Antes # 700281
30 kw
240 V
3 P
60 Hz

SIMPLEX LOAD BANK MANUAL

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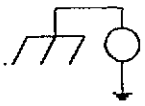
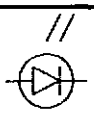
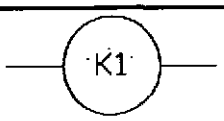
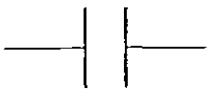
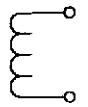
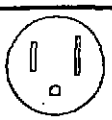
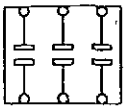
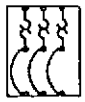
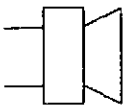
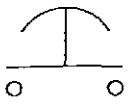
Simplex, Inc. 1139 North MacArthur Springfield, Illinois 62702 217-525-6995 24hr 217-528-3130 Fax 217-525-7984

SECTION 1. DRAWING COMPONENT DESIGNATIONS

The following components are commonly found on Simplex load bank drawings.

L, lamp	Lamp used for status annunciation	
Cabinet Ground	Cabinet earth grounding lug	
L.E.D.	Light emitting diode	
K, Relay	Relay coil designation	
Relay contacts	Normally open relay contacts	
CT, Current transformer	AC current transformer, used for current sensing	
Plug, Receptacle	Used for supplying external Fan/control power	
C1, FMC, contactor	Used to energize load steps, cooling fan motor	
CB, circuit breaker	Used for overcurrent protection	
AH, alarm horn	Used to annunciate failure alarms	
F, fuse	Used for overcurrent protection	
PB, pushbutton	Normally open momentary switch	
R, resistor	Carbon or wire fixed value resistor	
CAP, capacitor	Fixed value capacitor	

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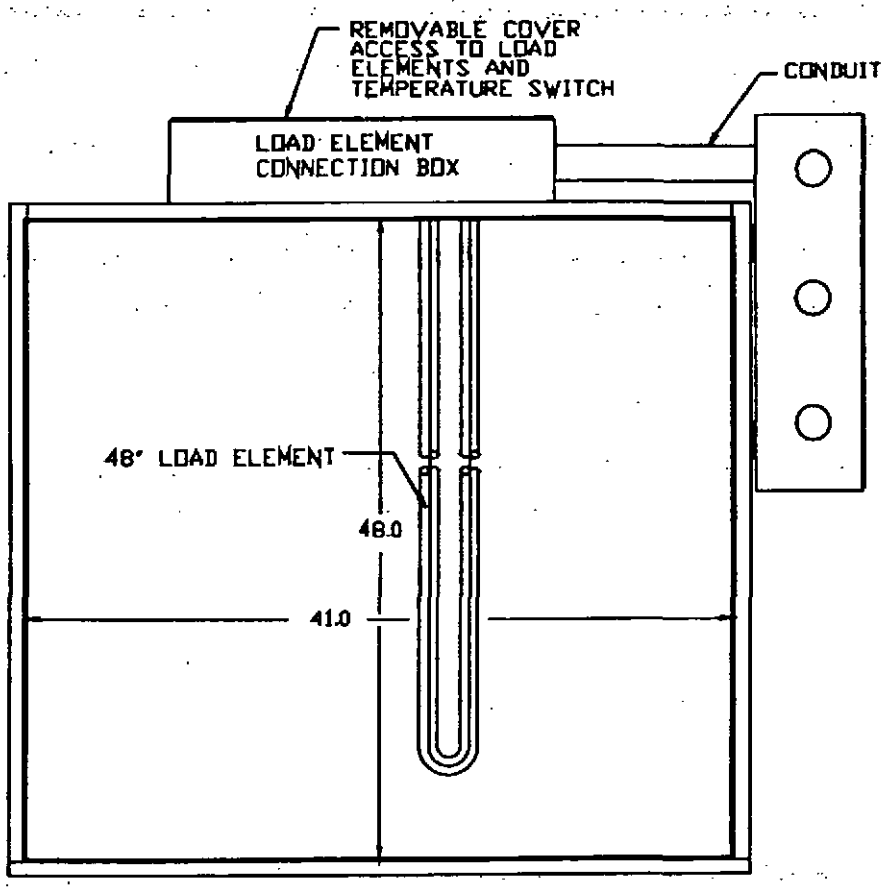
SECTION 2. GENERAL DESCRIPTION



The Simplex LBD Load Bank is a precision instrument specifically designed to apply a discrete, selectable electrical load to a power source. The load bank is designed to test a power source rated at the specifications listed on the product profile sheet inside the cover of this manual. Power source testing is accomplished by applying resistive load steps at unity (1.0) power factor. The maximum total load of the LBD load bank is plus or minus 5% of the model name at the specified voltage (LBD 100 = 100KW). The LBD load bank provides for periodic manual and/or automatic loaded exercise of engine generator sets, enhancing their reliability and performance. Radiator duct mounted load banks (LBD) are built to the customer's specifications. The LBD inner dimension is generally greater than or equal to the radiator outlet dimension. Load bank mounting provisions include radiator flanges, angles, and feet. Mounting dimensions are shown on the dimensional drawing in this manual. Operating controls are located on the load bank local and/or remote control panel. A typical LBD load bank is illustrated above. The load bank is protected against cooling failures (high exhaust air temperature). A cooling failure will immediately de-energize all load contactors. The load bank cooling failure must be corrected before the load can be re-applied to the load source. The LBD load bank consists of two principal systems: the Control System and the Load System. The functions of these systems are described in the following paragraphs.

CONTROL SYSTEM

The load bank Control System allows the operator to apply the desired load to the load source. The Control System also contains the circuitry utilized to detect cooling failures and protect the load bank. The Control System consists of switches located on the control panel and logic circuitry located in the load bank Control Section. 120V control power is supplied to the load bank by one of the following: the test source via a control power transformer, the test source line to neutral, an external source. The generator output is connected directly to the main load block (MLB) or load bus as illustrated on the electrical drawing in the drawing section of this manual.

