

**AVTRON MODEL LPV700
RESISTIVE LOAD BANK
Part Number LPV700D32451-1**

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WARRANTY

The last page of this document contains an express limited warranty. The provisions of this warranty cover any and all rights extended to holders of Avtron equipment.

AVTRON MANUFACTURING, INC.
Cleveland, Ohio

AVTRON MODEL LPV700
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Part Number LPV700D32451-1

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
I	SAFETY CONSIDERATIONS	1-1
II	DESCRIPTION	2-1
III	INSTALLATION	3-1
IV	OPERATION	4-1
V	MAINTENANCE	5-1
VI	REPLACEMENT PARTS LIST	6-1

APPENDIX - Avtron Load Bank Troubleshooting Guide

DRAWINGS

SB3166	Outline Drawing
D32465	Schematic, Load Bank
C25354	Option 1, Dual Voltage Control Transformer

SUPPLEMENTAL MANUAL (Provided Separately)

Electro Industries/Gauge Tech	DMMS 300 + and DMMS425, 3-Phase Multifunction Power Monitors Installation, Operation and Programming Manual, Version 4.75/5-99 (Avtron Part Number 338272)
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**AVTRON MODEL LPV700
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**SECTION I
SAFETY CONSIDERATIONS**

Throughout this manual, you will find **WARNING** and **CAUTION** statements. Personal injury or death to an operator using or repairing the equipment may occur if a **WARNING** statement is ignored. Damage to the equipment and potentially hazardous conditions for personnel may occur if a **CAUTION** statement is ignored.

Each Avtron unit is safety checked for opens and shorts, and the insulation is high potential tested to ensure safe operation. All fuses, safety interlocks and related safety equipment have been tested as part of the testing procedure of each unit.

As part of your safety program, an initial inspection after receiving the unit(s) and periodic preventive maintenance and safety inspections should be conducted to ensure the reliability and safety built into your Avtron equipment.

The Model LPV700 Load Banks are industrial test units designed for safe use indoors. However, because the Load Bank's function is to dissipate electrical energy, there are inherent dangers to the operators and to the equipment. These dangers shall be outlined in this section.

Electrical energy is transformed into heat by the resistors. This heat must be removed from the Load Bank by the cooling fan. If there is any restriction or stoppage of airflow, the Load Bank may overheat and may even start a fire. The following events must be conducted if safe operation of the Load Bank is to take place.

1. Read the manual before operating Load Bank.
2. An approved ground conductor wire from the Load Bank ground point and the generator frame to a good earth ground must be connected.
3. Do not bypass the airflow switch to prevent nuisance tripping. The switch is designed to drop out the load if sufficient air is not reaching the load elements.
4. Do not bypass any fuses which have blown. Bypassing fuses can result in damage to the equipment and potentially hazardous conditions for the operator. If a fuse is blown, determine the cause of the blown fuse and correct the situation.

5. Replace any burned out bulbs on the Control Panel. Each lamp is an indication that a system is active or has failed and is important to the operation of the Load Bank and safety of the operator.
6. Maintenance personnel must always exercise caution when access panels are removed. Personal injury from electrical shock or from the moving fan blade may result if all sources of power are not disconnected before servicing. Maintenance work must be conducted only by qualified personnel.
7. The Load Bank should be operated in a cool, well ventilated area as described in the INSTALLATION section of this manual. Do not allow exhaust air to recirculate through the Load Bank.
8. Venting the heated air from the Load Bank exhaust is a potential hazard. The Load Bank should be used in a cool, well ventilated area.
9. Allow cool air to pass into the unit to cool the elements. Do not allow the unit to be placed where hot exhaust air can recirculate back through the unit causing a constant rise in cooling air temperature.
10. After running a load test, residual heat should be removed from the Load Bank by allowing the fan to operate for a few minutes after load is removed. This procedure is not required for maintaining Load Bank integrity, but it may guard operating personnel from possible burn injuries.
11. The operator should avoid coming in contact with the resistor elements or surrounding covers during and for some time after operation. These portions of the Load Bank become quite hot and may result in a serious burn, should contact be made with them.
12. Do not allow objects to enter or block the air intake or exhaust of the Load Bank. A blockage could cause Load Bank overheating. If an object enters the screens, it will cause damage to the resistor elements, possibly shorting them and causing shock and fire hazards.
13. Operators must not operate the Load Bank with the access panels, cover, or screens removed. To do so exposes the operator and other persons to possible personal injury from electrical shock or from the moving fan blade.
14. Keep both of the hinged access covers closed at all times during testing and while power is on the load bus. An access port (Load wiring opening) is provided in the bottom (Floor) of Load Bank for load wiring.
15. Always put a short or shunt across the current transformers (C.T.) when working on metering. Powering up an unshunted C.T. will destroy the C.T. with possible harm to personnel and metering.

16. Emergency shutdown procedure:
 - A. In an emergency, shut down the MASTER LOAD switch, then the generator. The MASTER LOAD switch will allow disconnection of all load steps and still allow the fan motor to run, cooling any heated elements.
 - B. The power ON/OFF switch will disconnect both load steps and fan motor. A customer-supplied Generator Emergency OFF switch should be located near the Load Bank.
17. An approved electrical fire extinguisher should be on hand at all times.
18. It is the responsibility of the customer to take diligent care in installing the Load Bank. The National Electrical Code (NEC), sound local electrical and safety codes, and the Occupational Safety and Health Act (OSHA) should be followed when installing the equipment to reduce hazards to persons and property.
19. Read and heed all **WARNING** and **CAUTION** statements in the manual.
20. Review supplemental metering manual prior to operation.

SECTION II

DESCRIPTION

The Model LPV700 Load Bank is a portable, primarily indoor, self-contained unit for electrically loading and testing generators. The Load Bank is rated at 700 kW at 240/480 volts. The available load steps are 200 kW, 200 kW, 100 kW, 100 kW, 50 kW, 25 kW, 10 kW, 10 kW, and 5 kW. All load steps are selected by toggle switches. The Load Bank provides a balanced load for 3-phase generators within the range listed above.

The fan motor is a 5 HP, 3-phase motor which operates from 208-230/460 volts, 3-phase, 60 Hz power. The fan motor obtains power from either the power source under test (fan motor connected to Load Bank main load bus) or from a remote source (external power source). When operating from the power source under test, the motor circuit connects the motor for high or low voltage. The unit will test 240/480 volt, 3-phase, 60 Hz generators without any wiring changes. It can be used to test 60 Hz, 50 Hz, or 400 Hz generators; however, the fan motor and control circuit power must be supplied by separate 60 Hz sources when testing 50 Hz or 400 Hz generators. For separate 60 Hz fan motor power connection, see Section III. Control power is 115 VAC, 60 Hz. A line cord is provided for control power unless Option 1 is included.

Fan failure protection is provided in two ways. A differential pneumatic pressure air switch (S51) senses the airflow through the Load Bank. An additional slave relay (K30) is activated only if power is applied to the fan motor terminals. This slave relay will disconnect control power to all load contactors should the fan power be disconnected, the motor overload trip out, or the air inlet/exhaust screens become blocked.

CAUTION

This Load Bank should never be used without the fan motor operating. Inadequate cooling airflow will result in resistor elements overheating and a definite fire hazard.

GENERAL CONSTRUCTION (Refer to Outline Drawing SB3166.)

The Control Panel is mounted on the front face of the Load Bank. It is also sized for mounting into a 19-inch rack enclosure. The control panel contains all the switches required to operate the Load Bank. Full digital metering is standard and displays volts, amps, and kW with individual phase selection. The Load Bank is constructed of aluminized steel, forming a rigid structure.

Mounted within this structure are the load element resistor assemblies, the cooling fan and motor, the load step contactors, motor starter, motor overload relay, fuses and customer connection load bus. The cooling air is drawn in from the bottom and lower sections of side access panels, forced across the resistor elements and exhausted out the top of the unit.

The unit is mounted on five-inch casters with one set provided with wheel locks. The customer connection is located on the front side of the unit. Load connection is made through the lower hinged access panel.

The Load Bank can operate at either 480 or 240 volts. A switch on the control panel (S7) will switch the load from the high voltage configuration to the low voltage configuration. The fan motor configuration also changes if powered from generator under test. The fan motor has separate overload protection for high and low voltage operation. The voltage protection circuit will protect the circuit if improper voltage mode is applied. However, it is always best to confirm source voltage, then match control panel switches to proper configuration before energizing the unit.

Lower voltages and different frequencies may be applied to the load circuit only (not blower/fan or control power) of the Load Bank. Frequency change causes no derating of the load; however, the applied kW with a lower voltage is computed with the following formula:

$$kW_{Applied} = kW_{Rated} \times \frac{(Voltage\ Applied)^2}{(Voltage\ Rated)^2}$$

CAUTION

Never exceed the rated voltage, because this will cause the Load Bank to overheat. Do not apply DC voltages, because the contactors do not have arc blowout magnets.

CAUTION

External fan power will be required if a voltage different than 240/480 is being applied or a frequency other than 60 Hz. (See Section III for further details.)

SECTION III

INSTALLATION

BEFORE INSTALLATION

Inspect the Load Bank for obvious damage such as broken wires, broken or dented panels, cracked ceramic insulators, or any other component breakage that may have occurred in shipment.

LOCATION

The Load Bank is designed primarily for indoor use. The Load Bank must be used in a cool, well ventilated area. It must be installed where cool air is continually available and where hot exhaust air will not be recirculated through the Load Bank. If the Load Bank is operated in a closed space, continuous ventilation of 15,000 CFM or greater is required.

A minimum of four (4) feet of clearance from all sides and twelve (12) feet of clearance on the exhaust end are required for proper airflow.

W A R N I N G

The exhaust air will be in excess of 350°F above ambient under full load conditions. The unit must not be installed near any equipment, wiring or plumbing which may be damaged by high air temperatures or which may constitute a fire hazard. Care should also be taken so as not to set off a sprinkler system by exposing it to hot exhaust air.

DO NOT STACK LOAD BANKS.

Standard Load Bank design is suitable for operation between sea level and 2,000 ft. maximum altitude.

