

***Product Manual
J85501D-2***

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***Lucent Technologies
Lineage[®] 2000
ECS-12 Controller***

Notice:

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

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1 Introduction

General Information

This product manual (Select Code 167-790-033) describes the J85501D-2 ECS-12 Controller. The basic ECS-12 controller monitors and controls up to twelve Lucent Technologies switchmode (SR) rectifiers for systems such as the Lineage[®] 2000 ECS Battery Plants 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.

The Evolutionary Control System (ECS) demonstrates Lucent Technologies' continuing dedication to providing state-of-the-art energy systems management products. The Lineage[®] 2000 ECS Battery Plant product line is designed to provide battery-backed common system office voltages of +24Vdc, -24Vdc, or -48Vdc in telecommunications applications.

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

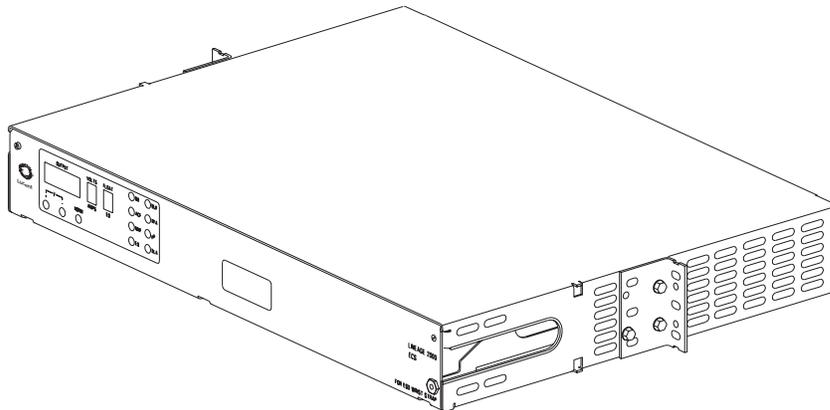


Figure 1-1: ECS-12 Controller

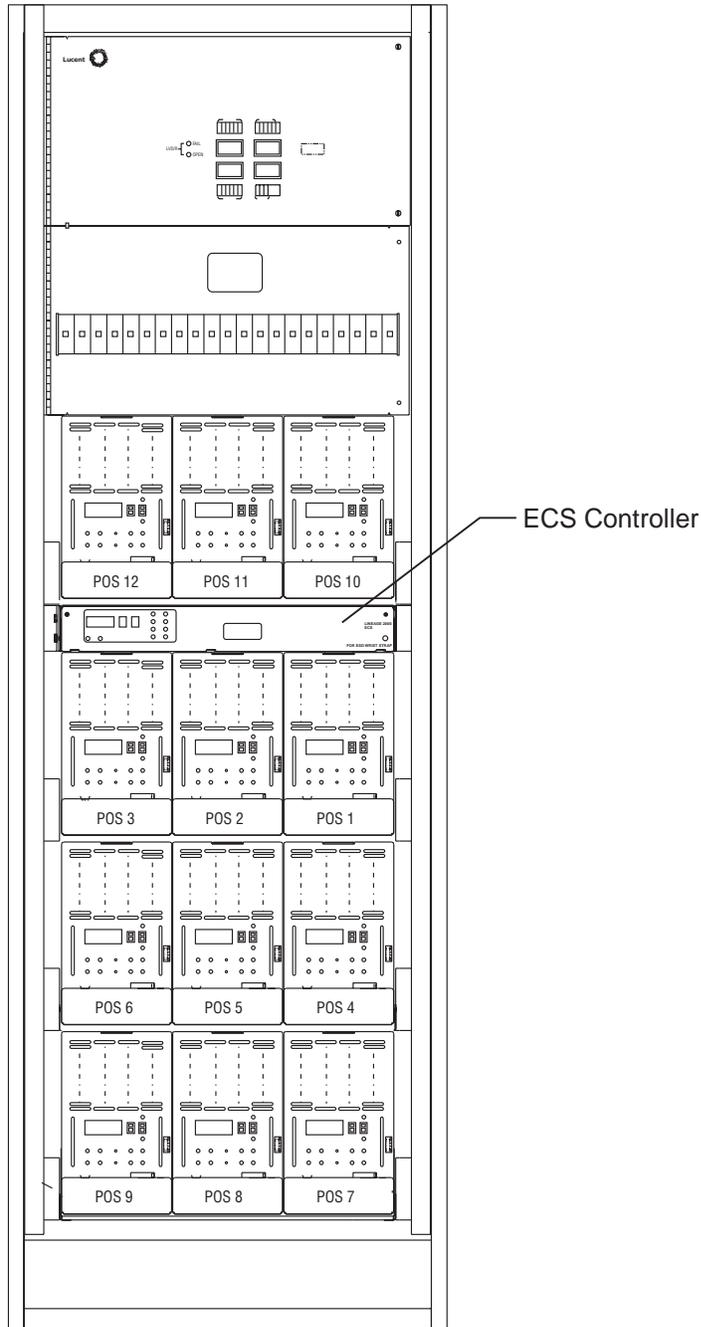


Figure 1-2: Typical ECS Controller Application

Customer Training

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

Customer Service

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

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

Technical Support

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

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

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

Product Repair and Return

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

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

Warranty Service

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

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

2 *Product Description*

Overview

The ECS-12 controller consists of a chassis equipped with a rectifier multiplexing circuit pack (BCC1) and a standard analog control unit, 113B, which consists of two circuit packs: the control board (CP1) and the display board (CP4). The control unit is plugged into a backplane with expansion slots for two optional circuit packs: the Microprocessor Board (CP2) and the Datalogger Board (CP3). The LVD/Fuse Board (CP5), which is located outside the controller, is always required to provide fusing for the controller and rectifier sense leads. The LVD/Fuse Board also provides the low voltage disconnect function, if the plant is so equipped.

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

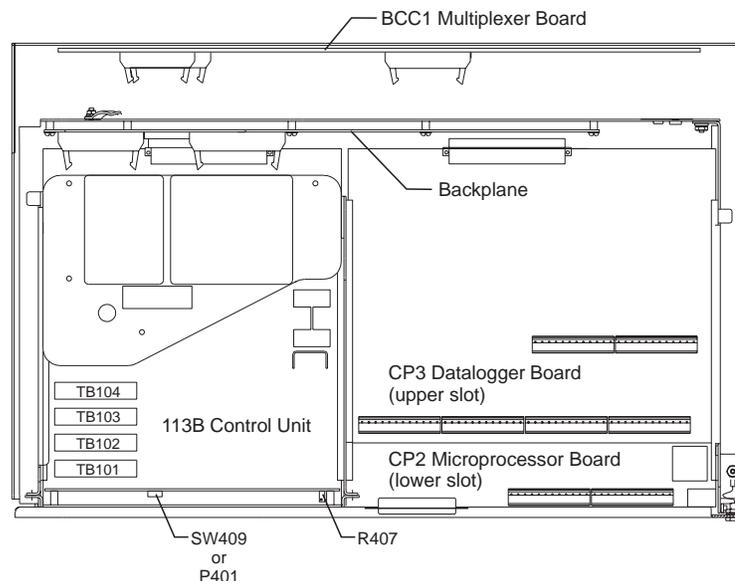


Figure 2-1: Top View of ECS-12 Controller

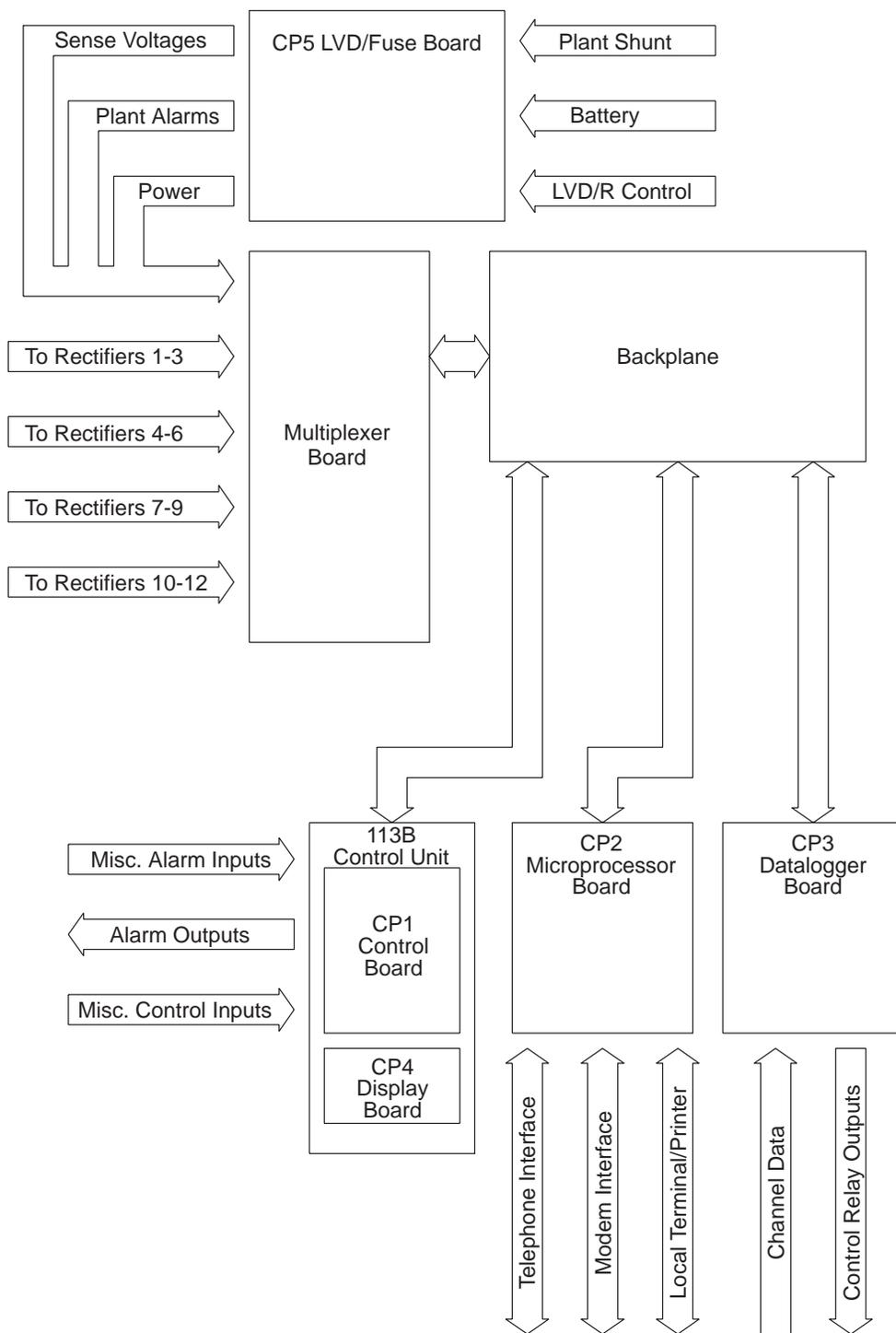


Figure 2-2: ECS-12 Controller Block Diagram

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

Acronym	Description
113B	Analog Control Unit
CP1	Control Board
CP2	Microprocessor Board
CP3	Datalogger Board
CP4	Display Board
CP5	LVD/Fuse Board (located outside controller)
MUX	Multiplexer Board

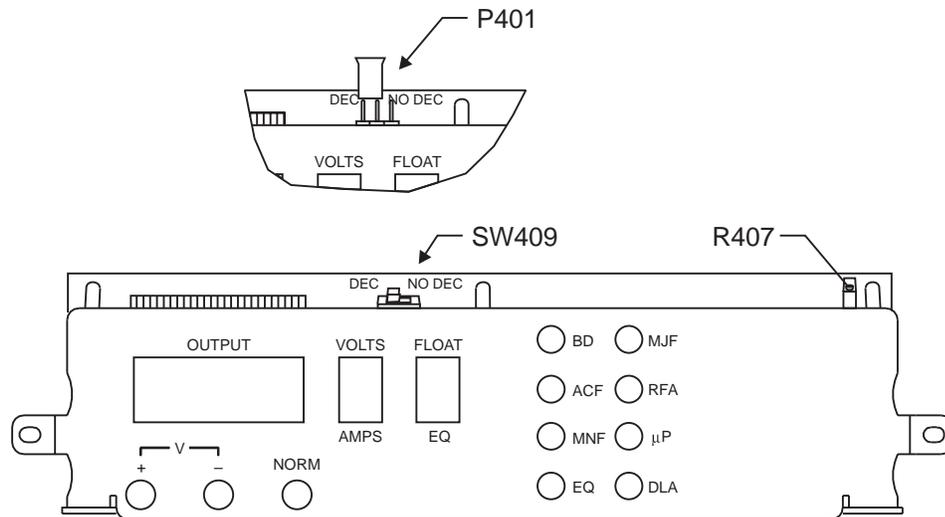


Figure 2-3: Detail of 113B Control Unit Display Panel

Basic Controller

The basic ECS-12 controller monitors and controls up to twelve Lucent Technologies switchmode rectifiers. The basic analog control functions of the ECS-12 are 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 backplane are positioned according to the plant voltage. The 113B may be plugged directly into any controller with a properly configured backplane. Each different plant voltage requires a different LVD/Fuse Board (CP5).

Batteryless Operation

The ECS-12 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-12 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, all Power Major and Power Minor alarms are automatically issued when the controller is powered down.

Rectifier Sense Leads

Separately fused sense leads run from the external LVD/Fuse Board to the rectifiers via the rectifier multiplexer board (BCC1). 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 alarm state of a relay is the “normal” state, i.e., when an alarm condition exists, a closure exists between the “C” and “R” poles and an open exists between the “O” and “R” poles.

