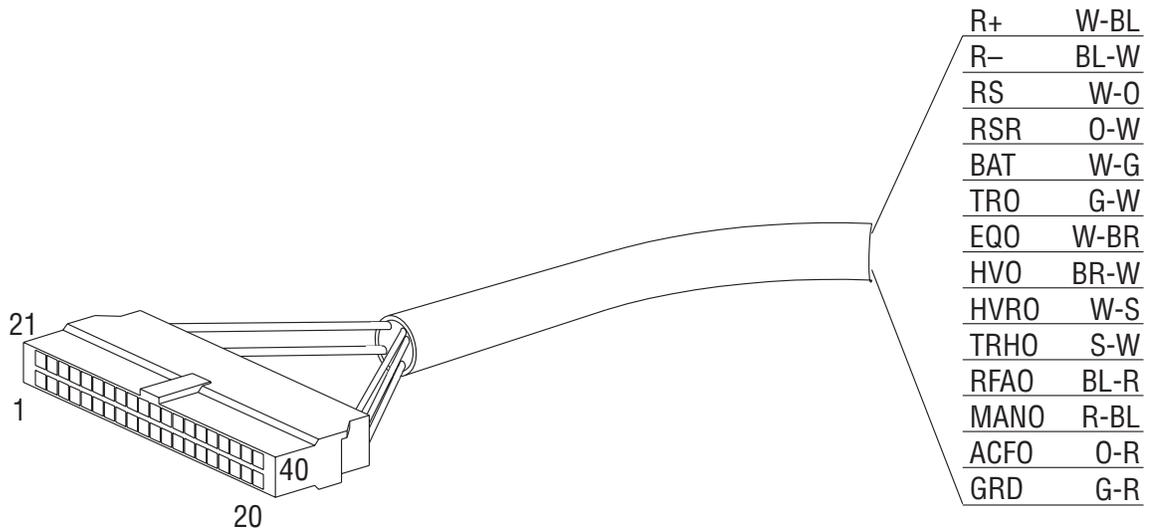


Figure 4-11: Control Cable for Non-Lucent Technologies Rectifier Connection

**Table 4-C: Non-Lucent Technologies
Rectifier Control Signals**

Signal Designation	Signal Description
R+	Positive voltage from point of regulation
R-	Negative voltage from point of regulation
RS RSR	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

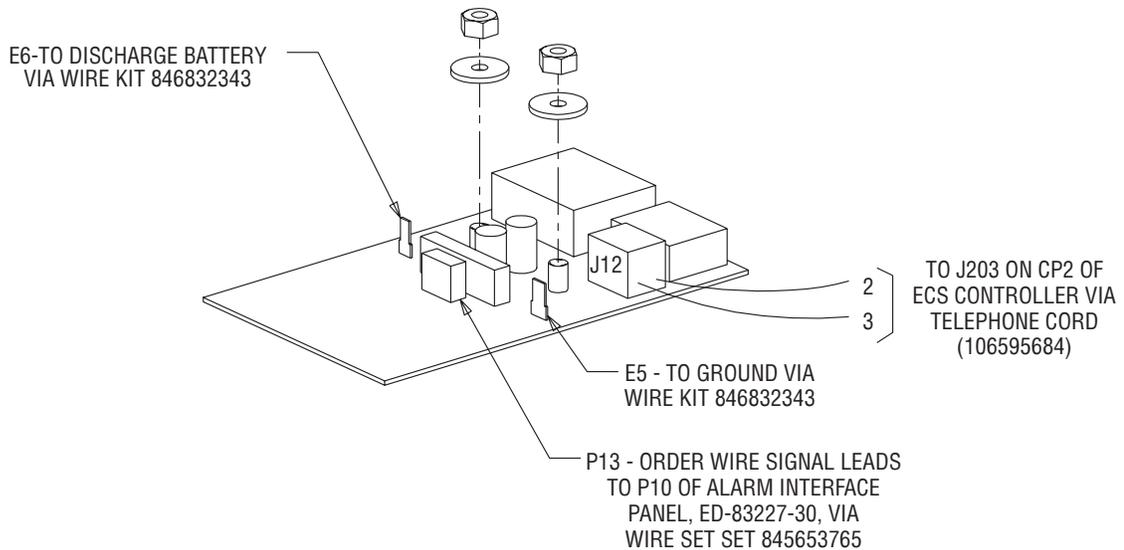


Figure 4-12: 248A Order Wire Board

**Optional 248A
Order Wire Board**

The Order Wire Board interface feature shown in Figure 4-12 is optional for the plant. This feature should be ordered when the plant will be monitored over the FT-Series G or a similar 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 each Line Repeater Bay (LRB). An SM534 (J98764T-1, L15) circuit pack is also required at the terminal site(s) of each route.

The external connections in Table 4-D are required at the back of the LRB and TCC (Telemetry Channel Control) in order to establish a communication link with the ECS-12U Controller over the FT-Series G embedded maintenance system (slot 4 is most commonly used).

Refer to the FT Series G Lightwave Systems Battery Plant (H569-367) product manual for more information about the installation and use of this option.

**Table 4-D: External Connections Required to Establish
a Communication Link
Over the FT-Series G Embedded Telemetry System**

Connection	For Site	SD-7C441-01		417 Repeater T-96654-32		1.7 Repeater T-96654-37		Terminal T-96653-32	
		Fig.	Note	Fig.	Note	Fig.	Note	Fig.	Note
2 A25C cables (from alarm interface panel)	Repeater	CAD 5	307	8, 7		13, 14		23 thru 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							

Shunt Isolator Circuit

When a plant whose shunt is located in the “hot” or battery lead is connected to the ECS-12U, the AKC1B Shunt Isolator Circuit must be used. This circuit provides an isolated signal, BATSH and BATSH G, that is connected to the terminal block TB1, 1 and 2 respectively. Power for the circuit is connected from the lower backplane connector J716. A 20-foot cable with fused shunt leads is furnished for bolting directly to the plant shunt. If the plant shunt is located further than 20 feet, the installer must splice the 22-gauge blue and white-blue wires in order to provide adequate length. This circuit, along with the mounting hardware, 847270022 wire set, and four 403929219 shunt fuses, is provided per J85501E-2, List P, field installation kit. Figure 4-13 shows the installation of the circuit in the controller.

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.

When the P716 and P1 plugs of the 847270022 wire set are connected, the green LEDs of the AKC1B should activate, indicating proper input power polarity to the AKC1B. If the red LED activates, polarity into P1-1 and P1-2 has been reversed. Reverse the Fast-on connectors of the yellow and violet wires of the wire set on the P716 plug.

The DIP switch settings required to configure the AKC1B board for the proper shunt size 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 voltage and current rating of the shunt.**

For shunts that do not match the settings in Tables 4-G and 4-H, use this recommended procedure to calibrate the AKC1B:

1. For shunts with current ratings not listed in Table 4-H, set DIP switches to the next higher current rating.
2. For shunts with voltage ratings not listed in Table 4-G, select the next lower voltage rating for SW1.
3. Measure plant voltage with voltmeter and record the reading.
4. Calculate the desired reading on the ECS controller using the following formula:

$$\text{Display} = (\text{MSV}/\text{SVR}) \text{ SCR}$$

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

5. Close SW2-9 and adjust potentiometer R45 (calibration) on the AKC1B to display the load 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

the switch settings in Tables 4-G and 4-H. 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 inputs 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: $(\text{Full Scale Shunt Amps} / \text{Full Scale Shunt mV}) \times \text{Shunt mV Reading}$. Adjust R29 to obtain this reading on the plant ammeter. Verify a second time.