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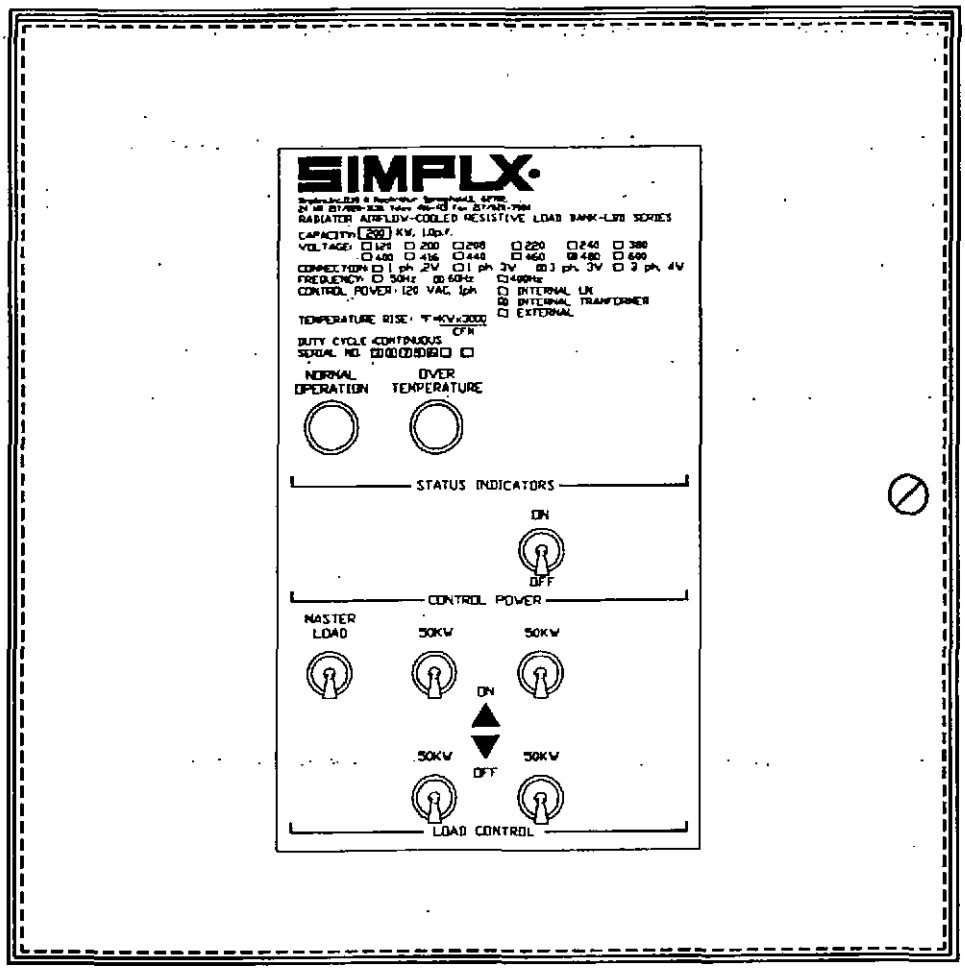
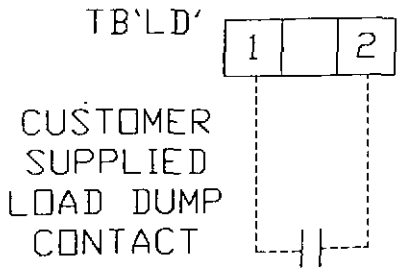
SYSTEM STARTUP - A typical LBD remote control panel and operational nameplate is illustrated below. This nameplate contains important information regarding the load bank specifications including: operating voltage, frequency, control power voltage, capacity, and serial number. Since the LBD is a duct mounted load bank and relies on the generator radiator fan for cooling air flow, the generator must be started and up to speed prior to energizing the load bank. Any attempt to operate the load bank without the generator running with sufficient speed to cool the load elements will cause the load bank to go into a cooling failure. The load bank is activated when the Power Distribution Block or load bus is energized by the test source. The control system is energized by the operator with the control power switch. Control power is supplied to various components in the control system and the cooling failure circuit is armed. System control power is generally supplied by the test source. The load bank user may be required to supply control power externally as specified by the load bank control panel nameplate. Consult the electrical drawing and specification sheet in the front of this manual.



LOAD DUMP - Many LBD load banks contain a load dump feature which will de-energize all applied load when a set of user supplied contacts open. A normally closed device (close to run, open to stop) with contacts rated at 2A @ 24VDC should be wired across terminals 1 and 2 of TB''LB''. When these contacts open all applied load will be immediately de-energized. The load bank user has the option of installing Automatic Transfer Switch contacts, a manual pushbutton, a jumper, a circuit breaker, or other device for this use. The load bank load section is disabled whenever open contacts exist across terminals 1 and 2 of TB''LB''.



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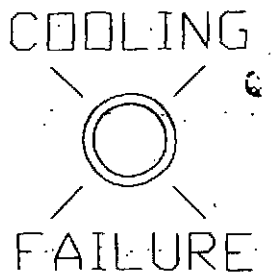
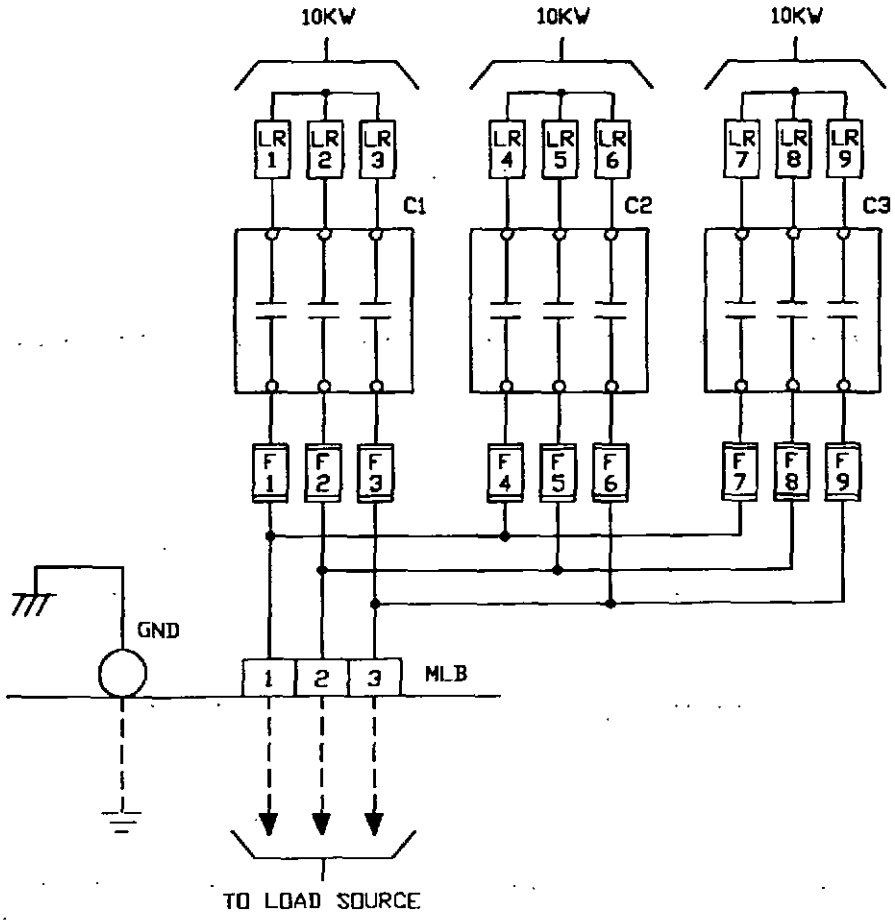


COOLING FAILURE DETECTION - LBD load bank temperature rise is calculated by the following formula: Temperature Rise (°F) = KW multiplied by 3000/CFM. LBD back pressure is less than or equal to .5 inches water. Excessive exhaust temperature (greater than 300°F) will remove the load bank from the load source. The malfunction must be corrected before the load can be re-applied to the load source. The cooling failure detection circuitry consists of an over temperature sensor (and/or pressure or wind switch) with one set of normally closed contacts. The over temperature sensor is located on the exhaust side of the load bank. Sensor contacts are wired in series with the control voltage to the cooling failure relay. During normal operation the cooling failure relay is energized and the Normal Operation lamp (if supplied) is illuminated through cooling failure contacts. Cooling failure contacts are also wired in series with the load step switches. Therefore, excessive exhaust air temperature will open the normally closed temperature switch contacts and de-energize the cooling failure relay. Cooling failure relay contacts will close and the Cooling failure lamp (if supplied) will be illuminated. Cooling failure relay contacts will open and de-energize the load step contactors. This disconnects all the resistive load elements from the load source. When the failure condition no longer exists, the over temperature switch will again be closed and the load selection circuitry will be enabled, as previously described.