AIRFLOW CONSIDERATIONS

Even with an ample supply of cooling air, the Load Bank may overheat, if it is not properly installed. There are two types of airflow problems that should be avoided:

1. **RECIRCULATING AIRFLOW** - If the hot, exhausted air is permitted to recirculate through the Load Bank, it will reach such a high temperature and low density that it will no longer cool the resistance elements. Maximum allowable intake air temperature is 110°F. A Load Bank should not be installed so close to any surface which may reflect the exhausted air back to the air intake. When two or more Load Banks are being used, care must be taken in positioning the Load Banks so that the exhausted air of one unit does not feed the air intake of another.
2. **RESTRICTION OF COOLING AIR** - Any obstruction located within four (4) feet of the inlet or twelve (12) feet of exhaust screens will restrict the Load Bank's airflow. Airflow is also restricted when two or more Load Banks have air inlets positioned close to each other. This competition for cooling air causes a low pressure area, restricting adequate airflow to either unit.

WARNING

It is vitally important to install the Load Bank properly. Installation errors may result in a catastrophic failure. The Airflow switch, a protective device in the Load Bank, will guard against some of these problems. If protective circuitry prevents application of the load, determine the source of the problem. **DO NOT DISABLE the AIRFLOW SWITCH.** This will cause a safety hazard and will void our warranty. The following installation instructions are critical to the safe operation of the Load Bank. (Refer to Section I, SAFETY CONSIDERATIONS, of this manual.)

3. The heated exhaust air stream can damage any temperature sensitive items if they are positioned within 30 ft. of exhaust air.
4. Load Banks mounted into a channel, trough, hollow, well, or pit, or exhausting into a full wall or corner, require special considerations even if above conditions are met. In these cases, provide a detailed sketch of site layout for Avtron to inspect and comment.

POWER REQUIREMENTS

The Load Bank requires a 115V, single phase, 60 Hz, 15 amp source of power for operation of the control circuit. A power cord for control power is provided with the Load Bank. Connect unit to a grounded 115 volt source.

An optional control transformer (Option #1) may be installed in the Load Bank. This option enables the operator to use the generator output for control power. When the operator applies either 240V or 480V to the primary, the control transformer supplies 120 VAC for control power. An external power source must be provided (as described in section B of Fan Motor Connections) if internal power for motor and control power is not desired.

During startup, be sure the load switch on the generator under test is not "ON" until the prime mover has the generator up to speed. Also, be sure the load switch is OFF before generator shutdown procedures are started.

CAUTION

When the Load Bank includes Option 1, never connect a control power line cord to TB1(1) and TB1 (2). This would permanently damage the control transformer.

FAN MOTOR CONNECTIONS

The fan circuit consists of fuses, motor starters, contactors, overload relays, and the fan motor.

- A. INTERNAL BLOWER POWER OPERATION: The fan is connected to load bus through relay K28 and fuses F7, 8, and 9. When operating the fan motor from the generator source, an additional load of 3400 watts will be applied. This additional load will be reflected in the meter readings and should be noted on load readings to prevent errors.
- B. REMOTE FAN POWER OPERATION: When testing single phase system or systems or a frequency other than 60 Hz, the fan motor must be run from a separate source. First review schematic, set control panel selector switch to match external voltage applied, and then connect external power. To do this, locate TB1 on the side of the load connection compartment inside the front access panels. Connect the external fan power source to terminals 11 through 13 of TB1.
- C. NON-STANDARD FAN MOTOR FREQUENCY: Fan motor will operate between 208 and 250 volts and between 416 and 500 volts at 3-phase, 60 Hz.

Connection at 50 Hz is the same as 60 Hz, with motor voltage range of 180 to 220 volts and 360 to 440 volts.

W A R N I N G

When operating at 50 Hz, the motor speed (RPM) is reduced, which also reduces cooling of the Load Bank. Do not exceed 400 volts in the 480 mode or 200 volts in the 240 mode, to input bus when running the fan at 50 Hz.

C A U T I O N

Do not attempt to operate fan motor at 400 Hz. When loading unit with power other than 50/60 Hz, the fan motor must be wired to external power source supplying any of the above proper voltages and frequencies.

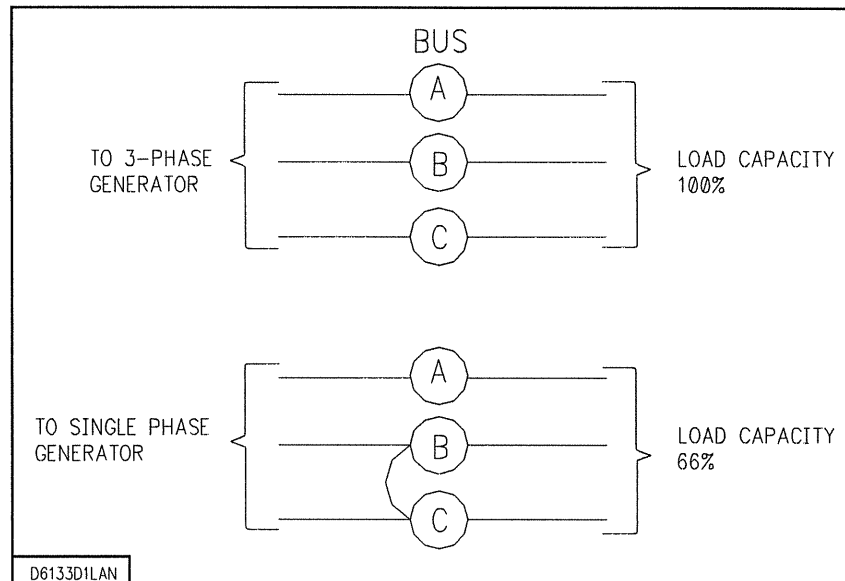
N O T E

When Option 1 is provided, follow correct jumper configuration on TB1 as shown on the schematic before applying load or external fan power.

LOAD CONNECTION

Connect a 240/480 volt, 3-phase source to the three fused bars labeled A, B and C, located within the Load Bank. (Access via the lower hinged panel on front of the unit.) Run cables through opening in floor (base) of Load Bank frame up to bus bars. Verify proper phase to phase clearance on cable lugs, mounting hardware, and wiring. Cables to the Load Bank should be sized to handle the maximum rated load according to the National Electric Code. The current can be determined by the following formula:

$$\text{Line Current} = \frac{\text{kW} \times 577}{\text{VOLTAGE(LINE TO LINE)}}$$



WARNING

"B" Bus and any attached wiring are electrically hot when operating Load Bank in single phase.

GROUNDING

A permanent ground should be connected to the Load Bank enclosure either by a grounded conduit or with a separate ground wire to prevent a potential above ground on the enclosure. No internal ground connections are made to any terminal on the Load Bank.

The ground conductor should be run with the load power conductors to provide the lowest impedance fault path. The ground stud within the Load Bank (located on floor near cable cutout) must be connected to both the generator frame and a good earth ground. The ground conductor should be sized for National Electric Code section 250-95 if not superseded by local codes.

W A R N I N G

Do not operate the Load Bank with any panel or screen removed. This may expose the operator to dangerous high voltage and the rotating fan blade, as well as disrupting the airflow.

Keep both of the front hinged covers closed and latched.

STORAGE

The Load Bank should be covered to limit long term effect of moisture and to reduce the accumulation of dust, dirt, and debris. The unit should be stored in a dry, enclosed area. An optional waterproof vinyl cover is available for the Load Bank; however, even with this cover, the Load Bank should not be stored outdoors permanently.

SECTION IV

OPERATION

PURPOSE AND USE OF CONTROLS

1. **BLOWER VOLTAGE SELECT Switch.** This switch selects the appropriate voltage and source for the fan motor. Set to proper position BEFORE operation.
2. **LOAD VOLTAGE SELECT 240/208/416/480 Switch.** This switch selects the 240 or 480 load voltage mode for the Load Bank.
3. **CONTROL POWER EXT 120V ON/OFF Switch.** This switch turns on externally provided control power to the control circuit. Digital meters will illuminate.
4. **CONTROL POWER INTEGRAL XFMR 240V/480V Select Switch.** When Option #1 is installed, this switch is used to set correct input voltage to the Control Transformer. This method should be used only if voltage and frequency of the generator under test falls within the ranges specified in the INSTALLATION section.
5. **BLOWER START/STOP Pushbuttons.** Pushbuttons are used to initiate fan motor start and stop circuits.
6. **FAN ROTATION ABC/CBA Switch.** This switch is used to reverse the rotation of the cooling fan if airflow is moving in the wrong direction. Always turn off fan by pressing the BLOWER STOP switch and allow the fan to coast to a stop before changing the FAN ROTATION ABC/CBA switch setting.
7. **BLOWER FAIL Lamp.** This lamp should momentarily light when power switch is turned on. This shows the air safety circuit is working. This lamp's purpose is to warn the operator of an air failure or improper cooling of load elements.
8. **Digital Metering Package - Operation** is performed through the front panel of the meter. See supplemental manual for complete operation instructions.
9. **MASTER LOAD ON/OFF Switch.** This switch connects power to all load steps, thus allowing all set load steps to be actuated at the same time. It is also a master load disconnect.
10. **KW LOAD Step Switches.** The load in kilowatts is marked above each actuating switch. A load step may be turned on or off before or during a test, but will load the unit only when the MASTER LOAD switch is ON.

OPERATING INSTRUCTIONS

1. Connect the Load Bank to a 120 volt, 60 Hz source for control power. Line cord provided. (Unless Option #1 is included)
2. Connect the unit to be tested as described in Section III, INSTALLATION, under Power Requirements. Use all three load bus bars behind the lower front panel for 3-phase generators, or connect the power cables to the Phase A and Phase C bus bars for single phase generators. (See Section III, INSTALLATION, for details.)

C A U T I O N

The cooling fan motor is rated at 208-240/480 volts, 3-phase, 60 Hz, with corresponding overload heaters for protection. The motor must be connected to a separate power source if:

1. Using the unit to test a single phase unit.
2. Operating at any frequencies other than 50/60 Hz.
3. Operating at any voltage other than 240/480 volts ± 10 @ 60 Hz.

(Refer to Non-Standard Blower Motor Frequency in Section III.)

