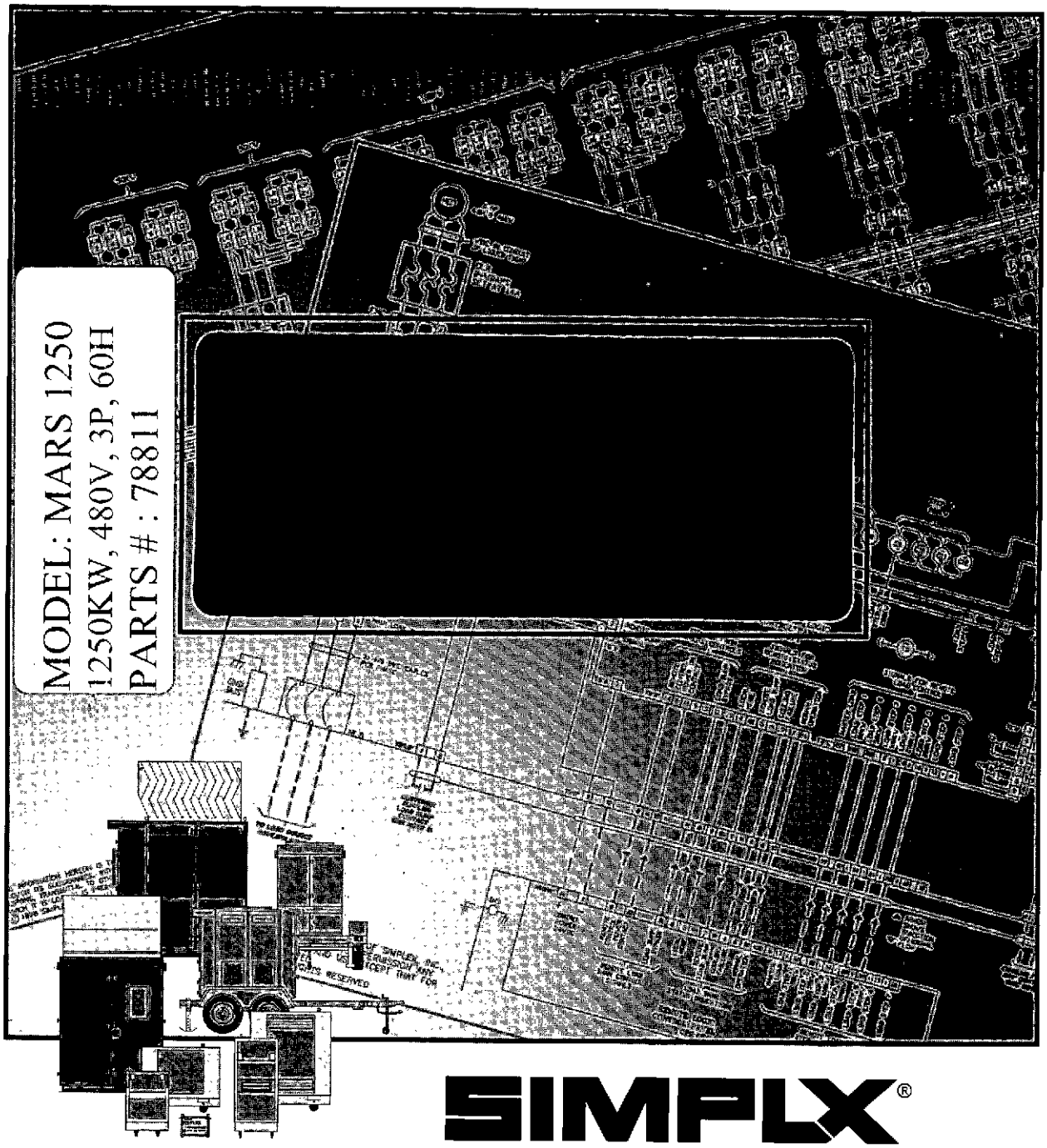
LOAD BANK
TECHNICAL MANUAL



SIMPLX®

LOAD BANKS & FUEL SUPPLY SYSTEMS

Simplex Inc., 1139 N. MacArthur Blvd., Springfield, IL 62702-2314
217-525-6995 (24 hr.) • Fax: 217-525-7984
www.simplexdirect.com

LOAD BANK
TECHNICAL MANUAL

Customer: Katolight Corp.

Work Order: 55819-04-43

Model: Mars 1250 UL

February 2004

(File: 55819.p65; Disk: SDCX153)

Contents

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 provides 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.

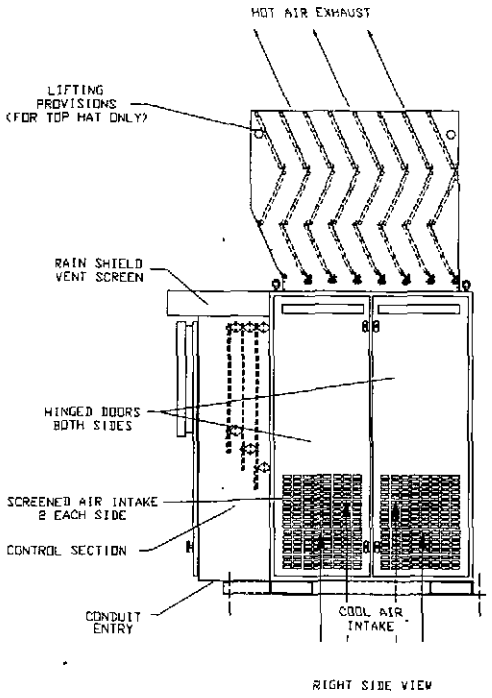
Power source testing is accomplished by applying resistive load steps at unity (1.0) power factor.

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

Operating controls are located on Local and Remote Control Panels. The Control Panels contain printed circuit boards with 24VDC components. DC control power is supplied to the printed circuit boards by a 24VDC power supply located in the Load Bank. Common serviceable components include Control Fuses (CF1–CF2), Load Application Fuses (F1–F75), and Power Supply Fuses (FU1–FU3). Lamps on the control panels indicate the Load Bank operating status. Control priority is determined by the "Load Bank Mode" selector switch: Off, Local-Manual, Local-Auto (NA), Remote.

⚠ WARNING ⚠

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



Part of Pictorial Drawing 7BD86857B

SPECIFICATIONS

Capacity:	1250KW @ 1.0 PF
Voltage:	480VAC, 3ø
Connection:	3-Wire
Frequency:	60Hz
Fan Power:	Internal 480V
Control Power:	Internal 120V Transformer
Cooling:	Forced Air
Airflow:	26,500 CFM
Maximum Air Intake Temp.:	120°F
Nominal Air Temp. Rise:	142°F Nominal
Temperature Rise:	$°F = \frac{KW \times 3000}{CFM}$
Duty Cycle:	Continuous
Serial Number:	55819-04-43

The Local Control Panel contains the following components:

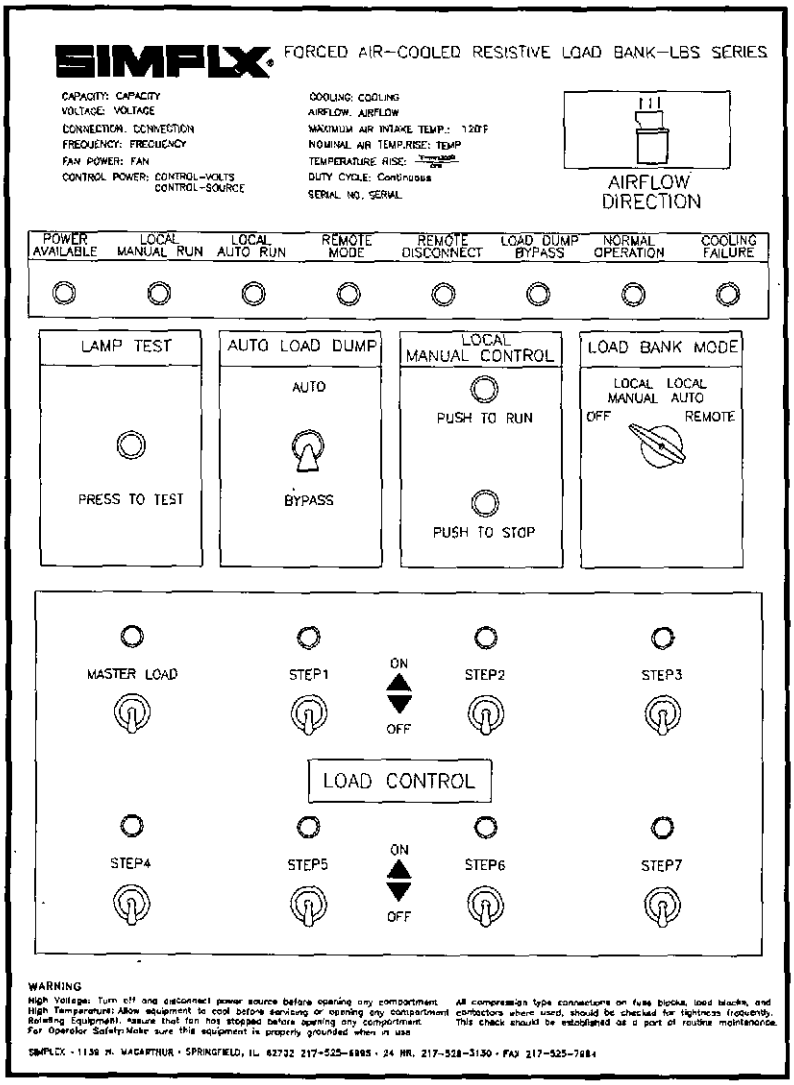
1. Power Available, Local Main Run, Local Auto Run (NA), Remote Mode, Remote Disconnect, Load Dump Bypass, Normal Operation and Cooling Failure indicator lamps
2. Lamp Test pushbutton
3. Auto Load Dump switch
4. Local Manual Control
5. Load Bank Mode switch
6. Master Load and load step indicaor lamps and switches

The Remote Control Panel contains the following components:

1. Control Power switch
2. Cooling Failure and Normal Operation indicator lamps
3. Master Load and load step switches

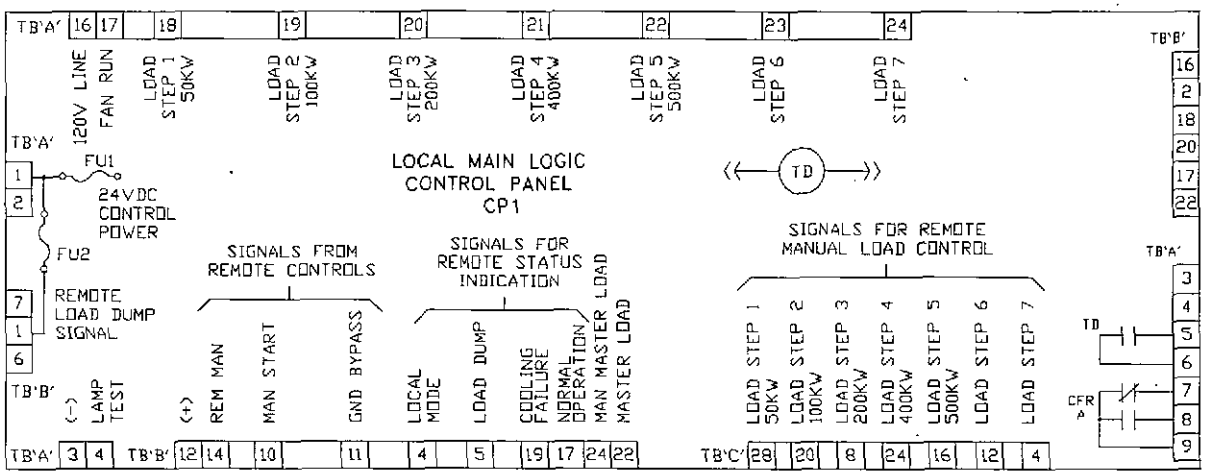
The "Power Available" lamp illuminates when the Load Bus is energized and Control Power is supplied to the system. The "Normal Operation" lamp illuminates when Control Power is available and the Cooling System is operating properly.

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 reapplied.



⚠ 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".



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. The Load Bank Control System components are located on the Local Main Logic Control Panel (CP1) printed circuit board.

Control power (120V) is supplied to the input of the 24VDC power supply (DCS) via the control power transformer (T1).

The 24VDC output of DCS is applied to the Local and Remote Main Logic Control panel circuit boards. 120V control power is applied to the coil of the Fan Motor Contactor (FMC) through terminal TB'A' 17 of the Main Logic Control Panel printed circuit board. Fan power is applied to the Fan Motor (MOT) through the Disconnect Switch (DSW), the Fan Circuit Breaker (FCB) and the Fan Motor Contactor (FMC) contacts.

COOLING SYSTEM

Resistive Load Elements are cooled by a forced air system consisting of a 42" fan blade directly driven by a 10HP, TEFC motor, creating a 26,500 CFM. The fan motor is energized by a 3 pole, 35A-resistive, 600VAC contactor and protected by a 100A frame, 20A trip, 3 pole circuit breaker.

⚠ 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.

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.

Simplex Resistive Load Elements conservatively operate at approximately half the maximum temperature rating of the alloy (1080°F vs. 1920°F). For example:

Alloy: FeCrAl

Ratings: 3333W@120V
4170W@139V

Connections: 120V wye (208V),
139V wye (240V, 3ø),
277V wye (480V, 3ø),
240 delta (240V, 3ø), or
480 delta (480V, 3ø).

See Parts Legend Drawing for specific elements used.

These elements are rigidly supported by high-temperature, ceramic-clad, stainless-steel supports. Element-to-element short circuits are virtually eliminated. The elements are assembled in discrete trays which are assembled in a vertical "stack". Each tray is independently serviceable without disturbing adjacent trays.