LOAD SYSTEM

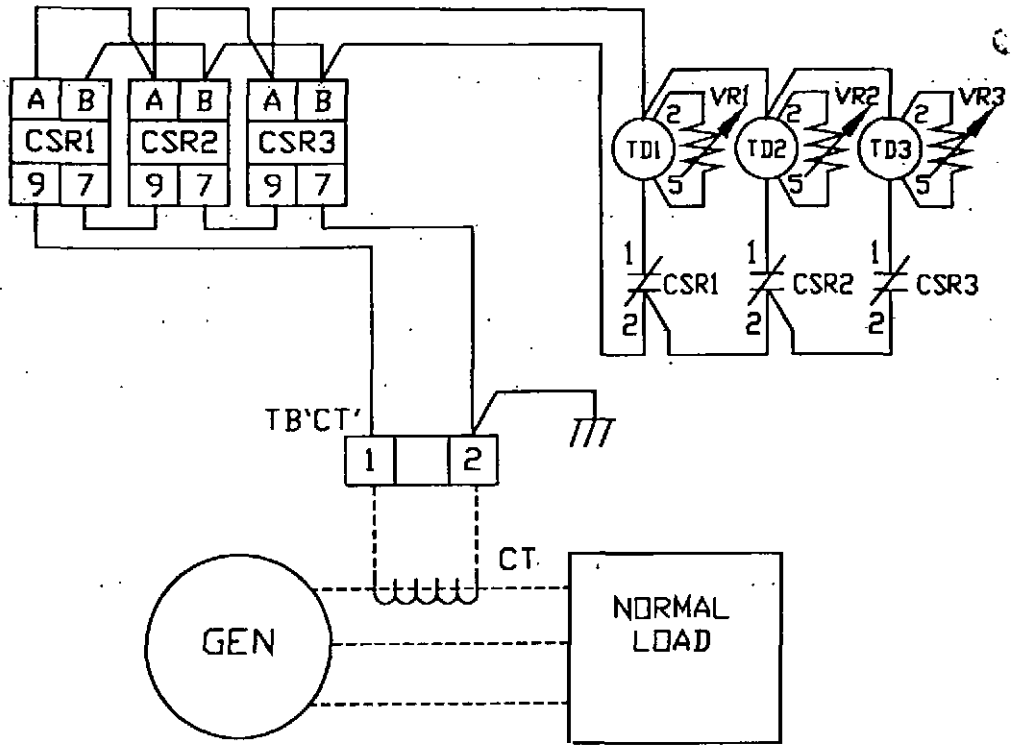
The load system consists of independently controlled resistive elements located in the load bank and operating controls located on the local or remote control panel (see the electrical drawing in the drawing section of this manual). Load steps are protected by 600V, 200,000AIC fuses (F1-F9) as illustrated by the example on the right.



The load steps are applied manually when the load step switches are placed in the "On" position and the load step contactors are energized. The load steps will remain energized until the load step switches are placed in the "Off" position, load dump contacts are opened, or a cooling failure occurs. On load banks with automatic load application the operator is not required to manually energize the load steps. The load source is connected to the Main Load Block (MLB), Power distribution Block, or Load Bus, as illustrated.

AUTOMATIC OPERATION -

An example of an automatic LBD load bank circuit is illustrated on the right. Load application is determined by the set point of current sensing relays. Automatic operation is explained below.



When automatic operation is desired the load step switches on the control panel must be placed in the automatic position. The current sensing relays (CSR) have individually adjustable set points for current. Each relay has a black adjustment knob located at the top of the relay dust cover with an arbitrary 1-15 scale. This knob is utilized to change the current sensing relay set point. Turn the potentiometer knob clockwise for a higher current pick-up point and counterclockwise for a lower current pick-up point (this is a 3/4 turn potentiometer). The current sensing relay outputs energize the time delay relays (TDR) which also have adjustable external potentiometers (VR). TDR contacts are in series with the load step contactors. These time delay relays are adjustable from .1 to 10 seconds (this is a one turn potentiometer). When adjusting the VR set points follow the directions on the white stickers for each individual potentiometer. The current sensors are factory adjusted to the following specifications:

1. This example is for a 30KW load bank consisting of three 10KW steps. With normal load applied to the generator, equal to the load bank rating, no load bank load steps are energized.

2. Load step #1 energizes when the normal load drops below 30KW. (After the specified time delay interval determined by VR1 at TDR1)

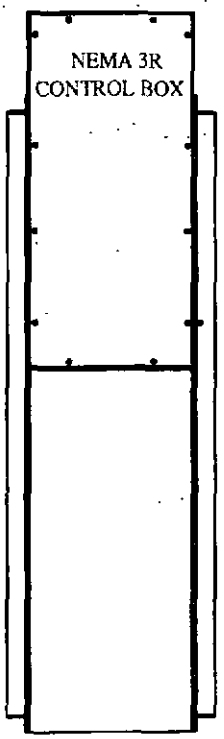
3. Load step #2 energizes when the normal load drops to 20KW. (After the specified time delay interval determined by VR2 at TDR2)

4. Load step #3 energizes when the normal load drops to 10KW. (After the specified time delay interval determined by VR3 at TDR3)

In this example, these factory set points maintain a minimum net load of 30KW on the generator set at all times. All current sensing relays are factory set for a 3 second time delay interval. Any one or all of the relay set points can be changed at any time.

SECTION 3. OPERATING INSTRUCTIONS

LBD, end view



INITIAL SYSTEM CHECK AND INSTALLATION

After the load bank is uncrated, several areas must be checked for problems which may have been caused by rough handling and/or vibrations during shipment.

1. The cabinet should be checked for structural damage that would lessen any electrical clearance or impair the safe operation of the load bank. Accessible electrical connections should be checked for tightness. If loose connections are found, a complete check of all electrical connections is required.