3. Place all switches on the control panel in the OFF position.
4. Place the BLOWER VOLTAGE SELECT switch to the correct voltage and source selection.
5. Place the LOAD VOLTAGE SELECT switch to the correct voltage to test the generator.
6. Start the generator to be tested. After unit stabilizes at operating speed, temperature, voltage, and any other required condition for testing per manufacturer's instructions, proceed to step 7.

CAUTION

DO NOT operate the Load Bank over the rated voltage as this will cause catastrophic failure in the Load Bank.

DO make sure that the VOLTS Select switch is in the proper position before applying load.

7. On standard units with external 120V control source, turn the CONTROL POWER EXT 120V switch to the ON position. On units with Option 1 (internal power derived from the generator under test), move the CONTROL POWER INTEGRAL XFMR 240V/480V selector switch to the voltage that matches the generator under test. Press the control power ON button.
8. Depress the BLOWER START pushbutton. Verify air flow is in the correct direction. If not, shut down fan by depressing the STOP pushbutton. Wait until fan blade stops rotating, then switch fan rotation switch ABC/CBA. Restart and verify airflow.

Upon energizing the fan, the red BLOWER FAIL lamp will light momentarily until the air switch detects sufficient cooling air, at which time it will go out, applying power load switches. If at any time, there is insufficient cooling air to the elements, this safety switch will drop out the load and the red BLOWER FAIL lamp will light.

CAUTION

The operation of the fan is vital to the safe operation of this Load Bank. When the BLOWER START pushbutton is depressed, the BLOWER FAIL light will come on momentarily until the blower accelerates up to its operating speed, at which time the light will go off. If the air switch prevents the load from being applied, do not bypass this switch. If the BLOWER FAIL light stays on for more than a few seconds, shut down the Load Bank and do not operate the unit until the problem is corrected. (Refer to Section I, SAFETY CONSIDERATIONS, of this manual.)

9. With the MASTER LOAD switch in the OFF position, verify that the voltage displayed by the Digital Meter matches the position of the LOAD VOLTAGE Select switch.

10. The resistive loading is selected by toggle switches, using any one or combination of toggle switches to make up a given load.
11. By placing the MASTER LOAD switch to the ON position, the preselected load will be applied to the power source.
12. Any KW LOAD switch can be added or removed as required with the MASTER LOAD switch closed (ON).
13. Monitor the unit under test using the digital metering package. Toggle through the phases to review individual phase amps, kW, and volts.
14. To remove load, move MASTER LOAD switch to OFF position.
15. Shutdown: Reverse steps 1 through 12. It is good procedure to allow the fan motor to operate for about 5 minutes after the load is removed. This will exhaust any accumulated heat and allow exhaust surfaces to cool. Although not required for maintaining Load Bank integrity, the cooling procedure helps to prevent burn injuries.

WARNING

DO NOT touch the exhaust screen during operation. The screen will become hot from the exhaust heat and may cause a serious burn. (Refer to Section I, SAFETY CONSIDERATIONS, of this manual.)

DO NOT allow objects to enter or block screens.

NOTE

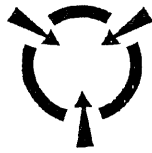
Lower voltages and different frequencies may be applied to the load circuit of the Load Bank. Frequency change causes no derating of the load. The Applied kW with a lower voltage is computed using the following formula:

$$kW_{Applied} = kW_{Rated} \times \frac{(Voltage Applied)^2}{(Voltage Rated)^2}$$

C A U T I O N

Never exceed the rated voltage. This will cause the Load Bank to overheat.

Do not apply DC voltages, because the contactors do not have arc blowout magnets.



ESD PRECAUTIONARY GUIDELINES

C A U T I O N

Certain circuit card assemblies and their components, typically integrated circuits, may be damaged by seemingly undetectable electrostatic discharge (ESD). Care must be exercised during handling/repair of these items. Use electrostatic discharge precautionary procedures.

The following guidelines are not necessarily all inclusive but rather serve as reminders for good shop practices for the handling/repair of ESD sensitive circuit card assemblies and devices.

- Store ESD sensitive items in their original containers. These items are often marked with the symbol shown at the top of this page.
- Put on a grounded wrist strap before handling any ESD sensitive item.
- Clear work area of Styrofoam®, plastic, and vinyl items such as coffee cups.
- Handle ESD items by the body, never the open edge connectors.
- Never slide ESD sensitive items over any surface.
- Transport ESD sensitive items in a static shielding container to a static-free work station.
- If a static-free work station is not available, ground the transport container before removing or inserting an ESD item.
- Electric tools used during repair should be grounded. For example, use only anti-static type solder suckers and grounded tip soldering irons. Discharge non-electric tools before use.
- Pack ESD items in static shielding containers before shipping them to Avtron for repair.

* Styrofoam® is a registered trademark of Dow Chemical.

SECTION V

MAINTENANCE

Good maintenance procedures must be followed to provide long equipment life and to reduce the chance of electric shock, fires, and personal injury. Before servicing, review Section I, **SAFETY CONSIDERATIONS**, of this manual.

The following are examples of scheduled maintenance procedures. These examples are not purported to be all-inclusive, but must be accomplished to maintain the equipment in a good, safe condition. All maintenance work must be done by qualified personnel only.

W A R N I N G

Personal injury from electrical shock or from the rotating fan blade may result if ALL sources of power are not disconnected before servicing. (Refer to Section I, **SAFETY CONSIDERATIONS**, of this manual.)

DAILY

1. Remove any Load Bank airflow restrictions.
2. Check the screens to make sure that no objects have blocked or entered the openings. Also verify screens are not damaged. Repair or replace any damaged screens. **NOTE:** The exhaust screen is on top of the Load Bank.
3. Verify that the airflow is in the proper direction.
4. Ensure that there is no recirculation of the exhaust air through the Load Bank.

THREE MONTHS OR 500 HOURS

1. Remove access panels and screens.
2. Inspect the load resistors for mechanical breakdown which is demonstrated by excessive sagging of the elements. Replace with new resistor elements, support rods, and insulators as required.
3. Inspect for broken ceramic insulators. Replace with new ceramic insulators if any cracks are found. Minor chips (less than 1/8" diameter) are acceptable and not cause for replacement.
4. Inspect for loose hardware or loose connections. Tighten where required.
5. Inspect all connections for oxidation or corrosion. Clean the connection or replace the hardware where required.
6. Verify that the airflow switch works properly.
7. Inspect all contactors to make sure that the contacts are not severely pitted or corroded. The contacts must move freely and be properly seated.
8. Clean all dirt and debris out of the Load Bank. This can be accomplished by blowing the inside of the unit with clean, dry compressed air.

W A R N I N G

Use only clean, dry compressed air (not to exceed 40 PSI). Eye protection must be worn when cleaning with compressed air. Do not direct compressed air against skin.

9. Inspect all the wiring for any sign of insulation failure, especially where wiring is close to resistor case sheet metal or element support rod or clip.
10. Care must be taken in repairing or replacing current transformers. If one is found to be defective, mark all leads before removing to ensure connecting new C.T. properly, since proper phasing is important.
11. Inspect for any signs of heat stress on connections. This could be caused by loose hardware or corroded connection. Repair or replace as condition warrants.

W A R N I N G

The secondary of an unshorted or unshunted current transformer can generate several thousands of volts, possibly causing harm to personnel or damage to the C.T. and related instruments. Verify that no primary current is going through the C.T. and that all C.T. leads are terminated properly.

12. Replace all access panels and screens. Tighten all the fastening hardware securely.
13. Check the indicator lamps on the control panel and replace as necessary.

ANNUALLY

The blower motor must be lubricated per the motor manufacturer's requirements and specifications on the motor nameplate.

PARTS REPLACEMENT

Access to any component is easily made with the removal of the cover panels. All components in the unit that may need replacement are listed in the Replacement Parts List. Avtron maintains an inventory of normally used items.

SECTION VI

REPLACEMENT PARTS LIST

INTRODUCTION

The parts list in this section contains the description, quantity required, and Avtron part numbers for each listed part. The list also includes, where appropriate, the manufacturer's part number and federal code number, as well as schematic reference designators to facilitate troubleshooting.

NOTE

Every effort has been made to ensure the accuracy of this information. However, changes are sometimes necessary and revisions to the parts list may be made at any time without notice.

REFERENCE DESIGNATORS

Service personnel may use this parts list along with the Avtron system schematics to identify and order replaceable parts. The reference designators were carefully selected and matched to those on the schematic diagrams and equipment to simplify the troubleshooting and repair process.

NOTE

When ordering replacement parts, be certain to state the part's description, Avtron part number, and the schematic reference designator number if one is available. Also include the model and serial number of the equipment.

MANUFACTURERS' FEDERAL CODE NUMBERS

The manufacturer and part number column contains, in parentheses, the Commercial and Government Entity code number (CAGE code), a five character string listed in H4-1/H4-2. This CAGE code identifies the manufacturer of the listed part. The following is a numerical cross-reference listing of CAGE codes to manufacturers' names and addresses.

