Final Acceptance of Instruction Manual

Customer: Active Power
W.O. #: 35159-99-43
Load Bank Type: Mars-250KVAR/150KVAR
Inductive/Capacitive

1 Manual Shipped for the Load Bank described above.
250/150KVAR Inductive/Capacitive,
240/480V, 3ø, 60Hz, Remote Manual Control, Nema-3R
File: 35159.p65; Disk: SDCX149

This instruction manual has been reviewed and is approved by me as being fully accurate and representative of the equipment being supplied thereunder and it (the manual) meets the customer's specification/order requirements for manuals.

1 Manual Received by: Date:

Accepted by: Date:

Please forward a copy of this "signed and dated" Final Acceptance Form to Graphics when available.

LOAD BANK
TECHNICAL MANUAL

Customer: Active Power

Work Order: 35159-99-43

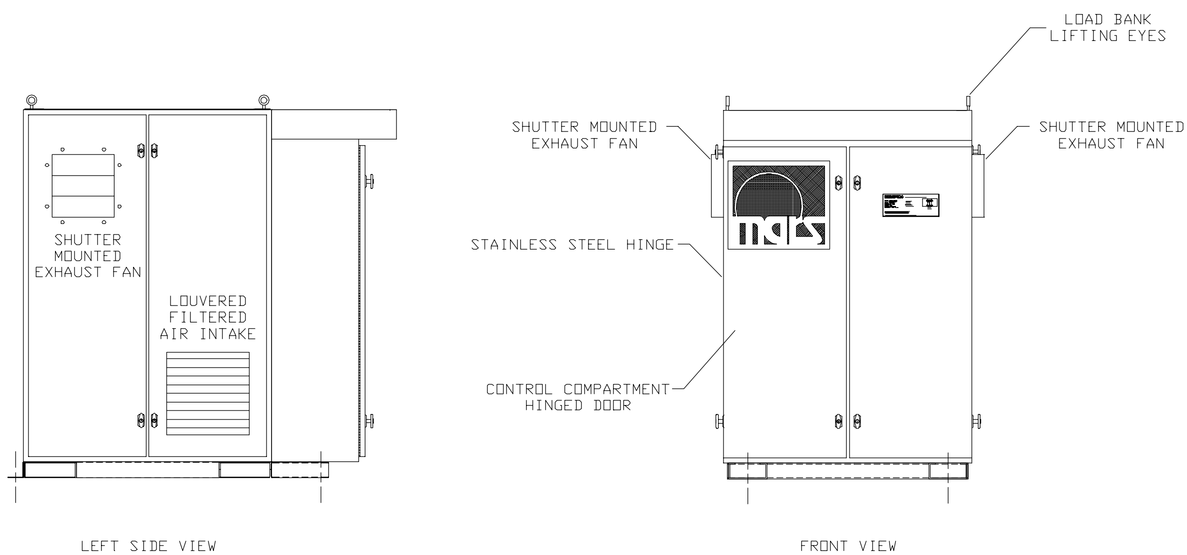
Model: Mars-250/150KVAR
Inductive/Capacitive

April 1999

(File: 35159.p65; Disk: SDCX149)

Contents

Simplex, Inc., 1139 North MacArthur Blvd., Springfield, IL 62702-2314 • 217-525-6995 (24 Hr.) • Fax 217-525-7984



Part of Pictorial Drawing 47BD98946A

DESCRIPTION

Simplex Load Banks are precision test instruments specifically designed to apply discrete, selectable electrical load to a power source while measuring the response of the generator to the applied load. They also provide a means for routine maintenance exercise to assure long term reliability and readiness of the standby generator. Exercise Load Banks eliminate the detrimental effects of unloaded operation of diesel engine generators.

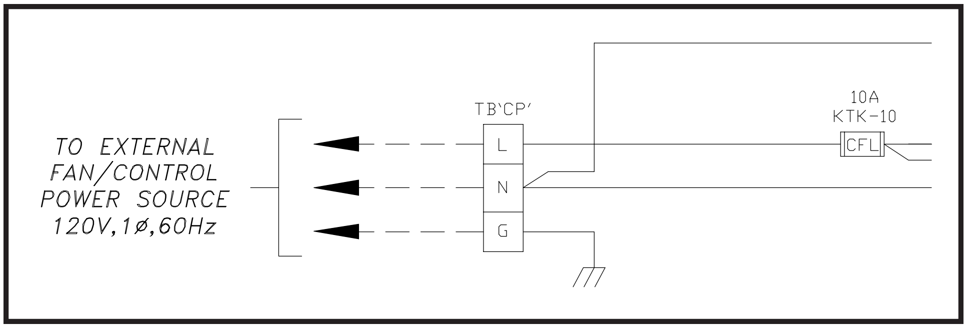
The cabinet on this Load Bank is rated NEMA Type 3R outdoor weatherproof.