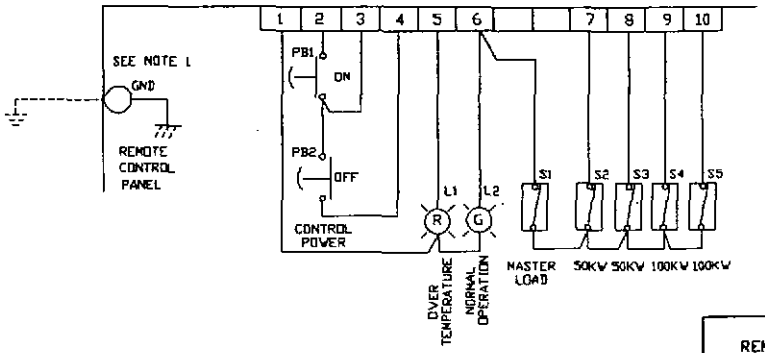
2. MAKE SURE THE LOAD BANK IS PROPERLY GROUNDED PRIOR TO MAKING ANY OTHER CONNECTIONS TO THE LOAD BANK!

3. Make the appropriate load bank-generator connection as shown on the generator connection diagram and the electrical drawing.

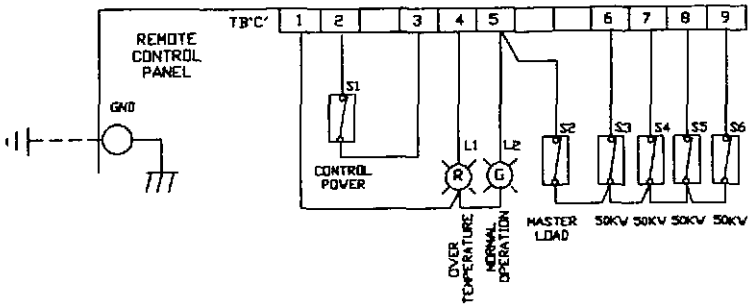
NORMAL OPERATION

1. Perform steps 1 through 4 under "INITIAL SYSTEM CHECK AND INSTALLATION" as necessary.

2. Apply the generator power source to be tested to the load bank. Adjust the voltage and frequency of the load source.



3. Activate the load bank with the control power pushbutton (as shown on the left) or with the control power switch (as shown below). Apply load steps with the master load switch and load step switches.



NORMAL SHUTDOWN

1. De-activate the load with the load step switches. Allow the generator to run for a few minutes to allow cool-down time for the load bank.

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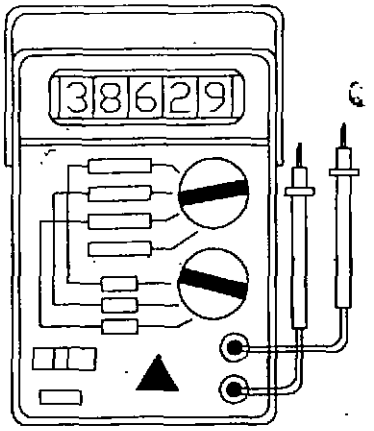
SECTION 4. TROUBLESHOOTING



The following 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 a load bank system always remove all test source power, fan/control power, anti-condensation heater power, etc. If you have questions regarding load bank troubleshooting call the Simplex service department at 217-525-6995 or 217-528-3130 (24HRS).

PROBLEM	CHECK FOR
Cooling failure indicated (exhaust temperature above EXTS setpoint)	1. Fan rotation reversed 2. Fan failure 3. Air restriction (intake or exhaust) 4. Overvoltage condition present 5. Altitude above 3500 ft. 6. Recirculating exhaust air
Cooling failure indicated with fan running (exhaust temperature below EXTS setpoint)	1. Restriction of air (intake or exhaust) 2. Fan pressure switch malfunction 3. Inoperative cooling failure relay
Unbalanced load steps	1. Unbalanced voltage from test source 2. Opened load resistor(s) 3. Blown fuse(s) 4. Inoperative load contactor(s)
Some load steps cannot be energized	1. Inoperative Load Step switches 2. Inoperative Load Step contactor(s) 3. All fuses of load step blown 4. Open load step resistor(s) 5. Remote control panel incorrectly interconnected to load bank

NOTE: IF YOU HAVE ANY QUESTIONS REGARDING LOAD BANK TROUBLESHOOTING CALL THE SIMPLEX SERVICE DEPARTMENT AT 217-525-6995 OR 217-528-3130 (24HRS)

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CALCULATIONS

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.

EXAMPLE

Current readings: L1 = 249A Voltage readings L1-L2 = 481V
L2 = 250A L2-L3 = 479V
L3 = 254A L3-L1 = 483V

$$\text{Average current} = \frac{L1A+L2A+L3A}{3}$$

$$= \frac{249+250+254}{3} = 251A$$

$$\text{Average voltage} = \frac{L1V-L2V+L2V-L3V+L3V-L1V}{3}$$

$$= \frac{481+479+483}{3} = 481V$$

$$\text{Kilowatts} = \frac{VoltsxAmpsx1.732}{1000}$$

$$= \frac{481x251x1.732}{1000} = 209.1KW$$

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.

EXAMPLE - Current reading: 150A Voltage reading: 240V

$$\text{Kilowatts} = \frac{VoltsxAmps}{1000} = \frac{150Ax240}{1000} = 36KW$$

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The following calculations are used to determine the amount ofcurrent 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.

EXAMPLE - Find the amperage of 50KW at a 480V operating voltage:

$$\frac{KWx1000}{Voltsx1.732} = \frac{50x1000}{480x1.732} = \frac{50,000}{831.36} = 60.1Amps$$

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.

EXAMPLE - Find the amperage of 25KW at a 240V operating voltage:

$$\frac{KWx1000}{Volts} = \frac{25x1000}{240} = \frac{2500}{240} = 104.2Amps$$

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.

Example - Find the value of a load step operating at 450VAC with a load step value of 80KW at 480VAC:

$$\text{New KW value} = \frac{\text{New Volts}^2}{\text{Ref. Volts}^2} \times \text{Referenxce KW} = \text{New KW}$$

$$= \frac{450^2}{480^2} = (.9375)^2 \times 80KW = 70.3KW$$

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FORMULAS

		ALTERNATING CURRENT	DIRECT CURRENT
Kilowatts	1 phase	$\frac{\text{VoltsxAmpsxpf*}}{1000}$	$\frac{\text{VoltsxAmps}}{1000}$
	3 phase	$\frac{\text{1.732xVoltsxAmpsxpf}}{1000}$	
Amperes (KW known)	1 phase	$\frac{\text{KWx1000}}{\text{Voltsxpf}}$	$\frac{\text{KWx1000}}{\text{Volts}}$
	3 phase	$\frac{\text{KWx1000}}{\text{1.732xVoltsxpf}}$	
KVA	1 phase	$\frac{\text{VoltsxAmps}}{1000}$	
	3 phase	$\frac{\text{1.732xVoltsxAmps}}{1000}$	
Amperes (KVA known)	1 phase	$\frac{\text{KVAx1000}}{\text{Volts}}$	
	3 phase	$\frac{\text{KVAx1000}}{\text{1.732xVolts}}$	
KVAR	1 phase	$\frac{\text{VoltsxAmpsx 1-pf}^2}{1000}$	
	3 phase	$\frac{\text{1.732xVoltsxAmpsx 1-pf}^2}{1000}$	

*Power factor, expressed as a decimal
(Resistive load bank power factor is 1.0)

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SECTION 5. PARTS LIST

When ordering replacement parts for Simplex LBD load banks, always consult the parts legend on the right hand side of the applicable drawing included in the instruction manual (this document). An example of a partial load bank electrical drawing legend is illustrated below. The most accurate source of load bank part numbers is always the legend found on the load bank electrical control, load, metering, etc. drawings. When contacting the Simplex service department always have your work order and drawing number ready for reference. The drawing numbers and work order number are located on the load bank specification sheet inside the front cover of this manual. They are also located on the load bank drawing legends. A typical drawing legend is illustrated above.

