



# Instruction Manual

## Series One Load Bank Controller

**IMPORTANT:** These instructions should be read thoroughly before operating equipment. All warnings and precautions should be observed for personal safety, proper equipment performance and longevity. Failure to follow these instructions could result in equipment failure, serious injury to personnel, and/or property damage. Load Banks contain lethal voltages when connected to the power source. It is very important to remove all sources of power to the load circuits, resistors, blower motor circuits, and control circuits before installing, operating, or servicing this unit. Always allow adequate time after removing power before touching any system components.

**PROPRIETARY:** This document is the property of Load Banks Direct LLC, and shall remain so while in user's possession. The information is provided for the instruction, operation, maintenance and service of this equipment and not to be used for manufacturing or procurement of equipment from any source other than Load Banks Direct LLC. The technology shown here is strictly proprietary and is not to be disclosed to any 3<sup>rd</sup> party without prior consent and the express written permission of Load Banks Direct LLC.

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**\* Advanced Customer Access Only - Password Required**

**\* CUSTOMER DEFAULT PASSWORD: LBD**

## Series One Controller

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### Series One Controller Overview

Load Banks Direct Series One Controller is an industrial grade, micro-processor based control available for installation on our entire line of load bank products. The Series One Controller offers complete and automatic load bank control during the entire test profile with a single screen of comprehensive power metering data with accompanying data collection. Users will have the option of linking up to 16 load banks with complete and sole control at the assigned Master Load Bank or through an optional hand held remote. Master Load Bank or the remote will display and control the total kW available from the entire fleet. Controller intelligently senses both load voltage and phase rotation allowing for automatic setup of blower starting and stopping, load voltage configuration and over-voltage protection. User friendly programs allow for Load Voltage Correction (compensates for variations in load voltage), KW Servo (controller monitors and compensates to keep load power within user defined parameters) and an Automatic Step Setup (program up to 10 load steps in kW and time for automatic and user-defined load testing).

### Series One Front Panel

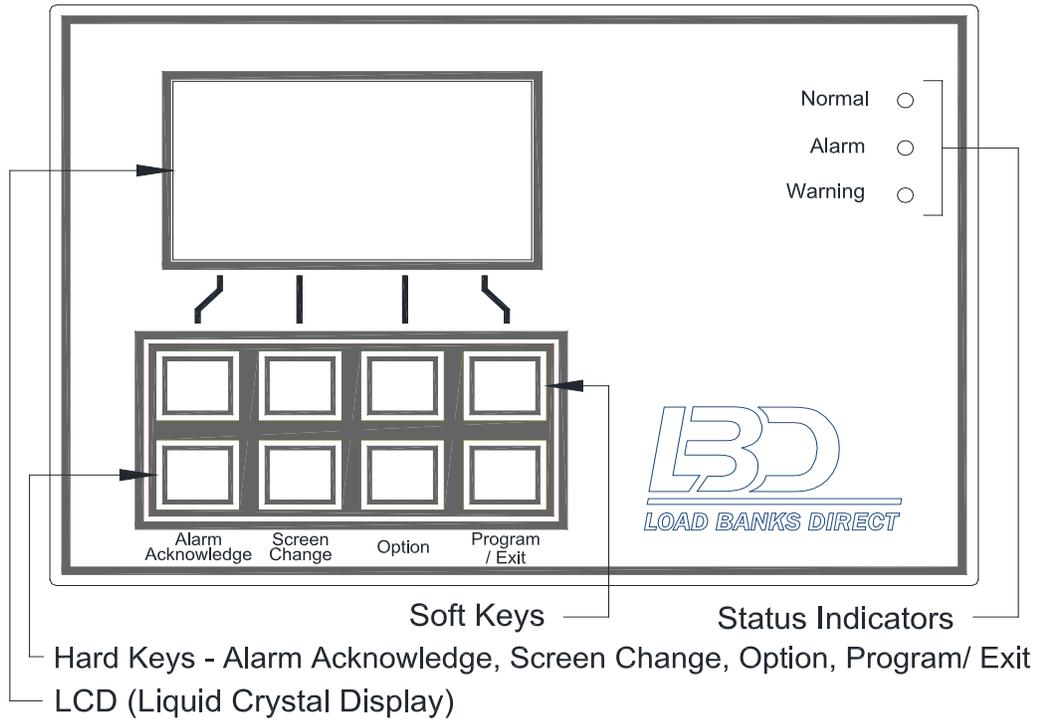
The Series One Controller features an LCD (liquid crystal display), the preferred display for industrial applications due to its dependability and ability to produce very bright and sharp text in both dim and bright lighting conditions. The display includes an automatic internal heater allowing for use in subzero weather conditions.

The front panel offers eight push button keys for easy and dependable programming. The top row features all Soft Keys with varying functions along every screen change. The bottom row features all Hard Keys defined as ALARM ACKNOWLEDGE, SCREEN CHANGE, OPTION and PROGRAM/EXIT.

There are three LED status lights on the front panel. The NORMAL LED lights up green, the ALARM light is red and the WARNING indicator is amber. The LED indicators offer a quick reference of the load bank status and highlight normal operating and potential fault conditions.