Each set of contacts can be in the non-alarm state only when the control unit is powered and the corresponding alarm is not present. When an alarm occurs or when the control unit loses power, each closed pair of contacts opens and each open pair of contacts closes.

An Alarm Battery Supply (ABS) and a ground return are available on one of the terminal blocks (TB101). These pins may be wired by the installer to one or more alarms on the terminal blocks to drive alarm lamps, buzzers, or remote relays in the office alarm system. The ABS is the same voltage as the plant bus voltage and is separately fused on the external LVD/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 4-3 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.

***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 shut down rectifiers that deliver high voltage power.

When the controller detects an increase in the plant voltage above a preset threshold, it immediately issues an HV alarm to the external alarm system. HV is considered a Major alarm, so all Power Major alarm groups are also issued.

When reporting the alarm, the controller sends a simultaneous shutdown signal to all rectifiers. Since the outputs of all rectifiers are paralleled in the plant, their output voltages are forced to be the same. Their output currents, however, may vary widely. In a high voltage condition caused by an individual rectifier failure,

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

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 1.5 volts for nominal 48V battery plants and 0.75 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.

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 are 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 on Figure 4-3 and on a label on the controller itself.

The high voltage alarm contacts can be tested by pressing switch SW104 (see Figure 4-2 for location). When SW104 is pressed, the HV, PMJA, PMJE, and PMJV alarms on the office alarm terminal blocks are activated, the NORM LED on the front panel is extinguished, and HV is sent to the CP2 Microprocessor Option Board if the controller is so equipped. The alarm remains as long as the switch is held, and 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.

***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.

The restart signal consists of two sets of clean contact closures. One set of closures is connected to rectifiers 1, 2, 3, 7, 8, and 9. The other set is connected to rectifiers 4, 5, 6, 10, 11, and 12. In this way, different types of rectifiers with restart circuits that are otherwise incompatible may be combined (in groups of six) in one plant. Different rectifier types may not be mixed within one group of six rectifiers. See “Mixed Types of Rectifiers in One Plant” in this section for further details.

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 lightning activity continues or they are actually faulty units. In either case, if the plant voltage goes high again during the 4-6 minute timeout, the shutdown signal (see previous section) will be reissued but will not be followed by an automatic restart.

The 4-6 minute timer may be reset manually before it times out by pressing switch SW107 (see Figure 4-2 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 and Setup*, for this procedure.) This function should be disabled only for batteryless plants equipped with only one rectifier. In such an application, the controller loses power if the rectifier is shut down and, in the process, issues a restart. If the one rectifier shuts down again, the cycle will repeat, since the controller will again lose power. To prevent a possibly infinite cycle of shutdown and restart, the automatic restart function should be disabled for batteryless plants with only one rectifier.

***Rectifier Fail
Alarm***

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

The loss of one or more rectifiers is not necessarily an emergency unless the plant voltage drops and the batteries begin to discharge. Rectifier Fail is treated as a Minor alarm by the controller, which issues all three sets of Power Minor office alarms in addition to the separate RFA alarm. If loss of rectifier output causes the plant voltage to drop significantly, a BD alarm is issued, which is a Major alarm condition.

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.

Since users may classify the loss of ac power as either a Major or a Minor alarm condition, ACF does not automatically result in a Power Major or Power Minor alarm. The user or installer may hard-wire parallel the ACF alarm to the desired Power Alarm to give loss of ac the proper priority. See Section 4, “Wiring” for alarm wiring details.

Major and Minor Fuse Alarms

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

A red MJF LED on the controller front panel lights 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.

Open Battery String Detection and Alarm

In a plant equipped with battery string disconnects, the disconnect circuit breakers on each battery string may be wired to the controller to indicate when they are open. The open breaker signal occurs when a battery string breaker is tripped 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 external LVD/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 Alarm (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 EQ (Equalize) LED 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.

A slide switch (SW409) or jumper (P401) is available on the CP4 display board to set a decimal point after the third digit. For maximum plant currents of 999A or less, place the jumper or slide switch in the decimal position (DEC); for currents over

999A, place the jumper or slide switch to the no decimal position (NO DEC). See Figure 2-3.

Ammeter Scale

Plant shunts are available with standard full-scale dc output voltages for a variety of full-scale dc currents. The signal from the shunt in any Lineage[®] 2000 battery plant is a 0 to 50 mV dc voltage proportional to the load current. The controller may also be used in a plant that is equipped with other than a 50 mV shunt, e.g., 100 mV, as long as the shunt is located in the distribution and return bus.

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 80 amperes per millivolt (See Section 4, "Hardware Setup" and Figure 4-3 for details.)

Front Panel Test Jacks

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

Rectifier Sequence Control Interface

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

The ECS-12 controller may be connected to the four output signals TR1, TR2, TR3, and TR4 provided by a Rectifier Sequence Controller, such as Lucent Technologies model J87339A-1. These signals are used to turn off rectifiers or groups of rectifiers.

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

The controller equipped with CP2 is capable of Rectifier Sequence Control without an external sequence controller. 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***

The Lineage® 2000 SR-series rectifiers used with the ECS-12 controller 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.

The equalize feature may also be used as a “Temperature Protection” mode in plants with sealed-type or valve-regulated batteries and 210-series Battery Thermal Compensation modules. In this mode, the rectifier equalize or temperature protection voltage is set **lower** than the float voltage and is initiated under control of the 210-series modules whenever a high battery temperature is sensed, in an effort to combat a thermal runaway event.

The ECS-12 controller has several methods of controlling the equalize function in plants that are so equipped:

Hardware Disable: A movable jumper strap 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 without temperature compensation 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 CP1 has no built-in on/off timer, CP1 may be connected to a timer panel to automatically terminate equalize without manual intervention (see Section 4, “Wiring”). Note that this control method is overridden when equalize is hardware disabled.

Microprocessor Control: CP2 is equipped with a variety of software features for float/equalize control. These features are also disabled by the hardware strap on CP1. (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.

LVD/Fuse Board

The LVD/Fuse board provides fused power and voltage sense distribution for the ECS-12 Controller and the rectifiers in the plant containing the ECS-12 Controller and low power distribution for customer applications. This board produces Major and Minor fuse alarms for the fuses on the board, as well as for plant distribution circuit breakers and user selectable interfaces. It also provides low voltage detection circuits that control the Low Voltage Disconnect Contactor, an optional feature on many of the plants that use the ECS-12 Controller.

Power and Sense Voltage Fusing

The LVD/Fuse Board has up to 18 fuses to distribute power and sense voltages:

- F501-F506 and F513-F518 provide battery sense voltage to the regulation leads of the rectifiers.
- F507 provides power and plant voltage sensing to the meter circuits of the 113B and optional microprocessor circuit pack.
- F508 provides power to the optional microprocessor and datalogger circuit packs.
- F509 provides power to the rectifier interface circuits on the 113B.

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

***Major and Minor
Fuse Alarms***

The LVD/Fuse Board provides Major and Minor Fuse Alarms to the controller. A Major Fuse Alarm is generated when F510, F511, F512 or F521-F523 opens, 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 one of the fuses F501-F509 or F513-F518 opens, when TB501-3 or TB501-5 is connected to the plant voltage, or when one or both of the low voltage detection circuits attempts to open the LVD Contactor (either under normal operation or in a fault situation. See “Low Voltage Detection for Disconnect/Reconnect Contactor” for further details).

***Low Power
Distribution***

The LVD/Fuse Board may provide low power distribution for customer applications. Plant voltage is supplied to TB501, pins 6, 7, and 8 via fuses F519, F520, and F521, 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 LVD/Fuse Board may also provide holders for three spare fuses. These fuses are labeled F522, F523, and F524. The holders come equipped from the factory with 1-1/3 ampere-rated fuses. These may be replaced with any ampere-rating fuses that a 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 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 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 for 48V plants or 21.25V for 24V plants, while placing the jumpers across pins 2 and 3 provides a disconnect voltage of 40.5V for 48V plants or 20.25V for 24V plants.

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 so 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 available 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 yellow LVD/FAIL LED will not 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 and Datalogger Board.

Microprocessor Board

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

Datalogger Board

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

Mixed Types of Rectifiers in One Plant

The ECS-12 controller may be used to control a total of 12 rectifiers. There are two grouped rectifier interface ports on the rectifier multiplexing board, the first for rectifiers 1, 2, 3, 7, 8, and 9 and the second for rectifiers 4, 5, 6, 10, 11, and 12. Each group of six may be of a different type, but mixing of different types of rectifiers within a group may not be possible due to the paralleling of various signals within the group by the rectifier multiplexing board.

NOTE The ECS-12 controller presently supports interfacing to Lineage® 2000 SR-series rectifiers only. Use of other rectifier types will require additional engineering to ensure proper operation of the controller and rectifiers. Special cables and/or circuitry may be required to translate signal levels or to interface the ribbon cable connectors of the controller to different connectors or pinouts of other types of rectifiers. The information below is provided to aid such an engineering effort.

Two isolated restart contacts are available on the 113B, one for each group of six rectifiers, for the purpose of isolating two rectifier types with different restart levels. A moveable jumper, P108, is provided on the 113B to connect (jumper across pins 1 and 2 of P108) or isolate (jumper across pins 2 and 3 of P108) the return leads of the two isolated restart contacts. The

connection or isolation of these restart contacts will be determined by the types of rectifiers used.

CAUTION In plants equipped with all Lineage[®] 2000 SR-series rectifiers, the return leads of the isolated restart contacts **MUST** be connected (jumper across pins 1 and 2 of P108) to ensure proper restart operation of all rectifiers.

Controller Specifications

Table 2-A: ECS-12 Controller Electrical Specifications

Float Voltage	47.0 - 58.5 volts dc (48 volts dc nominal) 23.5 - 29.0 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
Display Meter	4-digit backlit LCD <u>Range:</u> 0.00 to +/-60.00 V (voltmeter) 0.0 to 800.0 A (ammeter) <u>Accuracy:</u> +/-0.5% (ammeter) +/-0.05% (voltmeter) <u>Resolution:</u> +/-0.1 ampere +/-0.01 volts
Plant Shunt Compatibility	50 millivolts at 300, 600, 1200, 2000, 2600 or 4000 amperes 100 millivolts at 600, 1200, 2400, 4000, 5200 or 8000 amperes
Alarm Contact Rating	60 volts dc, 1.0 ampere, Form C
Temperature	32 to 122° F (0 to 50° C)

Table 2-A: ECS-12 Controller Electrical Specifications

Altitude	-200 to 13,000 feet (-61 to 3962 meters) For altitudes of 5000 to 13,000 feet, derate maximum temperature by 3.8 degrees Fahrenheit per 1000 feet above 5000 feet. For altitudes of 1524 to 3962 meters, derate maximum temperature by 0.656 degrees Celsius per 100 meters above 1524 meters
Humidity	10% to 95% noncondensing
Electrostatic Discharge	IEC 801-2 Level 5 (15kV) at 40% relative humidity
Radiated & Conducted Emissions	FCC Level A
Electromagnetic Immunity	10 V/m over the range of 20 to 2000 MHz
LVD/R Voltage Settings	40.5V +/-0.5V or 42.5V +/-0.5V for 48V plants 20.25V +/-0.25V or 21.25V +/-0.25V for 24V plants

Table 2-B: Battery Plant Alarm Voltage Ranges

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

Table 2-C: ECS-12 Controller Physical Specifications

Dimensions	Length 21.5" (546 mm) Depth 15.0" (381 mm) Height 3.0" (76 mm)
Frame Mounting Requirements	Standard 23" and 26" relay rack Vertical mounting centers: 1.00" (25 mm) Horizontal mounting centers: 22.32" (567 mm) for 23" rack-mount 24.32" (618 mm) for alternate 26" rack-mount
Weight	14 pounds (6.4 kilograms)
Earthquake	Zone 4, upper floors

3 *Ordering Information*

Controller

Table 3-A: ECS-12 Controller Ordering Information

List	Description
1	Assembly, wiring, and equipment for one Lineage® 2000 ECS Controller for +24V, -24V, or -48V Plant. (White color.)
2	Assembly, wiring, and equipment for one Lineage® 2000 ECS Controller for +24V, -24V, or -48V Plant. (Gray color.)
A	Optional equipment in addition to List 1 or 2. Provides 48V plug-in microprocessor circuit pack (CP2) <i>without voice response</i> , its backup battery, and product manual; shipped separately. CP2 provides remote/local monitoring and control functions.
B	Same as List A except <i>with voice response</i> . Provides 48V plug-in microprocessor circuit pack (CP2) equipped with speech chips, its backup battery, and product manual; shipped separately.
C	List C is the 24V version of List A. Provides 24V plug-in microprocessor circuit pack (CP2) <i>without voice response</i> , its backup battery, and product manual; shipped separately. CP2 provides remote/local monitoring and control functions.
D	List D is the 24V version of List B. Provides 24V plug-in microprocessor circuit pack (CP2) equipped with speech chips, its backup battery, and product manual; shipped separately.