FEDERAL CODE NUMBER LIST

01121	Allen-Bradley Co. 1201 S. Second St. Milwaukee, WI 53204	71400	Cooper Industries Inc. Bussmann Div. 114 Old State Rd. Ballwin, MO 63021-5942
042A0	Caster Connection Inc. 745 South St. P.O. Box 35 Chardon, OH 44024	72619	REPLACED BY:
05422	Tenor Controls Inc. 17020 W. Rogers Dr. New Berlin, WI 53151-2233	83330	Dialight Corp. Manasquan Div. 1913 Atlantic Ave. Manasquan, NJ 08736-1005
05472	Baldor Electric Co. 5711 S. 77th St. Fort Smith, AR 72901	73559	Carlingswitch Inc. 60 Johnson Ave. Plainville, CT 06062-1156
08275	Cleveland Controls Inc. Cleveland, OH	77342	Potter & Brumfield Inc. 200 S. Richland Creek Dr. Princeton, IN 47671-0001
15605	Eaton Corporation Operations & Technical Center 4201 N. 27th St. Milwaukee, WI 53216-1807	94222	South Co. Inc. 210 N. Brinton Lake Rd. Concordville, PA 19331
21604	The Buckeye Stamping Co. Columbus, OH		
23826	Furnas Electric Co. Batavia, IL		
5Y407	Phoenix Contact Inc. One Phoenix Plaza Middletown, PA 17057		
59138	Instrument Transformers Clearwater, FL		
6T923	Crouzet Controls Inc. Carrollton, TX 75006		
63988	Crowley Co., Inc. 15030 Berkshire Industrial Pky. P.O. Box 425 Burton, OH 44021		

REPLACEMENT PARTS LIST

SCHEMATIC REFERENCE	DESCRIPTION	MANUFACTURER and PART NO.	AVTRON P/N	QTY/ UNIT
RA2-RA4 K1B, K2B	AVTRON MODEL LPV700 ..LOAD BANK, PORTABLE 700 KW ..SCHEMATIC ..RESISTOR ASSEMBLY ..RELAY	(23826) 42GE35AF551R REF (71400) JJS-150	LPV700- D32451-1 D32465 D27555-3 351885	REF 3 2
F4-F6, 10-12	..FUSE, 150A	(71400) JJS-150	324463	6
K1A, K2A	..RESISTOR ASSEMBLY ...RELAY	(23826) 42GE35AF551R REF (71400) JJS-150	D27555-1 351885	1 2
F1-F3, 7-9	...FUSE, 150A	(71400) JJS-150	324463	6
RA1 K1-3(A & B) K4(A & B) XF1-12	...RESISTANCE ELEMENT, 100 KW ...INSULATOR (2.00 LG) ...INSULATOR (.50 LG) ...INSULATOR ...INSULATOR ..RESISTOR ASSEMBLY ..RELAY ..RELAY ..FUSEHOLDER	(71400) T60060-3CR (71400) JJS-40	A23914 411187 411188 411146 411147 D32427-1 B14795 B14796 324660	12 156 24 24 48 1 6 2 4
F1-F12	..FUSE, 40A	(71400) JJS-40	324419	12
F13-F18	..RESISTANCE ELEMENT, 5 KW ..RESISTANCE ELEMENT, 10 KW ..RESISTANCE ELEMENT, 25 KW ..INSULATOR (2.00 LG) ..INSULATOR (.50 LG) ..RESISTANCE ELEMENT, 50 KW ..INSULATOR ..INSULATOR ..FUSE, 80A	(71400) JJS-80	A23913-1 A23913-2 A23913-4 411187 411188 A24059 411181 411182 324420	6 12 6 390 60 6 48 96 6
DS2	..INSULATOR ..INSULATOR ..CONTROL PANEL ..SCHEMATIC/INTERCONNECTION DIAGRAM ..LAMP, INDICATOR, AMBER	(72619) 249-7841-1433-574 (72619) 249-7841-1431-574	411146 411147 D32460-1 D32465 329681	12 24 1 REF 1
DS1	..LAMP, INDICATOR, RED	(72619) 249-7841-1431-574	329682	1
M1	..METER, DIGITAL	ELECTRO INDUSTRIES DMMS300-2E-BRT- DSP3-120-D2 SF232DB3	338272	1
XF100	..FUSE HOLDER	(71400) HPS-RR	324985	1

SCHEMATIC REFERENCE	DESCRIPTION	MANUFACTURER and PART NO.	AVTRON P/N	QTY/ UNIT
F100	..FUSE, 10 AMP	(71400)	324128	1
S1, S8, S12-S20	..SWITCH, TOGGLE	KTK-R-10 (73559)	360589	11
S5	..SWITCH, PUSHBUTTON (RED)	2GK51-73 (01121)	361873	1
S4	..SWITCH, PUSHBUTTON (BLACK)	800T-B6D2 (01121)	361874	1
S6, S7	..SWITCH, TOGGLE	800T-A2D1 (15605)	360747	2
S9	..SWITCH, ROTARY	79923K10	620288	1
XS9	..KNOB	(21604)	453602	1
P1-P6	..CONNECTOR, 10 CONDUCTOR	PS95BL-2 BLK (5Y407)	364874	5
XF4-9	..CONTROL BLOWER ASSEMBLY	1754601 (50 PCS)	D32462-1	1
F4-9	..FUSE	JP60030-3PR (71400)	324283	6
F101-103	..FUSE, 1A, 600V	LPJ-20SP (71400)	324449	3
XF101-103	..FUSEHOLDER	FNQ-R-1 (71400)	324615	1
K21, K22	..RELAY*	BM6033SQ (23826)	350980*	2
K30, K31	..RELAY	3RB1026-2QB0 (77342)	351060	2
K23-29	..RELAY	KUP14A15 (01121)	351650	7
VSR	..RELAY	100-C12D10 (6T923)	351653	1
XK30, 31	..SOCKET, RELAY	DUR-110A (77342)	358280	2
S51	..SWITCH, SENSING, RANGE 0.5 \pm 0.02 IN W.C. - 2.0 IN W.C., 300 VA, 115-277 VAC, INCLUDES LINE NUT AND FERRULE CONNECTORS	27E893 (08275)	360772	1
T1	..TRANSFORMER	AFS-271 PER DESC (59138)	371046	1
XK21, 22	..BRACKET, RELAY MTG*	2VT469-480 (23826)	408304*	2
XK30, 31	..SPRING, HOLD DOWN	3RU1926-3AA01 (77342)	467550	2
R100	..RESISTOR, 100K, 1/2W, 10%	20C318	110048	1
S3	..CONTROLLER, TEMP	(05422)	491017	1
XS3	..SOCKET	TOSB4RK6F TENOR IND. CONTROL	358311	1
XS3	..THERMOCOUPLE	600-3-0013	A24741	1
K5 (A&B)	..RELAY		B14796	2
B1	..MOTOR, 5 HP	(05472)	341064	1
		M3665T		

SCHEMATIC REFERENCE	DESCRIPTION	MANUFACTURER and PART NO.	AVTRON P/N	QTY/ UNIT
CT1,2	.TRANSFORMER, CURRENT	(59138) 568TS-202	370157	2
	.IMPELLER, FAN	(63988) 29.9-6-9-4ZR-AL- 32.5-AS 1 1/8"-P-1 BUSHING	406082	1
	.SPRING LATCH	(94222) 57-10-111-10	442595	4
	.CASTER, RIGID	(042A0) 4-5108-919	417113	2
	.CASTER, SWIVEL	(042A0) 4-5109-919	417114	2

APPENDIX

LOAD BANK TROUBLESHOOTING GUIDE

NOTE

Servicing should always be done only by trained, qualified service technicians.

W A R N I N G

Be sure that all sources of power to the Load Bank are disconnected before servicing.

PROBLEM	POSSIBLE CAUSES/REMEDIES
1. Load Bank main power fails to come on.	<ul style="list-style-type: none">a. Main switch or circuit breaker is not closed.b. Unit is not connected according to the Schematic/Interconnection Diagram.c. Terminals were damaged during shipment.d. Fuses are blown. (Check and replace as required.)*e. Fuse is blown in Load Bank control circuit. (Check and replace as required.)*f. Dirty or loose connection at Main Power Switch.
2. Blower motor does not operate.	<ul style="list-style-type: none">a. Main switch or circuit breaker is not closed.b. Power is not connected to Load Bank blower circuit.c. External power source is inadequate.d. Motor fuses are blown. (Check and replace as required.)*

* When checking fuses for continuity, be sure to remove all fuses from clips (in fuseblock or Disconnect Switch). Test each fuse individually, out of circuit. (If tested in circuit, there is the possibility of feedback which causes false readings. A blown fuse may still check out OK.)

PROBLEM	POSSIBLE CAUSES/REMEDIES
2. Blower motor does not operate. (Cont.)	<ul style="list-style-type: none"> e. Motor overload is tripped. f. Motor start is malfunctioning. g. Main Power Switch is inoperative. h. Connections are broken or loose. i. Motor shaft does not turn due to improper lubrication. (Replace or repair as necessary.)
3. BLOWER FAILURE indicator lights, yet blower is operating.	<ul style="list-style-type: none"> a. Airflow restrictions present at Load Bank intake or exhaust. b. Improper fan blade rotation or phase reversal. (Check fan motor power connections for proper phase sequence.) c. Air Differential Pressure Switch is malfunctioning. d. Blower Fail Relay is malfunctioning.
4. Fan blade is broken or not turning.	<ul style="list-style-type: none"> a. Fan blade motion is obstructed. b. Fan blade is loose at hub or is not keyed properly.
5. Load step(s) cannot be energized.	<ul style="list-style-type: none"> a. A blower failure exists. (See problem 2.) b. MASTER LOAD Switch is inoperative. c. Control power is inadequate. d. Fuse is blown in Load Bank control circuit or individual branch circuit load fuse (if so equipped) is blown. (Check and replace as required.)* e. Blower Fail Relay is malfunctioning. f. Load step switch is inoperative. g. Load step contactor is inoperative. h. Magnetic contactor has an open coil. i. Load step resistor is open.

* When checking fuses for continuity, be sure to remove all fuses from clips (in fuseblock or Disconnect Switch). Test each fuse individually, out of circuit. (If tested in circuit, there is the possibility of feedback which causes false readings. A blown fuse may still check out OK.)