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.
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.

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

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 the top of the cabinet. This Load Bank will produce a large quantity of exhaust air. 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 6 feet on all other sides of the Load Banks.
- Load Banks installed indoors must be equipped with an exhaust air duct of minimum back pressure (supplied by others) which routes all Load Bank hot exhaust air outdoors.
- Never install any structure or object at any height above the Load Bank.
- Always locate the Load Bank in a secure area accessible by trained personal only.
- Use the eyehooks and forklift channels provided to position the Load Bank.
- Never move the Load Bank with the exhaust hood attached.
- 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.

Failure to properly install this Load Bank may result in substantial damage to or the destruction of the Load Bank, adjacent equipment and the building in which the Load Bank is installed.

PROCEDURE

1. Confirm the test source is properly grounded and ground the Load Bank to its own independent ground.
2. *See Remote Panel Drawing 47BD-138338A.* Using slots provided mount the remote control panel to the desired location and ground it to its own independent ground.

   Caution: This panel is energized (24VDC) whenever the Load Bank is in operation.
3. Confirm all load command switches are in the "Off" position.
4. Confirm the Fan Circuit Breaker (FCB) is in the "Off" position.
5. *See Control Section Drawing 47B-138330:*

   a. Cable the load source to the Load Bank as shown. Consult NEC for proper wire size.

   b. Using copper wire #14 or greater, with a torque of 35 in. lbs., connect customer supplied Load Dump contacts to TB'LD' 1–2 or place the "Load Dump Mode" switch in the "Bypass" position.

   Load Dump Contact, open to disengage, close to energize.

c. If desired, using copper wire #14 or greater, with a torque of 35 in. lbs., connect customer supplied cooling failure contacts. Dry contacts are rated 10A @ 125VAC; 10A @ 28VDC.

Continuity between TB'CF' 1 and 3 indicates Cooling Failure.

Continuity between TB'CF' 1 and 2 indicates Normal Operation.

6. *See Remote Control Drawing 47B-138331.* Using copper wire #14 AWG or greater with a torque of 35 in. lbs., connect TB'R1' 1–11 on the Load Bank to the corresponding TB'R2' contacts on the Remote Control Panel.
7. Place the Fan Circuit Breaker (FCB) in the "On" position.

OPERATION

1. Place the "Load Bank Mode" switch in the "Local Manual" or "Remote" position.
2. Start-up generator or bring other test source on line.
3. Adjust power source voltage and frequency.
4. Confirm the illumination of the "Power Available" lamp.
5. Press the "Push to Run" pushbutton to energize the cooling fan.

   A false "Cooling Failure" lamp indication will be present until the cooling fan creates sufficient airflow to close the Fan Pressure Switch (PS). The "Normal Operation" lamp illuminates and control voltage is supplied to the "Master Load" switch. With voltage supplied to the "Master Load" switch, the operator is now ready to apply load steps.
6. Verify the illumination of the "Normal Operation" lamp before proceeding.
7. Visually observe correct fan operation and investigate any unusual fan related noises.
8. Check air intake for obstructions and confirm positive air flow.
9. Select the desired load steps by placing them in the "On" position.
10. Place the "Master Load" switch in 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 "Master Load" is in the "On" position.
11. Adjust source voltage and load. Monitor as needed.

LOAD DUMP

This Load Bank contains a Load Dump feature which de-energizes all applied load when customer supplied contacts open. Normally closed to run, they are rated at 2A @ 24VDC and should be wired to TB'LD' 1–2. When these contacts open all applied load will be de-energized and the load section will be disabled. If desired, the cus-tomer may install automatic transfer switch contacts, a manual pushbutton or circuit breaker for this use.

The operator also has the option of bypassing these contacts and enabling the load section by flipping the "Auto Load Dump" switch to the "Bypass" position. This disables the load dump feature and illuminates the "Load Dump Bypass" lamp.

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. Press the "Push to Stop" pushbutton.

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 components:

1. Time Delay Relay (TDR)
2. Intake Temperature Switch (INTS)
3. Exhaust Temperature Switch (EXTS)
4. Pressure Switch (PS)

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 high 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 top exhaust vent.

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".

MOTOR LUBRICATION

Motors are properly lubricated at the time of manufacture. It is not necessary to lubricate at the time of installation unless the motor has been in storage for a period of 12 months or longer (refer to lubrication procedure that follows).

Inspect the fan motor supplied with your Load Bank for grease fittings. If the motor contains grease fittings you must lubricate the motor. If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction. Belt driven cooling fans have bearings which should be lubricated. Bearings should be lubricated every 50 hours of operation or 6 months whichever comes first.

RELUBRICATION TIME INTERVAL
for motors with regreasing provisions.

	NEMA Frame Size					
	140 – 180		210 – 360		400 – 510	
	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM
Standard	3 yrs.	8 mo.	2 yrs.	8 mo.	1 yr.	3 mo.
Severe	1 yr.	3 mo.	1 yr.	3 mo.	6 mo.	1 mo.
Seasonal	See Note 2.					

Standard: Up to 16 hours of operation per day, indoors, 100°F maximum ambient.

Severe: Greater than 16 hours of operation per day. Continuous operation under high ambient temperatures (100° to 150°F) and/or any of the following: dirty, moist locations, high vibration (above NEMA standards), heavy shock loading, or where shaft extension end is hot.

Seasonal: The motor remains idle for a period of 6 months or more.

Note:

1. For motors nameplated as "belted duty only" divide the above intervals by 3.
2. Lubricate at the beginning of the season. Then follow service schedule above.

Lubrication Procedure

1. Stop motor. Disconnect and lock out of service.
2. Remove contaminants from grease inlet area.
3. Remove filler and drain plugs.
4. Check filler and drain holes for blockage and clean as necessary.
5. Add proper type and amount of grease. See the **Relubrication Time Intervals** table for service schedule and **Relubrication Amounts** table (see next page) for volume of grease required.
6. Wipe off excess grease and replace filler and drain plugs.
7. Motor is ready for operation.

   Warning: If motor is nameplated for hazardous locations, do not run motor without all of the grease or drain plugs installed.

⚠ WARNING ⚠

If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction.

⚠ WARNING ⚠

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

Grease Type

Unless stated otherwise on the motor nameplate, the motors on this Load Bank are pregreased with a polyurea mineral oil NGLI grade 2 type grease. Some compatible brands of polyurea mineral base type grease are:

- Chevron SRI #2
- Rykon Premium #2
- Exxon Polyrex EM
- Texaco Polystar RB

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. Inoperative Fan Circuit Breaker (FCB)
2. Fan/Control Power not available/incorrect
3. Inoperative Fan Motor (MOT)
4. Fan Motor Contactor (FMC) de-energized
5. Restriction of air (intake or exhaust)
6. Fan pressure switch inoperative

RELUBRICATION AMOUNTS for motors with regreasing provisions.	
NEMA Frame Size	**Volume cu. in. (fluid oz.)**
140	.25 (.14)
180	.50 (.28)
210	.75 (.42)
250	1.00 (.55)
280	1.25 (.69)
320	1.50 (.83)
360	1.75 (.97)
400	2.25 (1.2)
440	2.75 (1.5)
500	3.00 (1.7)

⚠ WARNING ⚠

Overgreasing is a major cause of bearing and/or motor failure. The amount of grease added should be carefully controlled. Also make sure dirt and contaminants are not introduced when adding grease.

⚠ WARNING ⚠

If motor is nameplated for hazardous locations, do not run motor without all of the grease or drain plugs installed.

⚠ WARNING ⚠

Do Not allow the Load Bank to operate unattended for extended periods.

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

Exhaust temp below EXTS setpoint:

1. Restriction of air (intake or exhaust)
2. Fan pressure switch inoperative
3. Overtemperature sensor failure

TEST METERS DO NOT OPERATE PROPERLY

1. Meter voltage switch failure
2. Meter multiplier resistor inoperative
3. Improper positioning of meter voltage selector switch
4. Current transformer or current transformer wiring failure
5. Test meter failure
6. Meter fuses open

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 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 below.*

SIMPLX®		SPRINGFIELD, ILLINOIS
SCALE :	APPROVED BY :	DRAWN BY : BC
DATE : 2/4/04		REVISED :
RESISTIVE LOAD BANK 1250KW,480V,3ø,60Hz		MARS-1250 UL CONTROL
W.O.# 55819-04-43		DRAWING NUMBER 47B138330

ITEM	QTY	PART#	DESIG	DESCRIPTION
1	150	24299630	LR1-LR150	LOAD RESISTORS 8333W @ 240V POWER-WEB
2	1	13014100	FMC	CONTACTOR, 3-POLE 35A-RESISTIVE, 600VAC 120VAC,50/60Hz,5VA COIL
3	25	13022500	C1-25	CONTACTOR, 3-POLE 65A-RESISTIVE, 600VAC 120VAC,50/60Hz,14VA COIL
4	2	14013000	CF1,2	FUSE, TIME DELAY 2A, 600V, 200KAIC
5	75	14086000	F1-75	FUSE, VERY FAST ACTING 70A, 600VAC, 200KAIC
6	1	15011500	[CF1,2]	FUSEBLOCK 30A, 600V, 2 POLE QUICK-CONNECT
7	2	7BD44465C	MLB'A'	MAIN LOAD BUS 0.25" X 3.00" X 30.50" TIN PLATED COPPER BAR

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

$$\text{Average Current} = \frac{A_1 + A_2 + A_3}{3}$$

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

$$= 251A$$

$$\text{Average Voltage} = \frac{V_{1-2} + V_{2-3} + V_{3-1}}{3}$$

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

$$= 481V$$

$$\text{Kilowatts} = \frac{\text{Volts x Amps x } 1.732}{1000}$$

$$= \frac{481 \times 251 \times 1.732}{1000}$$

$$= 209.1KW$$

Single Phase

Current Reading: 150A Voltage Reading: 240V

$$\text{Kilowatts} = \frac{\text{Volts x Amps}}{1000}$$

$$= \frac{150 \times 240}{1000}$$

$$= 36.1KW$$

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

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

$$= \frac{50 \times 1000}{480 \times 1.732}$$

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

$$= 60.1$$

Single Phase

Applied: 25KW Operating Voltage: 240V

$$\text{Amperage} = \frac{\text{KW} \times .1000}{\text{Volts}}$$

$$= \frac{25 \times 1000}{240}$$

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

$$= 104.2$$

Determining step KW at other than rated voltage:

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

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

$$= (450 \div 480)^2 \times 80$$

$$= .9375^2 \times 80$$

$$= 70.3$$

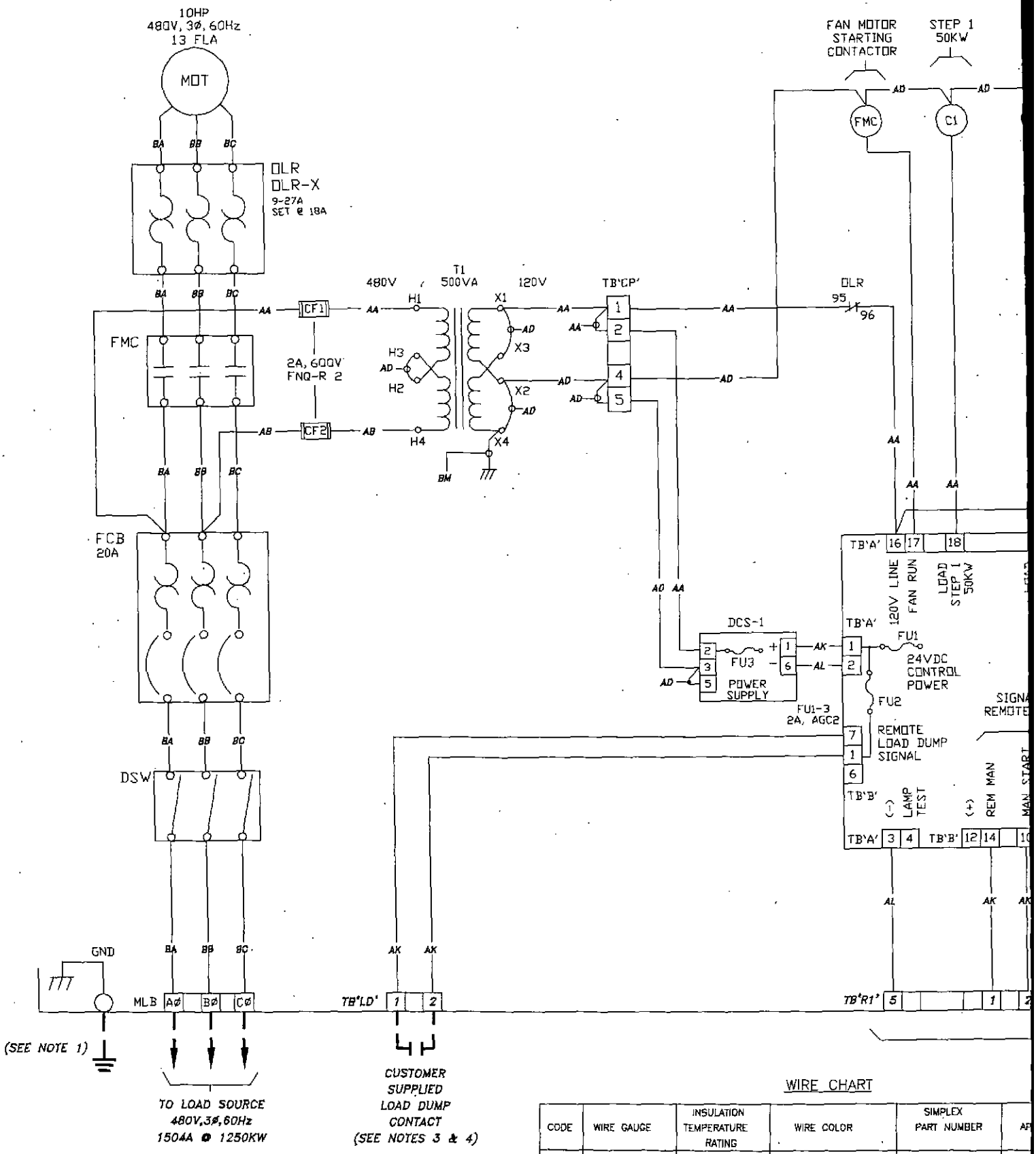
FORMULAS

		Alternating Current	Direct Current
Kilowatts	1 phase	$\frac{\text{Volts x Amps x PF*}}{1000}$	$\frac{\text{Volts x Amps}}{1000}$
	3 phase	$\frac{\text{1.732 x Volts x Amps x PF*}}{1000}$	
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	$\frac{\text{1.732 x Volts x Amps x } \sqrt{1-PF^2}}{1000}$	