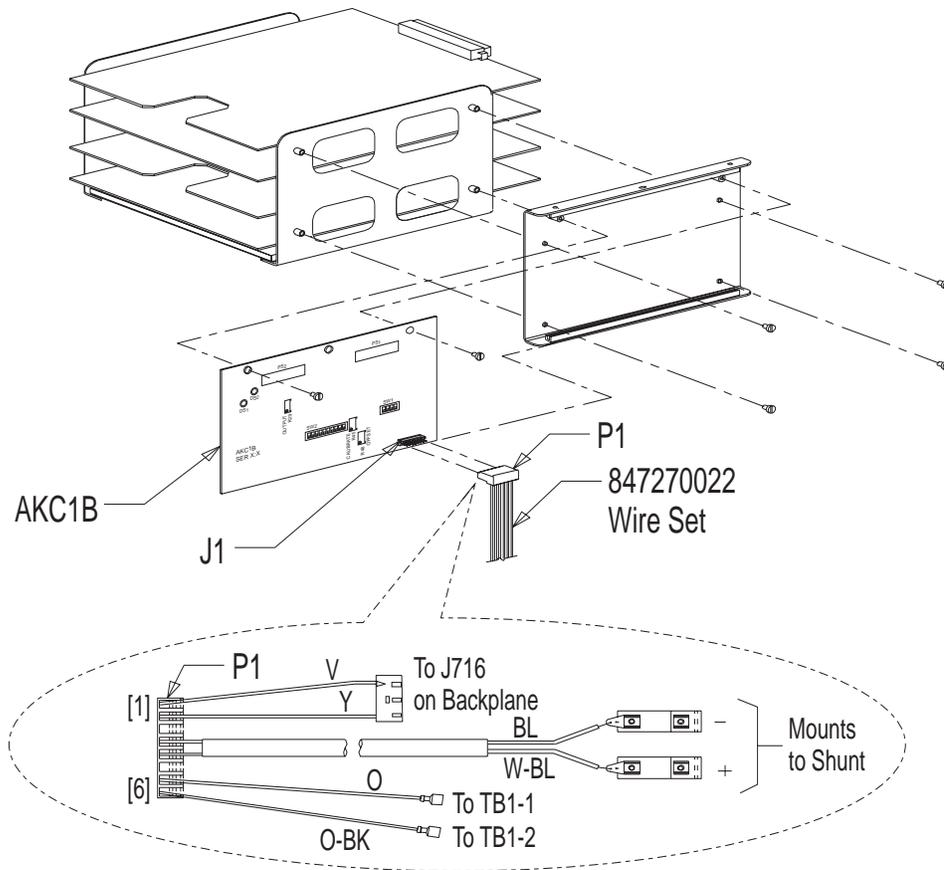


Figure 4-13: Shunt Isolator Circuit

**Low Voltage
Disconnect
Threshold
(Optional)**

The LVD Fuse board furnished with List 3 provides both controller power fusing and the low-voltage battery disconnect/reconnect function. The latter is an optional feature. If the plant is not equipped with a LVD contactor as part of the plant distribution, the disconnect feature of the LVD/Fuse board is not relevant. If the plant is equipped with low voltage disconnect/reconnect, the disconnect voltage threshold must be selected by placing jumpers J505.1 and J505.2 across pins 1 and 2 for 42.5 ± 0.5 volts or pins 2 and 3 for 40.5 ± 0.5 volts.

Table 4-E: LVD/Fuse Board Terminal Block Pin Assignments

Pin No.	Designation	Definition
TB501-1	MJF3	Major Fuse Alarm
TB501-2	MJF1	Major Fuse Alarm
TB501-3	MNF1	Minor Fuse Alarm
TB501-4	MJF2	Major Fuse Alarm
TB501-5	MNF2	Minor Fuse Alarm
TB501-6		Low Power Distribution via F19
TB501-7		Low Power Distribution via F20
TB501-8		Low Power Distribution via F21
TB501-9	Spare	No connection
TB501-10	Spare	No connection
TB501-11	Spare	No connection
TB501-12	Spare	No connection

Wiring

Basic Controller

The installer wiring associated with the basic controller is connected to four removable terminal blocks on the 113B. 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. Refer to Table 4-F for a list of terminal block pin assignments.

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.

Alarm Outputs: The alarm outputs (BD, HV, ACF, PMNA, PMNV, PMNE, PMJA, PMJV, PMJE, MNF and MJF) are clean 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 three alarm inputs (RMJ, RMN and OS) 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 4-14. 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-12U system, TR1 controls rectifiers G1, G5, and G9; TR2 controls rectifiers G2, G6, and G10; TR3 controls rectifiers G3, G7, and G11; TR4 controls rectifiers G4, G8, and G12.

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.

1. Select the desired alarms and other signals and 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 113B 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 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 anchor points provided with the controller.
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 4-15 shows some examples of typical alarm wiring.

**Table 4-F: CP1 Terminal Block Pin Assignments
for 113B Control Unit**

Pin Number	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
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

**Table 4-F: CP1 Terminal Block Pin Assignments
for 113B Control Unit**

Pin Number	Designation	Definition
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
TB102-10	LVC	Low Voltage Contactor, alarm causes closure
TB102-11	LV	Low Voltage Contactor, alarm return
TB102-12	LVO	Low Voltage Contactor, 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
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
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

**Table 4-F: CP1 Terminal Block Pin Assignments
for 113B Control Unit**

Pin Number	Designation	Definition
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

Plant Alarms Connect major and minor alarms for the battery plant to terminal block TB501 on the FAB mounted on the controller door. Connect major alarms to either pins 2 or 4 on TB501. Connect minor alarms to either pins 3 or 5 on TB501. See Table 4-E for terminal block pin assignments. The terminal block accepts 22- to 24-gauge stranded wire. Strip wire ends and clamp directly to the terminal block. Alarm inputs to TB501-2 to TB501-5 must be current-limited by an external 1K Ω , 2W resistor.

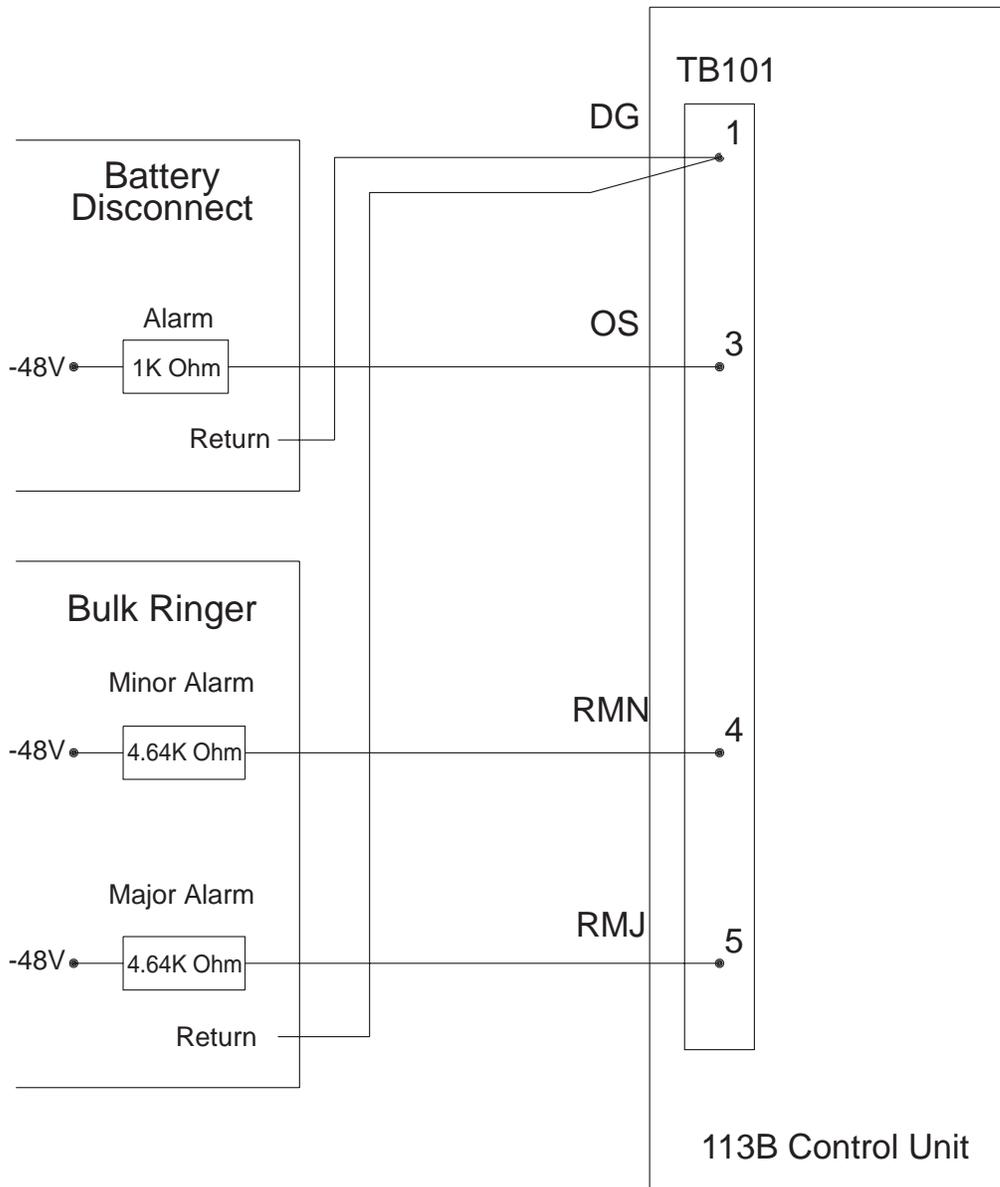
**Table 4-G: Shunt Isolator Circuit Pack
Shunt Voltage Programming Table**