Table 3-A: ECS-12 Controller Ordering Information

List	Description
E	Optional equipment in addition to List 1 or 2. Provides a plug-in datalogger circuit pack (CP3), a set of current limiting resistor assemblies, and a product manual; shipped separately. CP2 is required with a CP3. Current limiting resistor assemblies (part of List E or F) are required in the installation of CP3 and are calibrated into the datalogger. Analog channel readings will not be accurate without these resistors. They are required to ensure that field wiring to CP3 is Class 2 per NEC.
F	Same as List E (CP3) <i>except with a remote termination panel</i> . Provides a plug-in CP3 board, a set of current limiting resistor assemblies, a termination unit with cable set, and a product manual; shipped separately. The remote termination panel allows external connection to the CP3 circuit pack from outside the controller. Current limiting resistor assemblies (part of List E or F) are required in the installation of CP3 and are calibrated into the datalogger. Analog channel readings will not be accurate without these resistors. They are required to ensure that field wiring to CP3 is Class 2 per NEC.
K	Same as List A <i>except with X.25/TL1 features</i> . Lists K, L, M, N provide a plug-in microprocessor circuit pack (CP2) with X.25/TL1 functions, its backup battery, wiring, RS485-to-RS232 converter, and product manual; shipped separately. X.25/TL1 is a different communications protocol that may be used to access the controller. Refer to Table 3-B to order additional equipment for X.25/TL1 communication systems or for software upgrade to an existing microprocessor board (CP2). This upgrade is not available for CP2s coded MC80041A1-A4; if this option is desired, order new microprocessor board CP2.
L	Same as List B <i>except with X.25/TL1 features</i> . Lists K, L, M, N provide a plug-in microprocessor circuit pack (CP2) with X.25/TL1 functions, its backup battery, wiring, RS485-to-RS232 converter, and product manual; shipped separately. X.25/TL1 is a different communications protocol that may be used to access the controller. Refer to Table 3-B to order additional equipment for X.25/TL1 communication systems or for software upgrade to an existing microprocessor board (CP2). This upgrade is not available for CP2s coded MC80041A1-A4; if this option is desired, order new microprocessor board CP2.

Table 3-A: ECS-12 Controller Ordering Information

List	Description
M	Same as List C <i>except with X.25/TL1 features</i> . Lists K, L, M, N provide a plug-in microprocessor circuit pack (CP2) with X.25/TL1 functions, its backup battery, wiring, RS485-to-RS232 converter, and product manual; shipped separately. X.25/TL1 is a different communications protocol that may be used to access the controller. Refer to Table 3-B to order additional equipment for X.25/TL1 communication systems or for software upgrade to an existing microprocessor board (CP2). This upgrade is not available for CP2s coded MC80041A1-A4; if this option is desired, order new microprocessor board CP2.
N	Same as List D <i>except with X.25/TL1 features</i> . Lists K, L, M, N provide a plug-in microprocessor circuit pack (CP2) with X.25/TL1 functions, its backup battery, wiring, RS485-to-RS232 converter, and product manual; shipped separately. X.25/TL1 is a different communications protocol that may be used to access the controller. Refer to Table 3-B to order additional equipment for X.25/TL1 communication systems or for software upgrade to an existing microprocessor board (CP2). This upgrade is not available for CP2s coded MC80041A1-A4; if this option is desired, order new microprocessor board CP2.
KA	Optional equipment for controller equipped with a List A or C CP2. Provides an upgrade kit that consists of two integrated circuits and instructions to add the speech synthesis feature to the List A or List C CP2 that does not yet have this feature.
PM	Required in addition to List 1 to provide a product manual, mounting brackets, SD-82669-02, and J85501D-2 drawings when controller is not factory mounted. List PM should be ordered for field installed controllers (non-X).

Kits

Table 3-B: Additional Ordering Information

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

Spare Parts

Table 3-C lists the recommended spare parts for the ECS-12 Controller.

Table 3-C: Recommended Spare Parts

Comcode	Description	Recommended Quantity
106395064	113B Control Unit	1 per Controller Unit
846575280	Backplane	1 per 4 Controller Units
J85501D-2 LA - LD or LK - LN	Microprocessor Board	1 per 4 Controller Units
406281428	Replacement Battery (1/3N size Cylinder) for early versions of Microprocessor Board (coded MC80041A1B, etc.)	1 per Microprocessor Board
406526079	Replacement Battery (coin cell) for Microprocessor Board (coded MC80041A1, etc.)	
106615610 106615628	BAC1 Datalogger Board, or BAC2 Datalogger Board	1 per 4 Controller Units

Documentation

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

Document No.	Document Description
J85501D-2	Assembly, Ordering, and Installation Drawing for ECS-12 Controller
SD-82669-02	Schematic Drawing for ECS-12 Controller
167-790-033	ECS-12 Controller Product Manual
167-790-109	ECS Controller Options Product Manual (provided when Microprocessor Board, CP2, is ordered)

4 ***Installation and Setup***

Introduction

This section covers the installation and setup procedures for all configurations of the ECS-12 controller. Follow all the applicable steps in the following sections, in the order they are presented.

Tools Required

The tools required in this section are the following.

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

Shipped-Loose Unit Installation

Controllers are typically factory wired and assembled to a battery plant bay. For custom engineered applications or as a replacement, however, the ECS-12 controller may be shipped as a loose unit. The user must assemble and wire a shipped-loose unit to the plant.

The LVD/Fuse Board (CP5) must be mounted in the bay to provide fused power for the controller. Hardware setup for the LVD/Fuse Board is included in this section, but mounting details are not provided here. Refer to the battery plant product manual or separate kit installation instruction sheet for kit installation.

If the ECS-12 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-12 Controller J85501D-2
- Self-tapping mounting screws (#12-24 size)
- Wire ties
- Mounting brackets
- ECS-12 Controller product manual, Select Code 167-790-033
- ECS-12 Controller schematic and assembly drawings: J85501D-2 and SD-82669-02

Default Factory Settings

Factory settings for switches and jumpers for non-X controllers should be set to the defaults shown in Table 4-A. **However, all switch and jumper settings should be verified as part of the installation procedure.**

Table 4-A: Default Factory Settings for Non-X Controllers

Jumper Settings										
Board	Header	Jumper Pins	Function							
Backplane 846575280	P602.1	2 and 3	-48 Volts							
	P602.2									
	P602.3									
	P602.4									
CP1	P105	1 and 2	Restart enabled							
	P106	1 and 2	Equalize disabled							
	P108	1 and 2	For SR-series rectifiers							
(Display)	P401	1 and 2	Shunt size less than 1000A							
CP3	P302	1 and 2	-48 Volts							
Switch Settings (0 = Open, 1 = Closed)										
Board	Switch	Function	Switch Setting							
			-1	-2	-3	-4	-5	-6	-7	-8
CP1	SW101	HV/EQ Level (-57 Volts)	1	1	0	0	1	0	N/A	
	SW102	HV/FL Level (-55 Volts)	1	1	0	0	1	0	N/A	
	SW103	BD Level (-53 Volts)	1	0	0	0	1	0	N/A	
	SW109	Meter Shunt (300 Amps)	1	0	0	0	1	1	N/A	
CP2	SW202	(See Table 4-B)	0	1	0	1	0	0	0	

Controller Configurations

To configure a controller with other settings, refer to the required DIP switch settings and jumper positions in Tables 4-B and 4-C.

Table 4-B: CP2 DIP Switch Settings

(0 = Open, 1 = Closed)					
SW202	Function	Option	Switch Setting		
-1	Remote TR	Enabled	0		
		Disabled	1		
			-2	-3	-4
-2	Shunt Size	300A	1	0	1
		600A	0	0	1
-3		1200A	1	1	0
		2000A	0	1	0
-4		2600A	1	0	0
		4000A	0	0	0
-5	Remote Super-User Login	Enabled	0		
		Disabled	1		
-6	Maximum Number of Rectifiers	12 Rectifiers	0		
		6 Rectifiers	1		
-7	Nominal Battery Plant Voltage	-48 Volts	0		
		±24 Volts	1		
-8	Local Port	Terminal	0		
		Printer	1		

Table 4-C: Controller Jumper Settings

Board	Header	Jumper	
		Pins 1 and 2	Pins 2 and 3
CP1	P105	Restart	No Restart
	P106	Equalize Disabled	Equalize Enabled
	P108	For SR-series Rectifiers	For Non SR-series Rectifiers
(Display)	P401	Shunt Size Less Than 1000A	Shunt Size Greater Than 1000A
CP3	P302	-48 Volts	±24 Volts
Backplane 846575280	P602.1	±24 Volts	-48 Volts
	P602.2		
	P602.3		
	P602.4		

Frame Mounting

The controller should arrive configured for 23-inch frame mounting. For 26-inch mounting in plants such as J85500A, B, or C, the two mounting brackets may be removed and rotated as indicated on the controller assembly drawing, J85501D-2.

1. If the ribbon cables for the LVD/Fuse Board interface and rectifier interfaces are not already plugged into the controller, attach them to the rectifier multiplexing circuit pack (BCC1) and dress them as shown on the assembly drawing. Use wire ties as needed to secure the ribbon cables.
2. Using the mounting screws, attach the controller to the framework in the desired location.
3. Dress the ribbon cables from the controller to the LVD/Fuse Board and rectifier interfaces as indicated on the plant assembly drawing or battery plant product manual.
4. Proceed with “Hardware Setup.”

Hardware Setup

Refer to Figures 4-1 and 4-2 for backplane and CP1 set-up, respectively. The LVD/Fuse Board is shown in Figure 4-4.

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

There are jumper straps located on the backplane, the 113B Control Unit (CP1), and the LVD/Fuse Board (CP5) that must be set properly before powering the controller. These jumpers are set at the factory with proper settings for the plant in which the controller is shipped. In shipped-loose controllers, the jumpers are factory configured for 48-volt operation.

CAUTION **Applying power to the controller when jumper straps are improperly arranged may damage the controller circuit packs.**

In addition to the jumpers, several DIP switches should be set before applying power. Incorrect switch settings, however, will not damage the unit.

Voltage Selection

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

DIP switch position 6 on SW101, SW102, and SW103 must also be set for 24 or 48 volts. All three must be set to the same voltage. This switch setting may be done as part of the BD and HV level setting procedure in paragraphs “Battery on Discharge Threshold” and “High Voltage Shutdown Thresholds,” respectively.

***Equalize
Enable/Disable***

The equalize jumper P106, shown in Figure 4-2, 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 & 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.

***Automatic
Restart
Enable/Disable***

The restart jumper P105, is factory set in the ENABLE position (pins 1 and 2). (See Figure 4-2.) This setting allows the controller to attempt to restart rectifiers after a high voltage shutdown. For one rectifier plant without battery reserve, the jumper should be moved to the DISABLE position (pins 2 & 3). Manual intervention will be required to restart the rectifier in such an application.

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

Ammeter Scale

DIP switch SW109 is 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. Use the label on the cover plate of the 113B control unit to check the DIP switch settings versus the plant shunt rating. If the plant shunt rating is

not known and is not directly indicated in the plant manual, check the plant assembly drawing. (See Figure 4-3 or the label on the cover plate of the 113B control unit.)

***Battery on
Discharge
Threshold***

The voltage threshold for the BD alarms is set with DIP switch SW103. (See Figure 4-2.) Refer to the label on the CP1 cover plate for the DIP switch setting for the desired alarm threshold. The same table of settings also appears on the schematic drawing SD-82669-02 and assembly drawing J85501D-2. The recommended threshold is approximately 1.0 volts below the float voltage for nominal 48-volt plants or approximately 0.5 volts below float for nominal 24-volt plants.

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

***High Voltage
Shutdown
Thresholds***

The controller is equipped with two separate high voltage shutdown thresholds. The first is used during normal float operation. The second threshold is used when the plant is in equalize mode. The float shutdown is set with DIP switch SW102 on CP1. (See Figure 4-2.) The equalize shutdown is controlled by settings on DIP switch SW101 on CP1. The equalize shutdown level does not need to be set if equalize is hardware disabled (“Equalize Enable/Disable”). The recommended shutdown levels are approximately 1.0 volts above operating voltage for nominal 48-volt plants or approximately 0.5 volts 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 switch position 6 on SW101, SW102, and SW103 must also be set for 24 or 48 volts. All three must be set to the same voltage. This switch setting may be done as part of the BD and HV level setting procedures in this section.

***Rectifier Restart
Group Isolation***

In plants equipped with all SR-series rectifiers, the controller’s two restart signals should not be isolated from each other. Jumper P108 should be placed across pins 1 and 2 for all SR-series rectifiers. For plants with mixed rectifier types the jumper should be connected across pins 2 and 3.

CAUTION If jumper P108 is removed or lost, the restart signals are isolated. In this configuration all SR-series rectifiers may not self-restart after an ac power outage.