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

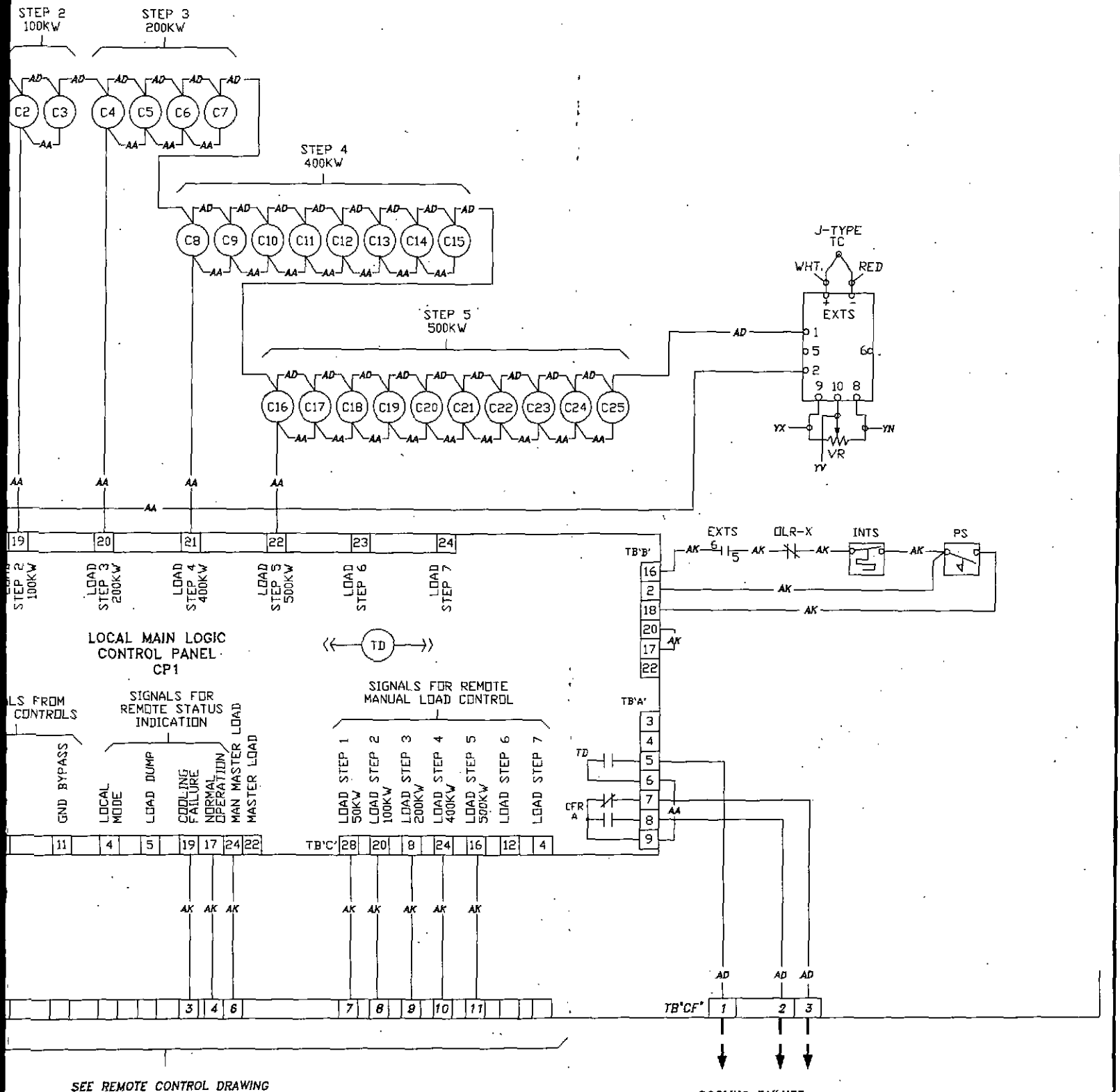
APPENDIX C - DRAWINGS

Title	Drawing
Control	47B138330
Remote Control	47B138331
Load	47B138332
Strapping	47B138333
Non-Standard Elements	47B138334
Parts Legend	47B138335
Pictorial	7BD86857B
Tray Layout	47BD138336A
Subpanel	47BD138337
Remote Panel	47BD138338A
Nameplates	47BD138339



WIRE CHART

CODE	WIRE GAUGE	INSULATION TEMPERATURE RATING	WIRE COLOR	SIMPLEX PART NUMBER	AP
YV	20 AWG	80°C	VIOLET (PURPLE)	25512140	CO
YN	20 AWG	80°C	YELLOW	25512150	CO
YX	20 AWG	80°C	ORANGE	25512155	CO
AA	16 AWG	105°C	BLACK	25518200	øA,
AB	16 AWG	105°C	RED	25518100	
AD	16 AWG	105°C	WHITE	25518000	CONT
AK	16 AWG	105°C	RED W/WHITE STRIP	25518310	DC C
AL	16 AWG	105°C	BLACK W/WHITE STRIP	25518320	DC C
BA	14 AWG	105°C	BLACK	25524500	
BB	14 AWG	105°C	RED	25526000	
BC	14 AWG	105°C	BLUE	25525000	
BM	14 AWG	105°C	GREEN	25526150	



PLICATION
TROL, EXTS
TROL, EXTS
TROL, EXTS
ONTROL-LINE
ØB
ROL-NEUTRAL
ONTROL, POS.
ONTROL, OVDC
ØA
ØB
ØC

NOTES:

1. *UNIT MUST BE GROUNDED FOR OPERATORS SAFETY.*
2. *DASHED LINES INDICATE WIRING NOT SUPPLIED BY SIMPLEX.*
3. *LOAD DUMP CONTACT, OPEN TO DISENGAGE THE LOAD, CLOSE TO ENERGIZE, JUMPER IF NOT USED.*
4. *COPPER WIRE, #14 AWG MINIMUM. TORQUE TO 35 IN*LBS.*
5. *CONTINUITY BETWEEN TB'CF' 1 & 3 INDICATES A COOLING FAILURE. CONTINUITY BETWEEN TB'CF' 1 & 2 INDICATES NORMAL OPERATION. DRY CONTACTS RATED 10A @ 125VAC; 10A @ 28VDC.*

DISK S/N: 4472

SIMPLX® SPRINGFIELD, ILLINOIS

SCALE :	APPROVED BY:
DATE : 2/4/04	DRAWN BY : BC
	REVISED :

RESISTIVE LOAD BANK
1250KW,480V,3ø,60Hz

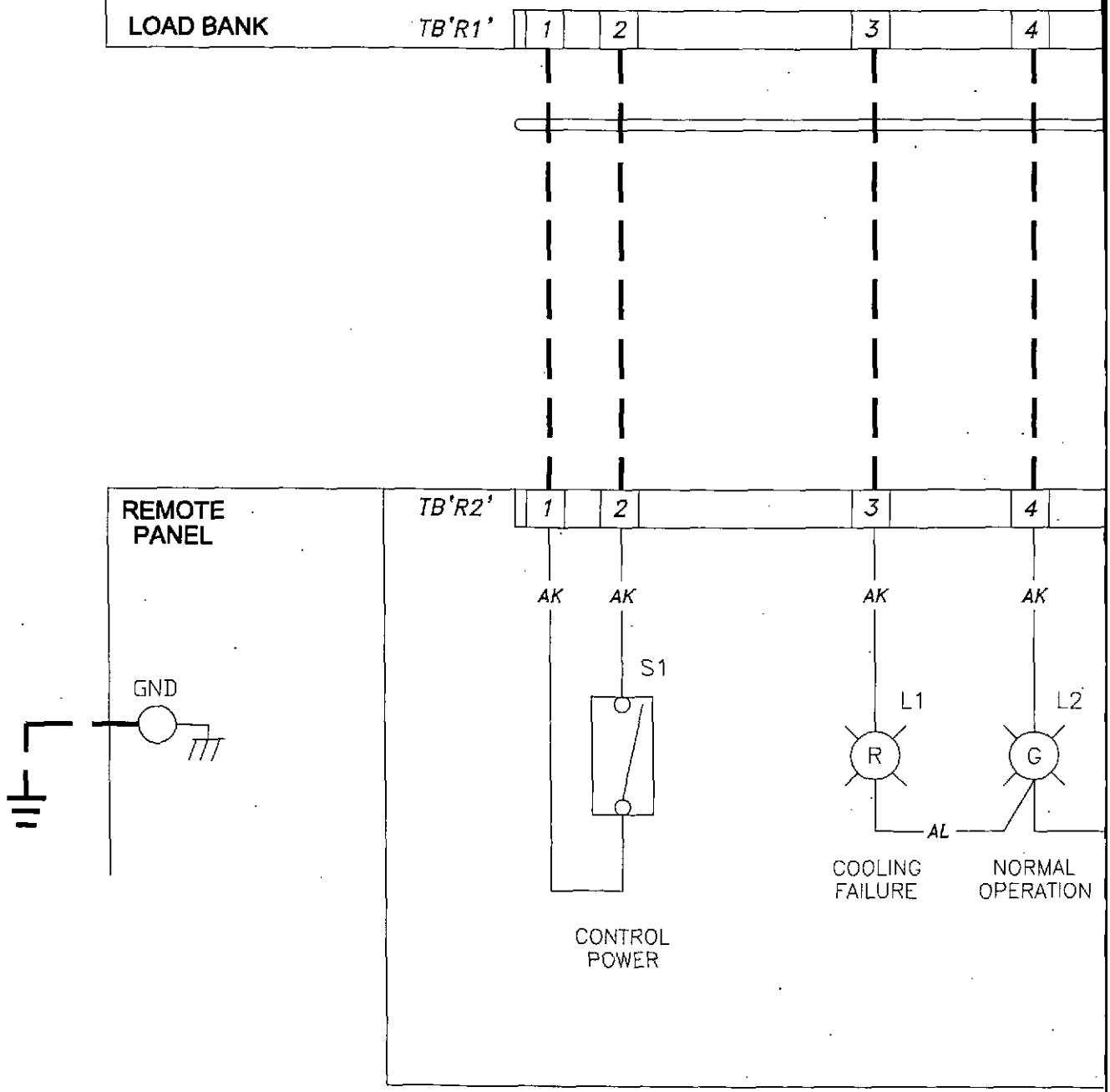
MARS-1250 UL
CONTROL

W.O.# 55819-04-43

DRAWING NUMBER
47B138330

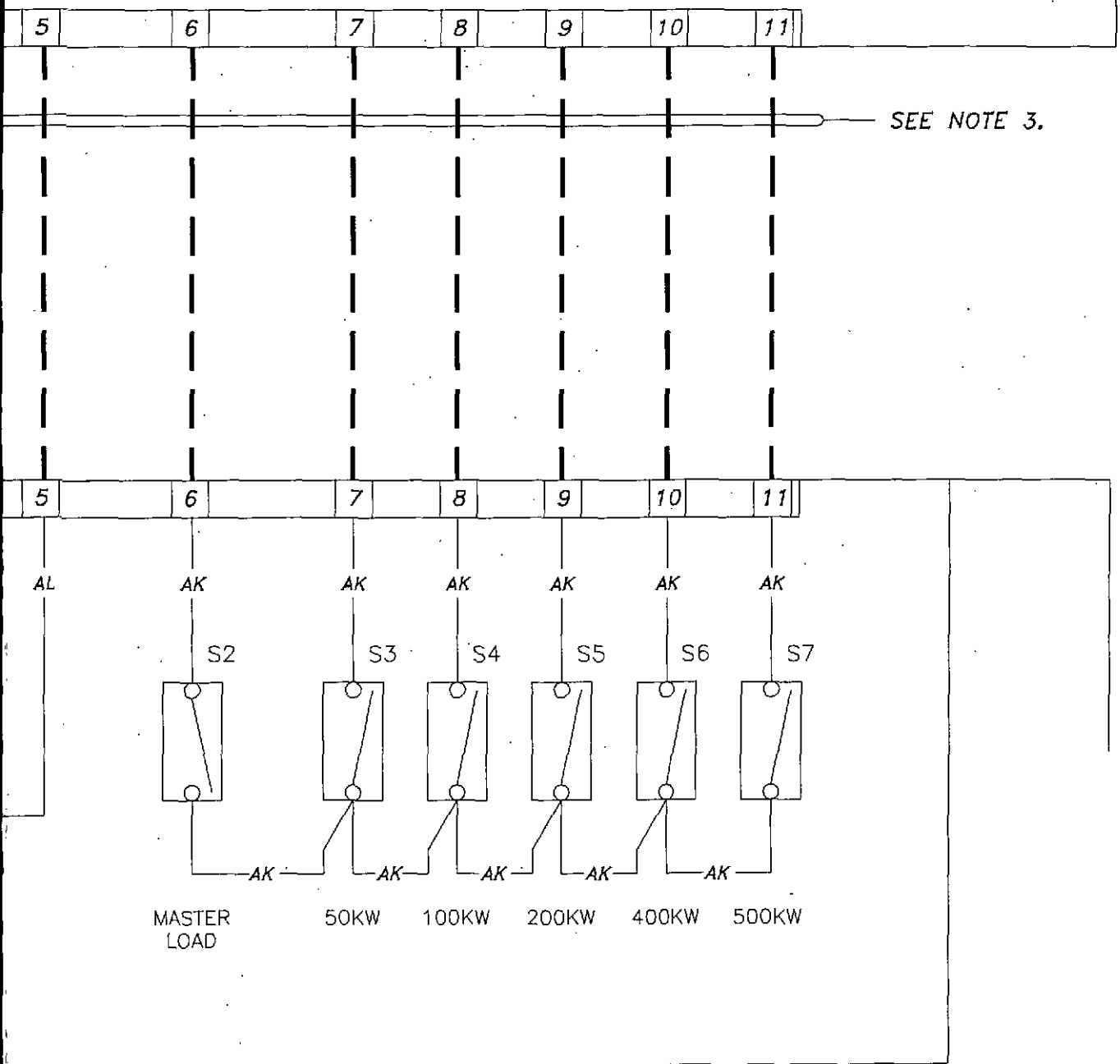
NOTES:

1. UNIT MUST BE GROUNDED FOR OPERATORS SAFETY.
2. DASHED LINES INDICATE WIRING NOT SUPPLIED BY SIMPLEX.
3. COPPER WIRE, #14 AWG MINIMUM. TORQUE TO 35 IN*LBS.