Figure 1 details the front panel and the location of the above components detailed above.

**FIGURE 1 FRONT PANEL**

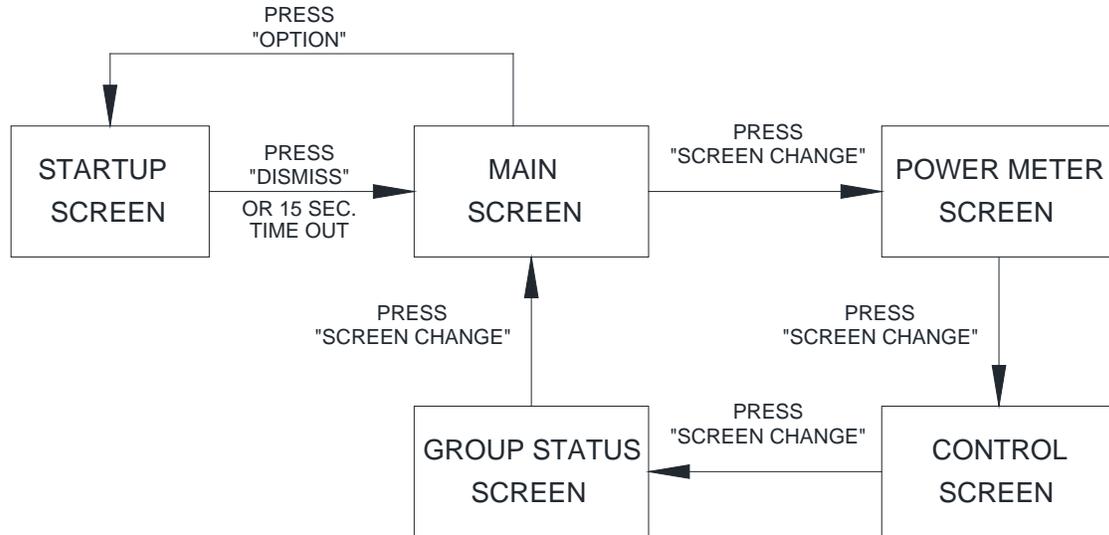


## **POWERING THE CONTROLLER**

The controller is powered by 24 volts DC which is supplied through the main Power ON/OFF Selector Switch on the load bank control panel. The unit will automatically start up when the operator powers the load bank. The optional hand held Remote Controller will power up in conjunction with the local controller/ load bank.

## SCREEN CHANGING

The user can easily move through four Main Operating Screens by pressing the SCREEN CHANGE key. The Startup Screen can be accessed at Start Up (within 15 seconds on powering the unit ON) or from the Main Screen by pressing the OPTION key. The below chart details the routing of the operating screens.