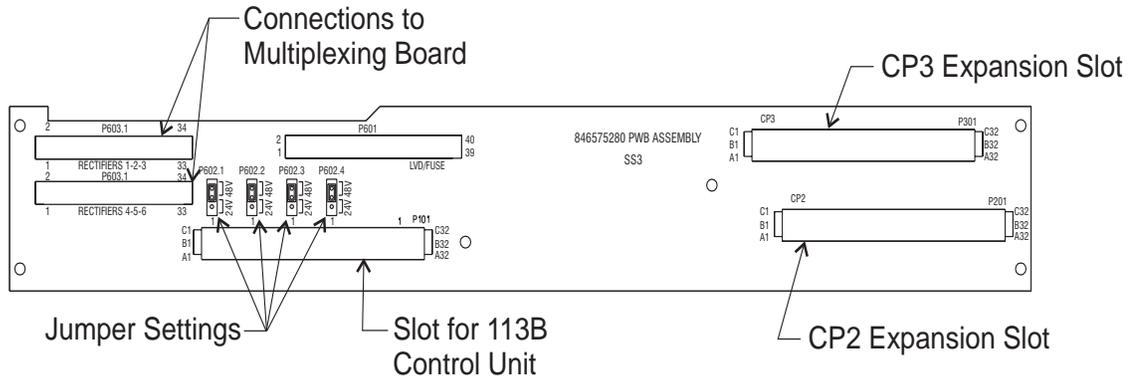


Figure 4-1: ECS-12 Controller Backplane

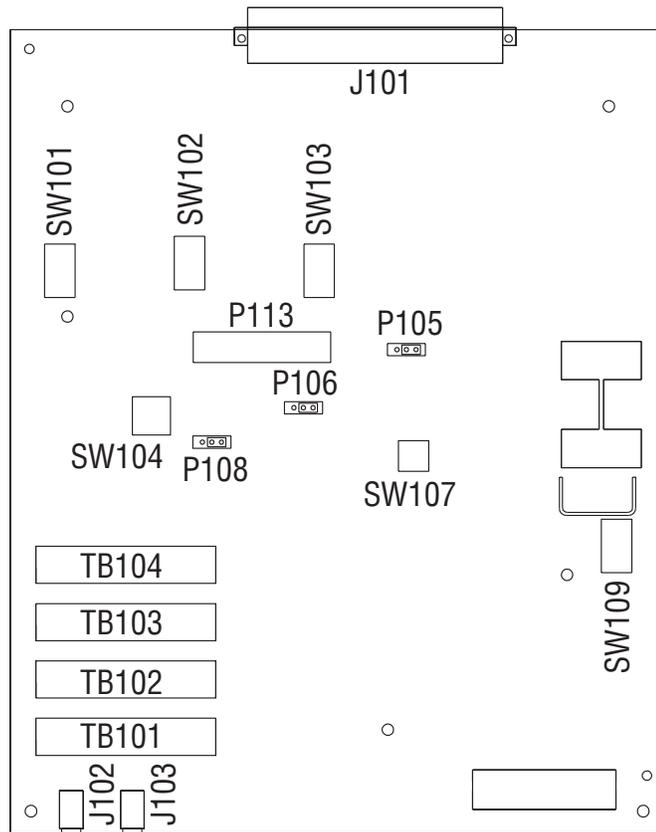


Figure 4-2: CPI Jumper and Switch Locations

CP1 DIP SWITCH SETTINGS																			
VOLTS						SWITCH POSITION						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							
	51.00		49.00	23.00	46.00	1	1	1	1	1	1	0	300	1	0	0	0	1	1
	51.50		49.50	23.50	46.50	0	1	1	1	1	1	0	600	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	1200	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	2000	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	2600	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	4000	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							
28.25	54.50	27.25	52.50	26.50	49.50	0	0	0	1	1	1	0							
28.75	55.00	27.75	53.00	27.00	50.00	1	1	1	0	1	1	0							
29.25	55.50	28.25	53.50	27.50	50.50	0	1	1	0	1	1	0							
29.75	56.00	28.75	54.00	28.00	51.00	1	0	1	0	1	1	0							
30.25	56.50	29.25	54.50	28.50	51.50	0	0	1	0	1	1	0							
30.75	57.00	29.75	55.00		52.00	1	1	0	0	1	1	0							
	57.50		55.50		52.50	0	1	0	0	1	1	0							
	58.00		56.00		53.00	1	0	0	0	1	1	0							
	58.50		56.50		53.50	0	0	0	0	1	1	0							
	59.00		57.00		54.00	1	1	1	1	0	1	0							
	59.50		57.50		54.50	0	1	1	1	0	1	0							
	60.00		58.00		55.00	1	0	1	1	0	1	0							
		58.50		55.50	0	0	1	1	0	1	0	0							
		59.00		56.00	1	1	0	1	0	1	0	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							

* 50mV SHUNT RATING

SWITCH POSITION (SETTINGS)

0 = OPEN
1 = CLOSED

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Figure 4-3: CP1 DIP Switch Settings

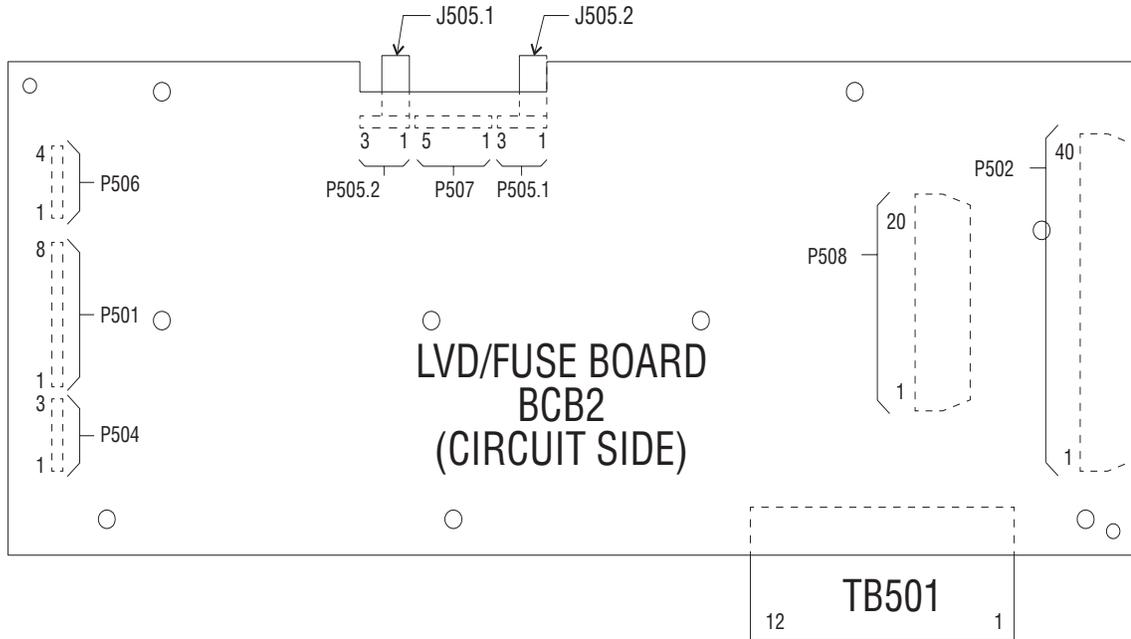


Figure 4-4: LVD/Fuse Board (CP5) Jumper Locations

**Low Voltage
Disconnect
Threshold
(Optional)**

The LVD/Fuse Board (CP5), illustrated in Figure 4-4, 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 an 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-D lists the Terminal Block Pin Assignments for the LVD/Fuse Board.

**Table 4-D: Terminal Block Pin Assignments
for LVD/Fuse Board**

Pin No.	Designation	Definition
TB501-1	CBA	Plant Distribution Circuit Breaker Alarm
TB501-2	EMJF1	External Major Fuse Alarm
TB501-3	EMNF1	External Minor Fuse Alarm
TB501-4	EMJF2	External Major Fuse Alarm
TB501-5	EMNF2	External Minor Fuse Alarm
TB501-6		Low power distribution via F519
TB501-7		Low power distribution via F520
TB501-8		Low power distribution via F521
TB501-9	Spare	No connection
TB501-10	Spare	No connection
TB501-11	Spare	No connection
TB501-12	Spare	No connection

Wiring

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

Basic Controller

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

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

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

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

Pin No.	Designation	Definition
TB101-1	DG	Discharge Ground
TB101-2	TF/ER	Timer Float/Equalize Return
TB101-3	OS	Open String Alarm
TB101-4	RMJ	Ringer Major Alarm
TB101-5	RMN	Ringer Minor Alarm
TB101-6	TEQ	Timer Equalize
TB101-7	TFL	Timer Float
TB101-8	ABS	Alarm Battery Supply
TB101-9	TR1	Transfer Shutdown from Engine
TB101-10	TR2	Transfer Shutdown from Engine
TB101-11	TR3	Transfer Shutdown from Engine
TB101-12	TR4	Transfer Shutdown from Engine
TB102-1	BDEC	Battery on Discharge External, alarm causes closure
TB102-2	BDER	Battery on Discharge External, return
TB102-3	BDEO	Battery on Discharge External, alarm causes open
TB102-4	HVEC	High Voltage External, alarm causes closure
TB102-5	HVER	High Voltage External, return
TB102-6	HVEO	High Voltage External, alarm causes open
TB102-7	ACFEC	AC Fail External, alarm causes closure
TB102-8	ACFER	AC Fail External, return
TB102-9	ACFEO	AC Fail External, alarm causes open
TB102-10	LVC	Low Voltage Contactor Closed
TB102-11	LVR	Low Voltage Contactor Return
TB102-12	LVO	Low Voltage Contactor Open
TB103-1	PMNAC	Power Minor Audible, alarm causes closure
TB103-2	PMNAR	Power Minor Audible, return
TB103-3	PMNAO	Power Minor Audible, alarm causes open

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

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

Alarm Outputs: The alarm outputs (BD, HV, ACF, LV, PMNA, PMNV, PMNE, PMJA, PMJV, PMJE, MNF, and MJF) are clean transfer contacts and are described functionally in Section 2. Most 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 4-5. Note that the resistor value for OS is 1000 ohms and the value for RMN and RMJ is 4,640 ohms.

Control Inputs: The control inputs from an external equalize timer panel (TEQ, TFL, and TF/ER) must be connected to clean 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-12 system, TR1 controls rectifiers G1, G5, and G9; TR2 controls rectifiers G2, G6, and G10; TR3 controls rectifiers G3, G7, and G11; and 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.

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

1. Select the desired alarms and other signals. Based on the selection, 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 CP1 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, should 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 4-6 shows some examples of typical alarm wiring.

***Microprocessor
and Datalogger
Boards***

See the ECS Controller Options product manual 167-790-109, for installation, wiring, and use of the optional expansion boards.

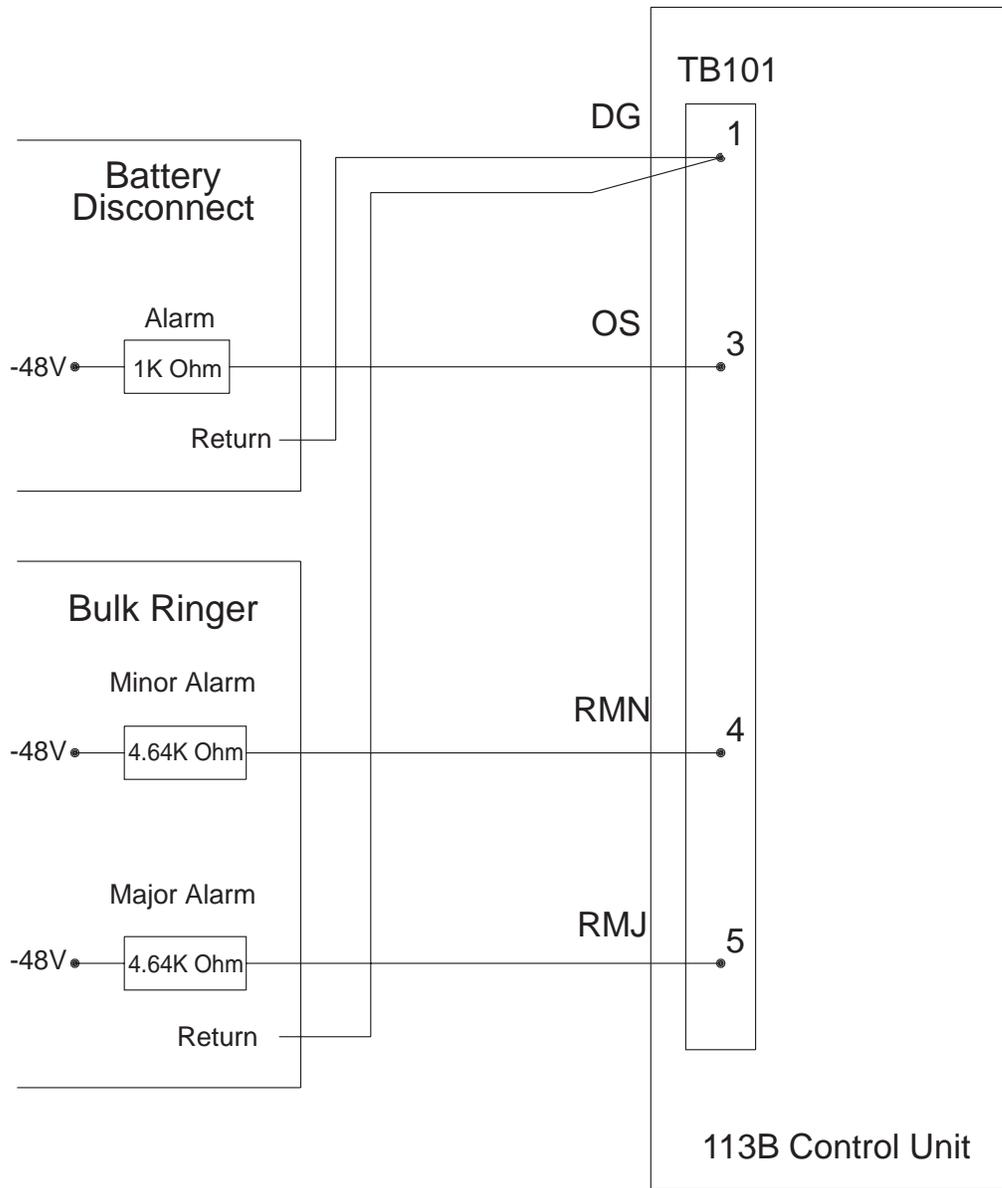
Circuit Pack Installation

When replacing a circuit pack or adding a new circuit pack to a controller that is in service, the circuit pack hardware must first be set up. (See “Hardware Setup.”)