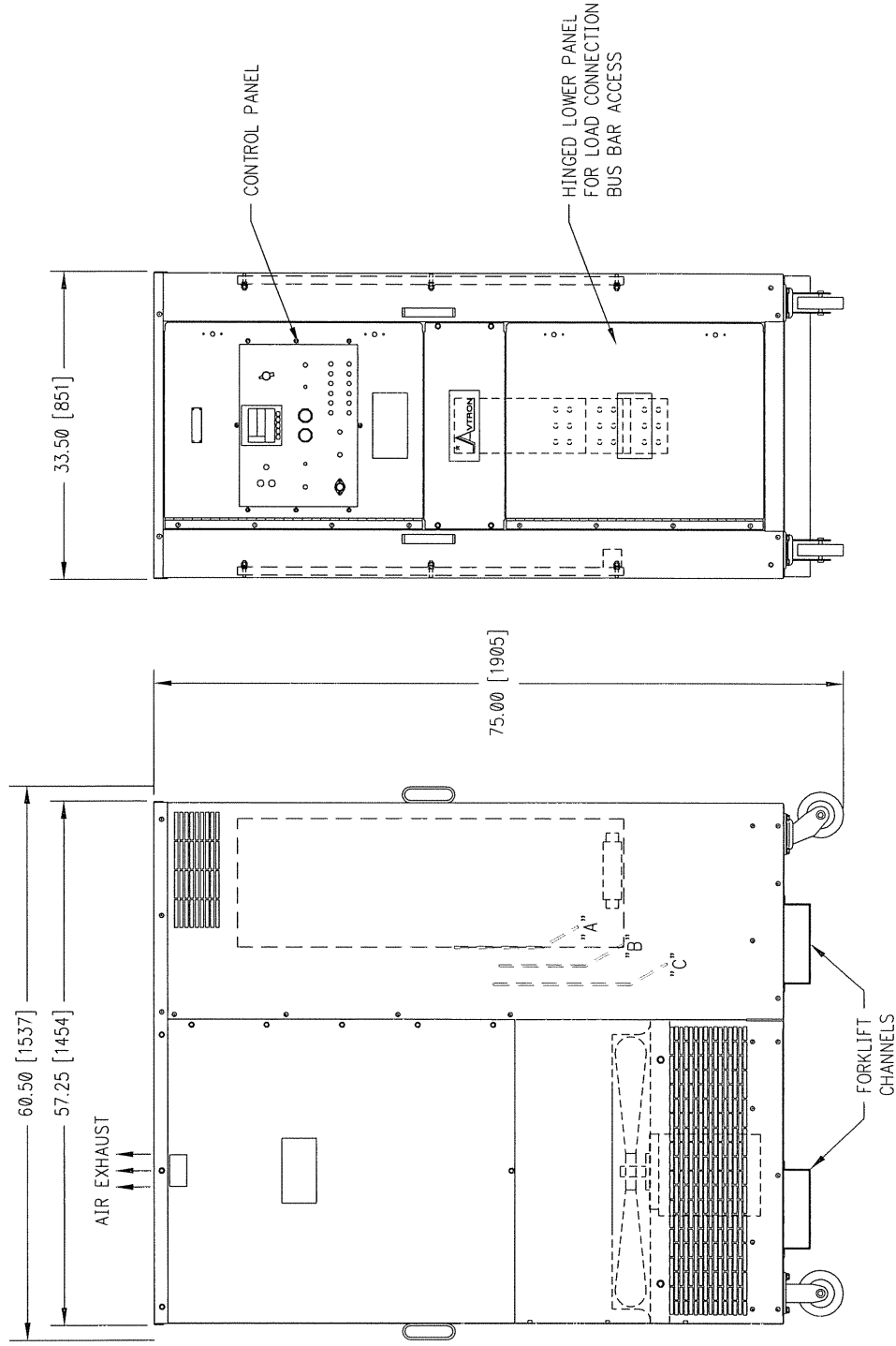
PROBLEM	POSSIBLE CAUSES/REMEDIES
6. Contactor "chattering" exists.	a. Contacts and/or core are dirty or corroded. b. Connections to contactor coil are loose. c. Control circuit line voltage is too low.
7. Load Bank or load step does not give rated load.	a. Applied load voltage is either derated or inadequate. b. Contactor does not close properly. c. Load step resistor element is open. d. One of the individual load branch circuit fuses is blown (if so equipped).
8. Disconnect Switch fuses are blown.	a. Fuses are undersized.* b. A short circuit exists in the blower or control circuit.*

- * When checking fuses for continuity, be sure to remove all fuses from clips (in fuseblock or Disconnect Switch). Test each fuse individually, out of circuit. (If tested in circuit, there is the possibility of feedback which causes false readings. A blown fuse may still check out OK.)

DRAWINGS

PROPRIETARY NOTE

The wiring diagrams and schematics which follow contain information PROPRIETARY to Avtron Manufacturing, Inc., are furnished solely to provide information sufficient for instruction, operation, maintenance, evaluation, and testing of the equipment herein disclosed, are not to be used for manufacturing or procurement and are not to be disclosed to anyone other than persons in the Division, or the Company, or the Government, as the case may be, responsible for action relating to this document without the express written permission of Avtron Manufacturing, Inc.

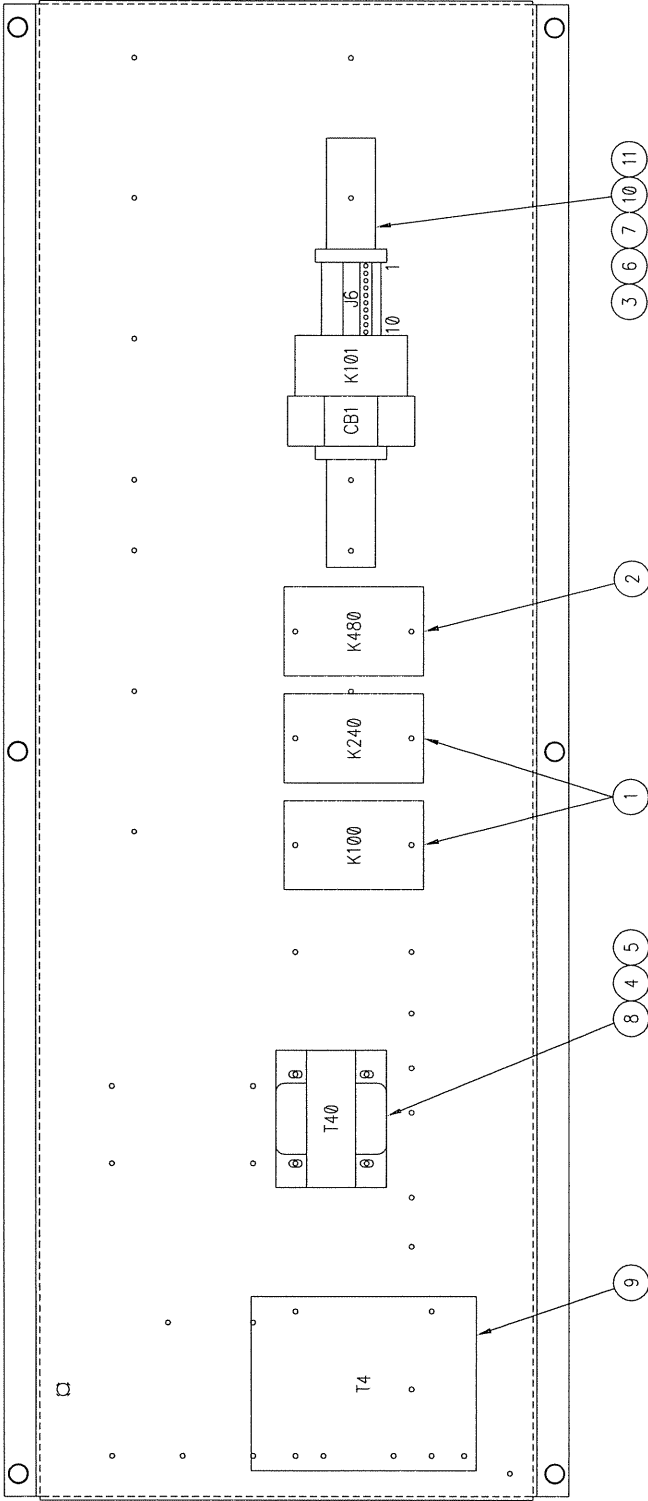


FOR APPLICATION ENGINEERING USAGE ONLY

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF AVTRON MANUFACTURING, INC. AND SHOULD NOT BE DISCLOSED OR USED FOR ANY OTHER PURPOSES WITHOUT THE WRITTEN CONSENT OF AVTRON MFG.				DRAWN J.FLAUTO 9/13/01 CHECKED J.FLAUTO 9/14/01 APPROVED J.EMERY 3/32		DATE 9/13/01 SCALE 3/32		*AVTRON MANUFACTURING, INC. INDEPENDENCE, OH		DRAWING NUMBER SB3166 SHT 1 OF 1 OUTLINE DRAWING	
3. DIMENSIONS IN INCHES EXCEPT "[xxx]"= mm. 2. ALL DIMENSIONS ARE APPROX. 1. WEIGHT: 1150 LBS [522 KG] APPROX.				CHANGE NO. LET.		CHG'D NO. LET.		LOAD BANK, PORTABLE, VERTICAL AIRFLOW			

NOTES:

REVISIONS			
ECON NO.	REV	DESCRIPTION	DATE
CD208	A	ADDED "10" AND "1" TO J6.	11/5/02
APPROVED			EMERY



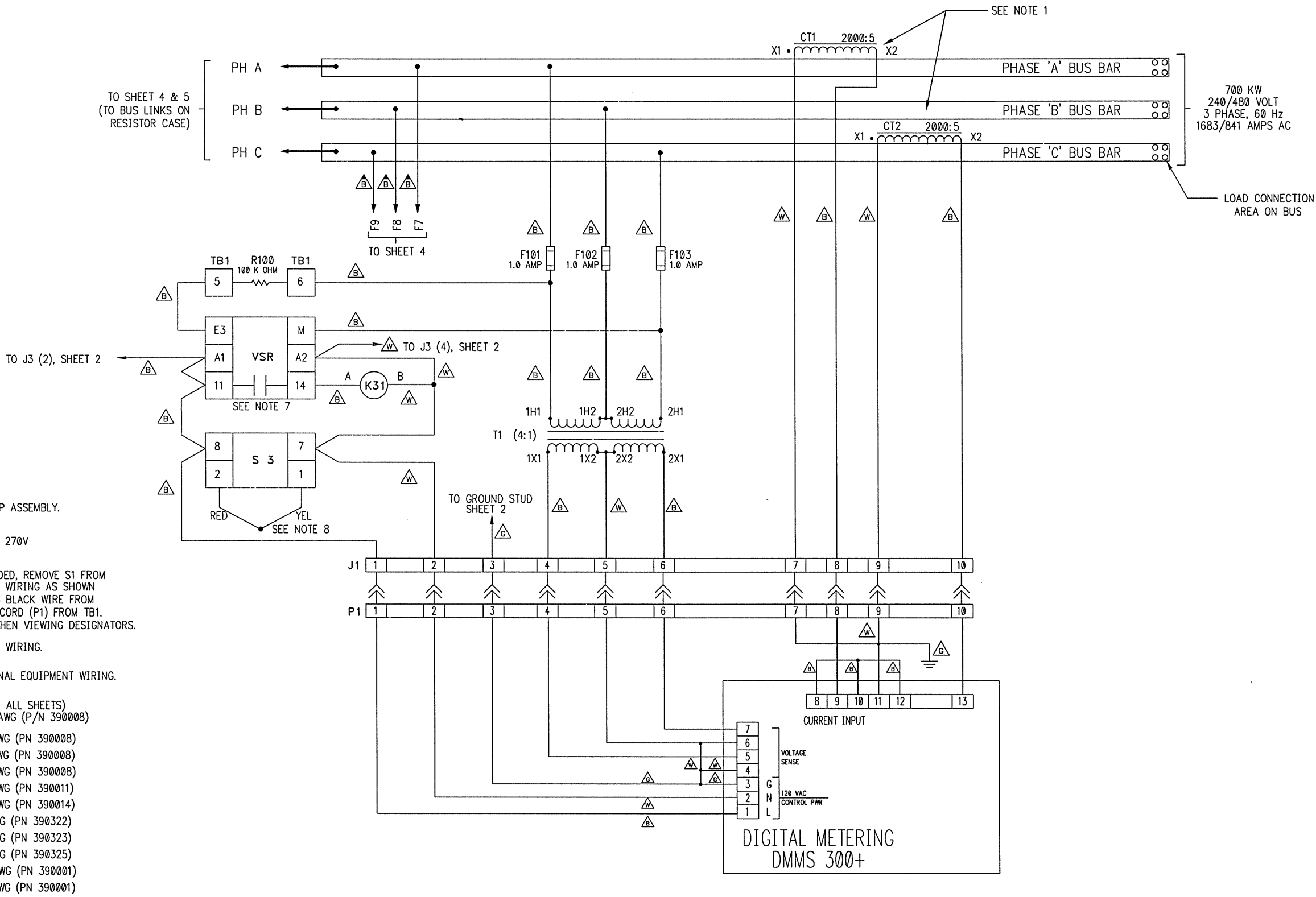
2. SEE SHEET 1 FOR GENERAL INSTRUCTIONS & BOM.

1. MARK REFERENCE DESIGNATORS 12 HIGH MINIMUM USING PRODUCTION DECALS AND OR INK STAMPING. SPRAY OVER INK STAMPING WITH CLEAR ACRYLIC LACQUER. REFERENCE DESIGNATORS SHALL BE LOCATED ADJACENT TO COMPONENTS SO THAT THEY REMAIN VISIBLE AFTER WIRING.

UNLESS OTHERWISE SPECIFIED THE ABOVE NOTES APPLY

<div> <div> ★ AVTRON MANUFACTURING INC </div> <div> 7900 EPLEASANT VALLEY ROAD INDEPENDENCE, OH 44131-5529 </div> </div>				DUAL VOLTAGE CONTROL TRANSFORMER, OPTION #1			
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		C	01014	C25354	A		
		SCALE	3/8	MODEL	LPV	SHEET	2

REVISIONS				
ECN NO.	REV	DESCRIPTION	DATE	APPROVED
CC947	A	REV SHT 2 PER ECN	2/11/02	D.KOZAR
CD208	B	REV SHT 1 NOTE #6.	11/5/02	EMERY



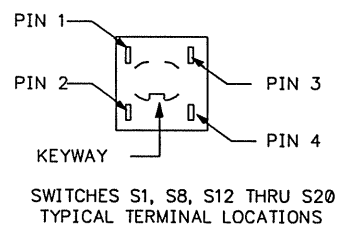
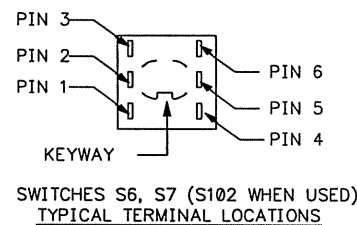
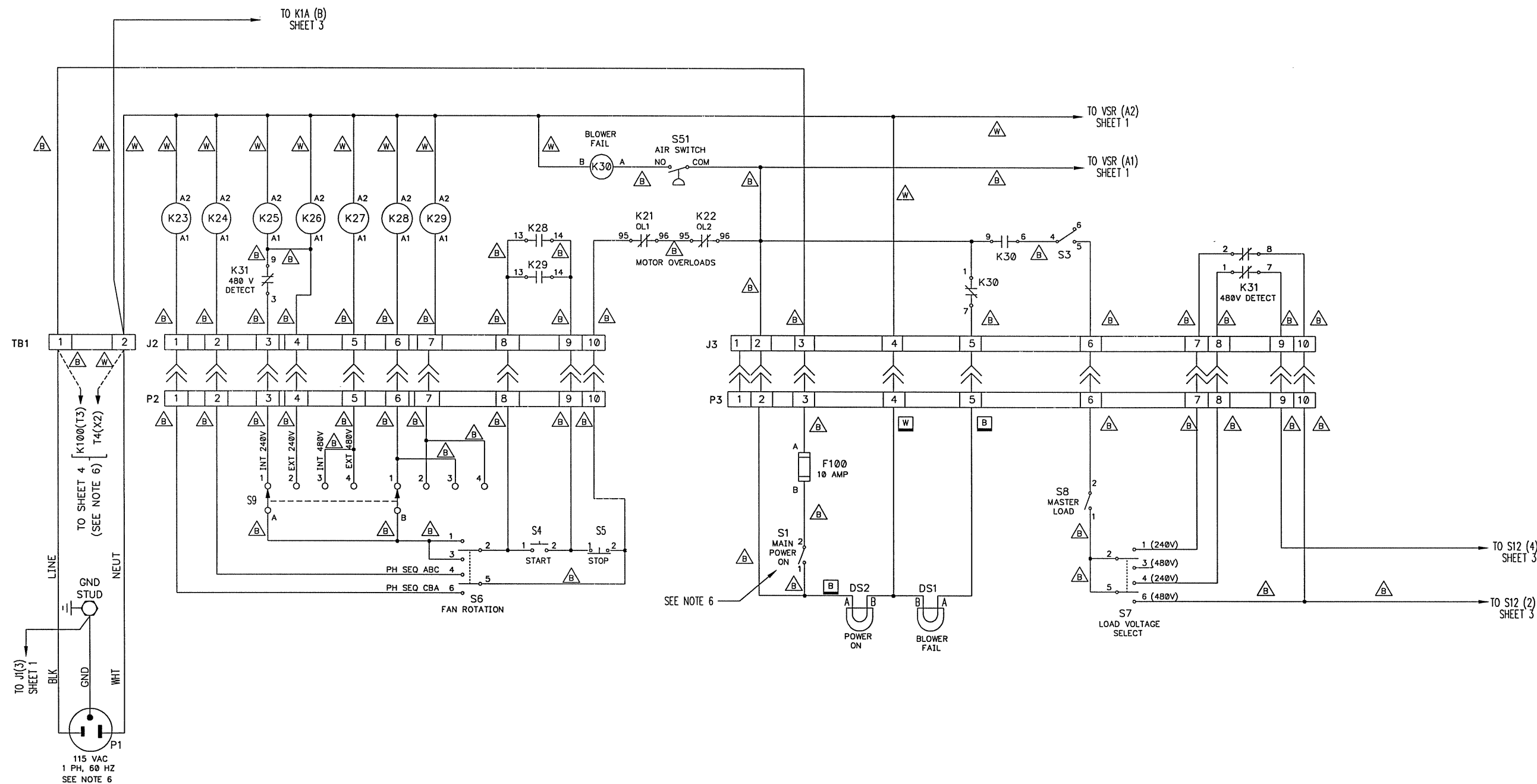
- 8- THERMOCOUPLE A24741 IS WIRED AT TOP ASSEMBLY. SET THERMOCOUPLE TO 375 DEGREES F.
- 7- PRESET VOLTAGE SENSE RELAY (VSR) TO 270V BUS VOLTS, 0% HYS.
- 6- OPTION #1 NOTE: IF OPTION #1 IS ADDED, REMOVE S1 FROM CONTROL PANEL, ADD COMPONENTS AND WIRING AS SHOWN IN BLOCK ON SHEET 4, ADD A 16 AWG BLACK WIRE FROM F100 (B) TO P3 (2) AND REMOVE LINE CORD (P1) FROM TB1. ON PLUG P6 LOCATION 1 IS ON LEFT WHEN VIEWING DESIGNATORS.
- 5- - - - - LINES INDICATE CUSTOMER WIRING.
- 4- - - - - DASHED LINES INDICATE OPTIONAL EQUIPMENT WIRING.
- 3- WIRE LEGEND: (WIRE CODE TYPICAL FOR ALL SHEETS)
ALL UNMARKED WIRE TO BE BLACK #16 AWG (P/N 390008)
- △ INDICATES WIRE TO BE BLACK #16 AWG (PN 390008)
- △ INDICATES WIRE TO BE WHITE #16 AWG (PN 390008)
- △ INDICATES WIRE TO BE GREEN #16 AWG (PN 390008)
- △ INDICATES WIRE TO BE BLACK #14 AWG (PN 390011)
- △ INDICATES WIRE TO BE BLACK #12 AWG (PN 390014)
- △ INDICATES WIRE TO BE BLACK #8 AWG (PN 390322)
- △ INDICATES WIRE TO BE BLACK #6 AWG (PN 390323)
- △ INDICATES WIRE TO BE BLACK #2 AWG (PN 390325)
- △ INDICATES WIRE TO BE BLACK #22 AWG (PN 390001)
- △ INDICATES WIRE TO BE WHITE #22 AWG (PN 390001)
- 2- DO NOT RUN POWER WIRING IN THE SAME BUNDLE AS CONTROL PANEL WIRING.
- 1- CT1 & CT2 LEADS SHOULD BE THE SAME LENGTH.