Power source testing is accomplished by applying resistive load steps at unity (1.0) power factor.

Load application is by magnetic contactor. All load branch circuits are protected by 200,000AIC class-T fuses.

SPECIFICATIONS

Capacity:	150KVAR Capacitive 250KVAR Inductive
Voltage:	240/480VAC
Connection:	3 Phase, 3 Wire
Frequency:	60Hz
Fan Power:	120V, 1ø, 60Hz
Control Power:	External 120VAC
Cooling:	Forced Air
Airflow:	1,550 CFM
Maximum Air Intake Temp.:	120° F
Nominal Air Temp. Rise:	75° – 150°F
Temperature Rise:	$\frac{°F \times 3000}{CFM}$
Duty Cycle:	Continuous
Serial Number:	35159-99-43



Part of Control Section 1 of 3 Drawing 47B98935

Fan/Control Power is achieved via an external 120V, 1ø, 60Hz source. Common serviceable components include a Control Fuse (CFL). Operating controls are located on a Remote Control Panel. Lamps on the control panel indicates the Load Bank operating status. The Remote Control Panel contains the following components:

1. Ammeter, Ammeter/Voltmeter Switch, Voltmeter
2. Fan/Control Power pushbuttons
3. Normal Operation, Load Over Voltage, and Cooling Failure lamps
4. Load Voltage Selector switch
5. System Master Load switch
6. Inductive Load Control Master Load and load step switches
7. Capacitive Load Control Master Load and load step switches

The “Normal Operation” lamp illuminates when Control Power is available and the Cooling System is operating properly.

This Load Bank is protected against cooling failures (loss of cooling air flow, high intake or exhaust air temperature which could damage the Load Bank or present a safety hazard to the operator). When a cooling failure occurs the automatic safety features in the Control System immediately remove the load from the load source. The malfunction must be corrected and the system must be reset by turning the Load Bank “Off” then “On” before the load can be re-applied.

The Load Bank consists of three principal systems:

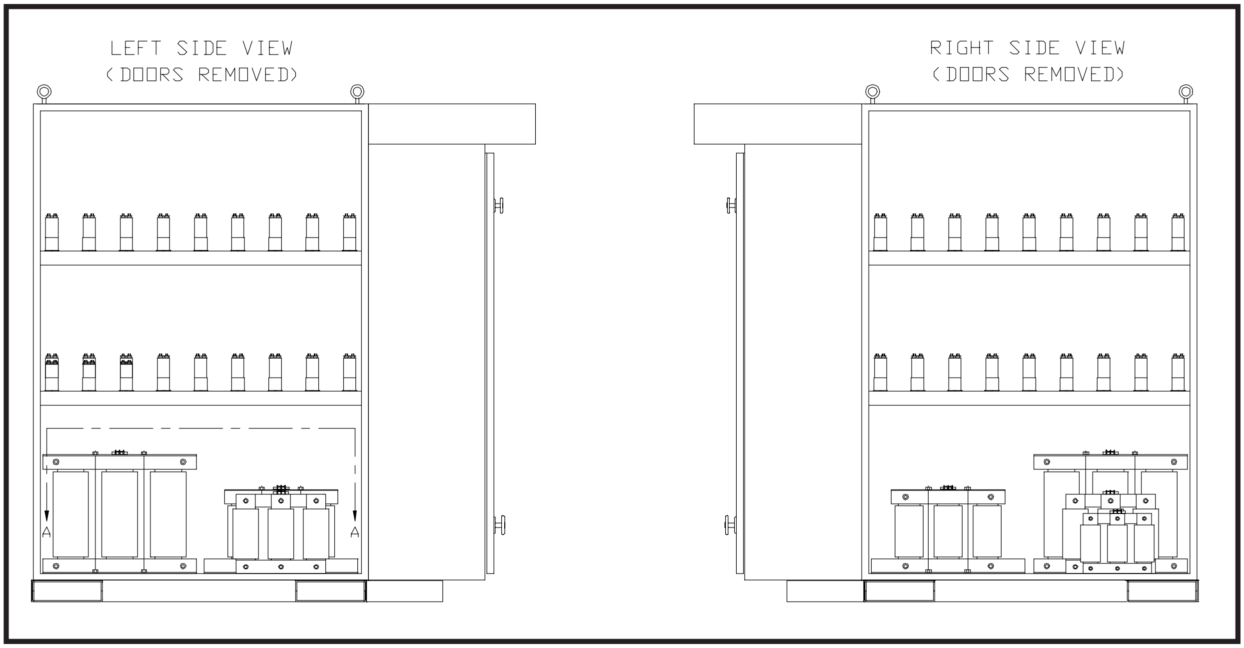
1. Control System
2. Cooling System
3. Load System

CONTROL SYSTEM

The Control System allows the operator to apply a desired load to the test source and measure the response of the test source to the load. This system also contains the circuitry utilized to disconnect the Load Bank from the test source in the event of cooling failures and/or improperly positioned operating controls. Control power is supplied via an external 120V, 1ø, 60Hz source. Control power is applied to the Fan Motors (MOT1 and MOT2) via terminal TB‘AL’ 2 when the Fan/Control Power On pushbutton is pressed.