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 Table**

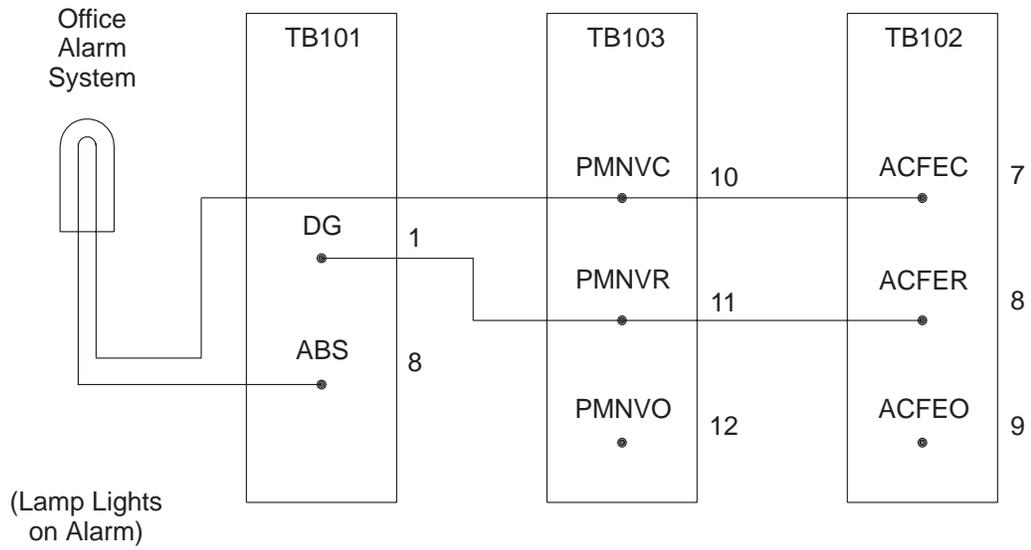
Shunt Current Rating (Amps)	AKC1B, SW2										ECS CP1, SW109						ECS CP2, SW202		
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	2	3	4
50	1	1	1	1	1	1	1	0	0	1	1	0	0	0	1	1	1	0	1
75	1	0	1	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1
100	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1
150	0	1	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1
200	0	0	1	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.

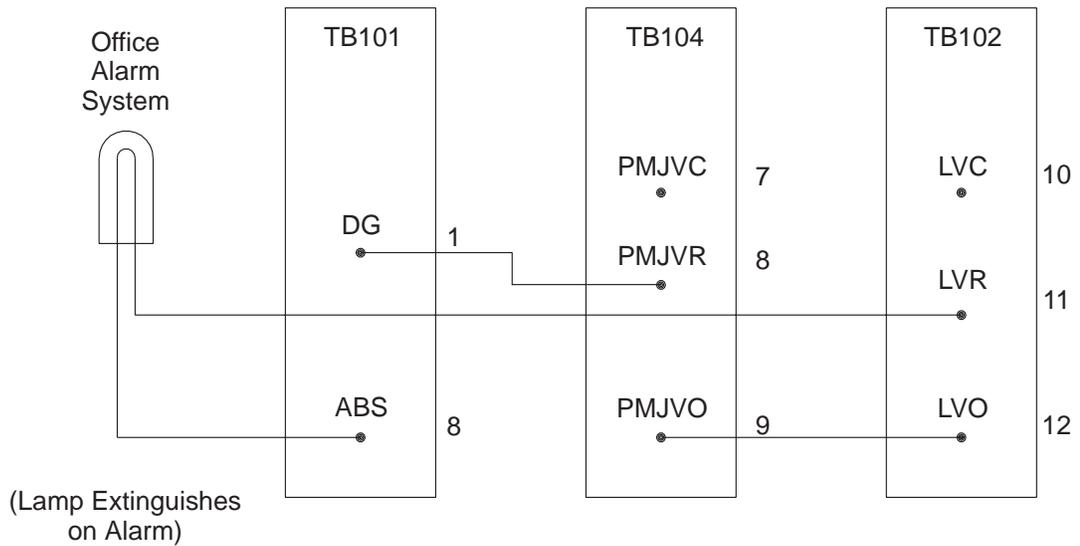


RMN and RMJ are general purpose alarm inputs that can be used for auxiliary equipment.

Figure 4-14: 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 4-15: Typical Alarm Wiring Examples

External Wiring

NOTE The ECS-12U Controller may provide false alarms if rectifier interface cables are connected to the controller and are not connected to the respective rectifiers.

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

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” in this section.

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

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 backplane connectors. Backplane connectors are arranged so that circuit packs cannot be inserted in the wrong slots. 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.

Replacement of Multiplexing Board

If the multiplexing board (BCC1, see Figure 4-16) must be replaced, use the following procedure:

1. Open the front cover, and pull out the drawer. Unplug any field wiring connected to CP1, CP2, or CP3 by lifting the terminal blocks off the board.
2. Lifting the front of the drawer, pull it out of the controller chassis completely and unplug the two ribbon cables at the multiplexing board BCC1 (P705 and P706) and the green ground lead.

3. Unplug the remaining ribbon cable connections to the board, noting the location of each so that they can be reconnected later.
4. The multiplexing board is mounted to the chassis by five screws. The controller chassis can be removed from the frame if necessary for access to the board.
5. Replace the board and reconnect ribbon cables and ground wire as they were.