UNLESS OTHERWISE SPECIFIED THE ABOVE NOTES APPLY

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CONSENT OF AVTRON MFG.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		DRAWN J. EMERY	DATE 5-24-01	<div> <div> <div>7900 E.PLEASANT VALLEY ROAD INDEPENDENCE, OH 44131-5529</div> <div>AVTRON MANUFACTURING INC</div> </div> </div>	
TOLERANCES: DECIMALS .XX±	ANGLES±1°	CHECKED J.FLAUTO	10-22-01		
FINISH		ENG APVD J.EMERY	10-26-01	<div> <div>SCHEMATIC/INTERCONNECTION DIAGRAM, LOAD BANK (700KW @ 240/480V, 3PH)</div> <div>IMF <input checked="" type="checkbox"/> PSF <input type="checkbox"/></div> </div>	
PAINT PER PS	PLATE PER	APVD PROD A.VYSOTSKY	10/29/01		
COAT PER PS	ANODIZED PER			SIZE D	CAGE NO. 01014
NEXT ASSY	USED ON			DWG. NO. D32465	REV B
APPLICATION		OTHER		SCALE	MODEL LPV 700

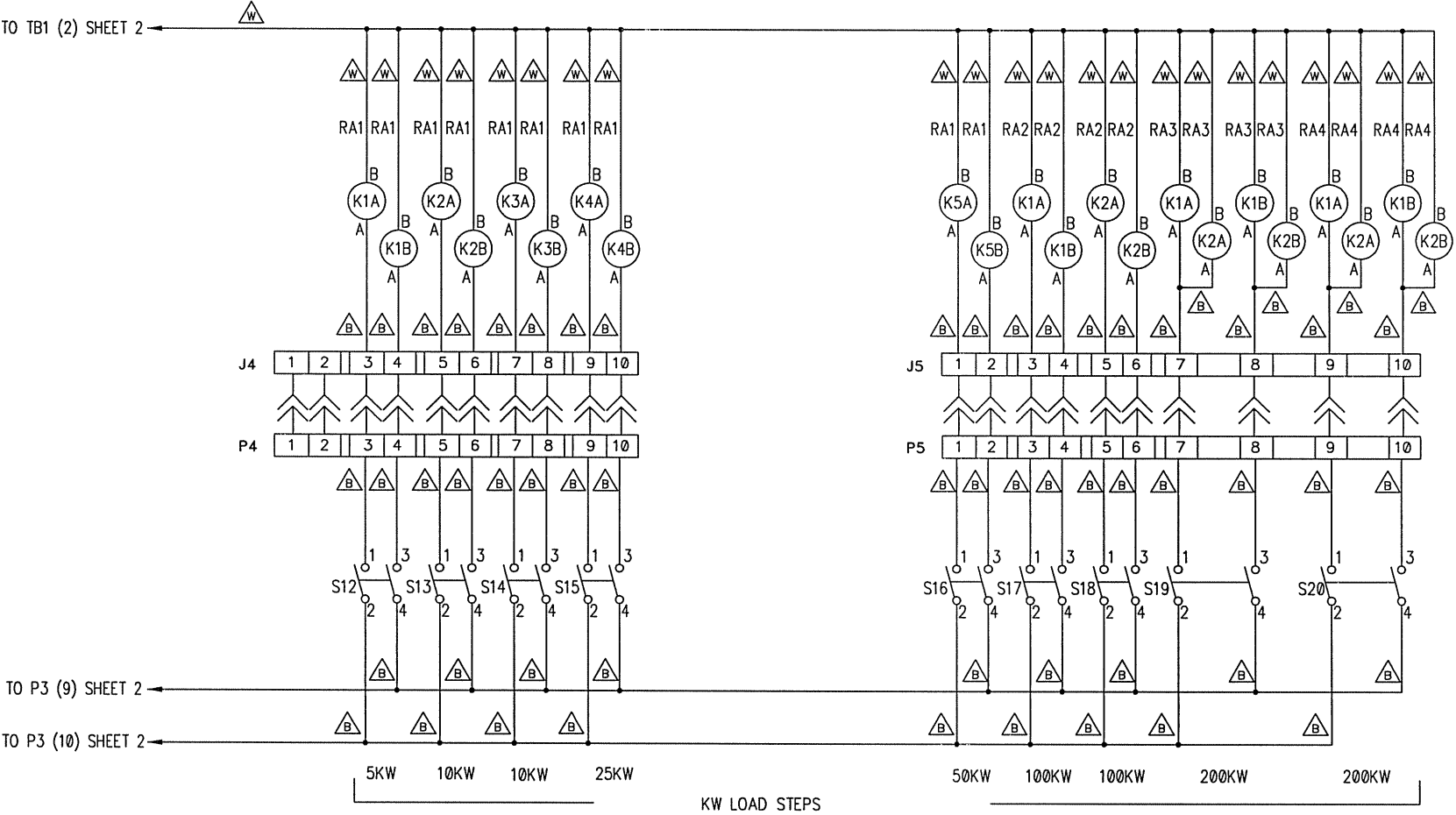
REVISIONS				
ECN NO.	REV	DESCRIPTION	DATE	APPROVED
CC947	A	REV PER ECN	FACKELMANN 2/11/02	D.KOZAR



SEE SHEET 1 FOR WIRE CODE AND NOTES.
UNLESS OTHERWISE SPECIFIED THE ABOVE NOTES APPLY

Avtron MANUFACTURING INC		SCHEMATIC/INTERCONNECTION DIAGRAM, LOAD BANK (700KW @ 240/480V, 3PH)		
7900 E.PLEASANT VALLEY ROAD INDEPENDENCE, OH 44131-5529		SIZE D	CAGE NO. 01014	REV B
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		SHEET 2		

REVISIONS				
ECN NO.	REV	DESCRIPTION	DATE	APPROVED



SEE SHEET 1 FOR WIRE CODE AND NOTES.
UNLESS OTHERWISE SPECIFIED THE ABOVE NOTES APPLY



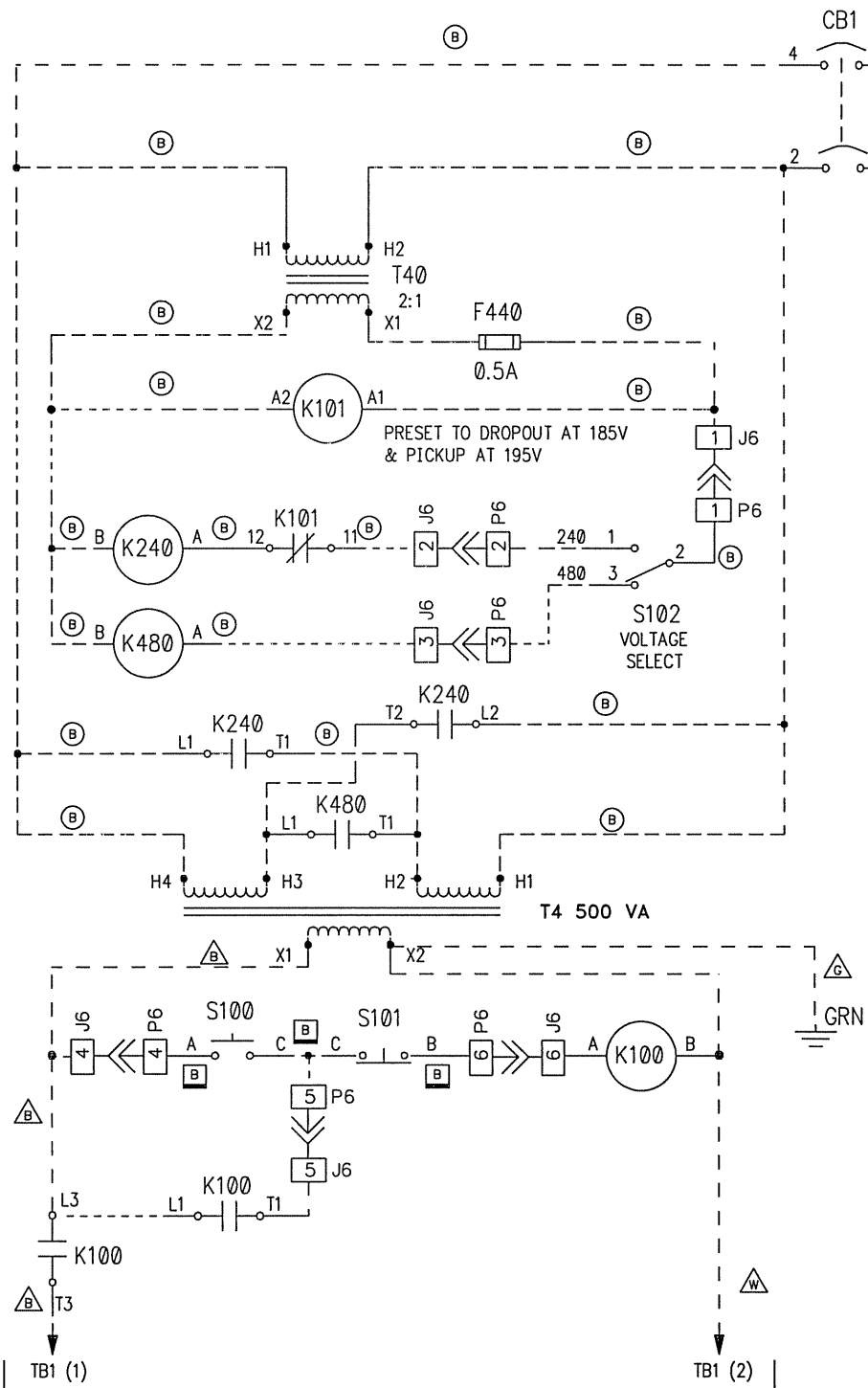
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SCHEMATIC/INTERCONNECTION
DIAGRAM, LOAD BANK
(700KW @ 240/480V, 3PH)

SIZE D	CAGE NO. 01014	DWG. NO. D32465	REV B
SCALE 1/1	MODEL LPV 700	SHEET 3	

REVISIONS				
ECN NO.	REV	DESCRIPTION	DATE	APPROVED

OPTION # 1
 DUAL VOLTAGE CONTROL TRANSFORMER
 PRIMARY: 240 / 480 VAC
 SECONDARY: 120 VAC
 (THIS WIRING ONLY IF OPTION #1 PROVIDED)