SIMPLX®		SPRINGFIELD, ILLINOIS
SCALE :	APPROVED BY :	DRAWN BY : SDC
DATE : 6-21-89	S.D. CLARK	REVISED : 1.5
RESISTIVE LOAD BANK - CONTROL SECTION 30KW, 3ø, 240V, 60HZ		
W.O. #29958-1-4		DRAWING NUMBER 47D40212

ITEM	DESCRIPTION	PART NO.
MOT	FAN MOTOR 3/4HP,3ø,60HZ,230/460V,TEFC	24638000
FMC	FAN MOTOR CONTACTOR 30A, 600V 3 POLE	13011000
FCB	FAN CIRCUIT BREAKER 5A, 240V, 3POLE	12105000
CF1, CF2	FUSE-CONTROL POWER 5A, 600V, 200,000 AIC	14035000
	FUSE HOLDER 30A, 600V, 2 POLE	15011500
T1	TRANSFORMER 50VA,240V PRI, 120V SEC	25445000
PS	PRESSURE SWITCH	25256500

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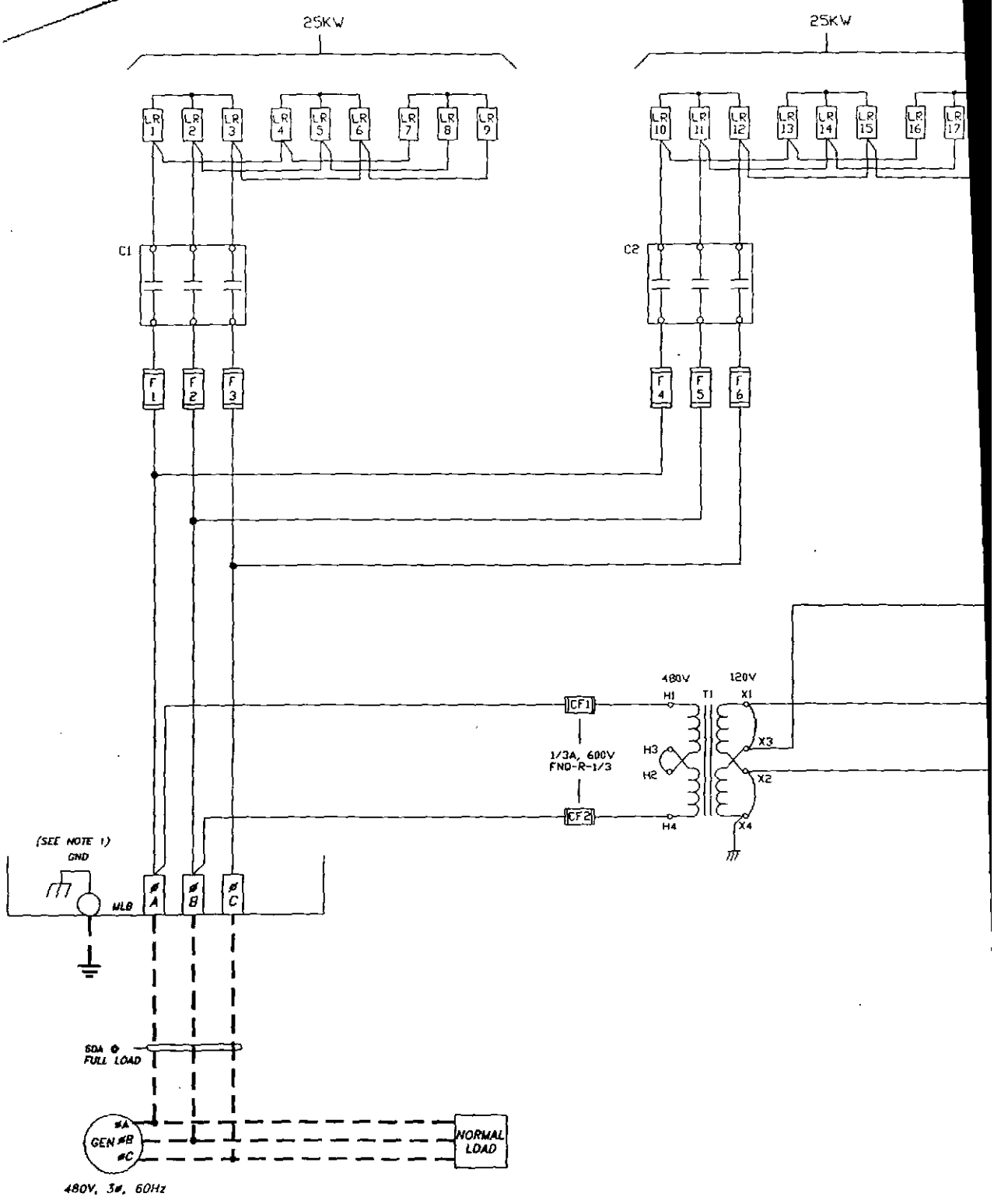
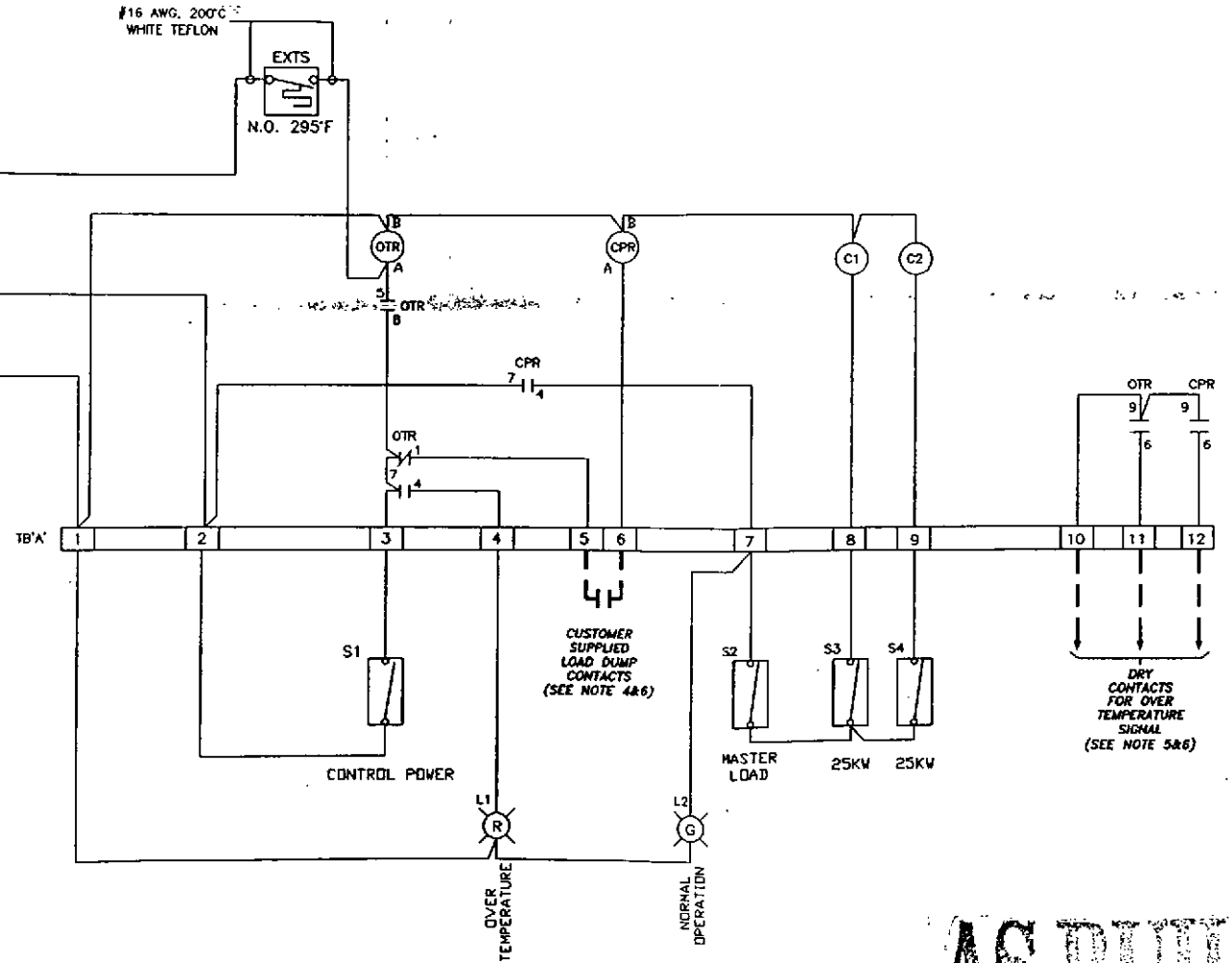