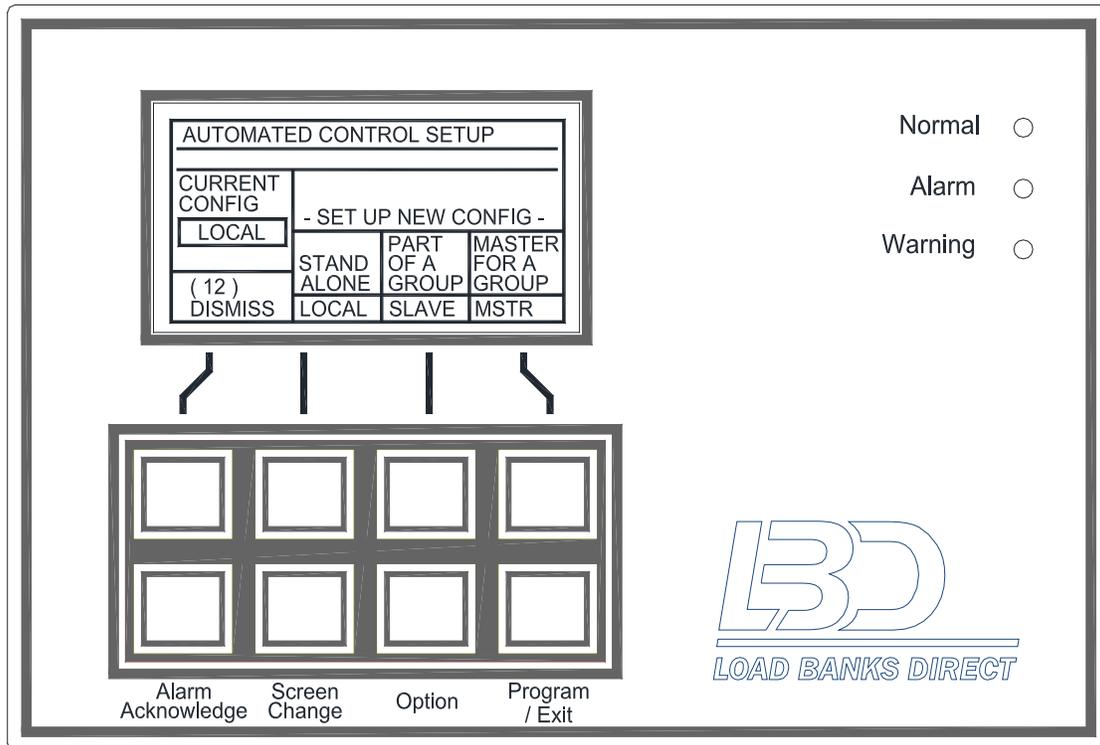
## STARTUP SCREEN

The Startup Screen displays the Current Configuration of Controller highlighted in a rectangle (LOCAL, SLAVE, MASTER) and with active Soft Keys. The top left soft key allows the operator to DISMISS a configuration change (and advance to the main screen) or change to another configuration. The controller always retains the previous configuration setting and must be reset (if required) by the operator. LOCAL Configuration is used when operating a single stand-alone load bank. MASTER and SLAVE configurations must be assigned when multiple load banks are needed to obtain a higher load kW rating than a single unit can supply. If the configuration displayed on the Startup Screen is correct, user can press DISMISS or wait 15 seconds for the controller screen to advance to the Main Screen.

Operator can advance back to the Startup Screen by pressing the OPTION Key. See Figure 2 for Startup Screen details.

## FIGURE 2 STARTUP SCREEN

Figure 2 is a typical Startup Screen displaying that the unit is in LOCAL mode with 12 seconds left before advancing to the Main Screen. Pressing DISMISS will advance to the Main Screen.



## MAIN SCREEN

The main screen displays the current operation status of the load bank. The Series One Controller automatically senses and changes the configuration of the load bank to match the load voltage and configures both the blower power voltage and phase rotation to insure the blower impeller always spins in the correct direction.

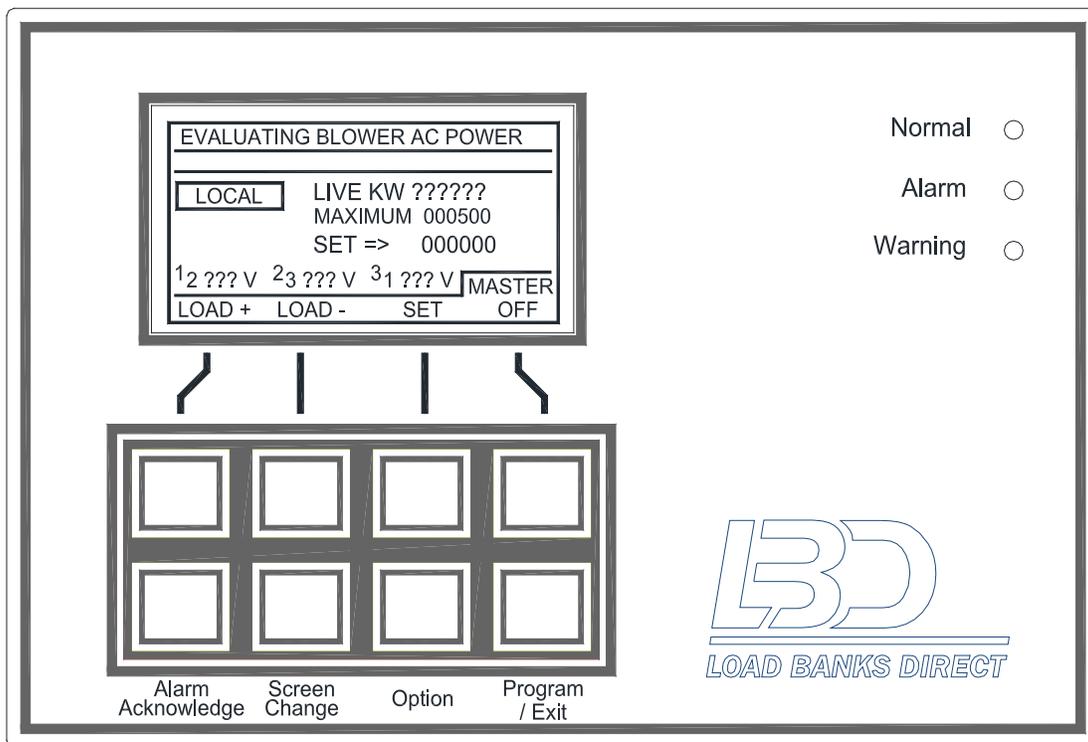
The main screen will allow the operator to perform a complete load test by simply selecting the load kW by pressing LOAD + to increase the desired kW or pressing LOAD - to decrease the desired kW. Once user obtains the desired kW that is displayed on the screen next to SET =>, load can be applied by pressing the SET key. Pressing the top right Soft Key allows the operator to turn the MASTER LOAD ON or OFF. MASTER OFF confirms the load is OFF, MASTER ON confirms the load is ON.

LIVE KW displays the actual total power that is being applied to the generator or power system under test. MAXIMUM displays the maximum power (kW) available from the load bank (or load banks if multiple units are linked together in a master/slave configuration). SET displays the desired kW rating needed – Pressing SET will immediately change to the desired kW rating. The operator can increase and decrease the load at any time during testing using only three keys – LOAD +, LOAD – and SET. Note that LIVE KW and SET kW will normally differ due to the nominal versus actual load voltages, the added kW from the blower(s) and the resistance tolerance of the load elements.