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.**

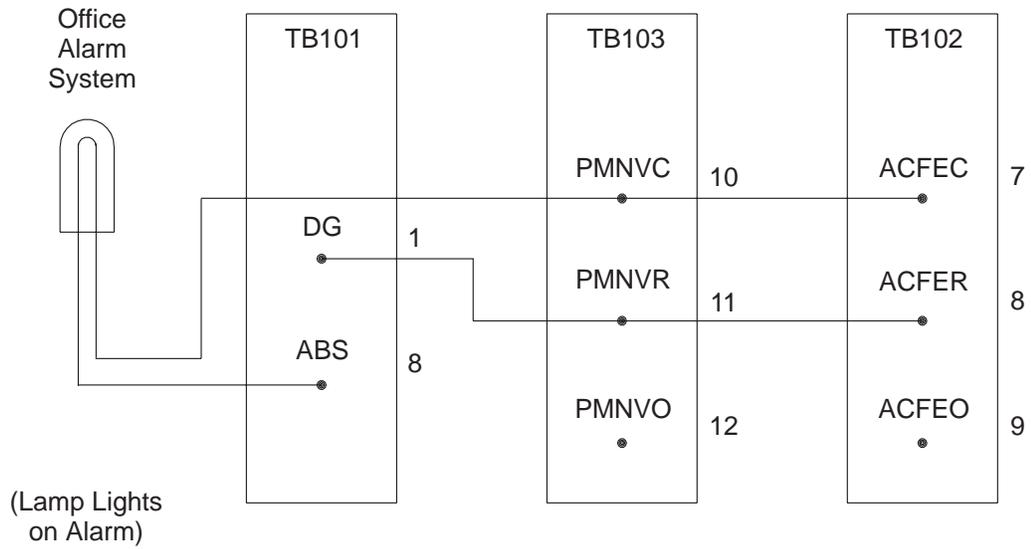
To install a circuit pack, simply open the controller front panel, pull out the drawer, and slide the board along its guide rails into the proper backplane connectors. For CP1, secure it in place with retaining screws at the front edges of the display. Backplane connectors are arranged so that circuit 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.

NOTE **Early versions of the basic Control Unit, coded 113A, do not allow full functionality and should not be used in this controller. Use only the 113B Control Unit.**

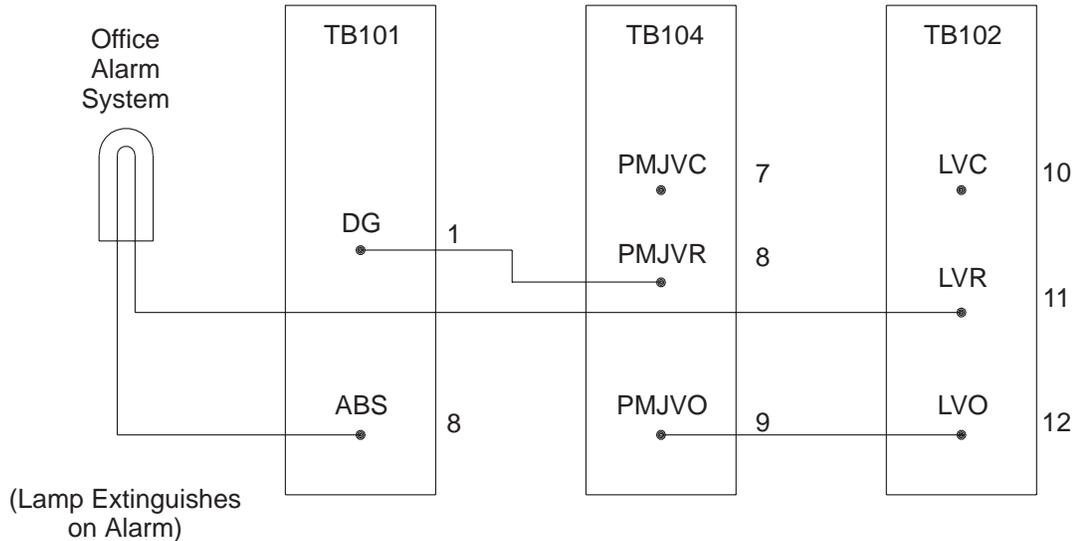


RMN and RMJ are general purpose alarm inputs that can be used for auxiliary equipment.

Figure 4-5: 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 4-6: Typical Alarm Wiring Examples

Replacement of Multiplexing Board

If the multiplexing board (BCC1), illustrated in Figure 4-7, must be replaced, 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.

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.

Unplug the remaining ribbon cable connections to the board, noting the location of each so that they can be reconnected later. 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. Replace the board and reconnect ribbon cables and ground wire as they were.

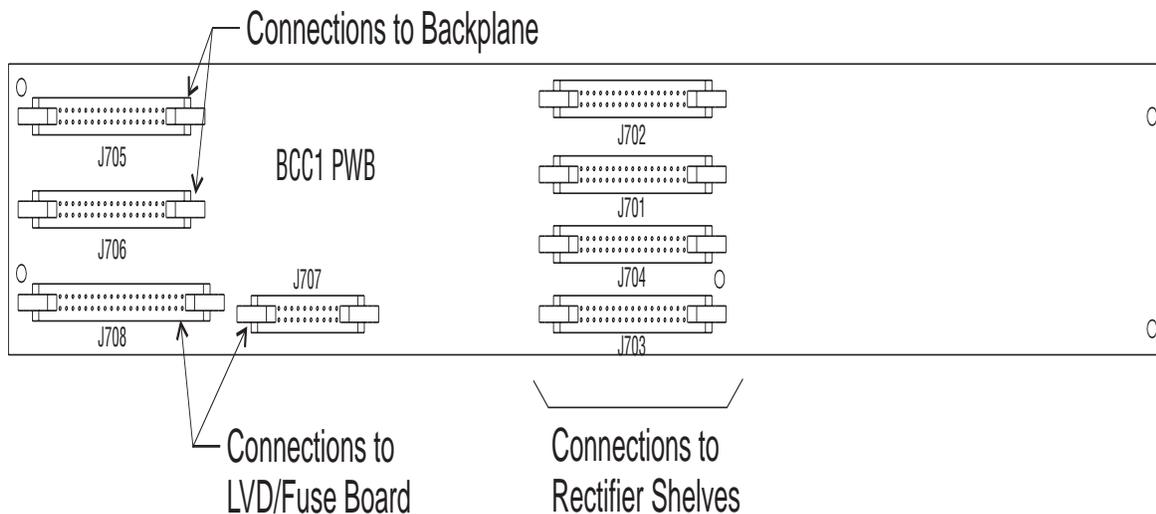


Figure 4-7: Rectifier Multiplexing Circuit Pack

5 *Acceptance Testing*

Test Procedures

The ECS-12 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 are not suitable for plants in service.**

Test equipment required:

- Test load - 5 kW minimum (60V minimum for 48V plants; 30V minimum for 24V plants)
- Multimeter
- Jeweler's screwdriver
- Flat-blade screwdriver
- Blown fuse (Bussman GMT type)
- Resistor, 4.64K ohm, 2W minimum, 10%
- Short length of 22 to 26-gauge wire, 4" (100 mm) maximum
- Power supply, adjustable 0-60 volts dc, 1 ampere, with clip leads

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

Meter Calibration

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

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

***Battery on
Discharge Alarm
Test***

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

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

1. Identify the BD threshold level set on DIP switch SW103.
2. Set the controller meter select switch to the VOLTS position and verify that the plant voltage is above the BD threshold.
3. Turn off all but one rectifier until rectifier capacity is less than plant load.
4. Adjust the test load to draw 5%-10% of the rectifier rating.
5. Adjust the rectifier output voltage down until the BD LED on the controller lights. This should occur at the set threshold within the tolerance specified in Table 2-B.

If Step 5 fails to produce the desired result, more load may be required if a large capacity battery string is connected.

Recheck the SW103 setting, raise the plant voltage back to normal, and repeat Step 5 by adjusting the rectifier voltage down slowly. Refer to the rectifier product manual for voltage adjustment procedures.

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

BDE, PMJE, PMJV, and PMJA

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

7. Slowly adjust the rectifier output voltage back up to normal, or turn the rectifier back on (i.e., reverse Step 5). Observe that the BD LED extinguishes at the correct voltage level, within the specified tolerance. The green NORM LED should light when the BD LED goes out.
8. Check the office alarms on the 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. A test load is not required for this test.

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

3. Momentarily short together pins 2 and 6 on TB101 on CP1 with a piece of wire. This simulates an equalize initiation signal from an external timer panel. Verify that the equalize LED lights and the rectifiers change to equalize mode.
4. Momentarily short pins 2 and 7 on TB101 with a piece of wire. This should stop equalize and return the plant to float mode.

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

High Voltage Shutdown and Restart Test

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

1. Identify the high voltage shutdown threshold for float operation on DIP switch SW102.
2. Set all rectifiers to non-load share mode.
3. Turn on two rectifiers and adjust the test load so that each rectifier delivers more than 10% of its full load current. Do not load plant more than 90% of the capacity of one rectifier.
4. Set the controller meter to read VOLTS, and verify that the green NORM indicator is the only LED that is lit on the controller.
5. At any one rectifier, slowly adjust its output voltage up until a shutdown occurs. This should occur at the specified HV shutdown threshold within the tolerance indicated in Table 2-B. Verify that the rectifier being adjusted has shut down.
6. Note that the NORM LED goes out and the yellow RFA LED lights on the controller. If enough rectifier capacity is

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

7. Within ten (10) seconds of rectifier shutdown, the controller should automatically restart all rectifiers. The RFA LED should extinguish and the NORM LED should come on.
8. Since one rectifier is adjusted high, the controller should issue another shutdown signal when the plant voltage again reaches the HV shutdown threshold. Verify that the rectifier shuts down again.
9. After the second shutdown, the controller should NOT automatically attempt to restart rectifiers.

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

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

PMNE, PMNA, and PMNV

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

BDE, PMJE, PMJA, and PMJV

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

12. Verify that only the NORM LED is lit on the controller. Reset the restart timer in the controller by pressing switch SW107, shown on Figure 4-2. 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. Locate the LVD/Fuse Board, referring to the battery plant product manual, if necessary. Insert a blown fuse in place of F501. 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 CP1.

PMNE, PMNV, PMN, MNF

2. Replace the blown fuse with a good fuse. The alarms should retire and the MNF LED extinguish.
3. Repeat Steps 1 and 2 for all minor fuses, including F502 through F509 and F513 through F518 on the LVD/Fuse Board.
4. Replace F510 with a blown fuse. The MJF (Major Fuse Alarm) LED should light, and the NORM LED should go out. Check terminal blocks for the following major alarms.

MJFE, PMJE, PMJA, and PMJV

5. Reinsert the good fuse, and note that the alarms retire and that LEDs return to normal.
6. Repeat Steps 4 and 5 for major fuses F511, F512, and F519 through F521.
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 LVD/Fuse Board. If OS is wired into the LVD/Fuse Board, 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 breaker.

***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 turn off. When the wire is removed, the rectifier(s) should restart automatically.
4. Disconnect the lead from both ends when finished.

***Bulk Ringer
Alarm Test***

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

1. Connect one end of a 4640 ohm resistor to the Ringer Major Alarm input (RMJ) on pin 4 of TB101. Bend the free end clear of any metal parts (e.g., the chassis).
2. Attach one end of a piece of wire to Alarm Battery Supply (ABS) on pin 8 of TB101.
3. Touch the free end of the wire to the free end of the 4640 ohm resistor. The NORM LED on the controller front panel should go out. With a multimeter or the office alarm system, if connected, verify that the following major alarms are issued.

PMJE, PMJA, and PMJV

4. Disconnect the lead from the resistor, and note that the alarms retire and the NORM LED turns on.
5. Remove the resistor from TB101 pin 4, and connect it to the Ringer Minor Alarm input (RMN) on pin 5 of TB101.
6. Touch the wire to the free end of the resistor. Again, the NORM LED should extinguish and the following power minor alarms should appear on the controller terminal blocks or office alarm system.

PMNE, PMNA, and PMNV

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

**Low Voltage
Battery
Disconnect Test**

If the plant is not equipped with a low-voltage battery 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 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-12 activates.
 - Alarm contacts TB102/10-11 on CP1 of the ECS-12 controller **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-12 retires.
 - Alarm contacts TB102/10-11 on CP1 of the ECS-12 controller **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 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 and observe the external conditions listed in Step 1 of this procedure.
5. Raise the power supply voltage across 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 that is functioning normally. In the event of a controller malfunction, refer to Section 7, *Troubleshooting*. The front panel controls and displays are shown, as numbered and described below, in Figure 6-1.

Table 6-A: Front Panel Switches and Indicators

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

Table 6-A: Front Panel Switches and Indicators

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.	μP indicator	Yellow LED lights under certain conditions dictated by the CP2 microprocessor board to indicate a microprocessor alarm.
9.	DLA indicator	Yellow Datalogger Alarm LED lights as an alarm indication whenever an alarm exists on one of the CP3 data channels.
10.	EQ indicator	Yellow LED, when lit, indicates that plant is in equalize charge mode. This is not an alarm condition.

Table 6-A: Front Panel Switches and Indicators

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 microcomputer 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.