NOTES:

1. UNIT MUST BE GROUNDED FOR OPERATOR'S SAFETY.
2. DASHED LINES INDICATE WIRES NOT SUPPLIED BY SIMPLEX.
3. ALL CONTROL WIRE #16 AWG, 105°C, UNLESS OTHERWISE NOTED.
   ALL LOAD WIRE #12 AWG, 105°C, UNLESS OTHERWISE NOTED.
4. LOAD DUMP CONTACT, OPEN TO DISENGAGE THE LOAD, CLOSE TO ENERGIZE, JUMPER IF NOT USED.
5. CONTINUITY BETWEEN TB'A' 10 & 12 INDICATES NORMAL OPERATION.
   CONTINUITY BETWEEN TB'A' 10 & 11 INDICATES AN OVER TEMPERATURE CONDITION.
6. COPPER WIRE, #14 AWG MINIMUM. TORQUE TO 35 IN*LBS.

LOAD BANK WIRING COLOR CODED AS FOLLOWS:
ALL AC CONTROL WIRE JUMPERS:
LINE SIDE, "A" SIDE OF COIL - RED ("R")
COMMON (GROUND OR NEUTRAL), "B" SIDE OF COIL - BLUE ("B")
ALL AC POWER WIRING:
A PHASE, LINE 1 - BLACK ("BK")
B PHASE, LINE 2 - RED ("R")
C PHASE, LINE 3 - BLUE ("B")
ALL WIRES ATTACHED TO LOAD BANK GROUND - GREEN ("G")
ALL LOAD JUMPERS AND STRAPPING - WHITE ("W")



AS BUILT

DISK S/N: 4441

SIMPLX SPRINGFIELD, ILLINOIS

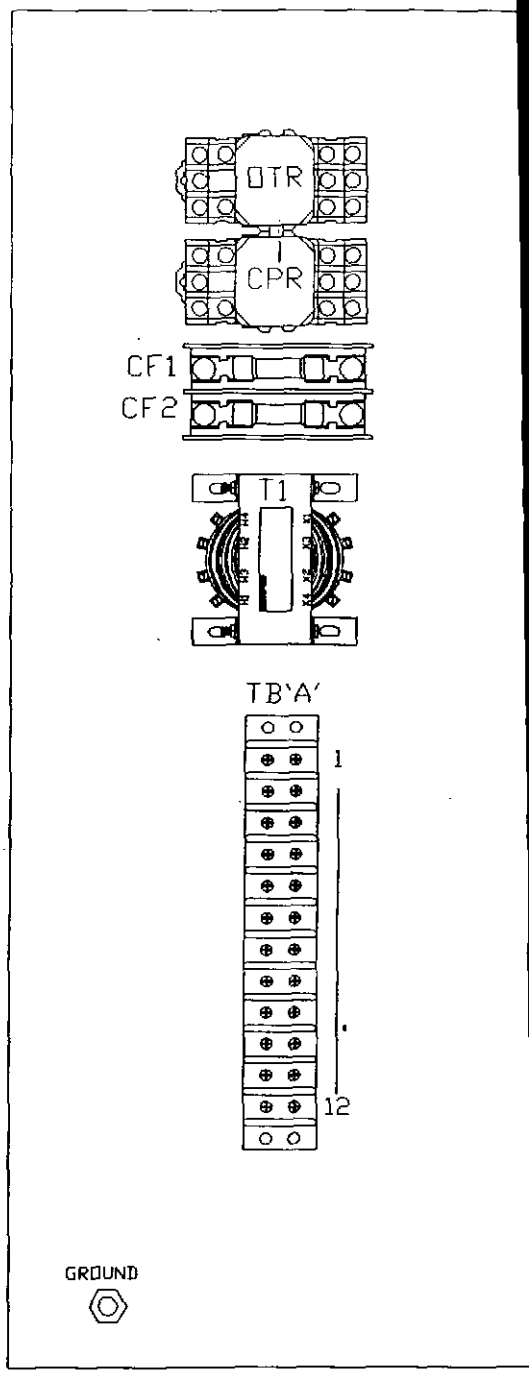
SCALE :	APPROVED BY :	DRAWN BY : ED
DATE : 9/30/99		REVISED :