COOLING SYSTEM

The Reactive Load Elements (inductive or capacitive) on this Load Bank are cooled by a forced air system consisting of 12" fan shutter assemblies. The fans turn approximately 1550 RPM at 60Hz.



Part of Inductor Layout Drawing 47BD98944

LOAD SYSTEM

The Load System consists of independently controlled resistive and/or reactive load elements specifically designed for Load Bank systems. They are protected by 200,000AIC, 600VAC fuses.

Reactive Load Elements are iron-core, non-saturable, air gap calibrated and air cooled. Elements may have a temperature sensor embedded in the windings to detect element overheating and are varnish coated. Epoxy coatings are available for severe environments.

PRIMARY INSPECTION

Preventative visual inspections of the shipping crate and Load Bank is advised. Physical or electrical problems due to handling and vibration may occur. Never apply power to a Load Bank before performing this procedure. The following Nine Point/30 Minute Inspection is recommended before installation, as part of the 50 hour / 6 month maintenance schedule and whenever the Load Bank is relocated:

1. If crate shows any signs of damage examine the Load Bank in the corresponding areas for signs of initial problems.
2. Check the entire outside of the cabinet for any visual damage which could cause internal electrical or mechanical problems due to reduced clearance.
3. Inspect all hinged panels and doors for smooth and safe operation, try all latches and knobs.
4. Rotate and push all switches through all positions to ensure smooth operation.

If any problems are observed during Primary Inspection call the Simplex Service Manager at 217-525-6995 (24hrs.)

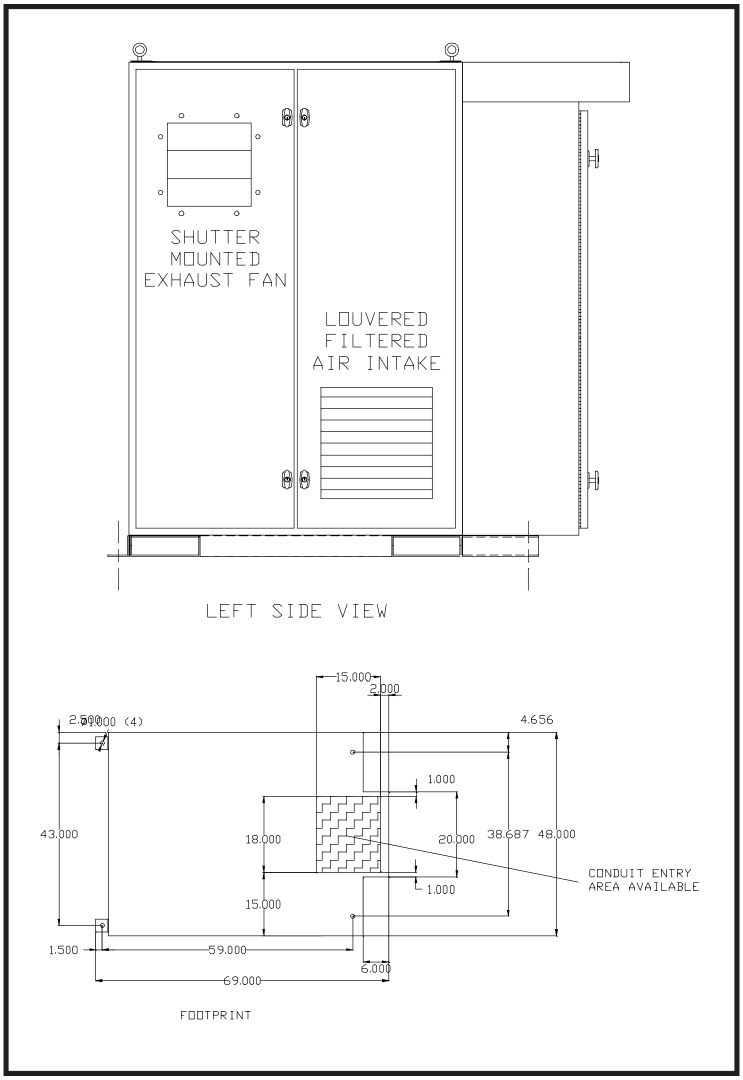
5. Check cooling system by inspecting fan motor and blade. Slowly rotate blade by hand and note clearance of blade tip through its rotation near the housing. Observe free rotation of motor shaft.
6. Inspect all relays, timers, and control modules by opening all accessible panels. Make sure all components are secure in their bases and safety bails are in place. Spot check electrical connections for tightness. If any loose connections are found inspect and tighten all remaining connections.
7. Examine all accessible internal electrical components such as fuses, contactors and transformers. Check lugged wires at these components.
8. Inspect bottom of crate/enclosure for any components that may have jarred loose during shipment such as indicator light lenses, switch knobs, etc.
9. Visually inspect element chamber for foreign objects, broken ceramic insulators, mechanical damage.