The main screen displays the Load Voltage between Phase 1 and 2, Phase 2 and 3, Phase 3 and 1.

### FIGURE 3 MAIN SCREEN

Figure 3 is a typical view of the Main Screen displaying that the unit is EVALUATING BLOWER AC POWER and is in LOCAL mode. The controller displays a MAXIMUM available load of 500kW. Note that the Phase Voltage ??? readings indicate that load voltage has not been applied to the load bank. Status Indicators will light Green for NORMAL, Red for ALARM and Amber for WARNING.

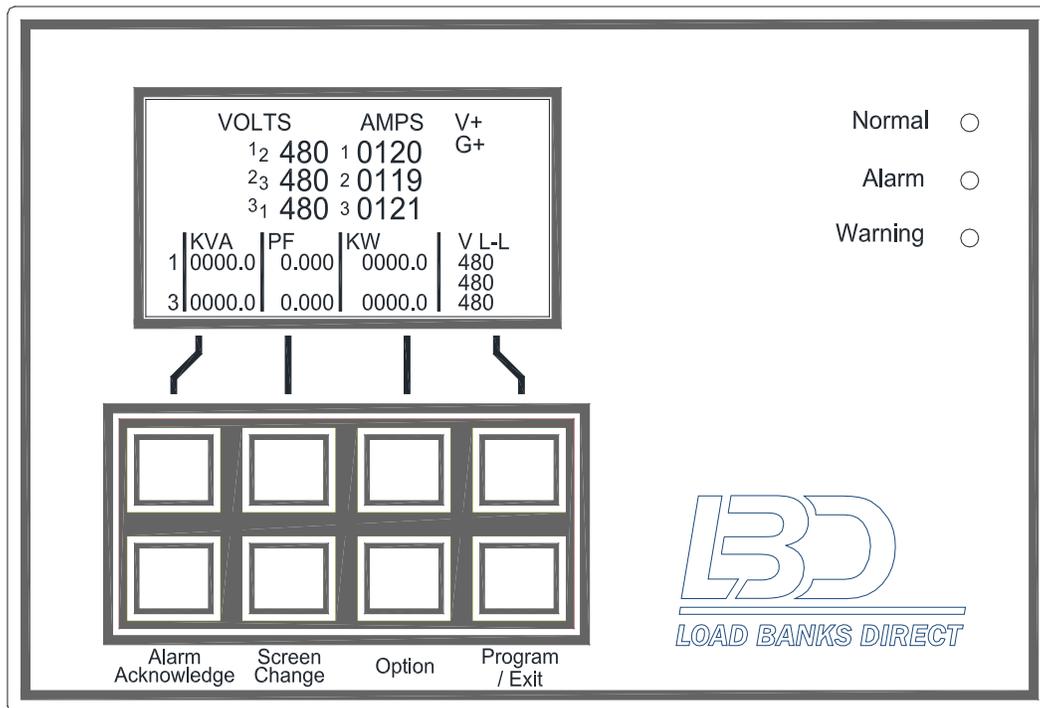


## POWER METER SCREEN

The user can change from the main screen to the Power Metering Screen by pressing SCREEN CHANGE. The convenient single page Power Metering Screen displays Line Volts and Amps for all three phases including KVA, Power Factor (PF) and KW. See Figure 4 for details.

### FIGURE 4 POWER METER SCREEN

Figure 4 is a typical Power Meter Screen displaying an applied load voltage of 480 and phase currents ranging between 119 and 121. The top row of soft keys do not offer any function.