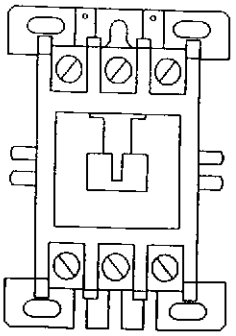
RESISTIVE LOAD BANK
50KW, 480V,3ø,60HZ

LBD-50 UL
CONTROL/LOAD SECTION

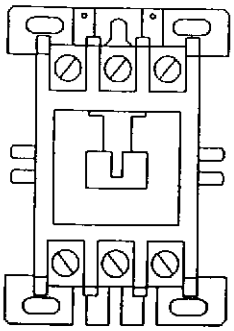
W.O.# 37907-99-43

DRAWING NUMBER
47B103649

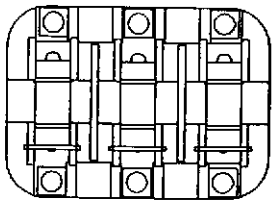




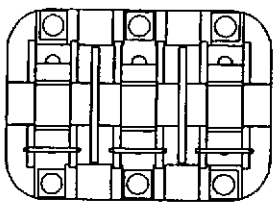
C1



C2

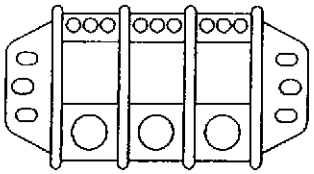


F1 F2 F3



F4 F5 F6

ML B



AS BUILT

DISK S/N: 4441

SIMPLX. SPRINGFIELD, ILLINOIS

SCALE :	APPROVED BY :	DRAWN BY : ED
DATE : 10/01/99		REVISED :

RESISTIVE LOAD BANK
50KW,480V,3ø,60HZ

LBD-50 UL
SUBPANEL LAYOUT

W.O.# 37907-99-43

DRAWING NUMBER
47B103651

	QTY	PART#	DESIG	DESCRIPTION
1	12	24309520	LR1-6 LR10-15	LOAD ELEMENTS, 3333W@277V OPERATING AT 3333W @ 277V 18", INCOLLOY SHEATH
2	6	24304520	LR7-9 LR16-18	LOAD ELEMENTS, 1667W@277V OPERATING AT 1667W@277V 21.25", INCOLLOY SHEATH
3	2	13013100	C1-C2	CONTACTOR 35A, 600V, 3POLE 120VAC COIL
4	2	13901500	CF1-2	FUSE 0.3A, 600V, 200KAIC
5	6	14073000	F1-6	FUSE 35A, 600V, 200KAIC
6	1	15011500	[CF1-2]	FUSEBLOCK 30A, 600V, 2 POLE
7	2	15015500	[F1-6]	FUSEBLOCK 60A, 600V, 3 POLE
8	1	25649500	MLB	MAIN LOAD BLOCK, 175A 600V, 3-POLE, LINE CONS: 2/0-#14AWG, 1 CONN./PH.
9	1	25670000	TB'A'	TERMINAL BLOCK 30A, 600V, 12 LINE
10	1	25445100	T1	TRANSFORMER, 50VA MACHINE TOOL CLASS

ITEM	QTY	PART#	DESIG	DESCRIPTION
11	2	24771000	OTR,CPR	GENERAL PURPOSE RELAY 10A, 240VAC, 3PDT 120VAC COIL
12	2	24891000	[OTR,CPR]	RELAY BASE 11 PIN SCREW TRM
13	4	25303031	S1-4	SWITCH 3R DPST, TOGGLE
14	1	25309790	EXTS	EXHAUST TEMP SWITCH NO, CLOSE @ TEMP >295F
15	2	24261500	L1,L2	LIGHT-BASE 125V, NEON, FOR B2A BULB
16	2	24250500	[L1,L2]	LIGHT-BULB NEON, 125V, B2A HIGH BRIGHTNESS
17	2	24272001	[L1,L2]	LENS CLEAR CYLIND. CLEAR
18	2	16750600	[L1,L2]	O-RINGS FOR NEON LAMP BASE
19	2	16750500	[L1,L2]	O-RINGS FOR NEON LENS
20	1	47BD56534B	[EXTS]	EXTS BOX
21	1	47BD56535	[EXTS]	EXTS COVER

AS BUILT

DISK S/N: 4441

SIMPLX. SPRINGFIELD, ILLINOIS

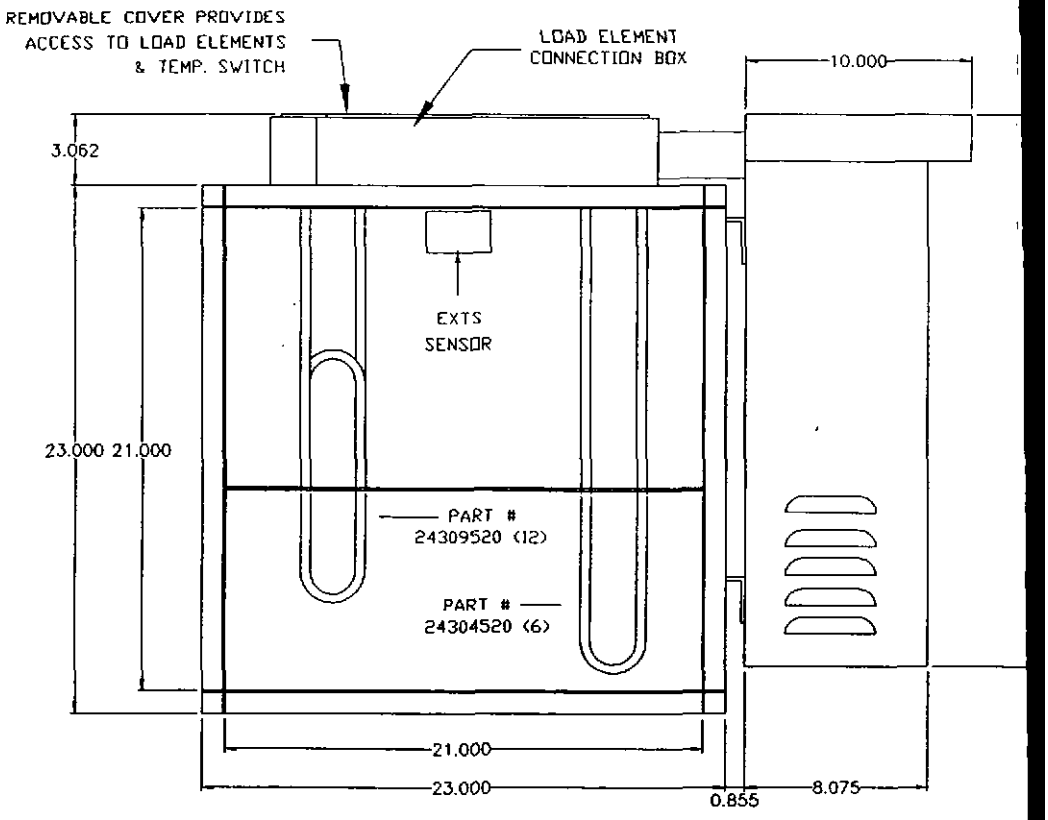
SCALE :	APPROVED BY :	DRAWN BY : ED
DATE : 10/05/99		REVISED :