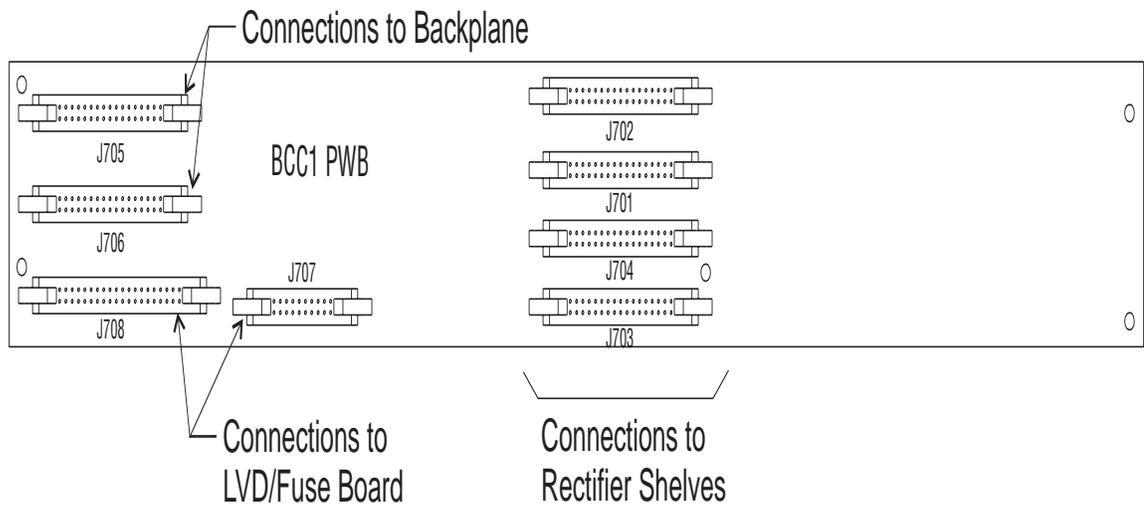


Figure 4-16: Rectifier Multiplexing Circuit Pack

5 *Acceptance Testing*

Test Procedures

The ECS-12U 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*
- Low Voltage Battery Disconnect

***These tests generate major alarms for plants in service.**

Test Equipment

The following equipment is required for performing these tests:

- 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, 2W minimum, 10%
- Short length of 22-26 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 1 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, which is part of the 113B control unit. (See Figure 2-3 for its location.)

***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 113B terminal blocks to verify that no alarms are present.
9. If the test fails, replace the 113B.
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 113B 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.
5. 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*, 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 4-4. 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 F1 (see Figure 2-4). 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 113B:

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 on the front panel.
4. Place a paper clip or equivalent to connect the battery lead of the fuse to the alarm lead of the fuse F16. 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 all major fuses on the front panel.
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.

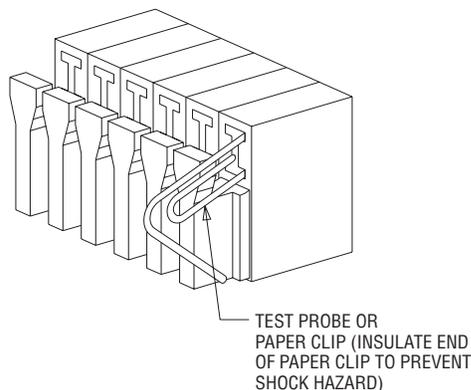


Figure 5-1: Fuse Alarm Test

***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.

	<u>TB101 Pin #</u>	<u>Rectifier(s)</u>
TR1	9	1, 5, 9
TR2	10	2, 6, 10
TR3	11	3, 7, 11
TR4	12	4, 8, 12

3. Verify that the listed rectifier or rectifiers go to standby. When the wire is removed, the rectifier(s) should restart automatically. Disconnect the lead from both ends when finished.

NOTE Some commercial rectifiers may not allow turning rectifiers off via the TR control.

***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. Disconnect the lead and the resistor from both ends when finished. Close the controller front panel.

***Low Voltage
Battery
Disconnect Test***

If the plant is not equipped with a low voltage disconnect contactor, skip this test.

1. Identify the LV- lead at P501-6 (for -48V or -24V controllers) or the LV+ lead at P501-8 (for +24V controllers) of the CP5 LVD/Fuse Board. Follow this lead through its wire form on the controller door to its termination on a quick-disconnect tab terminal on the battery bus of the plant distribution panel. Disconnect this lead at the battery bus and observe the following:
 - The LVD contactor **opens**.
 - The LVD OPEN LED on the front of the CP5 card activates.
 - The MNF LED of the ECS-12U activates.
 - Alarm contacts TB102/10-11 on CP1 of the ECS-12U **close**.
2. Connect a 0-60V variable power supply from the plant ground bus to the disconnected LV- (or LV+) lead, along with a voltmeter. Turn on the power supply and adjust its output to 48V (24V). Observe the following:

- The LVD contactor **closes**.
 - The LVD OPEN LED on the front of the CP5 card retires.
 - The MNF LED of the ECS-12U retires.
 - Alarm contacts TB102/10-11 on CP1 of the ECS-12U **open**.
3. Check the locations of the jumpers P505.1 and P505.2 on the rear of the CP5 LVD/Fuse Board. For 48V plants, place both jumpers across pins 1 and 2 for a threshold of $42.5 \pm 0.5V$, or across pins 2 and 3 for a threshold of $40.5 \pm 0.5V$. For 24V plants, place both jumpers across pins 1 and 2 for a threshold of $21.25 \pm 0.25V$, or across pins 2 and 3 for a threshold of $20.25 \pm 0.25V$. Slowly lower the power supply voltage toward the selected threshold.

NOTE As the power supply's voltage decreases and approaches the disconnect threshold, the yellow LVD FAIL LED may light. This is normal, and indicates that one part of the LVD circuit has reached its threshold before the other redundant circuit. If the yellow LVD FAIL LED lights within the disconnect tolerance and then the contactor opens, also within the tolerance, the low voltage battery disconnect circuit is functioning normally.

4. Note the disconnect voltage at which the contactor opens; observe the external conditions listed in Step 1 of this procedure.
5. Raise the power supply voltage above the LVD threshold identified in Step 3. When the contactor operates again, observe the external conditions listed in Step 2.
6. Turn off and disconnect the power supply and voltmeter. The LVD will open once again. Reconnect LV- (or LV+) to its position on the battery bus. Verify that the contactor closes once again and that all alarm indications retire.

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.

- | | |
|----------------------|---|
| 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. |

- | | |
|----------------------|--|
| 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. μ P 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 an alarm indication whenever an alarm exists on one of the data channels on CP3. |
| 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. |