INSTALLATION

Location

Nema-3R Load Banks are intended for outdoor installation. The load elements in this Load Bank are cooled by a forced air system which discharges through shutters mounted on the side of the cabinet. Location of the Load Bank is of prime importance and should be done by trained personnel. It is one of the most critical factors involved in safe operation. The Load Bank must be positioned and installed according to large airflow requirements.

- There must be a minimum clearance of 25 feet on the discharge side and 6 feet on all other sides.



Parts of Pictorial Drawing 47BD98946A

- Always locate the Load Bank in a secure area accessible by trained personal only.
- Never install any structure or object at any height above the Load Bank.
- Use the eyehooks and forklift channels provided to position the Load Bank.
- Never point the exhaust at a nearby surface or object which may be adversely affected by high temperature.

- Never operate the Load Bank in a confined space without regard for adequate intake of air and provision for exit of high temperature exhaust.
- Consider that the Load Bank and a nearby generator set may have to compete for cooling air.
- Never bounce hot exhaust air off nearby objects and allow it to recirculate through the cooling system.
- Never operate the Load Bank in proximity to a sprinkler system.

Load Banks installed indoors must be equipped with an exhaust air duct of minimum back pressure (supplied by others) which will route all Load Bank hot exhaust air outdoors. This Load Bank will produce a large quantity of exhaust air. This air must not be exhausted within an indoor space and must not be allowed to recirculate to the Load Bank air intake. Failure to properly install this Load Bank with an exhaust duct will result in substantial damage to or the destruction of the Load Bank, adjacent equipment and the building in which the Load Bank is installed.

⚠ WARNING ⚠

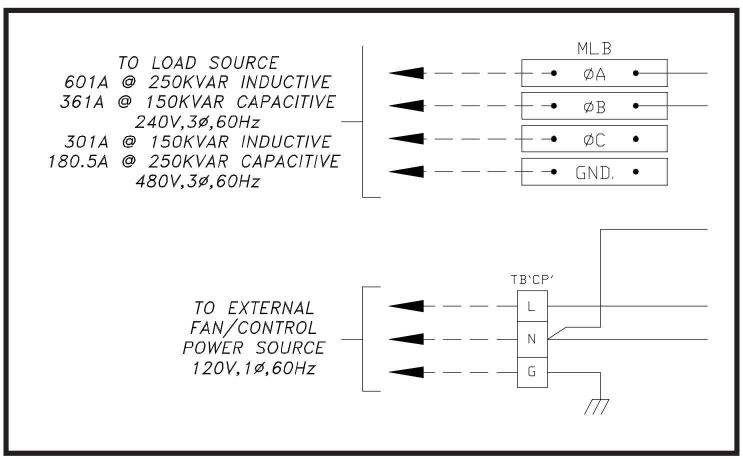
Always remove all power from the load bus and all fan/control power before servicing the Load Bank. Never operate or service a Load Bank that is not properly connected to an earthground.

⚠ WARNING ⚠

Do not store or operate in rain or spray unless unit is designed for this service or adequate protection is provided.

PROCEDURE

1. Confirm the test source is properly grounded and ground the Load Bank to its own independent ground.
2. Properly mount the Remote Control Panel and ground it to its own independent ground.
3. Confirm all load command switches are in the "Off" position.
4. *See Control Section 2 of 3 Drawing 47B98936.* Using copper wire #14 AWG wire or greater with a torque of 35 in. lbs. connect TB'BR' 1–31 on the Remote Control Box to TB'BL' 1–31 on the Load Bank.
5. See Control Section 1 of 3 Drawing 47B98935:
   a. Using copper wire #14 AWG wire or greater with a torque of 35 in. lbs. connect TB'AR' 1–8 on the Remote Control Box to TB'AL' 1–8 on the Load Bank.
   b. Connect the Master Load Bus (MLB) on the Load Bank to the load source as shown. Consult NEC for proper wire size.
   c. Connect TB'CP' on the Load Bank to an external 120V, 1ø, 60Hz power source.