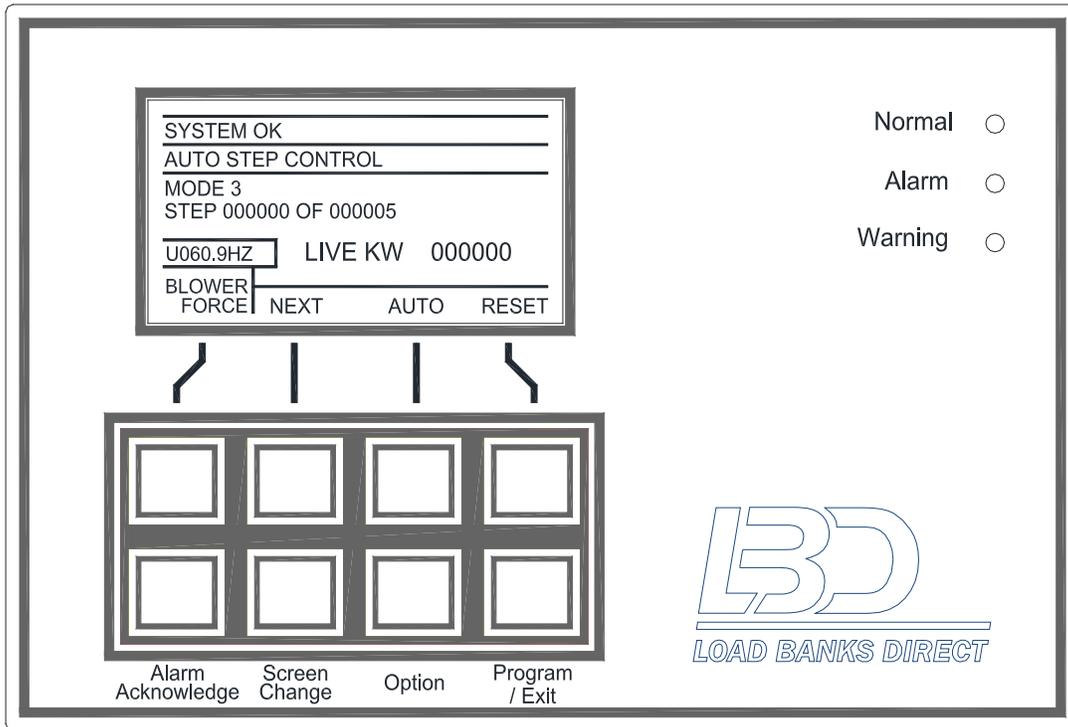


## CONTROL SCREEN

The user can change from the Power Meter Screen to the Control Screen by pressing SCREEN CHANGE. The Control Screen will allow the operator to power ON the blower by pressing BLOWER FORCE (it may be necessary to check exhaust air results or potential issues before starting the load test). Note that the Blower will turn ON automatically the instant a load is applied to the generator or test system. The Control Screen allows the user to begin an automatic (pre-programmed) Auto Step test by pressing AUTO. Pressing NEXT will skip to the next LOAD PROFILE step. Select RESET to repeat the automatic LOAD PROFILE test. See Figure 5 for details. The controller retains the previous Auto Step Program and it is important to check the Load Profile to insure the program is accurate and does not exceed the ratings of the generator, load cables or power system.

### FIGURE 5 CONTROL SCREEN

Figure 5 details a typical Control Screen indicating the SYSTEM OK and ready for testing. The Control Screen confirms the Controller has a Load Profile (AUTO STEP CONTROL, MODE 3) programmed with a total of 5 steps. User can start the Automated Load Profile by pressing AUTO. Note that previously programmed Load Profile parameters are not lost when the load bank and controller are powered down. User should always make sure Load Profile parameters are accurate and do not exceed the ratings of the test system before implementing.



**CAUTION**

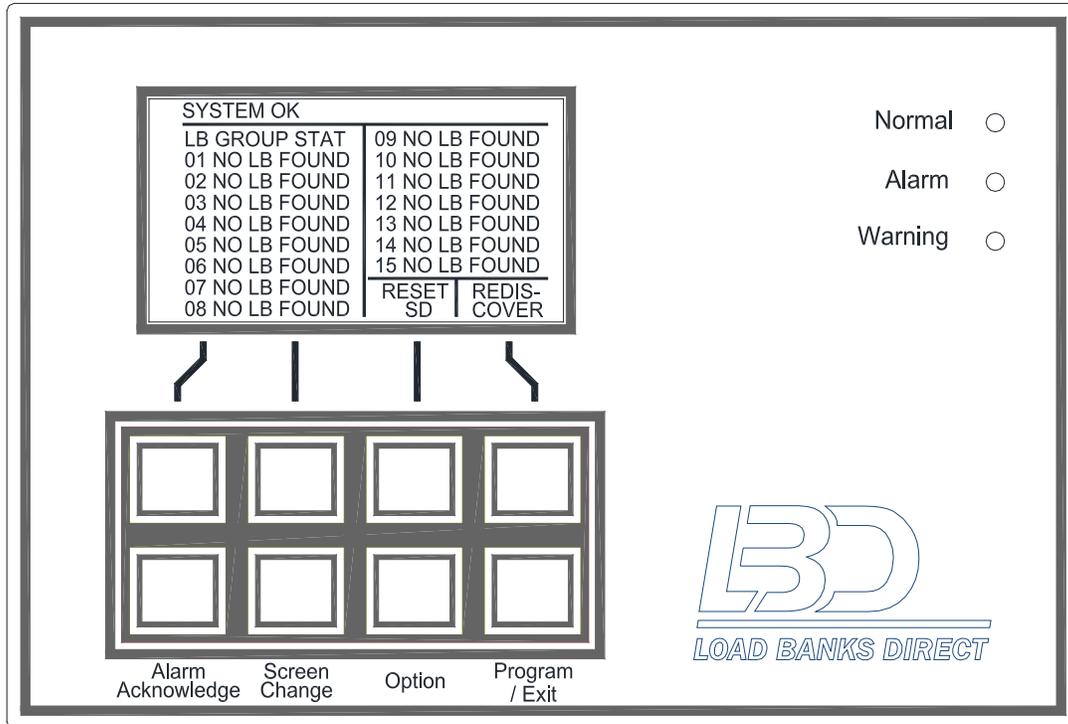
Auto Step Parameters are retained by the Controller and are not lost or erased if the load bank has been powered down. Operator should carefully check the Auto Step settings before starting an automatic load test to insure the Load Profile is accurate and does not exceed the ratings of the generator, load cables or power system.