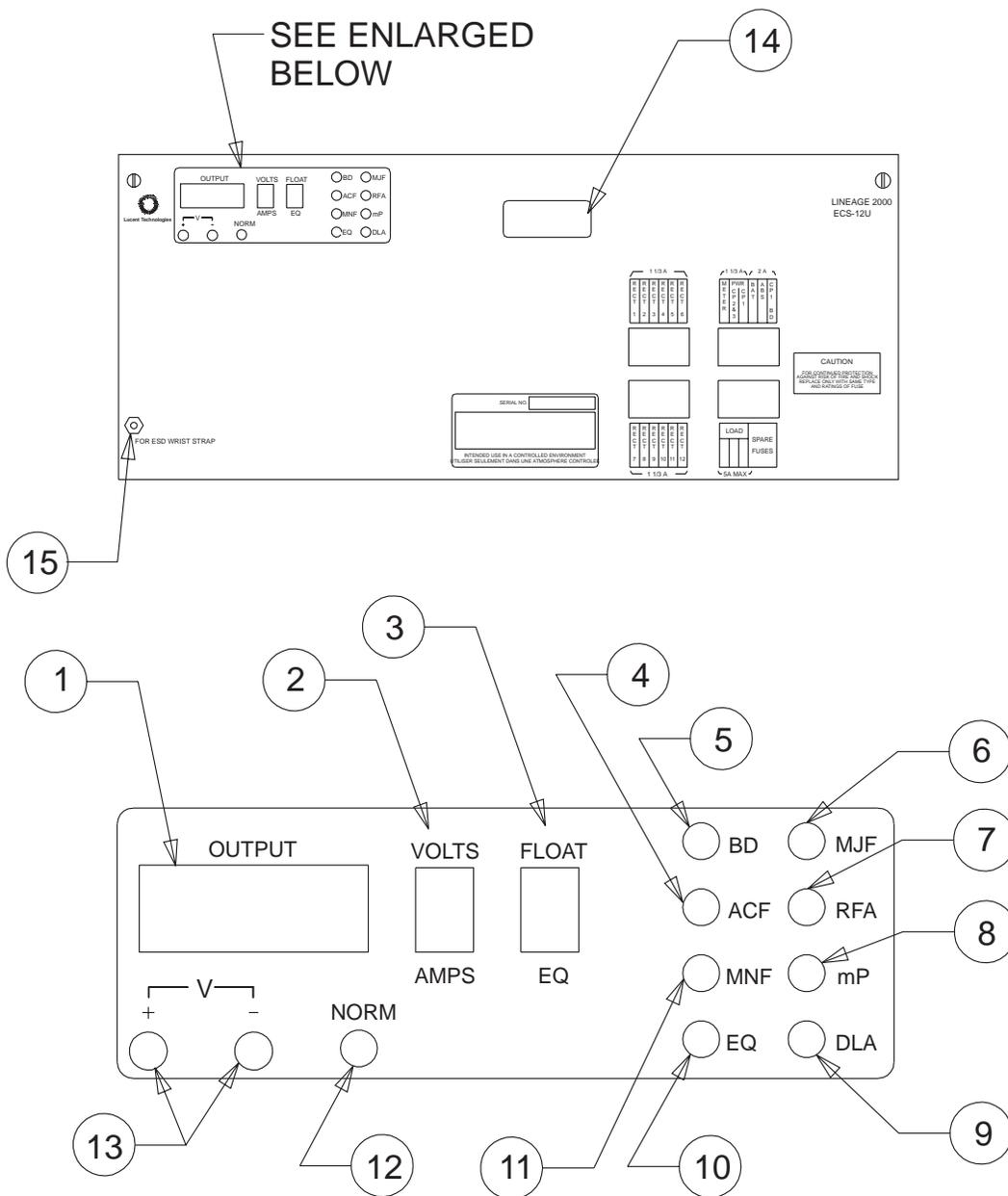


Figure 6-1: Front Panel Location of Controls and Displays

7 *Troubleshooting*

Flowcharts

This section contains five flowcharts for the purpose of troubleshooting the ECS-12U Controller, verifying controller alarms, and meter calibration. The flowcharts are listed below.