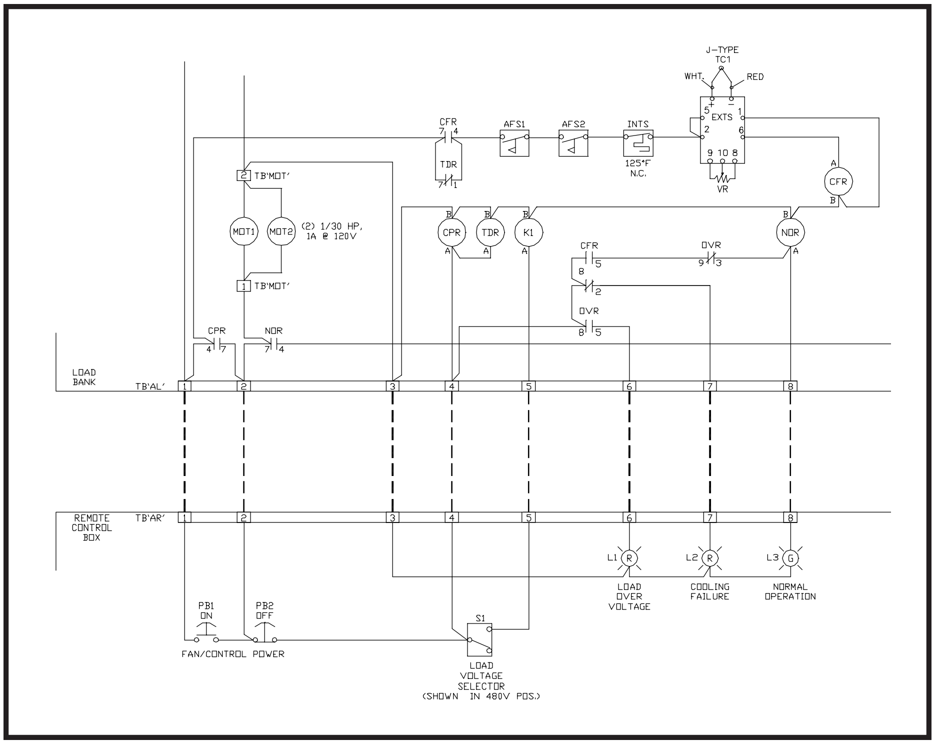


Parts of Control Section 1 of 3 Drawing 47B98935

OPERATION

1. Verfiy the “Load Voltage Selector” switch is in the proper position.
2. Press the Fan/Control Power “On” pushbutton to energize the cooling fan.

   When the fan motors create sufficient airflow to close the Air Flow Switches (AFS1 and AFS2) the Cooling Failure Relay (CFR) energizes. CFR contacts 8-5 close, energizing the Normal Operation Relay (OLR) and illuminating the “Normal Operation” lamp illuminates. NOR contacts 7-4 close and control voltage is supplied to the “Master Load” switch. With voltage supplied to the “System Master Load” switch, the operator is now ready to apply load steps by programming the “Master Load” and load step switches.



Part of Control Section 1 of 3 Drawing 47B98935

3. Verify the illumination of the “Normal Operation” lamp before proceeding.
4. Visually observe correct fan operation and investigate any unusual fan related noises.
5. Check air intake for obstructions and confirm positive air flow.
6. Start-up generator or bring other test source on line.

   If a high voltage is present while the “Load Voltage Selector” switch is in the low voltage position the Voltage Sensing Relay (VSR) will energize. VSR contacts 8-6 close and energize the Over Voltage Relay (OVR). OVR contacts 8-5 close and illuminate the “Load Over Voltage” lamp. OVR contacts 9-3 open, de-energize the Normal Operation Relay (NOR) and extinguish the “Normal Operation” lamp. When the NOR de-energizes, contacts 7-4 open and interrupt the power path to the “System Master Load” switch. Load cannot be applied until the the “Load Voltage Selector” switch is placed in the appropriate position.

7. Adjust power source voltage and frequency.
8. Select the desired load steps by placing them in the “On” position.

> ⚠ **WARNING** ⚠
>
> **Do Not allow the Load Bank to operate unattended for extended periods.**

9. Flip the desired "Master Load" switch(es) to the "On" position.
10. Flip the "System Master Load" switch to the "On" position.

    This simultaneously applies all of the load steps which are in the "On" position.

    Trim is achieved by flipping the load steps "On" and "Off" while the "System Master Load" switch and the corresponding "Master Load" switch are in the "On" positions.
11. Adjust source voltage and load. Monitor as needed.

SHUTDOWN

1 De-energize the load.
2. Run the cooling fan for 5 minutes to assure a thorough cool down of all load elements (optional).
3. Place the "Fan/Control Power" switch in the "OFF" position or depress the "Push to Stop" pushbutton.

⚠ WARNING ⚠

If a failure occurs the corresponding lamp will illuminate and the load will be de-energized. Before reapplying a load, the failure must be corrected and the system must be reset by turning the Load Bank "Off" then "On".

⚠ WARNING ⚠

Never operate or service a Load Bank that is not properly connected to an earthground.