RESISTIVE LOAD BANK
50KW,480V,3ø,60HZ

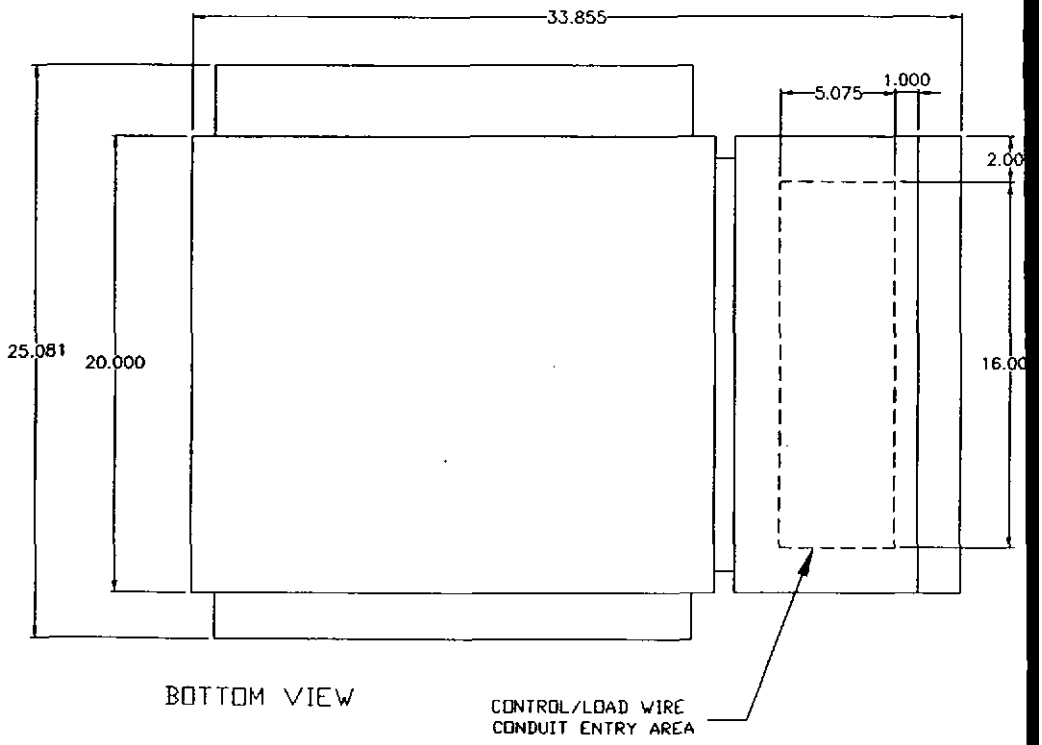
LBD-50 UL
LEGEND

W.O.# 37907-99-43

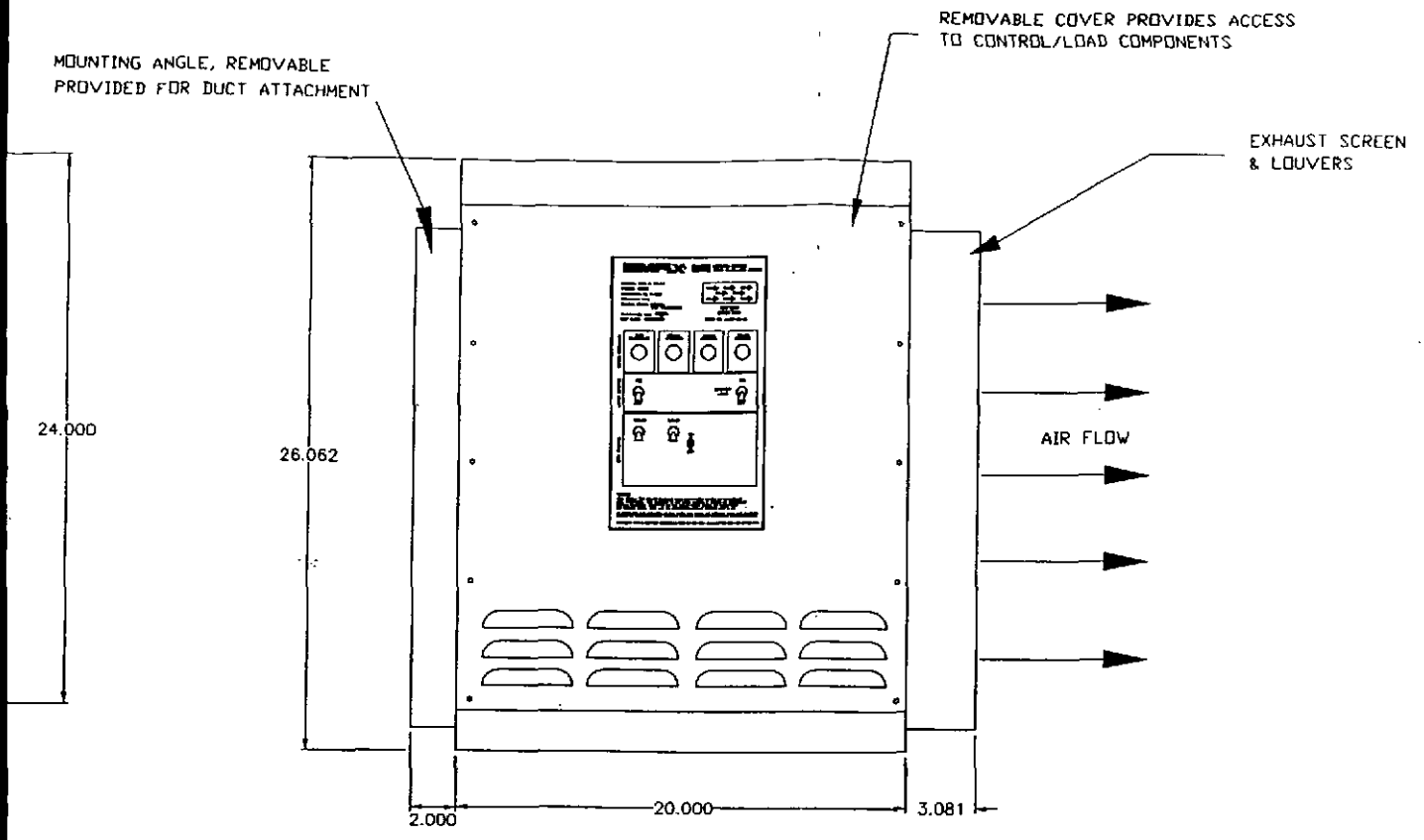
DRAWING NUMBER
47B103652



FRONT VIEW
(VIEW SHOWN LESS EXHAUST SCREEN AND LOUVERS)



BOTTOM VIEW



SIDE VIEW

NOTES:

1) CONTROL & ELEMENT BOX
   MATERIAL - 14 GA. GALV.
2) DUCT FRAME MATERIAL - 12 GA. GALV.
3) CONDUIT - 2" ALUMINUM TUBING
   NEMA 3R

DISK S/N: 4441

SIMPLX. SPRINGFIELD, ILLINOIS

SCALE : 1=1"	APPROVED BY : ED	DRAWN BY : ED
DATE : 10/01/99		REVISED :
RESISTIVE LOAD BANK 50KW,480V,3Ø,60HZ		LBD-50 UL PICTORIAL
W.O. # 37907-99-43		DRAWING NUMBER 47BD103653