7-1 Office Alarms Received

7-2 113B Control Unit Has Lost Power

7-3 Verify Controller Alarms

7-4 Display Is Not Lit

7-5 Meter Out of Calibration

A. OFFICE ALARMS RECEIVED

SHEET 1 OF 1

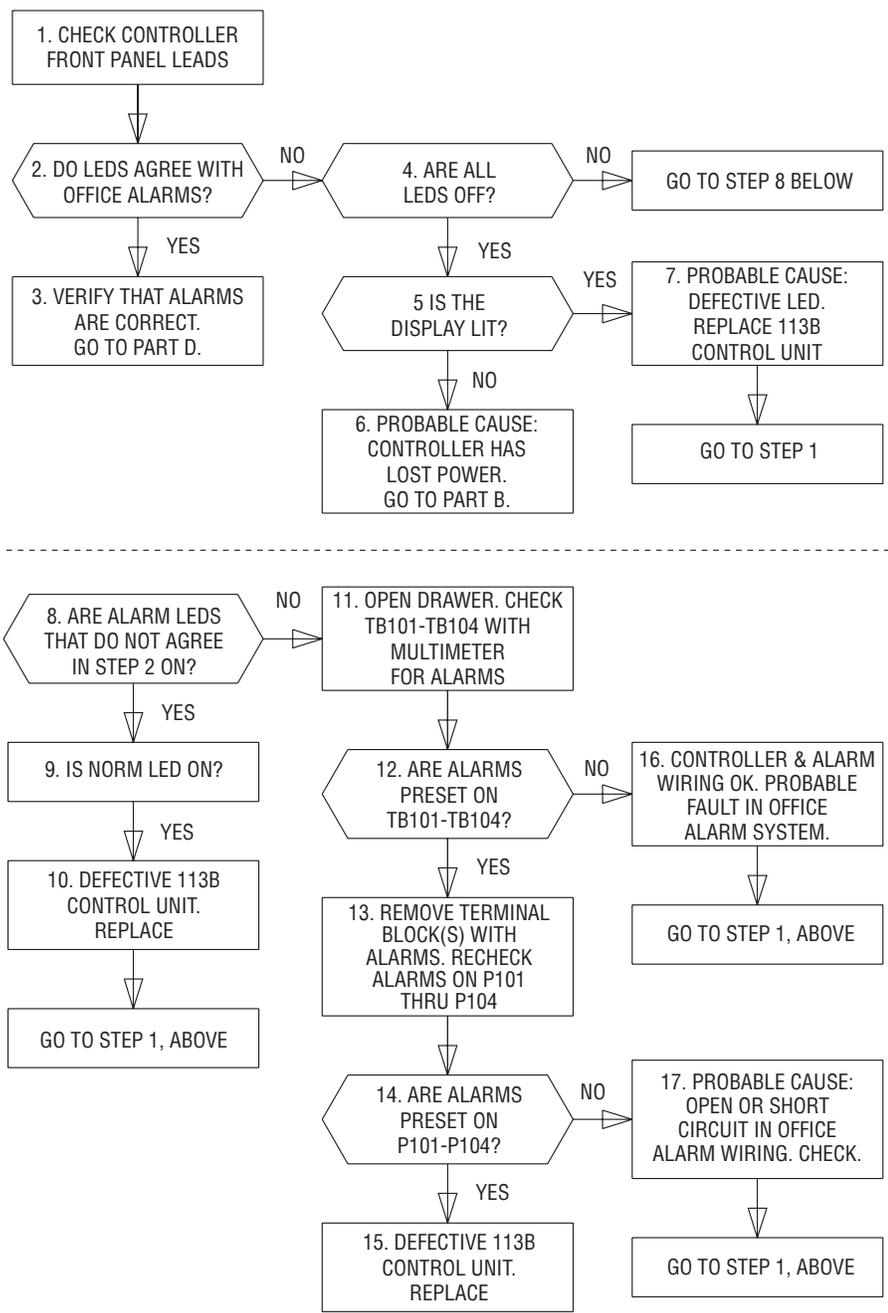


Figure 7-1: Office Alarms Received

B. 113B CONTROL UNIT HAS LOST POWER

SHEET 1 OF 2

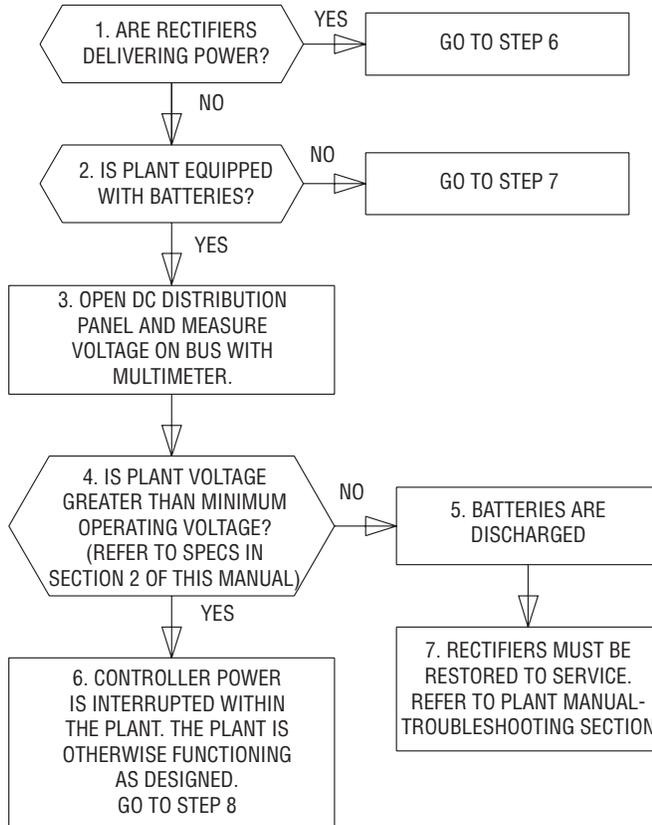


Figure 7-2.1: 113B Control Unit Has Lost Power

B. 113B CONTROL UNIT HAS LOST POWER

SHEET 2 OF 2

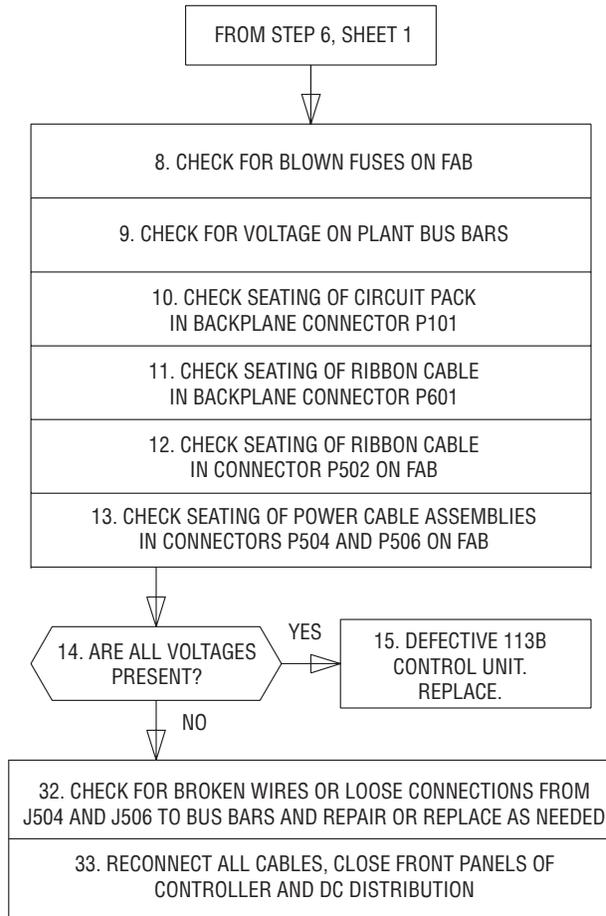


Figure 7-2.2: 113B Control Unit Has Lost Power (continued)