FAILURE DETECTION

If a "Failure" occurs the corresponding lamp will illuminate and the load will be de-energized. Before reapplying a load, the failure must be corrected and the system must be reset by turning the Load Bank "Off" then "On".

This is a permissive/energize-to-run circuit in which all safety sensors must energize their control relays on normal operation before load can be applied. This system includes the following switches and relays:

1. Air Flow Switches (AFS1 and AFS2),
2. Intake Temperature Switch (INTS),
3. Cooling Failure Relay (CFR), and
4. Normal Operation Relay (NOR).

Thermocouple Temperature Switch

The exhaust temperature network consists of a type J thermocouple (TC) and a solid state thermocouple sensor (EXTS). The temperature switch has been factory adjusted for precise Load Bank over temperature protection under normal operating conditions. Unusual operating conditions may require field adjustment. The setpoint of the Exhaust Temperature Switch (EXTS) may be changed by rotating the adjustment knob on the variable resistor. Consult the Simplex Service Department (217-525-6995 24hrs) before changing the temperature switch setpoint.

MAINTENANCE

The Load Bank has been designed to require minimum maintenance. All components have been chosen for a long, reliable life. Two basic intervals of maintenance are required: each operation and every 50 hours or 6 months (whichever comes first).

EACH OPERATION

The air intake screens and louvers, fan and cooling chamber, and exhaust openings must be checked for any obstructions or foreign objects. Due to the volume of air circulated, paper and other items can be drawn into the air intakes. During Load Bank operation insure that air is exiting from the exhaust vents.

The load branches should be checked for blown fuses or opened load resistors. To check the fuses or load resistors, operate the Load Bank from a balanced 3-phase source and check the three line currents. The three current readings should be essentially the same. If a sizeable difference is noted one or more load fuses or load resistors may have malfunctioned.

EVERY 50 HOURS OR 6 MONTHS

Check the tightness of the electrical connections. The expansion and contraction caused by Load Bank operation may result in loose connections. The vibrations caused by the cooling fan may also loosen electrical connections. If the Load Bank is transported "over the road", the electrical connections should be checked for tightness at a shorter-than-normal time interval. See "Primary Inspection".

TROUBLESHOOTING

This section is designed to aid the electrical technician in basic Load Bank system troubleshooting. All of the problems listed can be verified with a basic test meter and/or continuity tester. For safety reasons, when troubleshooting Load Bank systems always remove all test source power, fan/control power, anti-condensation heater power, etc.

COOLING FAN MOTOR WILL NOT OPERATE

1. Fan/Control Power not available/incorrect
2. Inoperative Fan Motor (MOT)

COOLING FAILURE INDICATED

Exhaust temp above EXTS setpoint:

1. Over temperature sensor failure
2. Fan failure
3. Air restriction (intake or exhaust)
4. Overvoltage condition present
5. Altitude above 3500 ft.

⚠ WARNING ⚠

When troubleshooting Load Bank systems always remove all test source power, fan/control power, anti-condensation heater power, etc.

⚠ WARNING ⚠

For continued safety and for maximum equipment protection, always replace fuses with one of equal rating only.

Exhaust temp below EXTS setpoint:

1. Restriction of air
   (intake or exhaust)
2. Fan pressure switch inoperative
4. Airflow Switch inoperative
5. Overtemperature sensor failure
6. Cooling Failure Relay (CFR) failure

SOME LOAD STEPS CANNOT BE ENERGIZED

1. Inoperative load step switches
2. Open load step resistor(s)
3. Inoperative load step relays
4. Inoperative load step contactors
5. Open load step fuses

DRAWINGS AND PARTS LIST

The drawings included in this manual are the most accurate source of part numbers for your Load Bank. When ordering replacement parts for Simplex Load Banks, always consult the Parts Legend Drawing. When contacting the Simplex Service Department always have your work order and drawing number ready for reference. The Work Order Number and the Drawing Numbers are also located on each drawing legend. *A typical drawing legend and parts list is illustrated at right.*

SIMPLX®		SPRINGFIELD, ILLINOIS
SCALE :	APPROVED BY :	DRAWN BY : GB
DATE : 3/5/99		REVISED :
INDUCTIVE/CAPACITIVE LOAD BANK 250KVAR,240/480V,3ø,60Hz 150KVAR,240/480V,3ø,60Hz	MARS–250/150KVAR CONTROL SECTION 1 OF 3	
W.O.# 35159–99–43		DRAWING NUMBER 47B98935