WIR

CODE	WIRE GAUGE	INSULATION TEMPERATURE RATING	WIR
AK	16 AWG	105°C	RED
AL	16 AWG	105°C	BLACK



E CHART

E COLOR	SIMPLEX PART NUMBER	APPLICATION
W/WHITE STRIP	25518310	DC CONTROL, POS.
W/WHITE STRIP	25518320	DC CONTROL, 0VDC

DISK S/N: 4472

SIMPLX® SPRINGFIELD, ILLINOIS

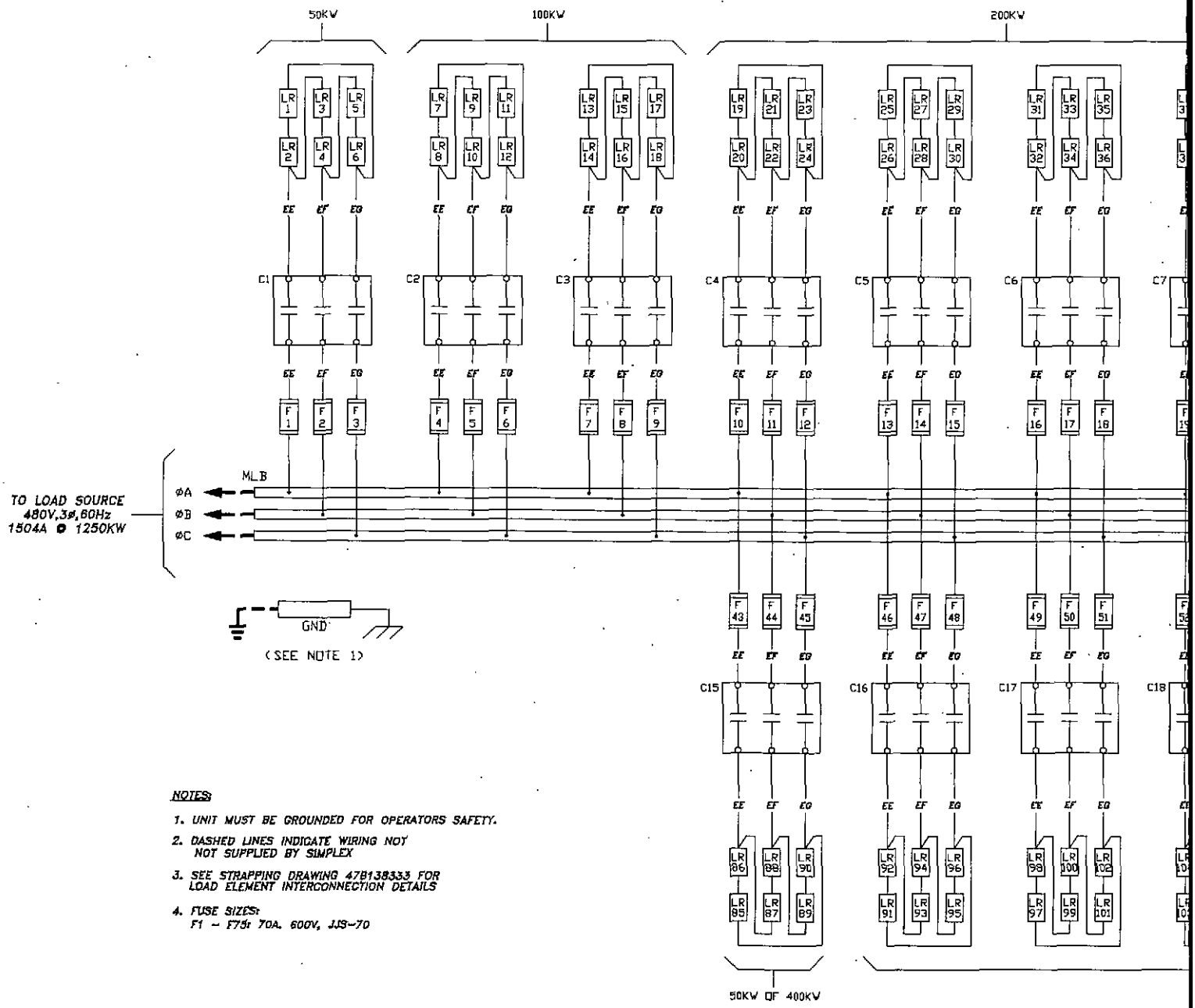
SCALE :
DATE : 2/4/04
APPROVED BY:
DRAWN BY : BC
REVISED :

RESISTIVE LOAD BANK
1250KW,480V,3ø,60Hz

MARS-1250 UL
REMOTE CONTROL

W.O.# 55819-04-43

DRAWING NUMBER
47B138331

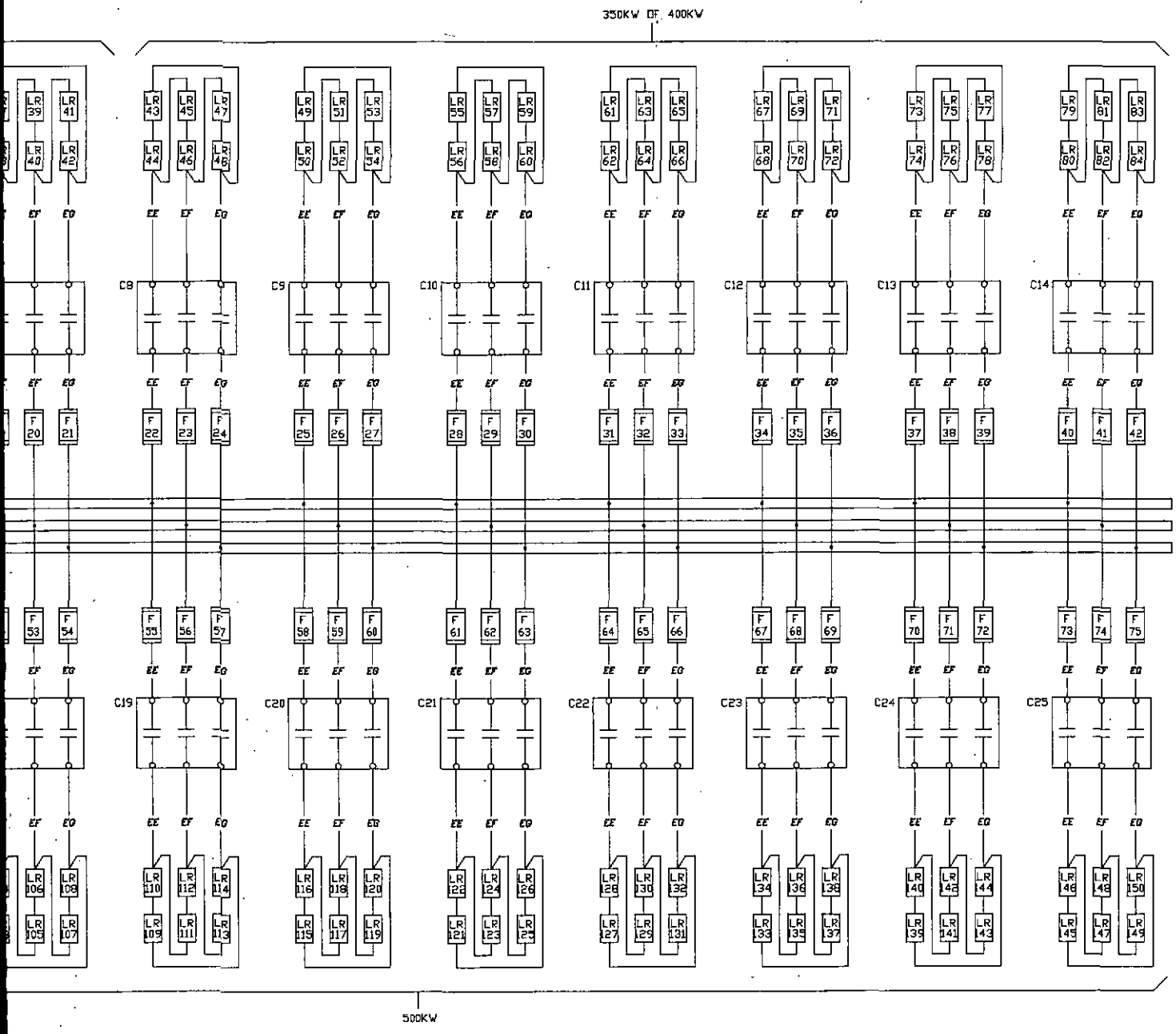


NOTES:

1. UNIT MUST BE GROUNDED FOR OPERATORS SAFETY.
2. DASHED LINES INDICATE WIRING NOT NOT SUPPLIED BY SIMPLEX
3. SEE STRAPPING DRAWING 47B138333 FOR LOAD ELEMENT INTERCONNECTION DETAILS
4. FUSE SIZES:
   F1 – F75: 70A, 600V, JJS-70

WI

CODE	WIRE GAUGE	INSULATION TEMPERATURE RATING	W
EE	8 AWG	150°C	
EF	8 AWG	150°C	
EG	8 AWG	150°C	



RE CHART

RE COLOR	SIMPLEX PART NUMBER	APPLICATION
BLACK	25633100	øA LOAD
RED	25633200	øB LOAD
BLUE	25633300	øC LOAD

DISK S/N: 4472

SIMPLX® SPRINGFIELD, ILLINOIS

SCALE :	APPROVED BY:	DRAWN BY : BC
DATE : 2/2/04		REVISED :