**GROUP STATUS SCREEN**

The user can change from the Control Screen to the Group Status Screen by pressing SCREEN CHANGE. Group Status Screen will display the Load Group Status of the Slave load banks connected in a Master/ Slave Configuration. The Control Screen is used to reset a load bank after clearing an Alarm or Fault Condition by selecting RESET SD (Reset Shutdown). User must press REDISCOVER to re-activate a Slave after clearing a Fault or Alarm Condition. See Figure 6 for screen details.

## FIGURE 6 GROUP STATUS SCREEN

Figure 6 details a typical Group Status Screen which is indicating that the unit is in LOCAL mode because there are no configured Slaves available (NO LB FOUND). There are a total of two Soft Keys available - RESET SD (Reset Shutdown) and REDISCOVER.



## DATA LOGGER CONTROL

Access DATA LOGGER CONTROL from any Operating Screen by pressing PROGRAM/EXIT then selecting DATA LOGGER CONTROL. DATA LOGGER CONTROL will record up to 2046 events detailing all the critical load test measurements displayed on the power meter along with additional parameters such as the blower power data. The data is recorded independently by the controller and is stored in a non-volatile memory giving the operator the ability to download the test results after leaving the test site. Controller will store the data permanently until user presses ERASE on the Data Logger Screen. Operator must always press ERASE to clear the previous test data before selecting REC (Record) to start collecting new test data. Pressing the right most soft key will toggle the sample frequency between once every SECOND to once every MINUTE.

## FAULT DIAGNOSTICS

Access FAULT DIAGNOSTICS from any Operating Screen by pressing PROGRAM/EXIT then selecting FAULT DIAGNOSTICS to view any Active Fault Messages needed to troubleshoot the load bank.

### Fault Messages are as follows:

**LOAD BANK ERR SLAVE# xx** – Error message displayed on the Master when a shutdown (SD) condition is caused by an issue with a specific Slave # (1-15).

**BLOWER VOLTAGE ERROR SD** – Error message displayed with shutdown (SD) if the blower voltage changes beyond an acceptable range during operation or the blower voltage could not be sensed during operation.

**AIRFAIL SD** – Error message displayed with shutdown (SD) from the Pressure Differential Switch indicating a loss of air flow.

**OVER TEMP SD** – Error message displayed with shutdown (SD) from the Over-Temperature Switch indicating an Over-Temperature Condition.

**MOTOR OVERLOAD SD** – Error message displayed with shutdown (SD) from the Motor Starter Overload(s) operating the blower.

**LOAD DUMP SD** – Error message displayed with shutdown (SD) from the input signaling for a Load Dump.

**XFMR CONFIGURE SD** – Error message displayed with shutdown (SD) from an issue with the control power transformer configuration.

**BLOWER NOT ON SD** – Error message displayed with shutdown (SD) from the blower not operating properly.

**BLOWER HERTZ ERROR SD** – Error message displayed with shutdown (SD) if the blower frequency went out of range or could not be determined during operation.

**BLOWER PHASE ROTATION ERR SD** – Error message displayed with shutdown (SD) if the blower phase rotation changed or could not be determined during operation.

**LOAD VOLTS OUT OF RANGE SD** – Error message displayed with shutdown (SD) if the load voltage went out of range or could not be determined during while one or more load elements are active.

**MASTER CONTROL COM LOST SD** – Error message with shutdown (SD) displayed by when too much time has passed without communicating between the Master and Slave(s).

**RELAY MODULE COM ERROR SD** – Error message with shutdown (SD) when the relay module has encountered too many errors.

**BLOWER AC POWER UNUSABLE SD** – Error message with shutdown (SD) set when no usable power configuration was detected on the blower power input before Blower ON was requested.

**BAD LOAD SET SD. UPDATE FW?** – Error message with shutdown (SD) set when an unexpected data format code is received in a load set request while in Slave Mode.

**BAD DISCOVER SD. UPDATE FW?** – Error message with shutdown (SD) set when an unexpected data format code is received during discovery. Reset sequence from this shutdown involves pressing the re-discovery soft key.

## ABOUT UNIT

Access ABOUT UNIT from any Operating Screen by pressing PROGRAM/EXIT then selecting ABOUT UNIT to view the Controller Part Number, Manufacturing Date, Software Version and Serial Number. Contact the factory to download the latest software version to your existing controller.

## USER LOGIN

Access USER LOGIN from any Operating Screen by pressing PROGRAM/EXIT then selecting USER LOGIN. A password is required to access certain portions of CUSTOMER OPTIONS and ADVANCED OPTIONS to allow the customer to limit user access to the more advanced and automated programming options.

## CUSTOMER OPTIONS

Access CUSTOMER OPTIONS from any Operating Screen by pressing PROGRAM/EXIT then selecting CUSTOMER OPTIONS to access the following Programming Options.

### AUTO STEP SETUP

Load Banks with a Series One Controller can be programmed to run a load test automatically by programming a Load Profile through the AUTO STEP SETUP. The Load Profile can be programmed with up to 10 test steps of defined kW and time.

### WARNING

Always program controller carefully and accurately to not exceed the limits of the load bank or generator. Load banks operating in a programmed Automatic Mode and/or with a Master-Slave Configuration will turn ON and OFF without notice as needed. Be sure personnel are aware of the automatic operating conditions and keep clear all load bank blowers and hot exhausts during testing.