C. VERIFY CONTROLLER ALARMS

SHEET 1 OF 4

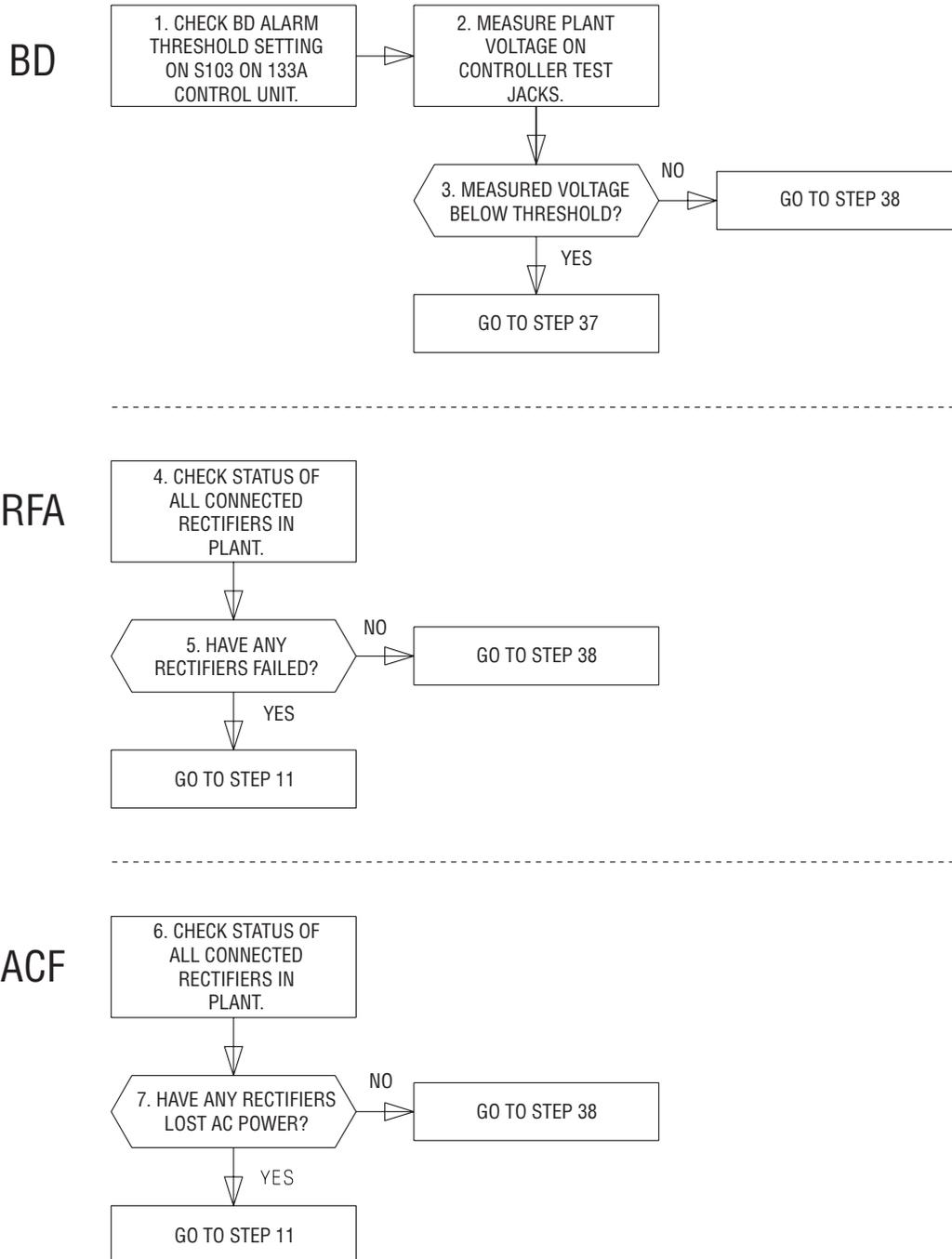


Figure 7-3.1: Verify Controller Alarms

C. VERIFY CONTROLLER ALARMS

SHEET 2 OF 4

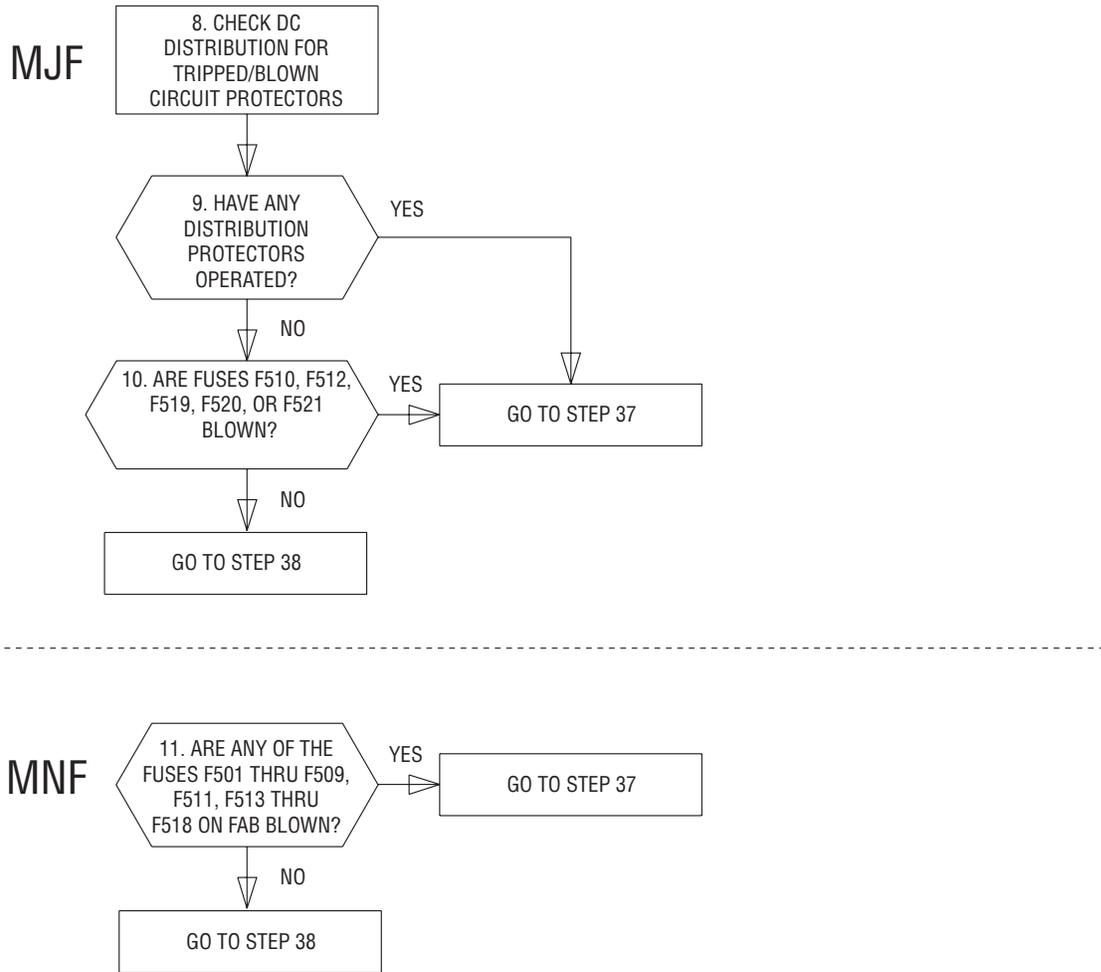


Figure 7-3.2: Verify Controller Alarms (continued)

C. VERIFY CONTROLLER ALARMS

SHEET 3 OF 4

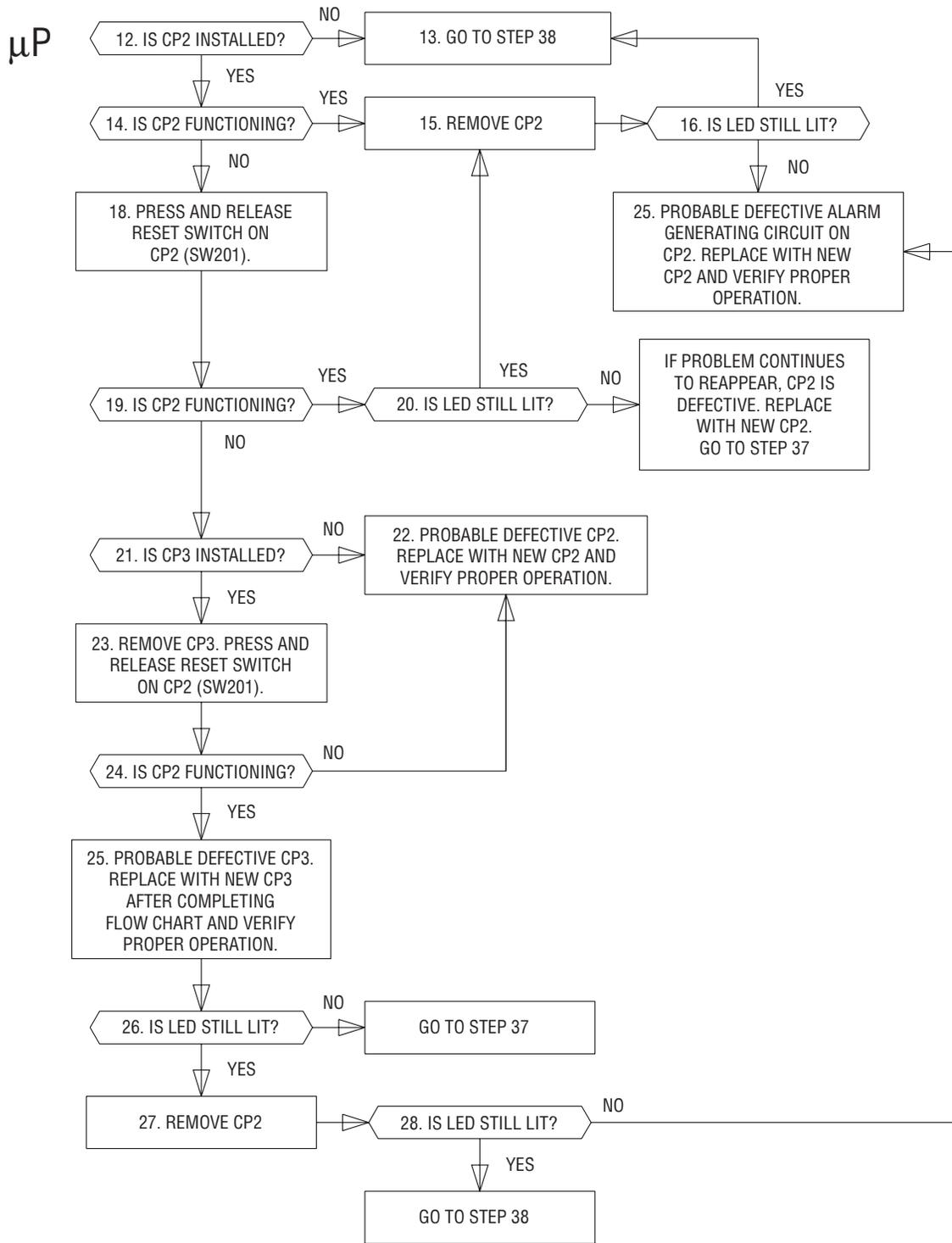


Figure 7-3.3: Verify Controller Alarms (continued)