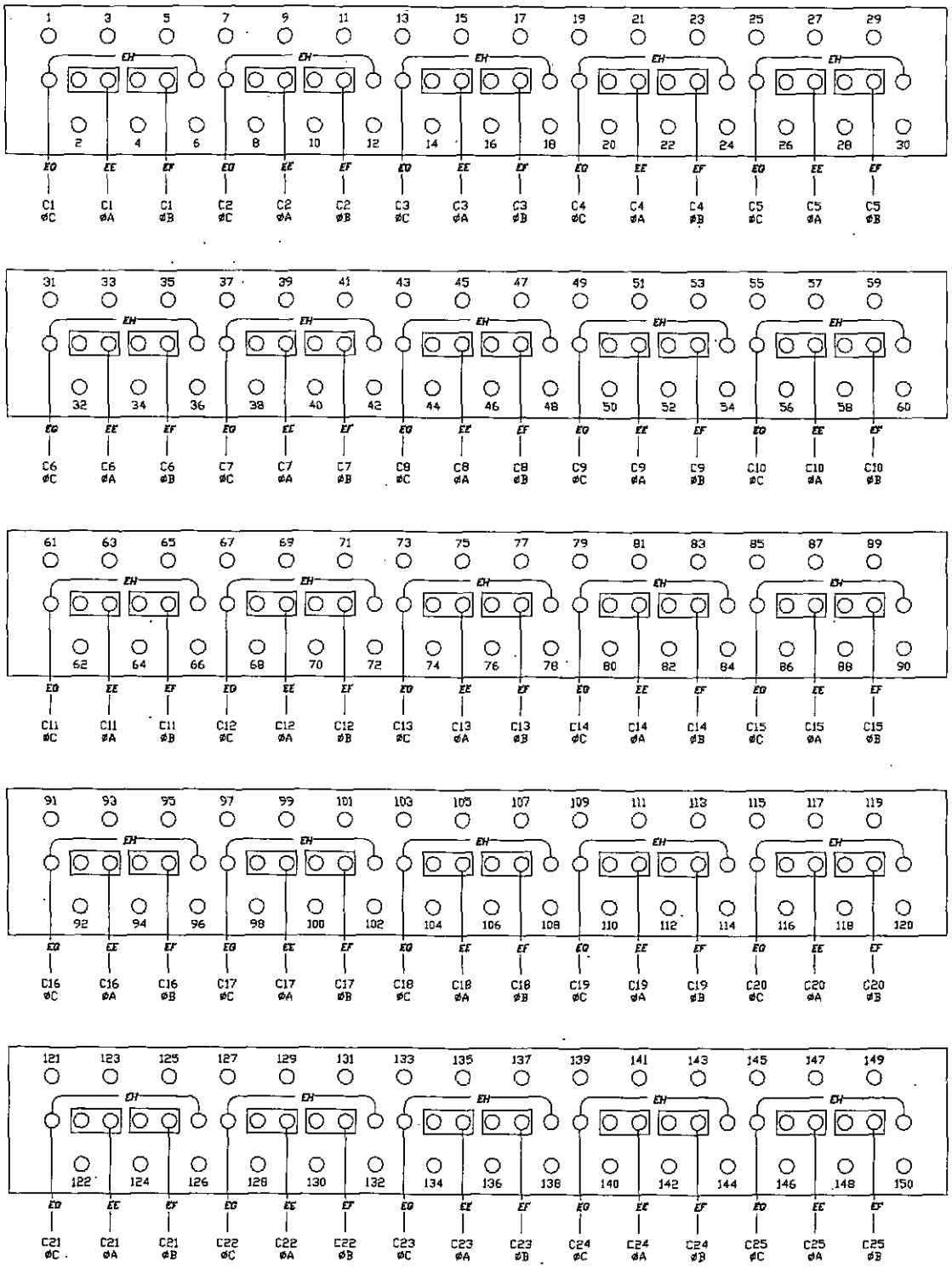
RESISTIVE LOAD BANK
1250KW,480V,3ø,60Hz

MARS-1250 UL
LOAD SECTION

W.O.# 55819-04-43

DRAWING NUMBER
47B138332

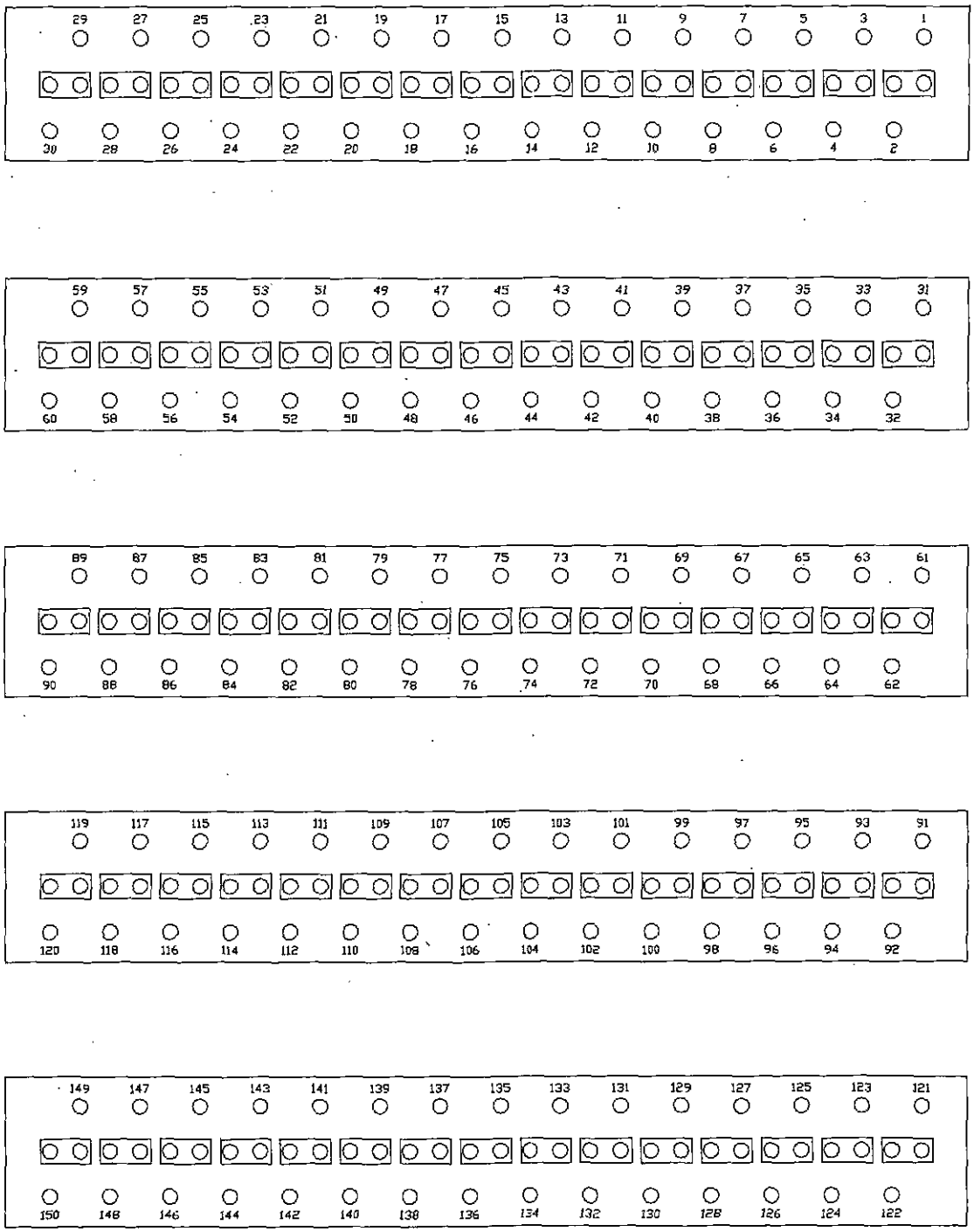
FRONT OF TRAY



WIRE C

CODE	WIRE GAUGE	INSULATION TEMPERATURE RATING	WIRE COL
EE	8 AWG	150°C	BLAC
EF	8 AWG	150°C	RED
EG	8 AWG	150°C	BLUE
EH	8 AWG	150°C	WHIT

REAR OF TRAY



HART

OR	SIMPLEX PART NUMBER	APPLICATION
K	25533100	ØA LOAD
	25533200	ØB LOAD
	25533300	ØC LOAD
	25533350	LOAD JUMPER

DISK S/N: 4472

SIMPLX® SPRINGFIELD, ILLINOIS

SCALE:	APPROVED BY:	DRAWN BY: BD
DATE: 2/2/04		REVISED:

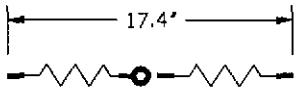
RESISTIVE LOAD BANK
1250KW,480V,3ø,60Hz

MARS-1250 UL
STRAPPING DIAGRAM

W.O.# 55819-04-43

DRAWING NUMBER
47B138333

A. LR1-LR150
8,333W@240V
12GA, 0.081ø WIRE
6.71 ΩHMS COLD
POWER-WEB



EACH ELEMENT CUT INTO 2 PIECES
4,167W @ 120V
3.36 ΩHMS COLD
(300) PIECES TOTAL
(150) PIECES W/1 STUD AND 1 RING
(150) PIECES W/2 STUDS

ENGIN

ELEMENT TYPE	PART NUMBER	OHMS
A	24299630	6.71

INSTRUCTIONS:

ENGINEERING DEPARTMENT—
FILL OUT ONE OF THESE FORM
NON-STANDARD ELEMENTS. FI
AT LEFT AND TRANSFER ELEME
COMPUTE TOTAL WATTS FOR TH

TESTING DEPARTMENT—
MEASURE LOAD ELEMENT RESIS
EACH ELEMENT TYPE, MULTIPLY
LOAD BANK TOTAL WATTAGE. C
ELEMENT DATA ABOVE. FILL O
SIGN BELOW.

ENGINEER BC

ENGINEER APPROVAL

TEST TECH.

EERING

VOLTAGE	WATTAGE	QTY	TOTAL WATTS
240	8333	150	1,250,000

TOTAL WATTS FOR LOAD BANK 1,250,000

TESTING

OHMS	CALCULATED WATTS V^2/R	TOTAL WATTS

TOTAL WATTS FOR LOAD BANK _____

COMPARE

S FOR ALL LOAD BANKS USING
ND ELEMENT(S) USED IN TABLE
NT DATA TO TABLE ABOVE.
E LOAD BANK AND SIGN BELOW.

TANCE, CALCULATE WATTAGE FOR
TIMES QUANTITY AND CALCULATE
OMPARE TO ENGINEERING LOAD
UT TABLE AT ABOVE RIGHT AND

DISK S/N: 4472

SIMPLX® SPRINGFIELD, ILLINOIS

SCALE :	APPROVED BY:	DRAWN BY : BC
DATE : 2/2/04		REVISED :

RESISTIVE LOAD BANK
1250KW,480V,3ø;60Hz

MARS–1250 UL
NON–STD ELEMENTS

W.O.# 55819–04–43

DRAWING NUMBER
47B138334

ITEM	QTY	PART#	DESIG	DESCRIPTION
1	150	24299630	LR1-LR150	LOAD RESISTORS 8333W @ 240V POWER-WEB
2	1	13014100	FMC	CONTACTOR, 3-POLE 35A-RESISTIVE, 600VAC 120VAC,50/60Hz,5VA COIL
3	25	13022500	C1-25	CONTACTOR, 3-POLE 65A-RESISTIVE, 600VAC 120VAC,50/60Hz,14VA COIL
4	2	14013000	CF1,2	FUSE, TIME DELAY 2A, 600V, 200KAIC
5	75	14086000	F1-75	FUSE, VERY FAST ACTING 70A, 600VAC, 200KAIC
6	1	15011500	[CF1,2]	FUSEBLOCK 30A, 600V, 2 POLE QUICK-CONNECT
7	2	7BD44465C	MLB`A'	MAIN LOAD BUS 0.25" X 3.00" X 30.50" TIN PLATED COPPER BAR
8	2	7BD44466C	MLB`B'	MAIN LOAD BUS 0.25" X 3.00" X 34.75" TIN PLATED COPPER BAR
9	2	7BD44467E	MLB`C'	MAIN LOAD BUS 0.25" X 3.00" X 39.00" TIN PLATED COPPER BAR
10	3	7BD63693	[MLB]	NEMA BUS CONNECTOR 0.25" X 4.00" X 10.50" TIN PLATED COPPER BAR
11	1	47BD63191	GND.	GROUND BUS 0.25" X 3.00" X 12.25" TIN PLATED COPPER BAR
12	6	15400000	[MLB]	ISOLATOR, GLASTIC 3600V, 2¾"
13	2	25667000	TB`LD' TB`CF' TB`CP'	TERMINAL BLOCK 30A, 600V, 6 LINE #10-16AWG WIRE LUG SIZES
14	2	25670000	TB`R1' TB`R2'	TERMINAL BLOCK 30A, 600V, 12 LINE #10-16AWG WIRE LUG SIZES
15	1	24646015	MOT	MOTOR, 10HP, 3ϕ, TEFC 208-230/460VAC, 60Hz 30.0-26.0/13.0A, 1750RPM
16	1	13827600	[MOT]	FAN BLADE, 42" 26,500CFM @ 1"SP, 8.8 BHP 1750 RPM, 1-3/8"-dia
17	1	25256500	PS	PRESSURE SWITCH, SPDT DIFFERENTIAL SENSING 0.07-0.15"WC

ITEM	QTY	PART#	DESIG	DESCRIPTION
18	1	25309650	INTS	INTAKE TEMP SWITCH SPST, OPENS @ 125°F 12A @ 240V
19	1	25309560	EXTS	EXHAUST TEMP SWITCH SET @ 75°F ABOVE N.O.T. 120V, 50/60Hz
20	AR	25512400	TC	THERMOCOUPLE, TYPE J (FOR EXTS)
21	1	50016500	DCS	DC POWER SUPPLY 120VAC, 50/60Hz INPUT 24VDC OUTPUT
22	1	50000300	CP1	CONTROL PANEL, LOCAL PRINTED CIRCUIT BOARD
23	3	14010000	FU1-FU3	FUSE, 2A, 250V (COMPONENTS OF CP1, DCS)
24	1	50010300	TD	TIME DELAY RELAY 7 SEC DELAY ON OPERATE (COMPONENT OF CP1)
25	1	12046310	FCB	FAN CIRCUIT BREAKER 100A FRAME, 20A TRIP 3 POLE, 600V
26	1	25453500	T1	TRANSFORMER, 500VA 480/240:240/120
27	1	24827795	OLR	OVERLOAD RELAY 3 POLE 600V 9-27A ADJUSTABLE
28	1	24829000	OLRX	OLR AUXILIARY CONTACT
29	1	25317000	DSW	DISCONNECT SWITCH 3P, 40A, 480V, 20 HP
30	7	25301000	S1-7	SWITCH DPDT, TOGGLE 6A, 28VDC
31	2	24258000	L1,2	LIGHT-BASE 120V, PUSH SLD BASE 11/16", FOR T2 LAMP
32	2	24230000	[L1,2]	LIGHT-BULB 3W, 24V, INC T2-PSB
33	1	24280000	[L1]	LIGHT-LENS RED CONVEX FROSTED
34	1	24274000	[L2]	LIGHT-LENS GREEN CONVEX FROSTED