### LOOP CONTINUOUS

Enable LOOP CONTINUOUS by selecting a VALUE of 1 to repeat the defined Load Profile continuously. Normally the feature is left OFF (VALUE = 0) to complete normal testing requirements.

### TIME UNIT

Defines the TIME UNIT in either seconds or minutes to be used for the Load Profile step times.

### LOAD PROFILE LENGTH

LOAD PROFILE LENGTH sets the number of steps required for the load test with a maximum available VALUE of 10. The load bank will automatically remove the entire load after the last step and enter a cool down period before stopping the blower.

### DEFINE LOAD PROFILE

DEFINE LOAD PROFILE is used to enter the Load kW and the Time ON of each step of the load test. Note that the number of

steps shown when entering the Load Profile will always be 10 even though a VALUE of less than 10 was selected as the LOAD PROFILE LENGTH. Step data entered beyond the LOAD PROFILE LENGTH will be ignored by the controller. The load bank will automatically remove the entire load after completing the defined load test and enter a cool down period before stopping the blower.

## **SET MY ADDRESS**

Identifies where the unit is located within a chain of Master - Slave connected Load Banks. Select a value between 1 and 15 to assign a Slave Position. Note that the user does not have to manually set the address of any load banks because the controller is capable of intelligently setting up the entire master/slave configuration through the user friendly Startup Screen. See Operating Instructions for details.

## **LOCAL = 0, SLAVE = 1, MASTER = 2**

Configures the Controller: Local = 0, Slave = 1, Master = 2. Note that the user can easily setup the load bank as a LOCAL, SLAVE or MASTER with the Startup Screen.

## **RS-485**

It is important that the last load bank in a Master/ Slave chain is terminated (TERM ON) to insure that the shielding in the Master/ Slave Cable Chain keeps the communication signal free of electrical interference. All others should be should be OFF. TERM ON = 1, OFF = 0. Note that the user does not have to terminate any load banks using the RS-485 feature because the controller is capable of intelligently setting up the entire master/slave configuration through the user friendly Startup Screen. See Operating Instructions for details

## **REMOTE MASTER**

Configure the hand held controller as REMOTE MASTER. VALUE 1 = Yes, 0 = No. The hand held only has to be set up as a REMOTE MASTER initially; controller will retain the setting after powering down.

## **SERVO & RESCALE STATUS**

Screen view allows the user to follow the Load Servo and Element V Rescale adjustments in real time. Top of the screen lists the desired Set kW with two lower columns of Load Servo and Element V Rescale

information including the LIVE kW, Correction kW, MINIMUM DWELL SECONDS count down and Voltage Rescaling Parameters.

## **LOAD SERVO SETUP**

The Series One Controller can be programmed to operate in Load Servo Mode. When operating in Load Servo Mode the Controller will automatically adjust the LIVE kW to match the SET kW needed for the load test. Load Servo Mode will examine the actual blower power, resistor element tolerances, voltage changes and intelligently reset the load (throughout the load test) to keep it within a MINIMUM DELTA KW CHANGE every MINIMUM DWELL SECONDS selected.

### **CAUTION**

Load banks operating in Load Servo Mode rely on current transformers to measure the load currents used to calculate the kW rating of the load. Be aware that when using Load Servo in applications rated less than 20% of the load bank's total kW rating the current transformer accuracy is decreased. To avoid over-loading a generator or power system, do not operate the load bank in Load Servo Mode if the maximum kW rating of the test system is less than 20% of the Total kW Rating of the Load Bank.

## **LOAD SERVO ENABLE**

Select a VALUE of 1 to turn ON the LOAD SERVO ENABLE. Enter a VALUE of 0 to turn OFF the feature.

## **MAXIMUM CORRECTION %**

Limits the maximum correction % (kW) the controller can make while in Load Servo Mode. The % is the percentage of the requested load kW and not the total kW rating of the load bank(s). The feature is designed to protect the load bank and test system from a potential overload due to a component failure (resistor element, current transformer, contactor, fuse). A component failure could prevent accurate load readings and force the Load Servo to increase the load above acceptable levels. The factory default setting is 15%.

## **MINIMUM DELTA KW CHANGE**

Sets the Minimum kW Change allowable while in LOAD SERVO mode. LOAD SERVO will automatically adjust the load so that the LIVE kW stays within the MINIMUM DELTA KW CHANGE setting.

For instance, if the load bank is set for 400kW with MINIMUM KW DELTA KW CHANGE of 10, the LOAD SERVO will adjust the load if the LIVE KW drops below 390kW or exceeds 410kW. Operator should be aware that the smaller the setting of the MINIMUM KW DELTA KW CHANGE, the more likely the LOAD SERVO will make an adjustment. Avoid setting the value lower than necessary to increase the life of the load bank contactors and components.

### **MINIMUM DWELL SECONDS**

Sets the number of seconds the LOAD SERVO should automatically make a load re-adjustment. Note that user should be cautious set the MINIMUM DWELL SECONDS below 60 seconds so load bank resistor elements can reach steady state. Avoid setting the value lower than necessary to increase the life of the load bank contactors and components.