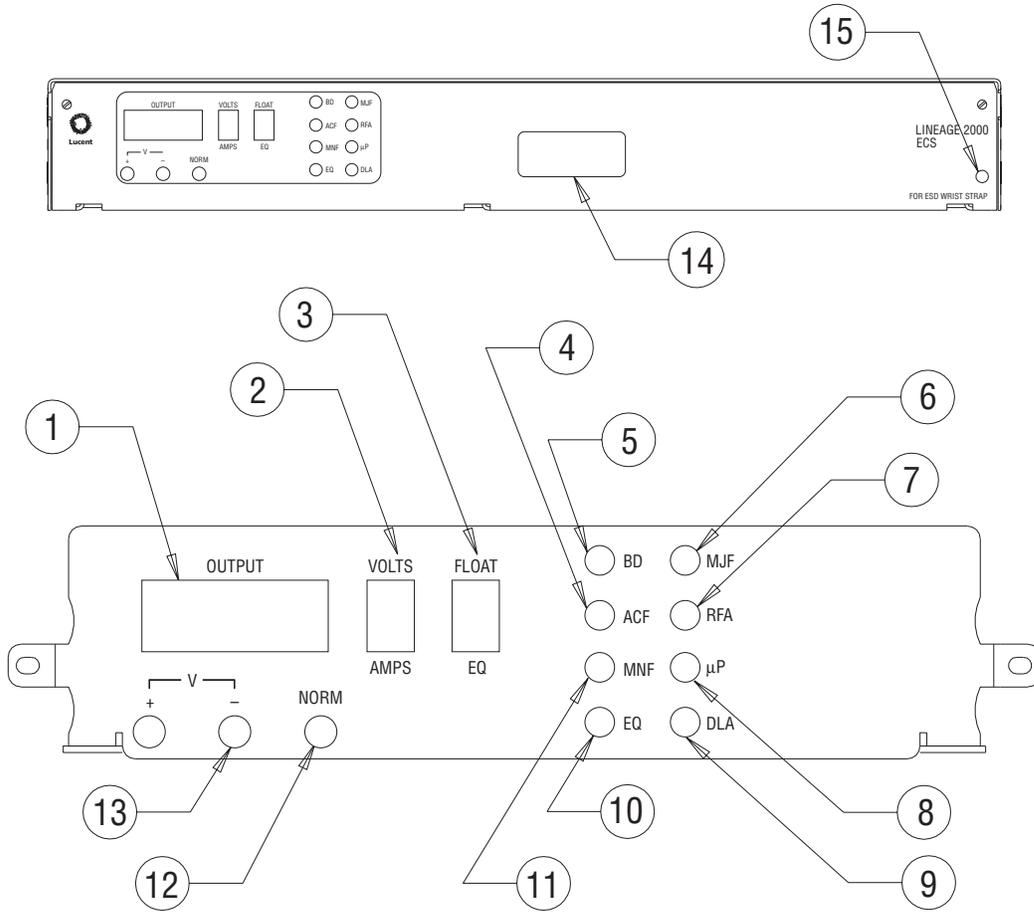


Figure 6-1: Front Panel Location of Controls and Displays

7 *Troubleshooting*

Tables and Flowcharts

This section contains four tables and five flowcharts for the purpose of troubleshooting the ECS-12 Controller, verifying controller alarms, and meter calibration.

The tables are listed below:

- 7-A Backplane Connector (P101)
- 7-B Ribbon Cable Connector Backplane to BCC1 (P601-1, P706)
- 7-C Ribbon Cable Connector BCC1 to LVD/Fuse Board (P708, P502)
- 7-D LVD/Fuse Board

The flowcharts, which follow the tables, 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

Table 7-A: Troubleshooting Table, Backplane Connector (P101)

	-48 V Plant -48 volts - nominal*		-24V Plant -24 volts - nominal*		+24V Plant +24 volts - nominal*	
	+	-	+	-	+	-
Signal	+	-	+	-	+	-
VS-, VS+	C13	C6	C13	C6, C7		
VS+, VS-					C6, C7	C13
RBMN48, RGM	C4	B15				
RBMN24, RGM			C9	B15		
RBMP, RGM					C17	B15
DB, RTN (DG)	C12	B17	C12	B17	C12	B17

* Voltage is read with volt meter polarity as shown in the "Signal" line.

**Table 7-B: Troubleshooting Table, Ribbon Cable Connector
Backplane to BCC1 (P601-1, P706)**

	-48 V Plant -48 volts - nominal*		-24V Plant -24 volts - nominal*		+24V Plant +24 volts - nominal*	
	+	-	+	-	+	-
Signal	+	-	+	-	+	-
VS-, VS+	4	13	4	13		
VS+, VS-					13	4
RBMN, RGM	10	8	10	8		
RBMP, RGM					32	8
DB, RTN (DG)	12	30	12	30	12	30

* Voltage is read with volt meter polarity as shown in the "Signal" line.

**Table 7-C: Troubleshooting Table, Ribbon Cable Connector
BCC1 to LVD/Fuse Board (P708, P502)**

	-48 V Plant -48 volts - nominal*		-24V Plant -24 volts - nominal*		+24V Plant +24 volts - nominal*	
	+	-	+	-	+	-
Signal	+	-	+	-	+	-
VS-, VS+	13	14	13	14		
VS+, VS-					14	13
RBMN, RGM	29	25	29	25		
RBMP, RGM					30	25
DB, RTN (DG)	31	32	31	32	31	32

* Voltage is read with volt meter polarity as shown in the "Signal" line.

Table 7-D: Troubleshooting Table, LVD/Fuse Board

	-48 V Plant -48 volts - nominal*		-24V Plant -24 volts - nominal*		+24V Plant +24 volts - nominal*	
	+	-	+	-	+	-
Signal	+	-	+	-	+	-
RB, RG	P504-2	P507-2	P504-2	P506-2	P504-2	P506-2
RBM, RG	P504-3	P506-2	P504-3	P506-2	P504-3	P506-2
DB, DG	P504-1	P506-1	P504-1	P506-1	P504-1	P506-1

* Voltage is read with volt meter polarity as shown in the "Signal" line.