DISK S/N: 4472

SIMPLX®

SPRINGFIELD, ILLINOIS

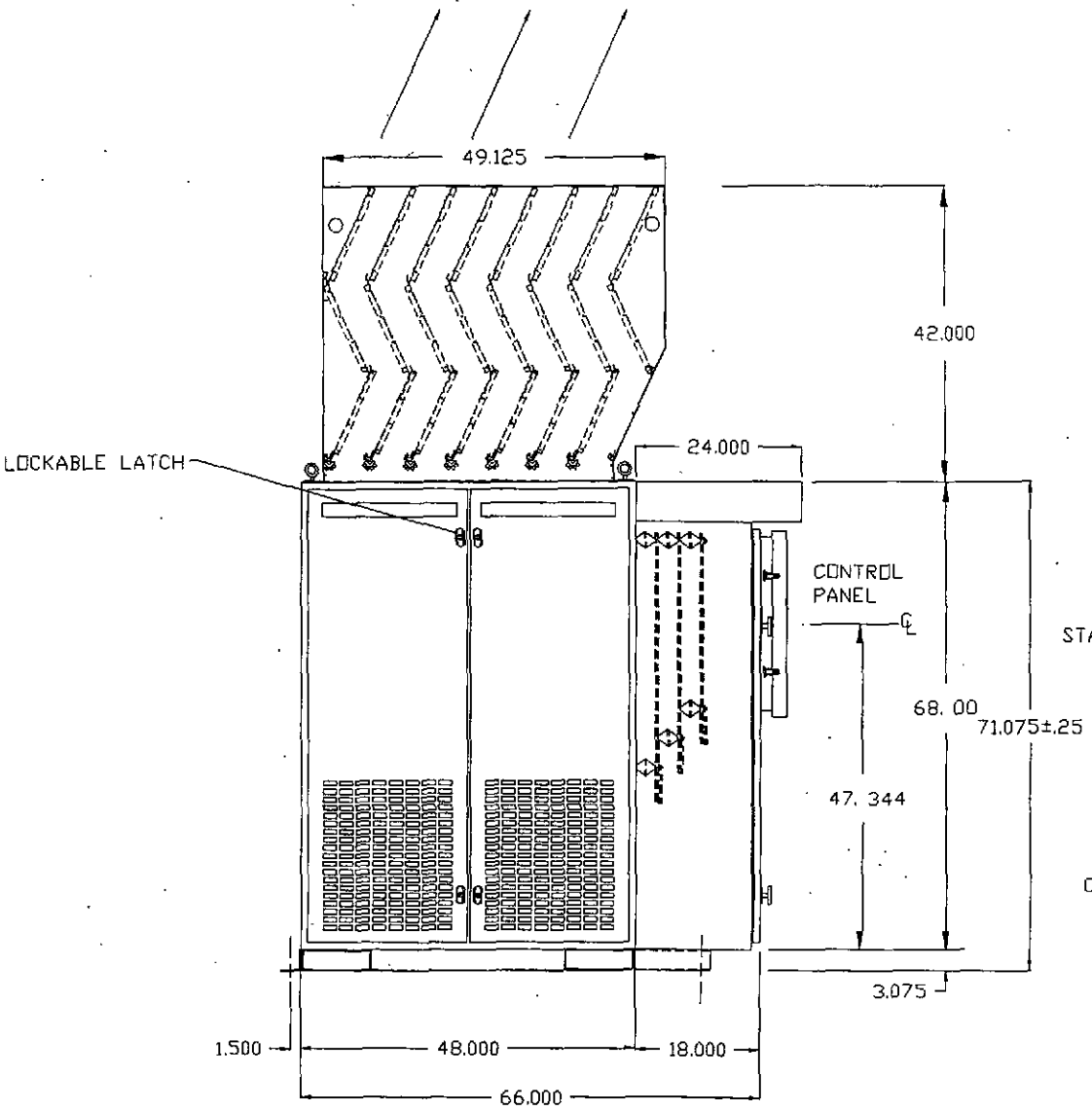
SCALE :	APPROVED BY :	DRAWN BY : BC
DATE : 2/6/04		REVISED :

RESISTIVE LOAD BANK
1250KW,480V,3ø,60Hz

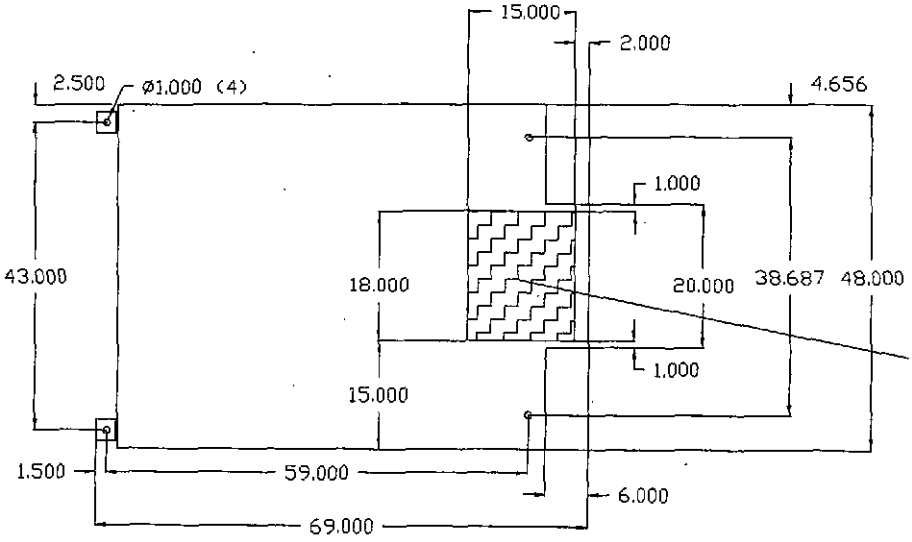
MARS-1250 UL
LEGEND

W.O.# 55819-04-43

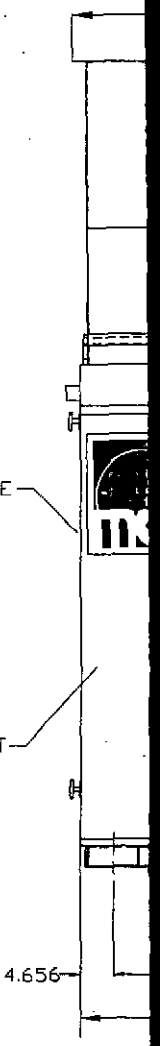
DRAWING NUMBER
47B138335



LEFT SIDE VIEW



FOOTPRINT

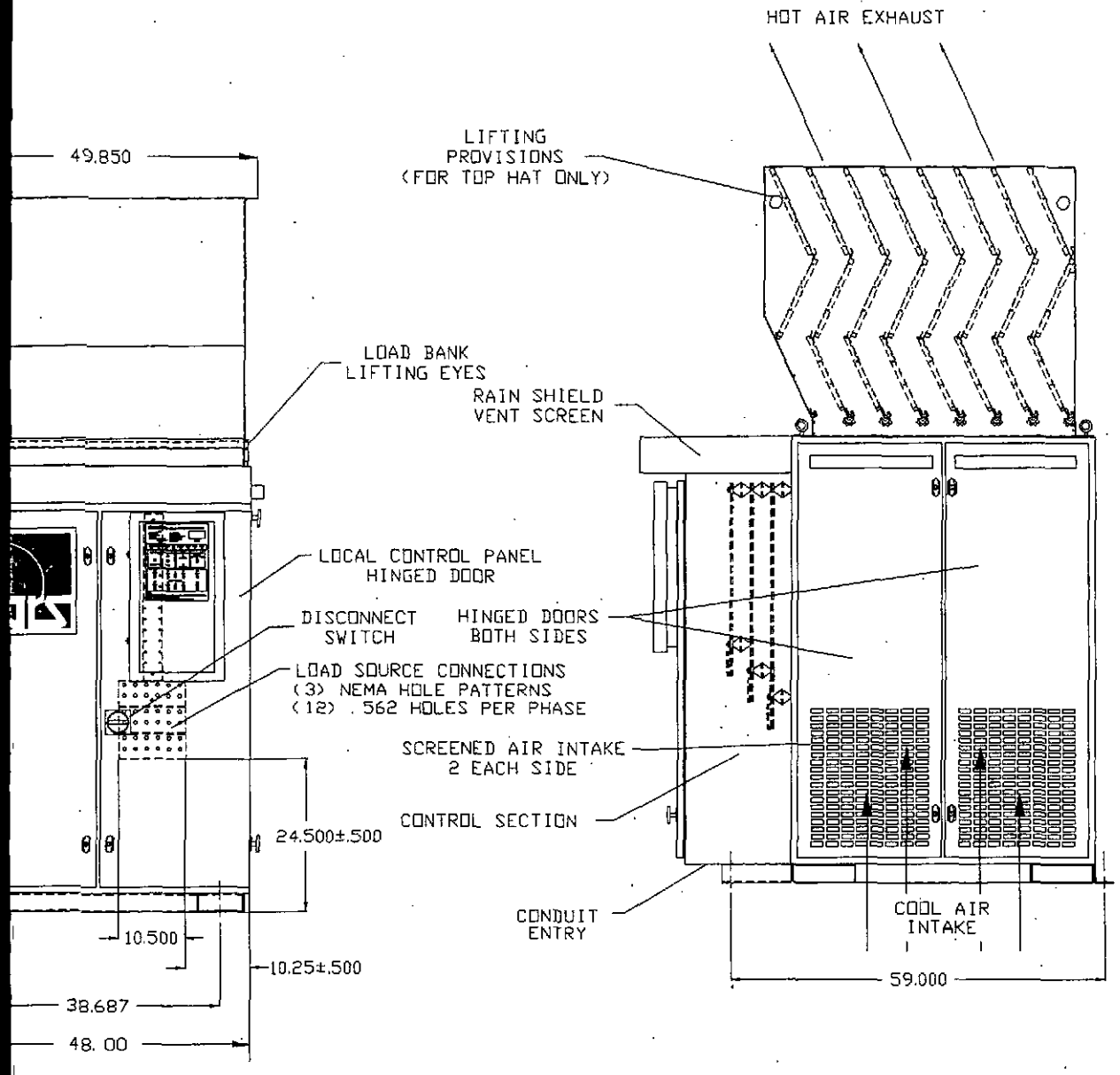


NOTES:

1. BOTTOM
2. CONSTRUC
3. SURFACE
FINISH
PRIMER:

PAINT:

4. APPROXIMA



OF CONTROL COMPARTMENT AVAILABLE FOR CONDUIT ENTRY.

TION: ALL WELDED FORMED STEEL FRAME, DOORS, PANELS AND SKID.
FORK LIFT TUBES 7GA HRS, OUTER SHELL 12GA HRS, BASE SKID,
CONTROL BOX AND DOORS 14GA HRS, FAN/ELEMENT DOORS 16GA HRS
ALL HINGES, EXTERIOR FASTENERS, AND EXTERIOR
HARDWARE ARE STAINLESS STEEL
EXHAUST HOOD IS GALVANIZED SHEET STEEL, RIVETED

PREPARATION: ABRASIVE CLEANED OR CHEMICALLY CLEANED AND PHOSPHATIZED

OLOR: ASA 49 GRAY
TILE/CENTURION
(24702501), PART A, B73A200, GRAY PRIMER
(24702502), PART B, B73V200, CATALYST
CENTURION POLYURETHANE
(24708500), B65W711, ASA 49 GRAY
(24722500), B65V700, CATALYST

TE SHIPPING WEIGHT: 2,370 LBS TOTAL UNT
: 1,800 LBS LOAD BANK
: 570 LBS TOP HAT

DISK S/N: 11085

A	PAINT WAS FAST PRODUCTION ENAMEL, WAS ON DISK 10427	DRAWN BY : AJC DATE :08/12/02
A	MADE TOP DOOR LATCH LOCKABLE	DRAWN BY : TFM DATE :9-29-97