ITEM	QTY	PART NUMBER	COMP. DESIG.	COMPONENT DESCRIPTION
1	20	--------	LC1-LC18 2 SPARE	CAPACITOR, 30uF METALIZED GE 97F8065S
2	176	--------	LC19-LC186 8 SPARE	CAPACITOR, 40uF METALIZED GE 97F8067S
3	186	--------	[LC1-LC186]	MOUNTING BRACKETS CASE STYLE P NEWARK 81F3216
4	6	--------	CF1-6	FUSE, TIME DELAY 7A, 600V, 300KAIC BUSSMANN LPJ-7SP
5	6	--------	CF7-12	FUSE, TIME DELAY 15A, 600V, 300KAIC BUSSMANN LPJ-15SP
6	12	--------	CF13-24	FUSE, TIME DELAY 25A, 600V, 300KAIC BUSSMANN LPJ-25SP
7	18	--------	CF25-42	FUSE, TIME DELAY 50A, 600V, 300KAIC BUSSMANN LPJ-50SP
8	6	--------	CF43-48	FUSE, TIME DELAY 30A, 600V, 300KAIC BUSSMANN LPJ-30SP
9	10	--------	[CF1-24] [CF43-48]	FUSEBLOCK 600V, 30A BUSSMANN J60030-3S
10	6	--------	[CF25-42]	FUSEBLOCK 600V, 60A BUSSMANN J60060-3C
11	1	--------	LX1	INDUCTIVE LOAD REACTOR 3.75KVAR, 240/480V 3 PHASE, DELTA CONNECTED POWER MAGNETICS

APPENDIX A - ABBREVIATIONS USED IN THIS MANUAL

Listed below are abbreviations of terms found on Simplex Load Bank Systems. When following a load bank drawing utilize this guide to define abbreviated system and component names. As this is a master list, drawings and text pertaining to your equipment may not contain all these terms.

AC-Alternating current

AIC-Ampere interrupting current-maximum short circuit fault current a component can safely interrupt

AM-Ammeter

AMSW- Ammeter selector switch-selects any phase for current reading

CF-Control fuse

CFM-Cubic feet per minute-used to rate fan air flow capacity and load bank cooling requirement

CFR-Cooling failure relay-normally energized relay in cooling failure subsystem

CPC-Control power contactor

CPF-Control power fuse

CT-Current transformer- used in metering circuits

DC-Direct current

EXTS-Exhaust air temperature switch

FCB-Fan circuit breaker-circuit breaker in series with fan control power

FCVR-Fan control voltage relay-normally energized relay on relay sub-panel

FM-Frequency meter-monitors frequency of test source

FMC-Fan motor contactor-controls power to fan motor

FMSW-Frequency meter switch

FPS-Fan power switch-used to energize cooling system

GFB-Ground fault breaker

GBTR-Ground breaker tripped relay

HVR-High voltage relay

Hz-Hertz-cycles per second, measurement of frequency

IFCV-Incorrect fan/control voltage

INTS-Intake air temperature switch

K-Relay coil/contact designation

KVA-Kilovolt amperes

KVAR-Kilovolt amperes-reactive

KW-Kilowatts

KWM-Kilowatt meter

KWT-Kilowatt meter transducer

LM-Louver motor

LMC-Louver motor contactor

LR-Load resistive element

LX-Load reactive element

L1-Line 1

L2-Line 2

L3-Line 3

MCB-Main circuit breaker

MDS-Main Disconnect Switch

MF-Meter fuse

MLB-Main Load Bus

MOT-Motor

NEMA-National electrical manufacturer's association

ODP-Open, drip-proof-refers to motor enclosure

OVR-Overvoltage relay-relay used in overvoltage failure system, located on relay sub-panel

OLR-Overload relay-used for motor protection

OTR-Overtemperature relay-used in failure system

PF-Power factor-in resistive only loads expressed as unity (1.0), in inductive loads expressed as lagging, in capacitive loads expressed as leading

PAR-Control power available relay-relay energized when control power is available

PFM-Power factor meter

PS-Pressure switch-switch used to detect fan failure

RR-Reset relay

RTM-Running time meter-keeps time log of equipment use.

TB-Terminal block

TDR-Time delay relay-relay which times out before contacts change state

TEFC-Totally enclosed, fan cooled-refers to motor enclosure

TEAO-Totally enclosed, air-over-refers to motor enclosure

UPS-Uninterruptable power source

V-Voltage

VSR-Voltage sensing relay

XCB-Reactive load controlling circuit breaker

APPENDIX B - CALCULATIONS & FORMULAS

The following calculations are used to determine the actual kilowatt load being applied by the Load Bank, when line voltages and currents are known (at 1.0 power factor).

3 Phase

1. Read all three line currents and find the average reading.
2. Read all three line-to-line voltages and find the average reading.
3. Multiply the average current times the average voltage.
4. Multiply the answer of step #3 times the square root of 3 (1.732).
5. Divide the answer of step #4 by 1000. The answer is the actual kilowatts of load being applied by the Load Bank.