A. OFFICE ALARMS RECEIVED

SHEET 1 OF 1

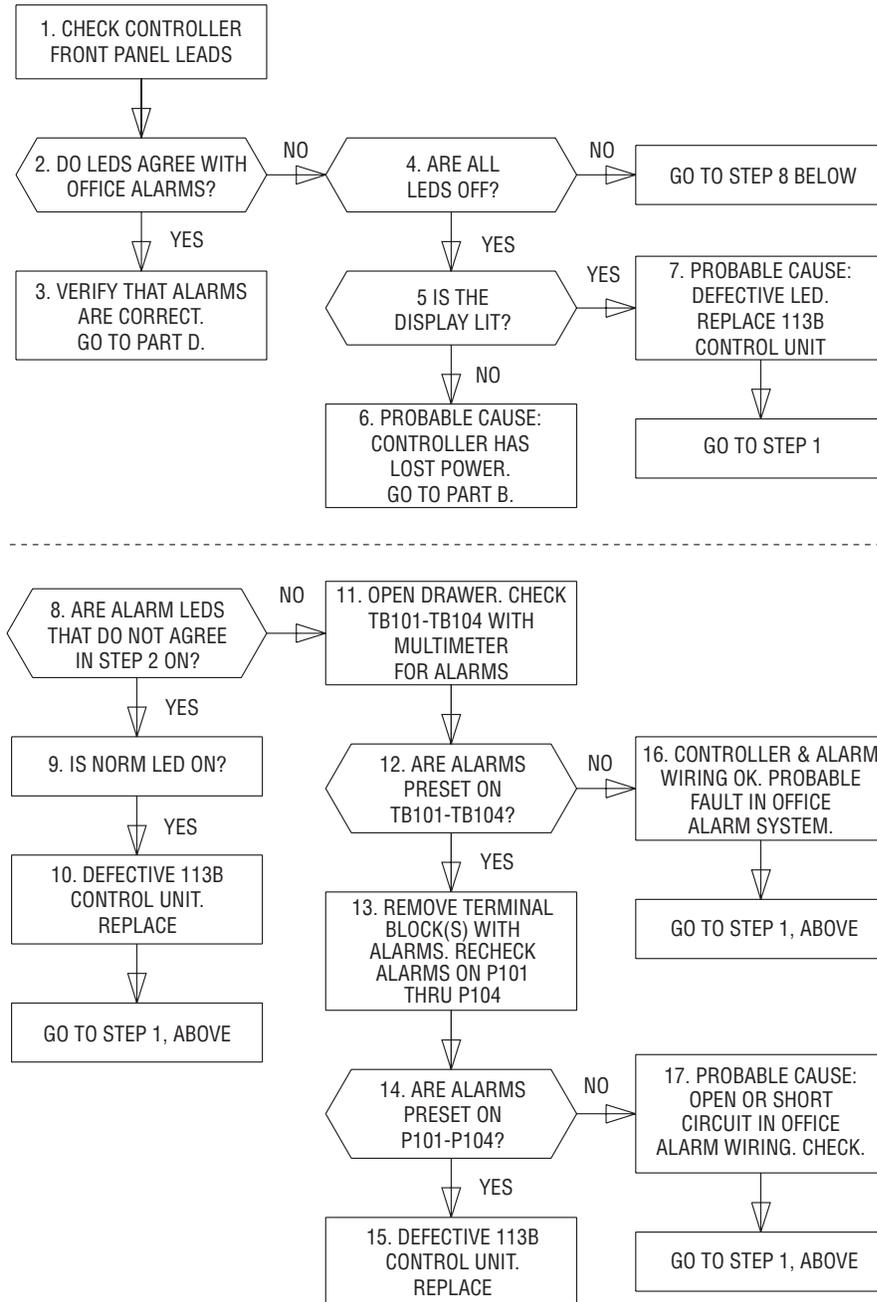


Figure 7-1: Office Alarms Received

B. 113B CONTROL UNIT HAS LOST POWER

SHEET 1 OF 3

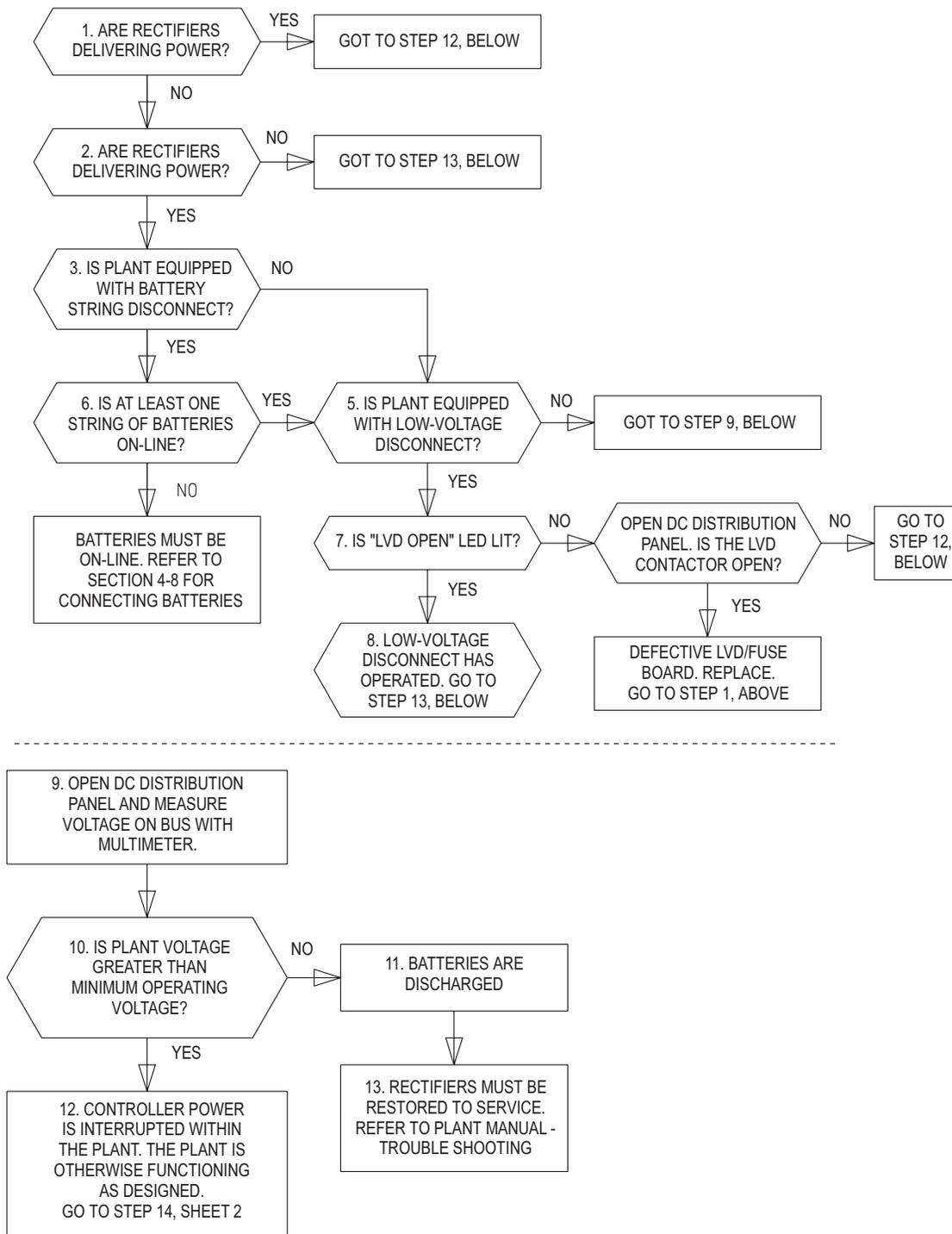


Figure 7-2.1: 113B Control Unit Has Lost Power

B. 113B CONTROL UNIT HAS LOST POWER

SHEET 2 OF 3

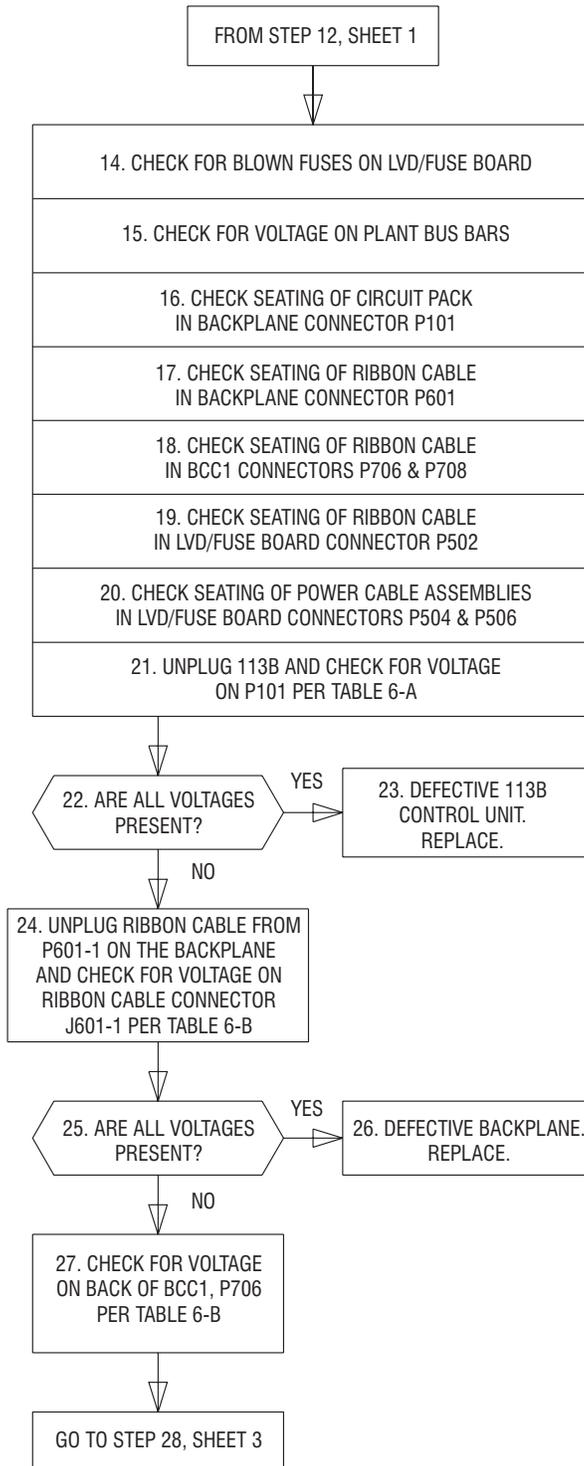


Figure 7-2.2: 113B Control Unit Has Lost Power (continued)

B. 113B CONTROL UNIT HAS LOST POWER SHEET 3 OF 3

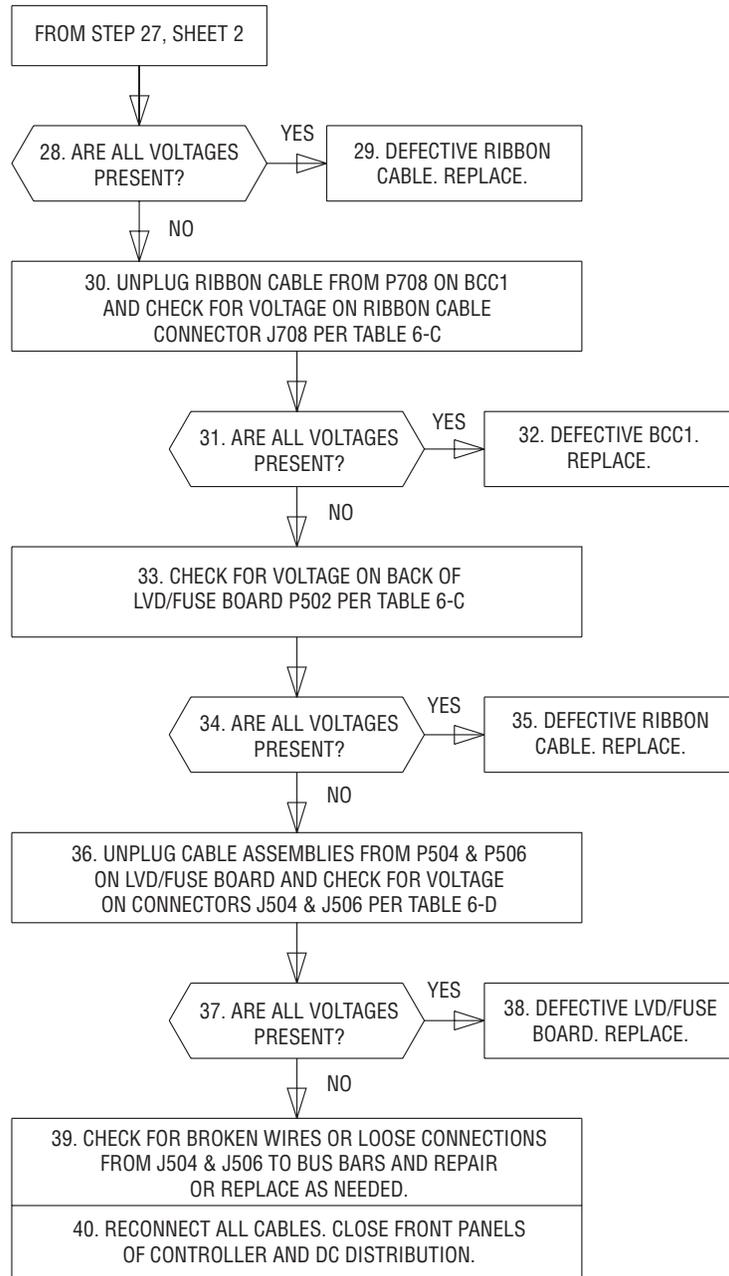


Figure 7-2.3: 113B Control Unit Has Lost Power (continued)

C. VERIFY CONTROLLER ALARMS

SHEET 1 OF 5

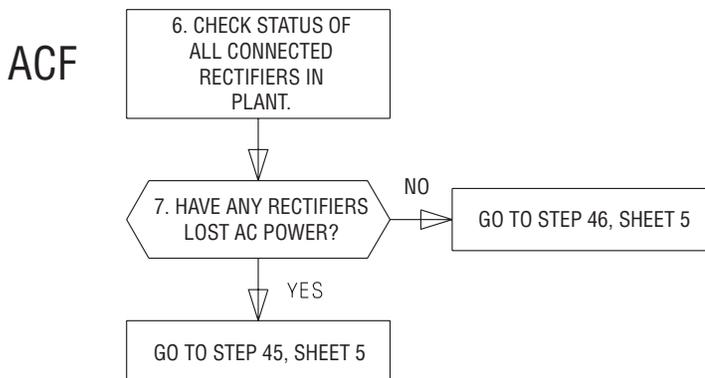
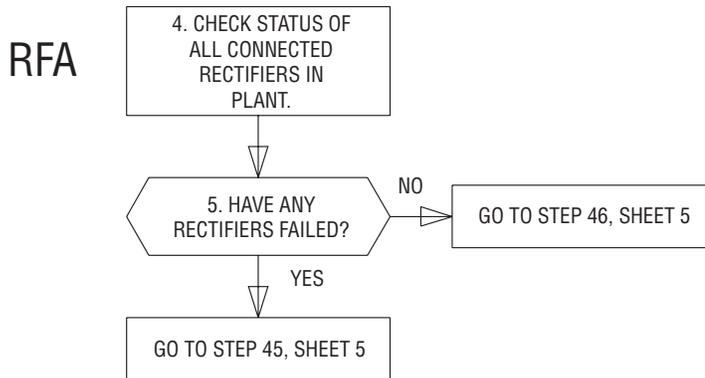
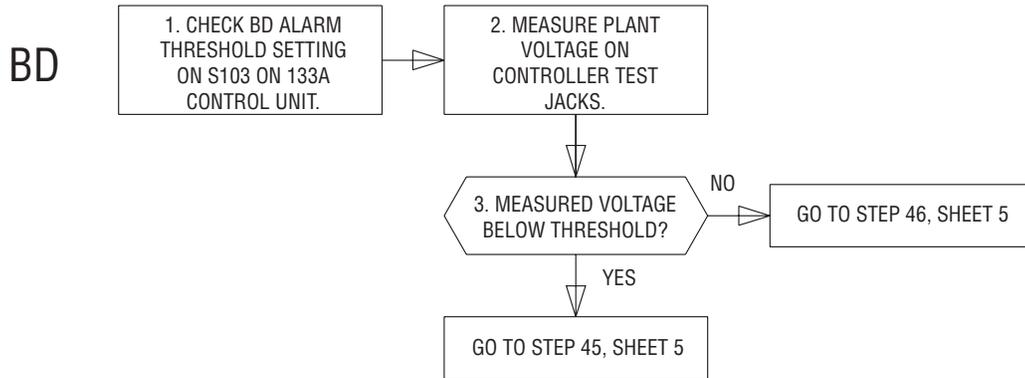


Figure 7-3.1: Verify Controller Alarms

C. VERIFY CONTROLLER ALARMS

SHEET 2 OF 5

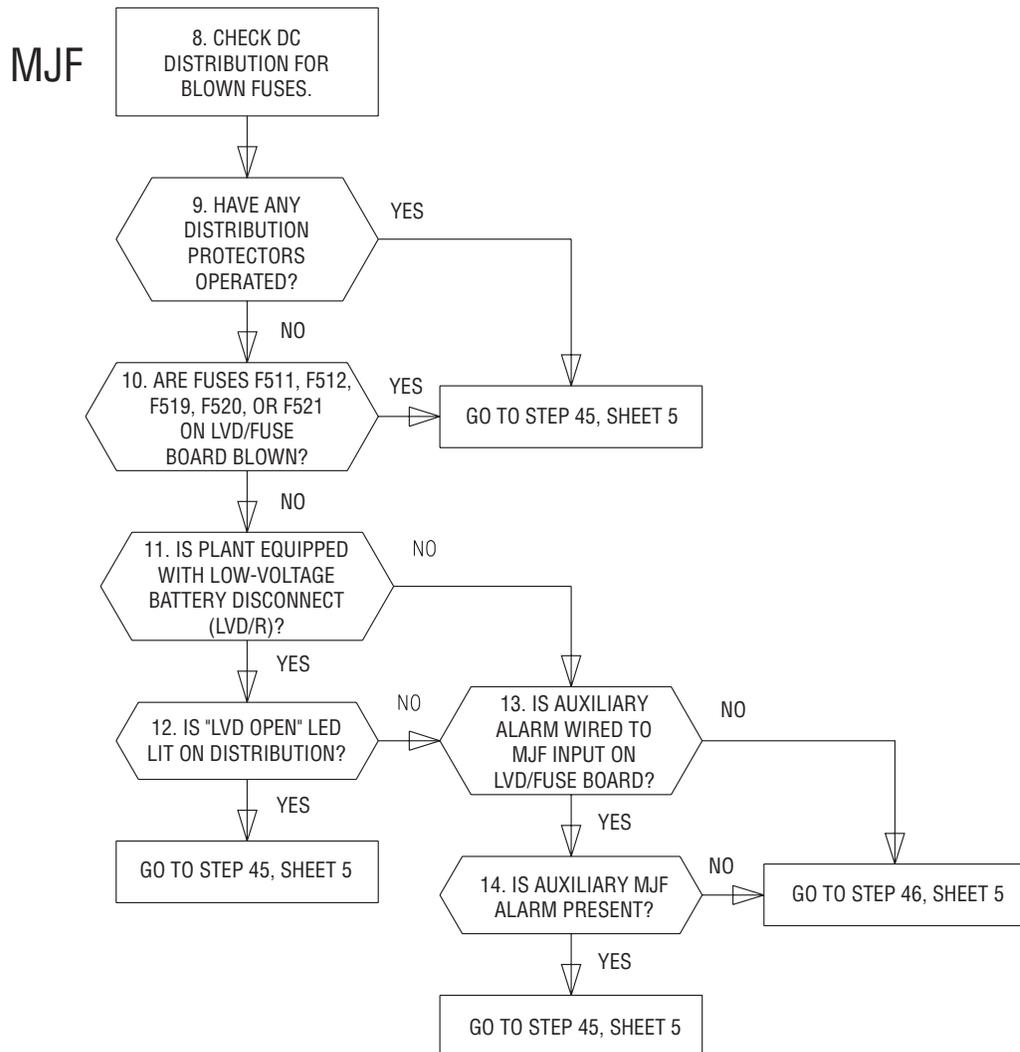


Figure 7-3.2: Verify Controller Alarms (continued)