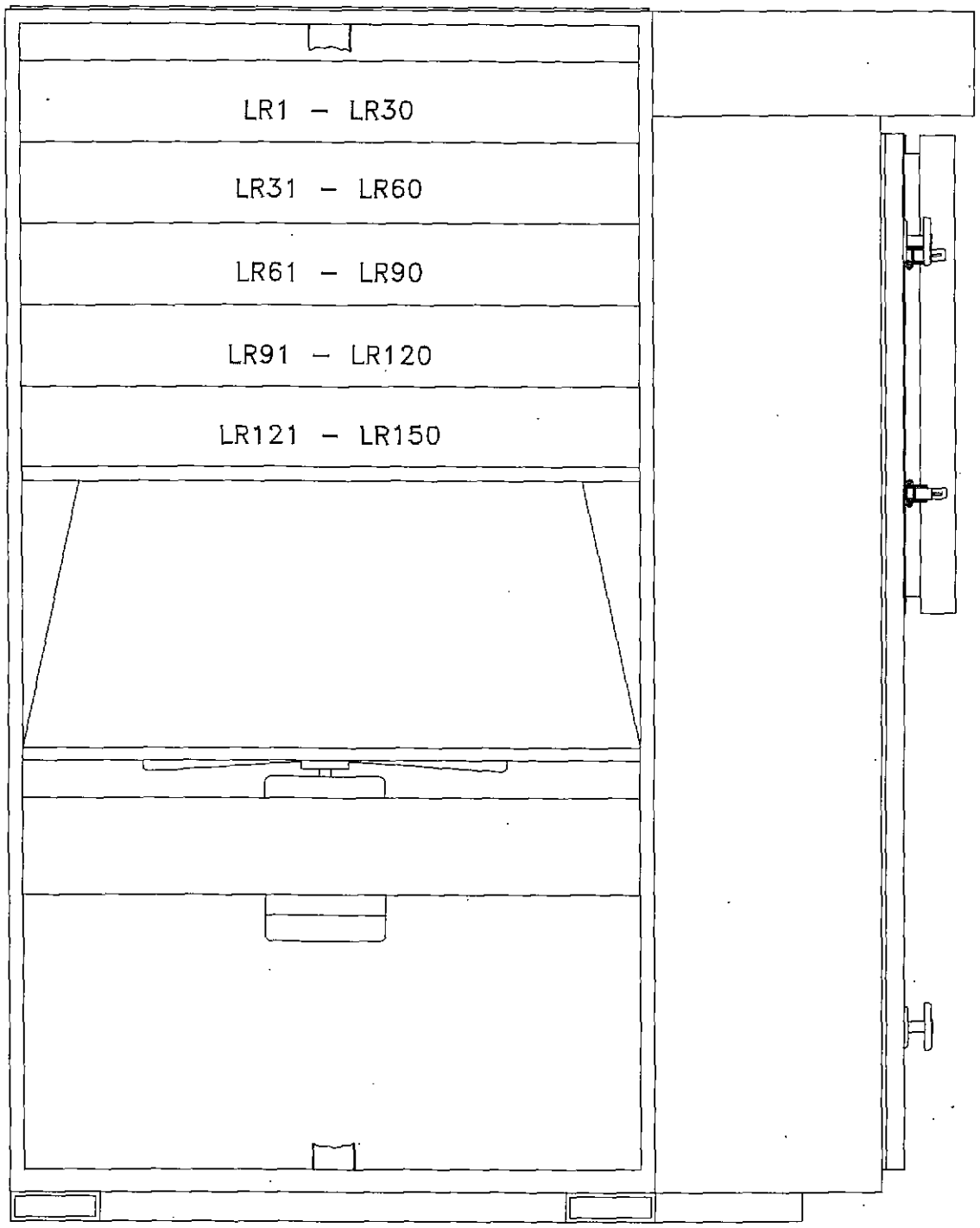
SIMPLX® SPRINGFIELD, ILLINOIS

QTY ~	APPROVED BY :	DRAWN BY : TFM
DATE : 7-9-97		TEMP #

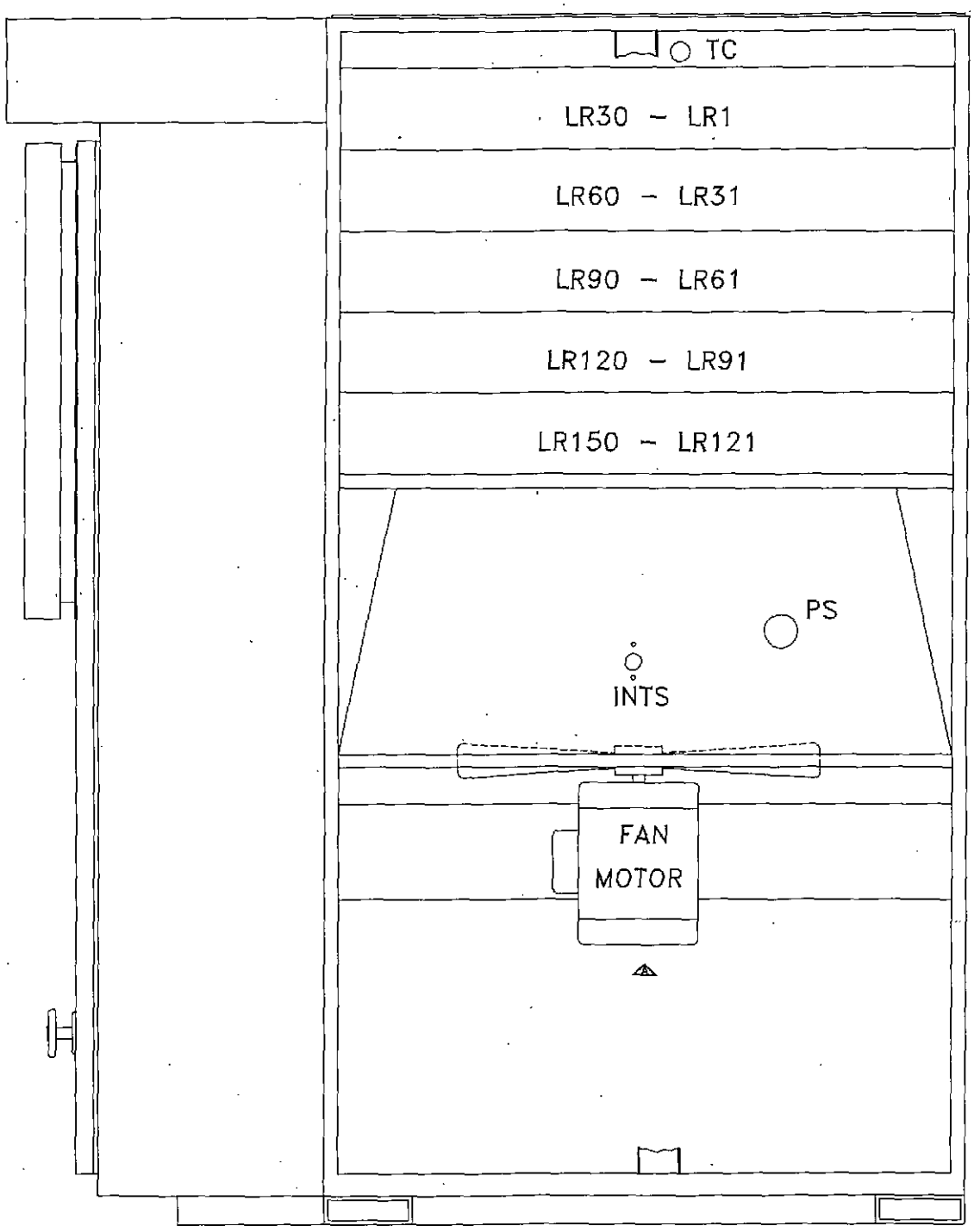
MARS PICTORIAL - NEMA 3R UL
SINGLE 18' BOTTOM CONNECTED

STD

DRAWING NUMBER 7BD86857B



LEFT - VIEW
FRONT OF TRAY



RIGHT - VIEW
REAR OF TRAY

DISK S/N: 4472

A	MOTOR WAS SHOWN ON LEFT-VIEW.	DRAWN BY : BC DATE : 2/26/04

SIMPLX® SPRINGFIELD, ILLINOIS

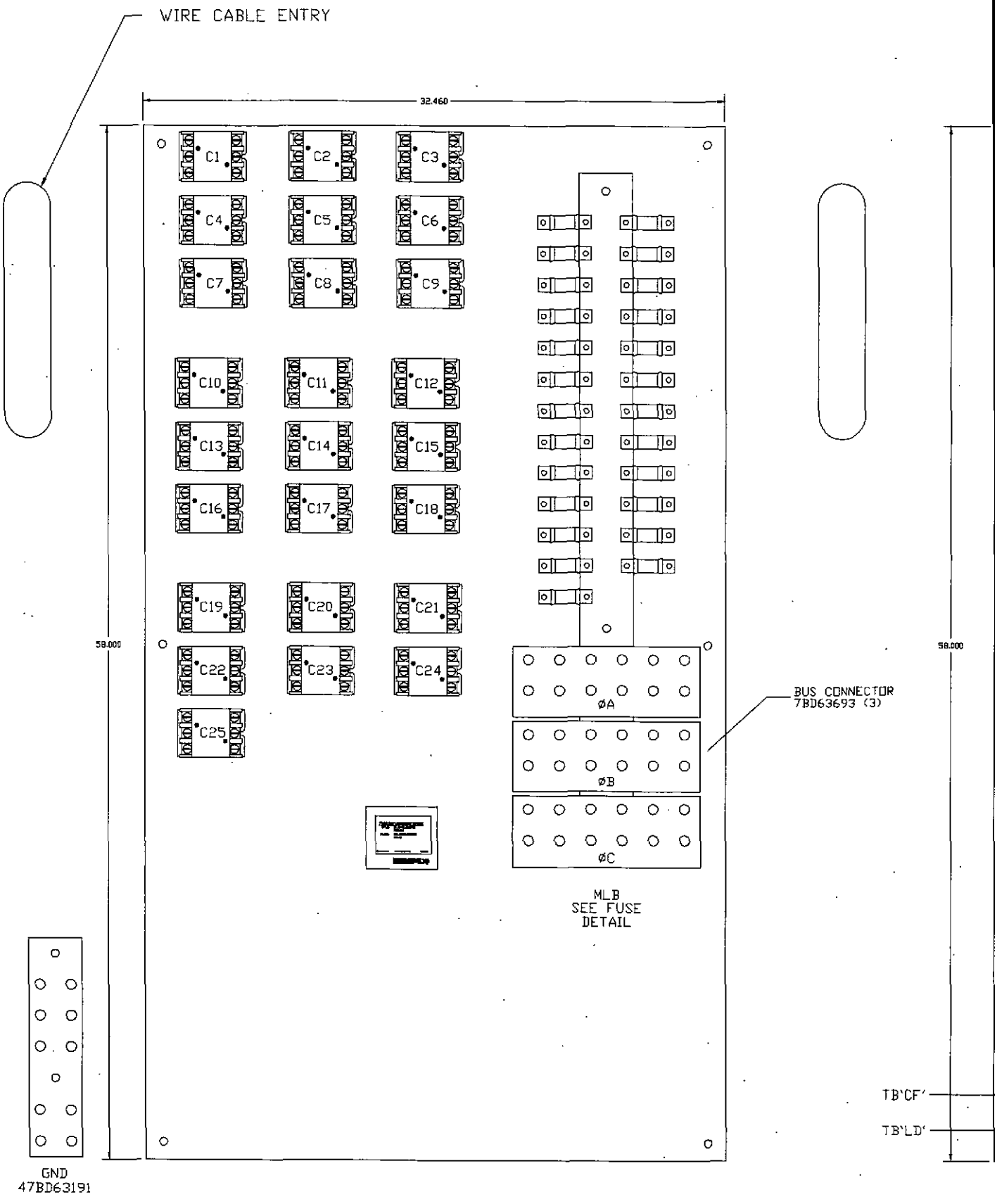
SCALE :	APPROVED BY :	DRAWN BY : BC
DATE : 2/2/04		REVISED : 1