### **SET LOAD ONLY**

Sets up the load bank to operate in Load Servo Mode using Element V Rescale only. If selected, the controller will continually reset the load after the MINIMUM DWELL SECONDS has expired using only the load voltage.

## **AC CONFIGURATION**

Customer calibration can adjust POWER METER values to more closely match another meter that is monitoring the same electrical load. For instance, if the alternate or calibration meter is reading 478 volts between Phase A and B and the Series One controller is displaying 480 volts between Phase A and B, user could change VOLTS FINE ADJ GA-GB setting to 0.9958 (which is  $478/480$ ). User can select a VALUE between 0.0000 and 6.5000 for all parameters. Factory Default VALUE = 1.0000.

## ADVANCED OPTIONS

Access ADVANCED OPTIONS from any Operating Screen by pressing PROGRAM/EXIT then selecting ADVANCED OPTIONS. Note that ADVANCED OPTIONS are password protected to allow the customer to limit user access to the more advanced and automated programming options.

### DISPLAY OPTIONS

Adjusts BACKLIGHT BRIGHTNESS, DISPLAY CONTRAST and DISPLAY DWELL TIME.

#### BACKLIGHT BRIGHTNESS

Adjust the BACKLIGHT BRIGHTNESS according to how much ambient lighting you have. While operating the unit in direct sunlight, you may need to decrease the BACKLIGHT BRIGHTNESS. User can select a VALUE between 0 and 10. Factory Default VALUE = 10.

#### DISPLAY CONTRAST

Adjusts the black level intensity so that the text displays as true black on the LCD. User can select a VALUE between 0 and 10. Factory Default VALUE = 4. Exceeding a value of 5 can darken the screen beyond text recognition. Always increment the VALUE by 1 to avoid completely blackening out the screen.

#### DISPLAY DWELL TIME

Adjusts the length of time status messages are displayed in the message center, which is the status text line at the top of most Operating Screens. Note that when a shutdown occurs, the message display locks on the cause message until the shutdown is reset. User can select a VALUE between 1 and 10. Factory Default VALUE = 2 (seconds).

### LOAD BANK SETUP

Controller can be set to scale the initial load kW to match the actual load voltage. For instance, if the load bank is configured for a 480VAC load and the actual load voltage is 472VAC, the initial kW applied to the load bus will be scaled to match the load voltage. In this case, if the user selects 500kW as the nominal load at 472VAC, then the controller will intelligently select an initial load value of approximately 517kW ( $480^2/472^2 \times 500\text{kW} = 517\text{kW}$ ) to obtain the an accurate initial kW load

of 500kW. Note that the controller sets the kW based on the load voltage only initially at the start of the test. Rescaling the kW based on load voltage can be performed during the test by manually pressing RESET from the Control Screen.

### **ELEMENT V RESCALE ENABLE**

Select a VALUE of 1 to turn ON the automatic Voltage RESCALE ENABLE.

### **ELEMENT V RESCALE MIN V**

Adjusts the minimum volts that can be applied to the load bank using the ELEMENT V RESCALE ENABLE. User can select a VALUE between 0 and 700. Factory Default VALUE = 50 (volts).

### **INSTALL/ COPY PROGRAMS**

Contact the factory for the latest firmware upgrade and download instructions.

## **QUICK GUIDE - GENERAL OPERATING INSTRUCTIONS**

### **1. LOAD TESTING FROM THE MAIN SCREEN (LOCAL MODE)**

Power the load bank and the Startup Screen displays the current configuration of controller highlighted in a rectangle (LOCAL, SLAVE, MASTER). Select LOCAL if the unit is configured as a MASTER or SLAVE. LOCAL Configuration is used when operating a single stand-alone load bank. The Main Screen will allow the operator to perform a load test by simply selecting the load kW by pressing LOAD + to increase the desired kW or pressing LOAD - to decrease the desired kW. Once user obtains the desired kW that is displayed on the screen next to SET =>, load can be applied by pressing the SET key. Pressing the top right Soft Key allows the operator to turn the MASTER LOAD ON or OFF. MASTER OFF confirms the load is OFF, MASTER ON confirms the load is ON.

**COMMON ENHANCEMENTS:** LOAD SERVO ENABLE,  
ELEMENT V RESCALE ENABLE.

## 2. MASTER/SLAVE CONFIGURATION

The controller is capable of intelligently setting up the entire master/slave configuration through the user friendly Startup Screen with detailed screen instructions. Be sure that all units are linked together with Master/Slave cables plugged into each control panel. First, power ON the Master load bank and press the MASTER key on the Startup Screen. Next power ON the first Slave unit and press the SLAVE key on the Startup Screen. Controller will then ask if the Slave is at the end of the row. If there are more Slaves to be added to the chain, select N (No). If the load bank is the last Slave to be added to the Group, then select Y (Yes). Once you select Y, you have added the last Slave and must select CANCEL on the Slave controller screen. Now return to the Master screen and press END SETUP. Once the Master screen verifies that, "SETUP HAS BEEN COMPLETED" press DISMISS. The Main screen of the Master will return to the Main Screen and now display the MAXIMUM kw as the total kW of all load banks in the group.