C. VERIFY CONTROLLER ALARMS

SHEET 3 OF 5

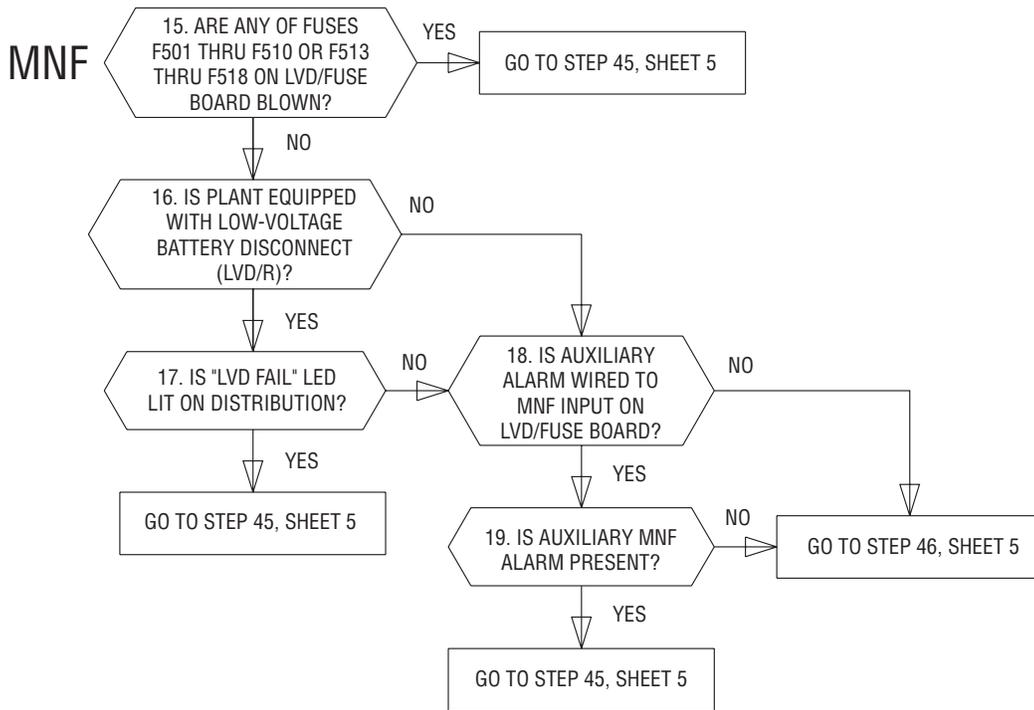


Figure 7-3.3: Verify Controller Alarms (continued)

C. VERIFY CONTROLLER ALARMS

SHEET 4 OF 5

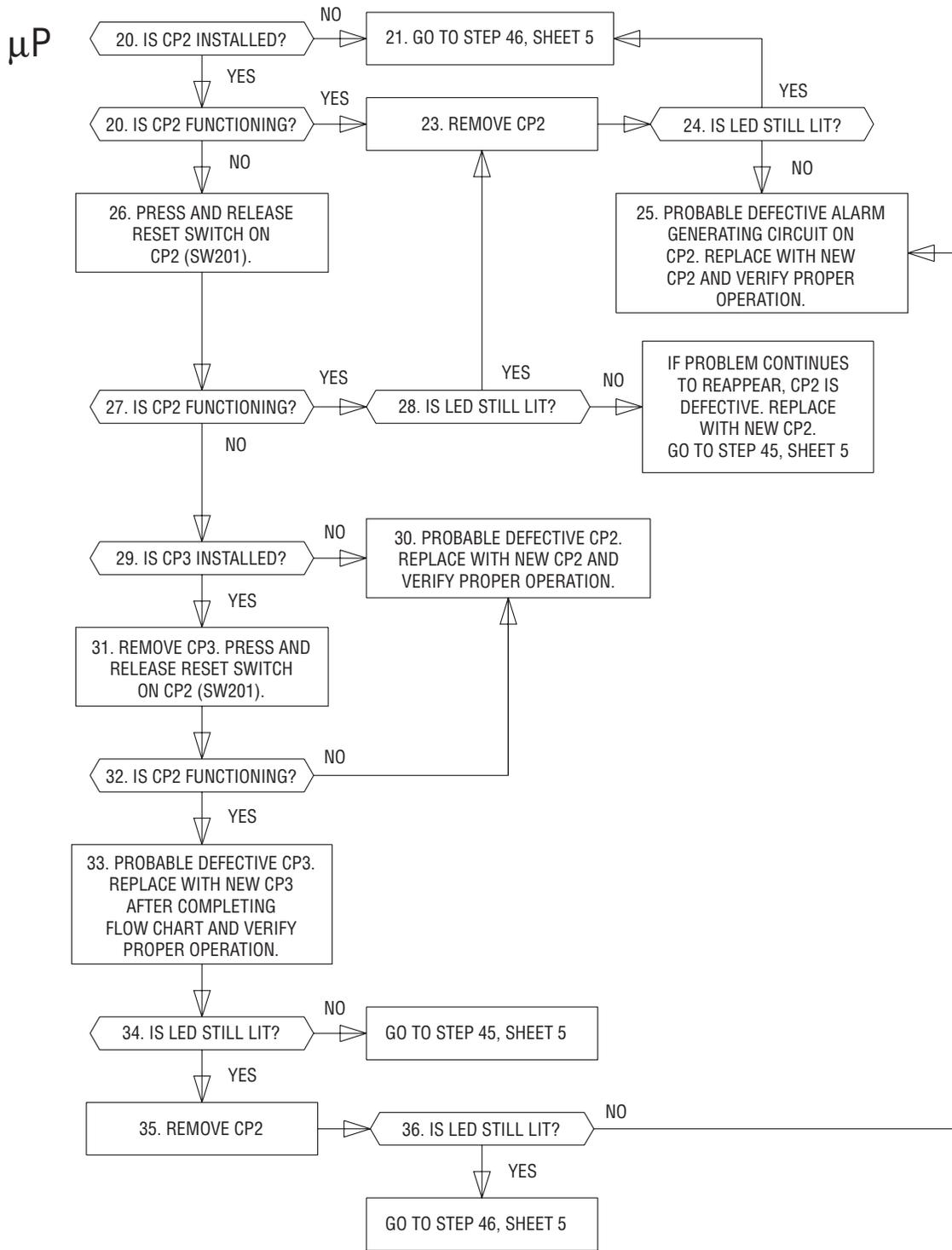
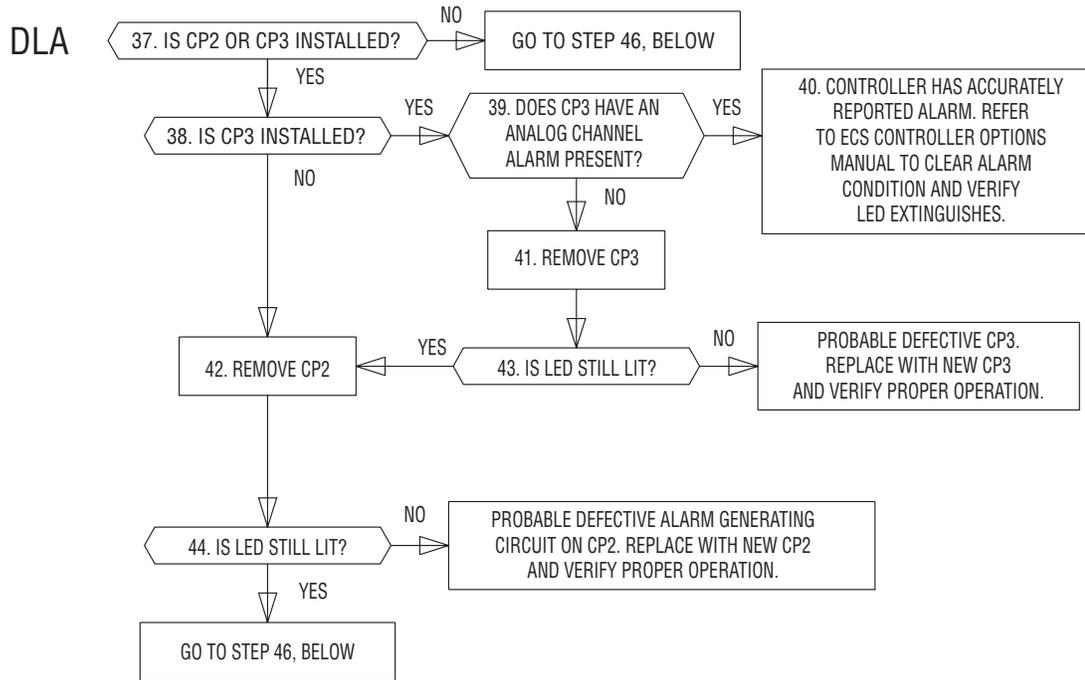


Figure 7-3.4: Verify Controller Alarms (continued)

C. VERIFY CONTROLLER ALARMS

SHEET 5 OF 5



45. CONTROLLER HAS ACCURATELY REPORTED ALARM. REFER TO PLANT MANUAL TROUBLESHOOTING SECTION TO CLEAR ALARM CONDITION.

46. PROBABLE DEFECTIVE ALARM SENSING CIRCUIT ON 113B CONTROL UNIT. REPLACE AND GO TO STEP 1, PART A.

Figure 7-3.5: Verify Controller Alarms (continued)

D. DISPLAY IS NOT LIT

SHEET 1 OF 1

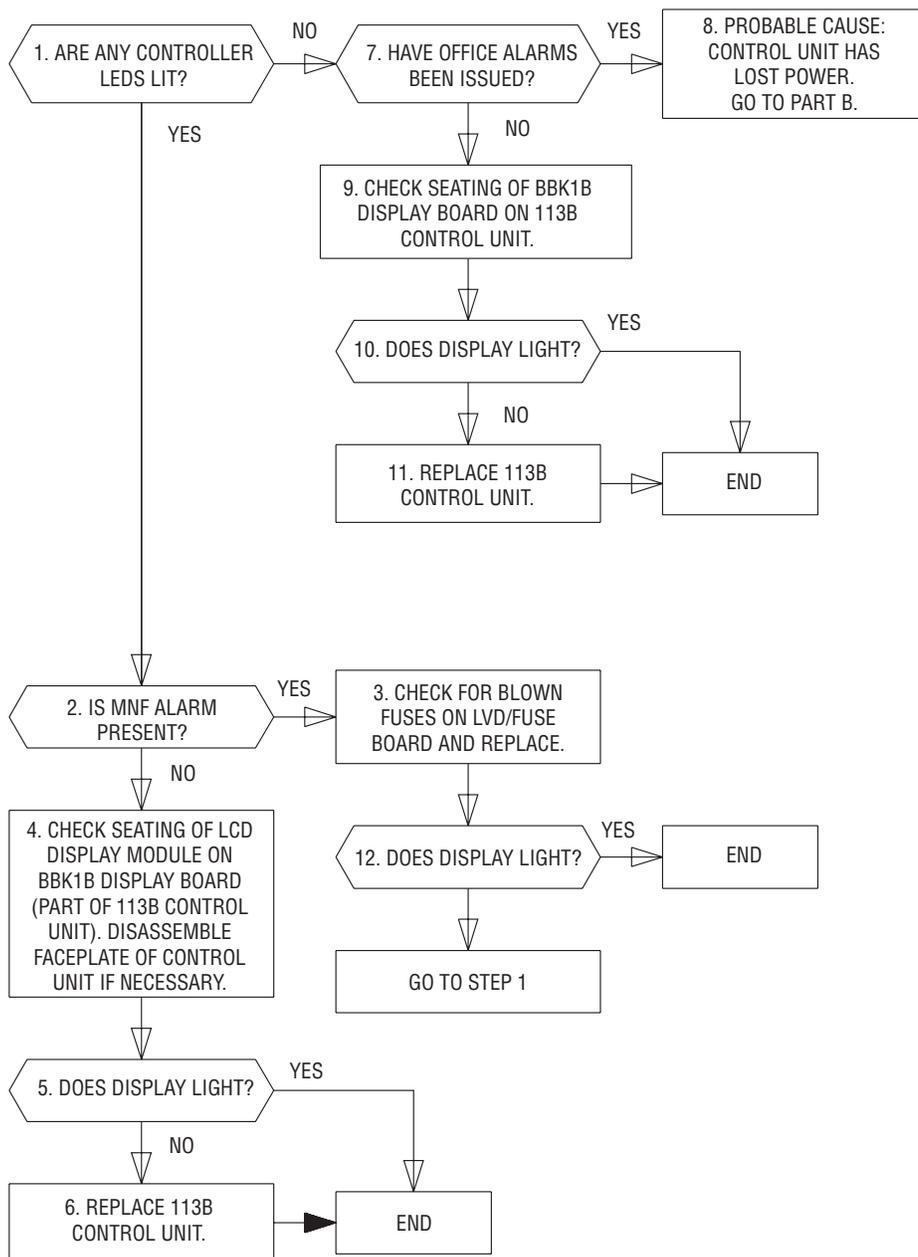


Figure 7-4: Display Is Not Lit

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.

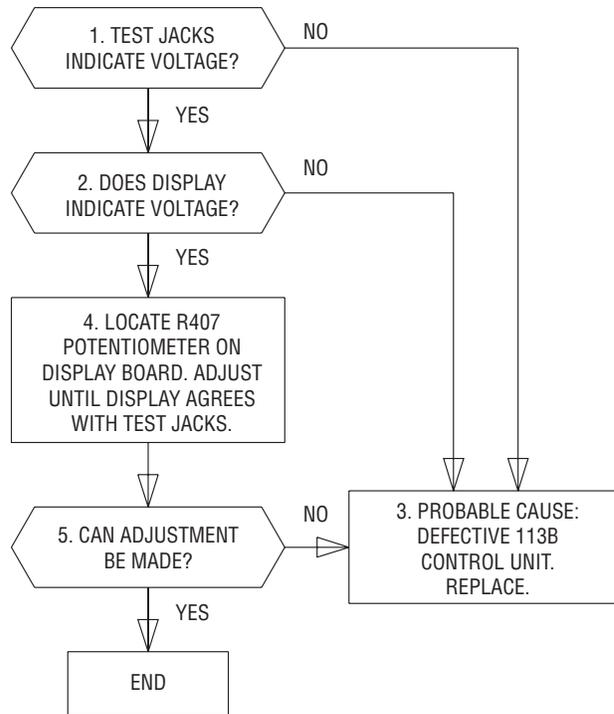


Figure 7-5: Meter Out of Calibration

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