Single Phase

1. Determine the line current.
2. Determine the line-to-line voltage.
3. Multiply the line current times the line-to-line voltage.
4. Divide the answer of step #3 by 1000.
5. The answer of step #4 is the actual kilowatts being applied by the load bank.

EXAMPLES

Using line voltages and currents:

3 Phase

Current Readings	Voltage Readings
A_1 = 249A	V_{1-2} = 481V
A_2 = 250A	V_{2-3} = 479V
A_3 = 254A	V_{3-1} = 483V

$$\text{Average Current} = \frac{A_1 + A_2 + A_3}{3} = \frac{249+250+254}{3} = 251\text{A}$$

$$\text{Average Voltage} = \frac{V_{1-2} + V_{2-3} + V_{3-1}}{3} = \frac{481 + 479 + 483}{3} = 481\text{V}$$

$$\text{Kilowatts} = \frac{\text{Volts x Amps x } 1.732}{1000} = \frac{481 \times 251 \times 1.732}{1000} = 209.1\text{KW}$$

Single Phase

Current Reading: 150A   Voltage Reading: 240V

$$\text{Kilowatts} = \frac{\text{Volts x Amps}}{1000} = \frac{150 \times 240}{1000} = 36.1\text{KW}$$

The following calculations are used to determine the amount of current when the desired amount of kilowatts is applied at 1.0 power factor.

3 Phase

1. Multiply the desired amount of kilowatts to be applied by 1000.
2. Multiply the operating voltage times the square root of 3 (1.732)
3. Divide the answer of step #1 by the answer of step #2.
4. The answer of step #3 is the average line current with the desired kilowatts applied at 1.0 power factor.

Single phase

1. Multiply the desired amount of kilowatts to be applied by 1000.
2. Divide the answer of step #1 by the operating voltage.
3. The answer of step #2 is the average line current with the desired amount of kilowatts applied at 1.0 power factor.

The following calculations are used to determine a step kilowatt rating at other than a rated voltage. This is accomplished by referencing the load step to a KW value at a known voltage.

1. Determine the new unrated operating voltage.
2. Divide the new operating voltage by the reference voltage.
3. Square the answer of step #2.
4. Multiply the answer of step #3 times the reference kilowatt value of the load step which the new kilowatt rating is desired.
5. The answer of step #4 is the kilowatt rating of the load step at the new voltage.

EXAMPLES

When desired amount of kilowatts is applied at 1.0 PF:

3 Phase

Applied: 50KW Operating Voltage: 480V

$$\text{Amperage} = \frac{\text{KW x 1000}}{\text{Volts x 1.732}}$$

$$= \frac{50 \text{ x } 1000}{480 \text{ x } 1.732}$$

$$= \frac{50{,}000}{831.36}$$

$$= 60.1$$

Single Phase

Applied: 25KW Operating Voltage: 240V

$$\text{Amperage} = \frac{\text{KW x 1000}}{\text{Volts}}$$

$$= \frac{25 \text{ x } 1000}{240}$$

$$= \frac{25{,}000}{240}$$

$$= 104.2$$

Determining step KW at other than rated voltage:

Applied: 80KW Operating Voltage: 450V
Rated Voltage: 480V

$$\text{Step KW} = (\text{Oper. Volt.} \div \text{Rated Volt.})^2 \text{ x Applied KW}$$

$$= (450 \div 480)^2 \text{ x } 80$$

$$= .9375^2 \text{ x } 80$$

$$= 70.3$$

FORMULAS

		Alternating Current	Direct Current
Kilowatts	1 phase	$\frac{\text{Volts x Amps x PF*}}{1000}$	$\frac{\text{Volts x Amps}}{1000}$
	3 phase	$\frac{\text{1.732 x Volts x Amps x PF*}}{1000}$	

*Power Factor, expressed as decimal.
(Resistive Load Bank PF is 1.0)

		Alternating Current	Direct Current
Amperes *(KW known)*	1 phase	$\frac{\text{KW x 1000}}{\text{Volts x PF}}$	$\frac{\text{KW x 1000}}{\text{Volts}}$
	3 phase	$\frac{\text{KW x 1000}}{\text{1.732 x Volts x PF}}$	
KVA	1 phase	$\frac{\text{Volts x Amps}}{1000}$	
	3 phase	$\frac{\text{1.732 x Volts x Amps}}{1000}$	
Amperes *(KVA known)*	1 phase	$\frac{\text{KVA x 1000}}{\text{Volts}}$	
	3 phase	$\frac{\text{KVA x 1000}}{\text{1.732 x Volts}}$	
KVAR	1 phase	$\frac{\text{Volts x Amps x }\sqrt{1-PF^2}}{1000}$	
	3 phase	$\frac{\text{1.732 x Volts x Amps x }\sqrt{1-PF^2}}{1000}$	

APPENDIX C - DRAWINGS