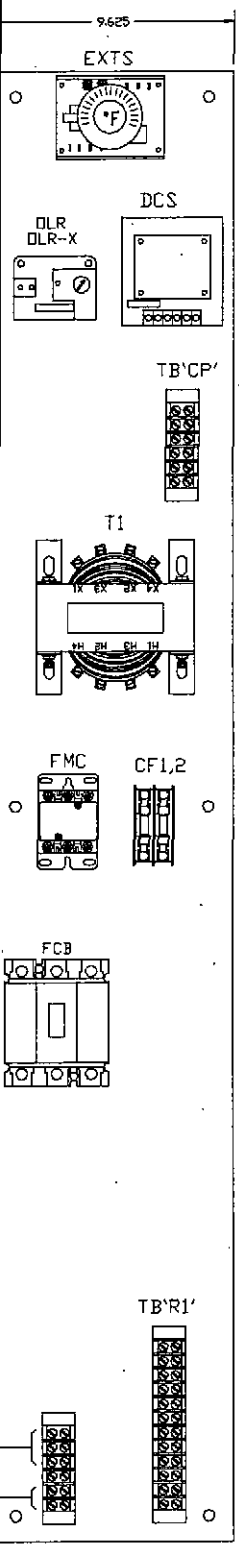
RESISTIVE LOAD BANK
1250KW,480V,3ø,60Hz

MARS-1250 UL
LOAD TRAY LAYOUT

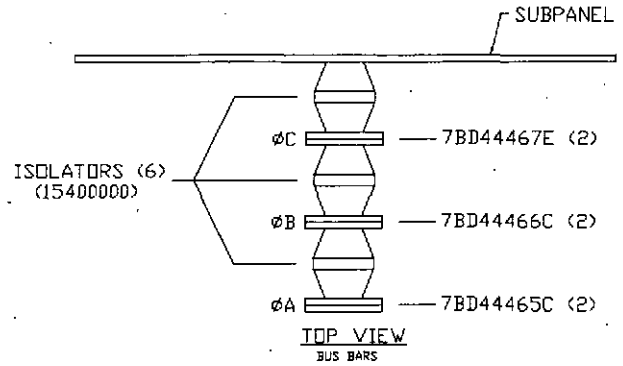
W.O.# 55819-04-43

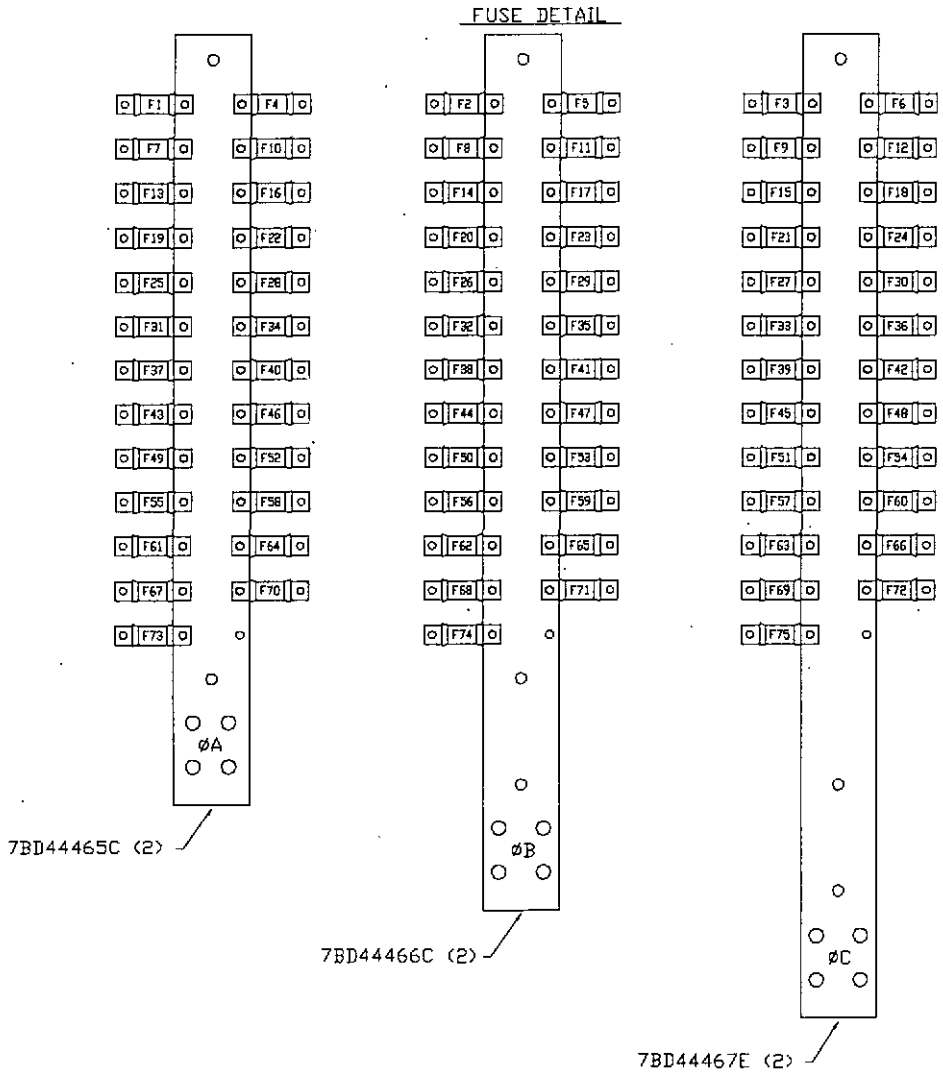
DRAWING NUMBER
47BD138336A





SIDE SUBPANEL





DISK: 4472

SIMPLX® SPRINGFIELD, ILLINOIS

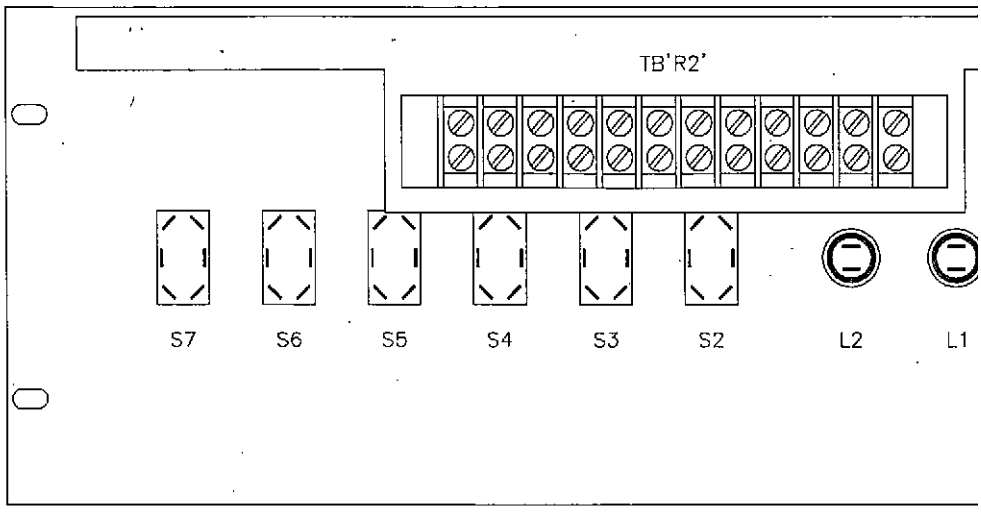
SCALE : 1=1"	APPROVED BY :	DRAWN BY : BC
DATE : 2/6/04		REVISED :

RESISTIVE LOAD BANK
1250KW,480V,3ø,60Hz

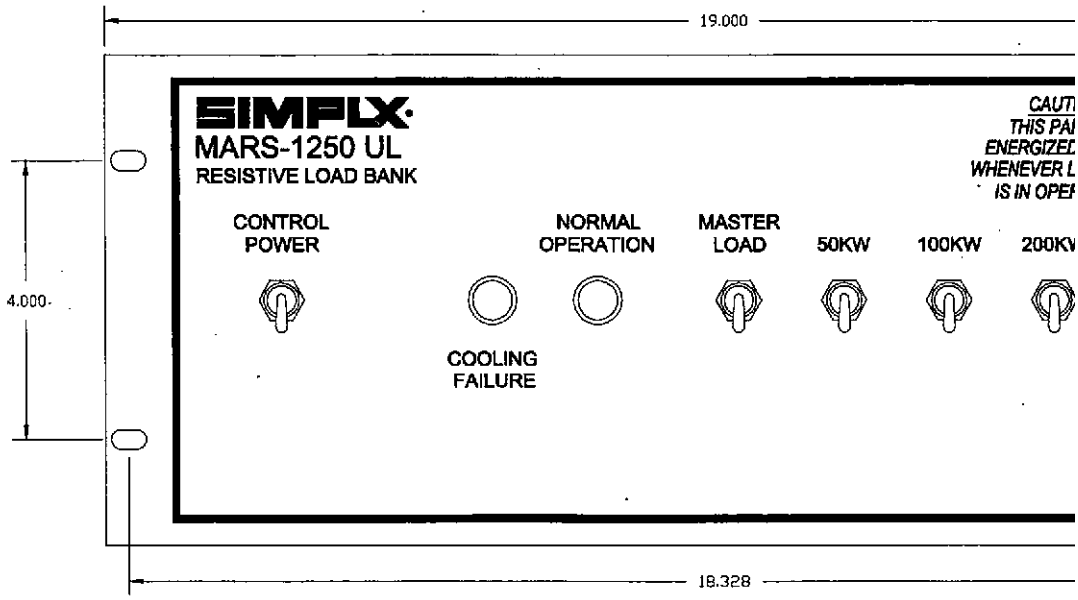
MARS-1250 UL
SUBPANEL LAYOUT

W.O.# 55819-04-43

DRAWING NUMBER
47BD138337



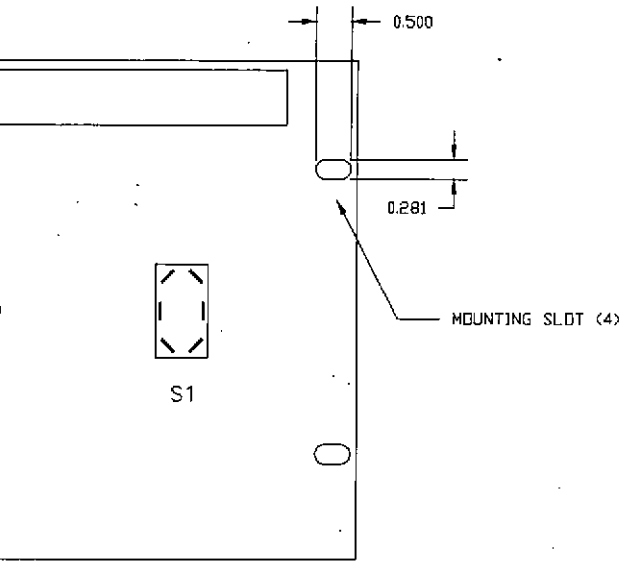
REAR VIEW

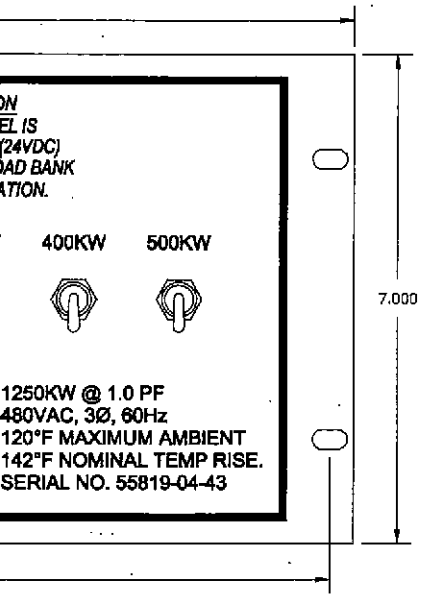


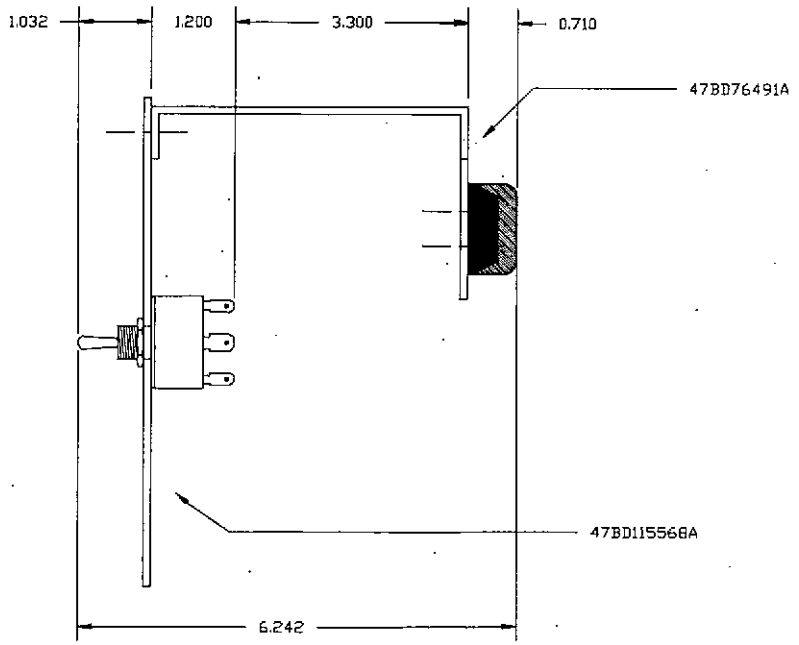
FRONT VIEW

NOTES:

1. MATERIAL -
2. FINISHED C
3. PRIMER: TI







SIDE VIEW

12GA (.105t) HRS
OLOR: CENTURION ASA-49 GRAY
E-CLAD

DISK S/N: 4472

A	MODIFIED DRAWING TO REFLECT SUPPLIED PARTS.	DRAWN BY : BC DATE : 2/12/04

SIMPLX® SPRINGFIELD, ILLINOIS

SCALE : 1=1"	APPROVED BY :	DRAWN BY : BC
DATE : 2/6/04		REVISED : 1

RESISTIVE LOAD BANK
1250KW,480V,3ø,60Hz

MARS-1250 UL
REMOTE PANEL

W.O.# 55819-04-43

DRAWING NUMBER
47BD138338A

10.250

14.000

6.250

SIMPLX® FORCED AIR-COOLED RESISTIVE LOAD BANK-LBS SERIES

CAPACITY: 1250KW @ 1.0 PF
VOLTAGE: 480VAC, 3ø
CONNECTION: 3-WIRE
FREQUENCY: 60Hz
FAN POWER: INTERNAL 480V
CONTROL POWER: INTERNAL 120V TRANSFORMER

COOLING: FORCED AIR
AIRFLOW: 28,500CFM
MAXIMUM AIR INTAKE TEMP.: 120°F
NOMINAL AIR TEMP.RISE: 142°F NOMINAL
TEMPERATURE RISE: $\frac{T=KW\times3000}{CFM}$
DUTY CYCLE: Continuous
SERIAL NO. 55819-04-43

AIRFLOW DIRECTION

POWER AVAILABLE | LOCAL MANUAL RUN | LOCAL AUTO RUN | REMOTE MODE | REMOTE DISCONNECT | LOAD DUMP BYPASS | NORMAL OPERATION | COOLING FAILURE

LAMP TEST
PRESS TO TEST

AUTO LOAD DUMP
AUTO
BYPASS

LOCAL MANUAL CONTROL
PUSH TO RUN
PUSH TO STOP

LOAD BANK MODE
LOCAL MANUAL | LOCAL AUTO
OFF | REMOTE

MASTER LOAD
50KW
100KW
200KW
ON
OFF

LOAD CONTROL

400KW
500KW
ON
OFF

WARNING

High Voltage: Turn off and disconnect power source before opening any compartment
High Temperature: Allow equipment to cool before servicing or opening any compartment
Rotating Equipment: Assure that fan has stopped before opening any compartment
For Operator Safety: Make sure this equipment is properly grounded when in use

All compression type connections on fuse blocks, load blocks, and contactors where used, should be checked for tightness frequently. This check should be established as a part of routine maintenance.

SIMPLEX · 1139 N. MACARTHUR · SPRINGFIELD, IL 62702 217-525-6995 · 24 HR. 217-528-3130 · FAX 217-525-7984

SIM
MARS-
RESISTIVI
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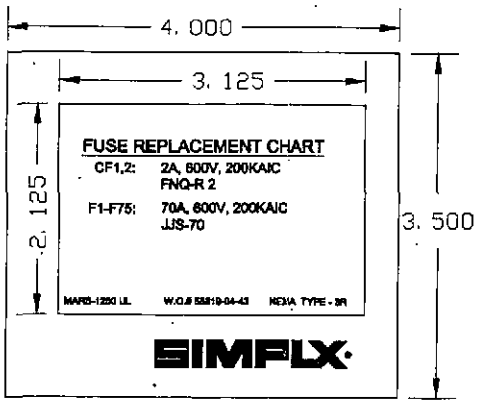
POW



17. 000

IPLX
1250 UL
LOAD BANK

ROL
ER

CAUTION
THIS PANEL IS ENERGIZED (24VDC) WHENEVER LOAD BANK IS IN OPERATION.

	NORMAL OPERATION	MASTER LOAD	50KW	100KW	200KW	400KW	500KW
~~0.688~~	~~0.688~~	~~0.500~~	~~0.500~~	~~0.500~~	~~0.500~~	~~0.500~~	~~0.500~~

COOLING FAILURE

1250KW @ 1.0 PF
480VAC, 3Ø, 60Hz
120°F MAXIMUM AMBIENT
142°F NOMINAL TEMP RISE.
SERIAL NO. 55819-04-43

DISK S/N: 4472

SIMPLX SPRINGFIELD, ILLINOIS

SCALE : 1=1"	APPROVED BY:	DRAWN BY: BC
DATE : 2/6/04		REVISED :
RESISTIVE LOAD BANK 1250KW,480V,3ø,60Hz		MARS-1250 UL NAMEPLATES
W.O.# 55819-04-43		DRAWING NUMBER 47BD138339