C. VERIFY CONTROLLER ALARMS

SHEET 4 OF 4

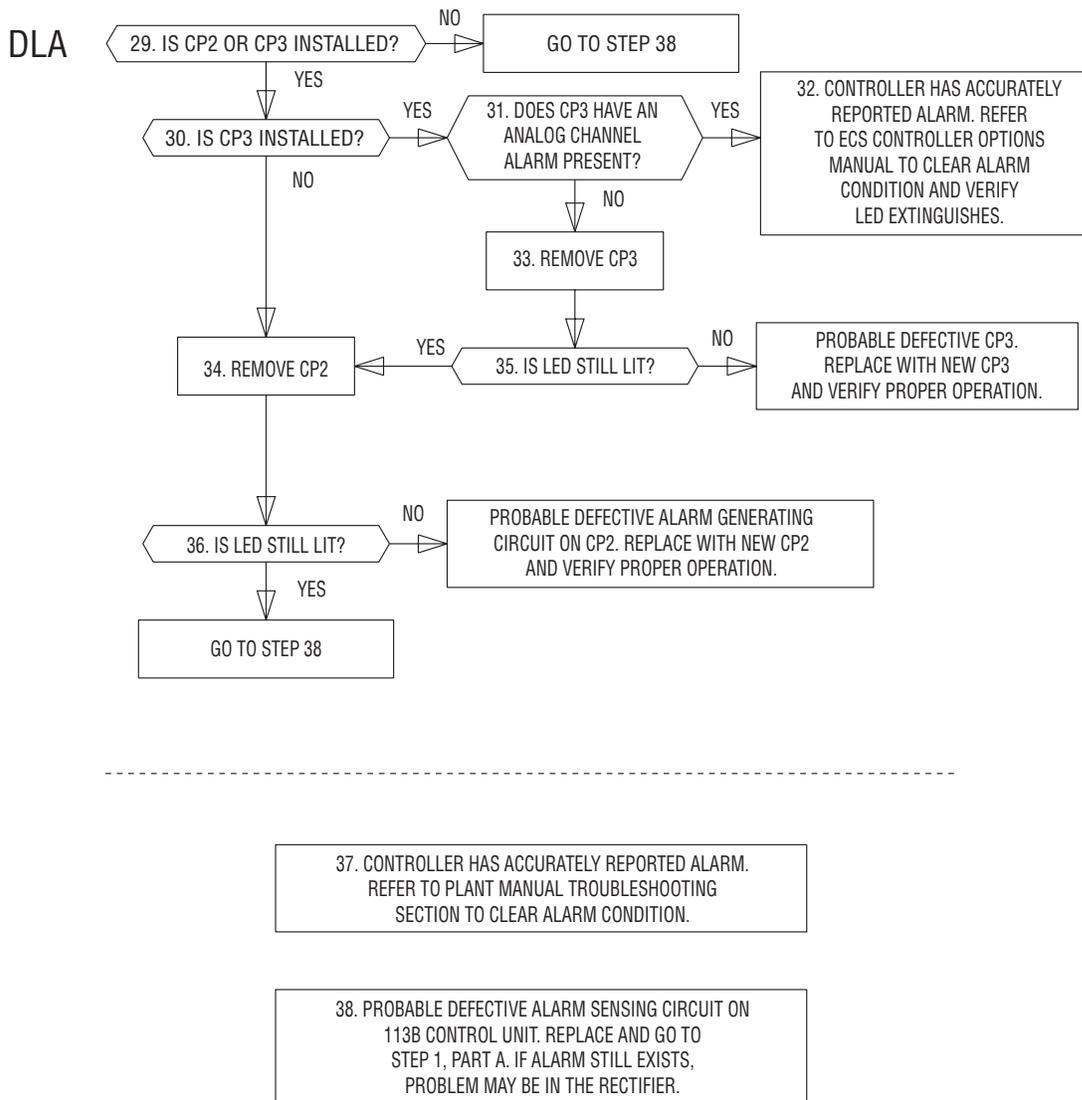


Figure 7-3.4: Verify Controller Alarms (continued)

D. DISPLAY IS NOT LIT

SHEET 1 OF 1

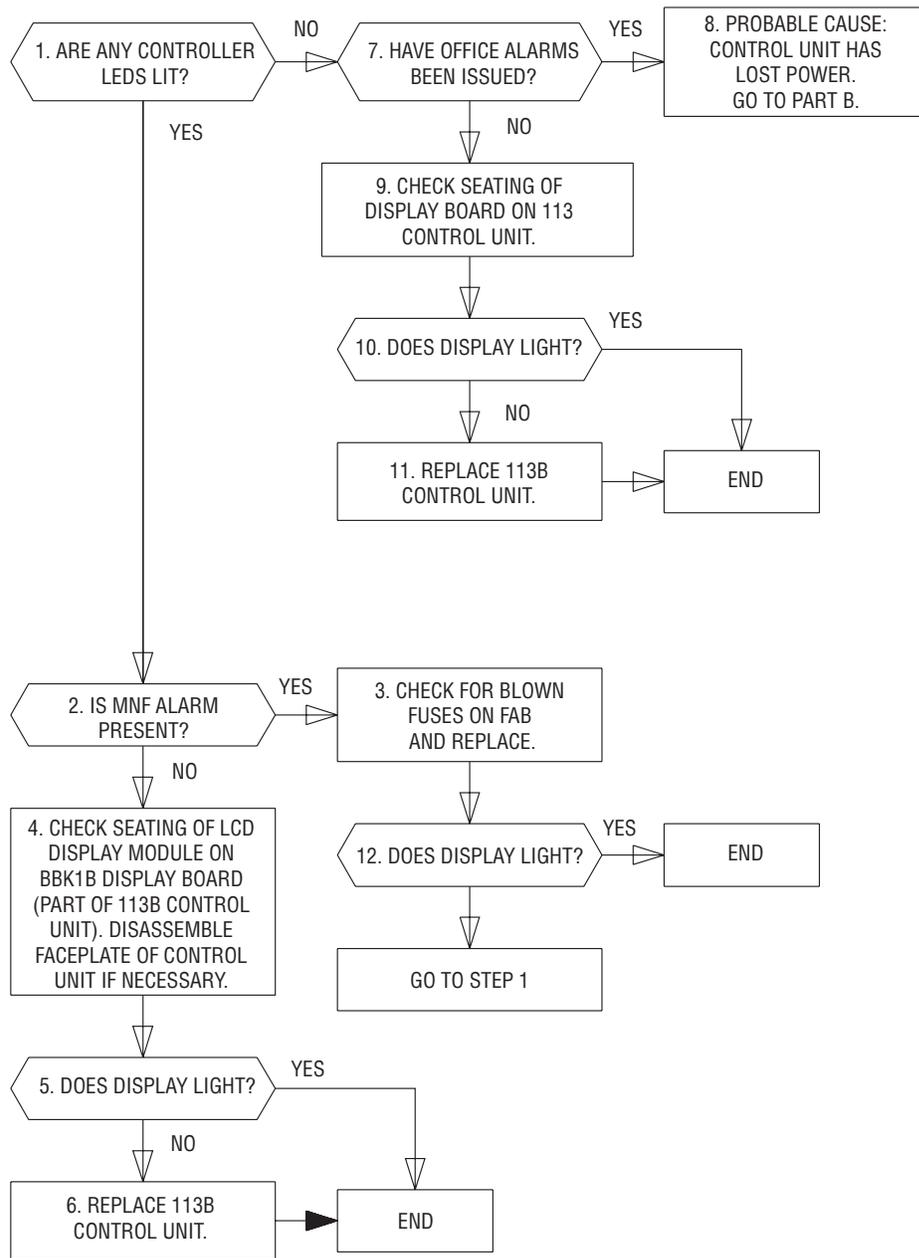


Figure 7-4: Display Is Not Lit

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.

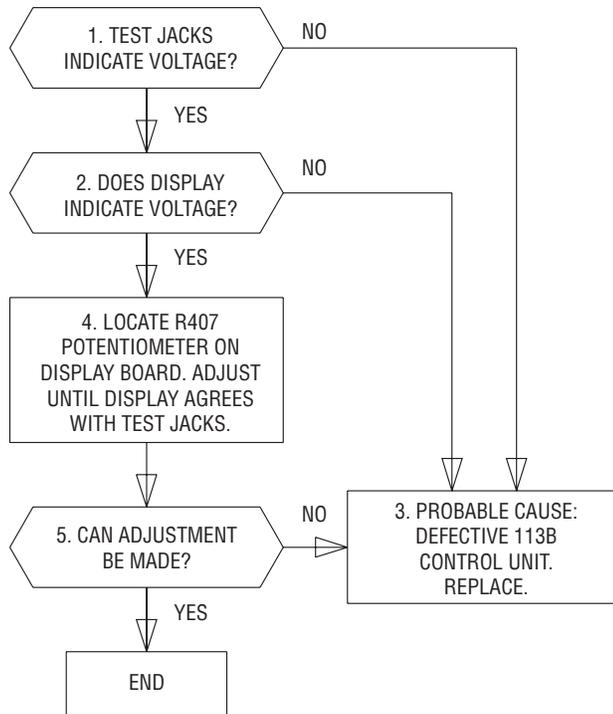


Figure 7-5: Meter Out of Calibration

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-12U Universal Rectifier Controller, J85501E-2.

25A				35A	
<u>24V and 48V</u>				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	
<u>24V and 48V</u>				<u>24V and 48V</u>	
J85502B	SD-82604-01			J85503A-1	SD-82605-01
364A3	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

125A		200A	
<u>24V and 48V</u>		<u>24V and 48V</u>	
J85502C-1	SD-82659-01	J85503B-2	SD-83281-01
		J85503B-1	SD-82605-01
		J87438A-1	SD-82399-01 24V
		J87439A-1	SD-82400-01 48V
400A		800A	
<u>24V and 48V</u>		<u>48V</u>	
J85503C-1	SD-83102-01	48V	KS21522
J85503C-2	SD-83102-02	48V	SD-82412-01
J85503C-3	SD-83103-03		
KS21520	SD-82409-01	48V	
	SD-82410-01	48V	
KS21521	SD-None	24V	