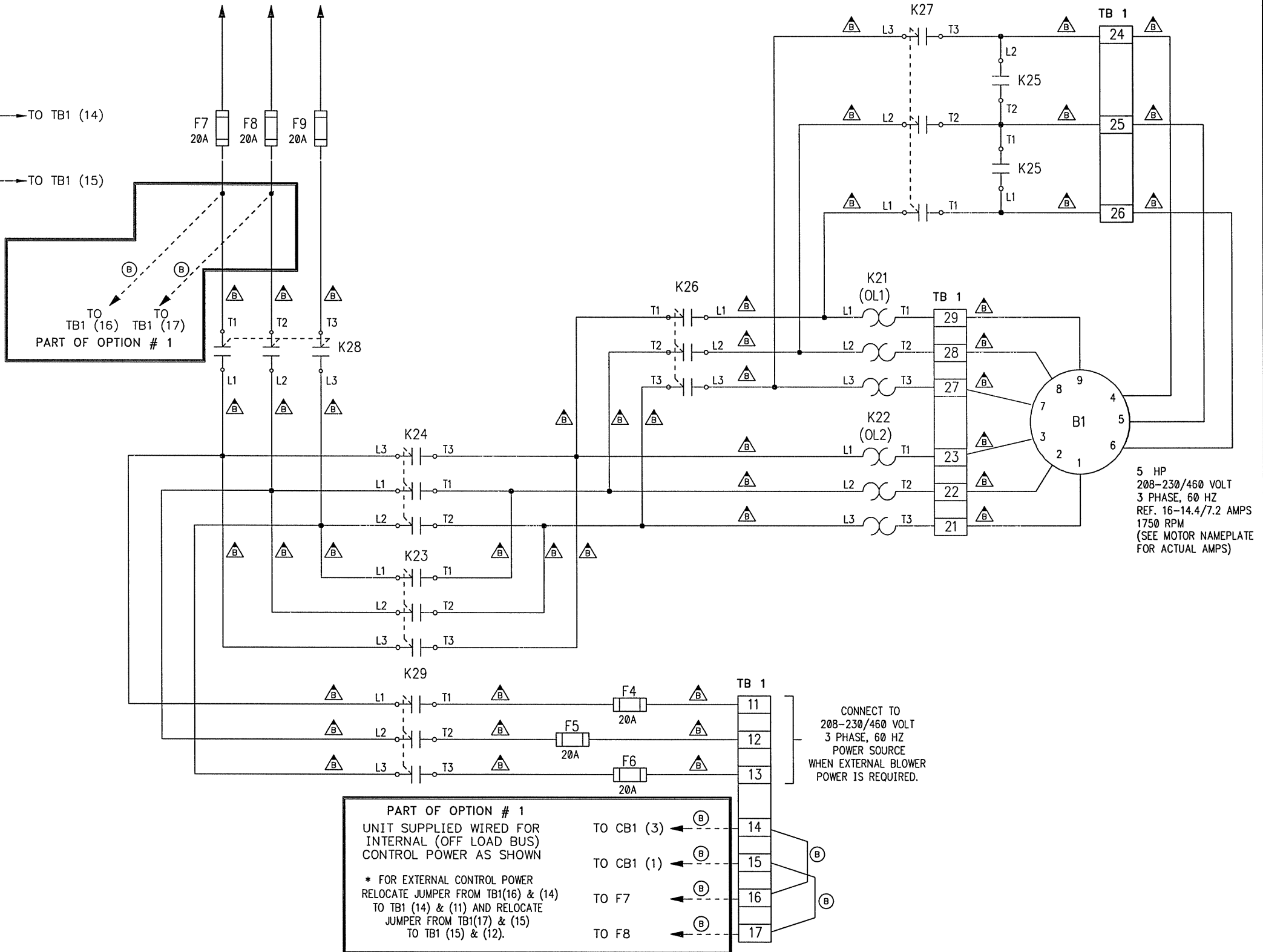


FROM SHEET 2

SEE SHEET 1 FOR WIRE CODE AND NOTES.

UNLESS OTHERWISE SPECIFIED THE ABOVE NOTES APPLY

FROM SHEET 1
 PH A PH B PH C



PART OF OPTION # 1
 UNIT SUPPLIED WIRED FOR
 INTERNAL (OFF LOAD BUS)
 CONTROL POWER AS SHOWN
 * FOR EXTERNAL CONTROL POWER
 RELOCATE JUMPER FROM TB1(16) & (14)
 TO TB1 (14) & (11) AND RELOCATE
 JUMPER FROM TB1(17) & (15)
 TO TB1 (15) & (12).

CONNECT TO
 208-230/460 VOLT
 3 PHASE, 60 HZ
 POWER SOURCE
 WHEN EXTERNAL BLOWER
 POWER IS REQUIRED.

AVTRON MANUFACTURING INC
7900 E.PLEASANT VALLEY ROAD
INDEPENDENCE, OH 44131-5529

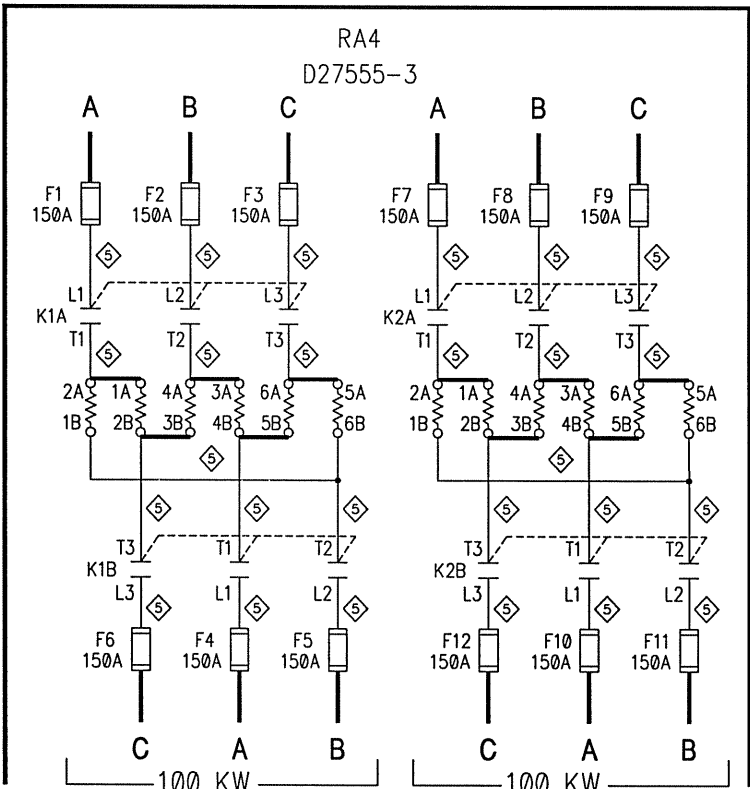
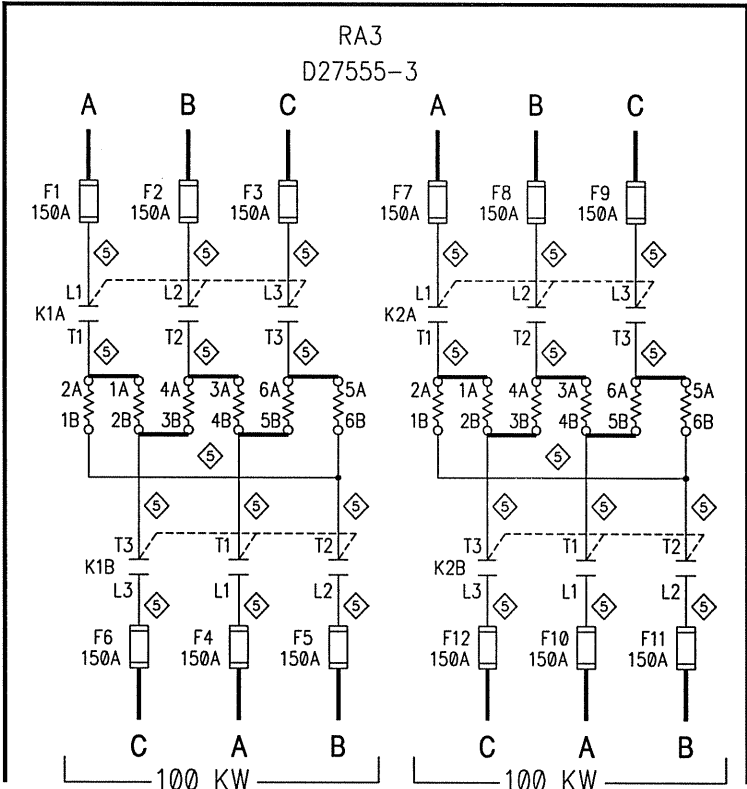
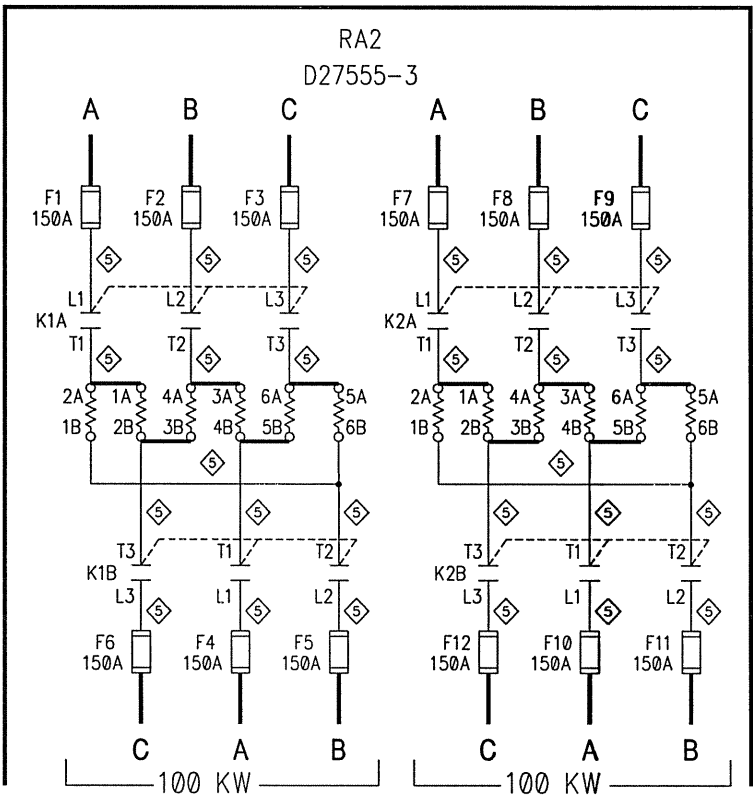
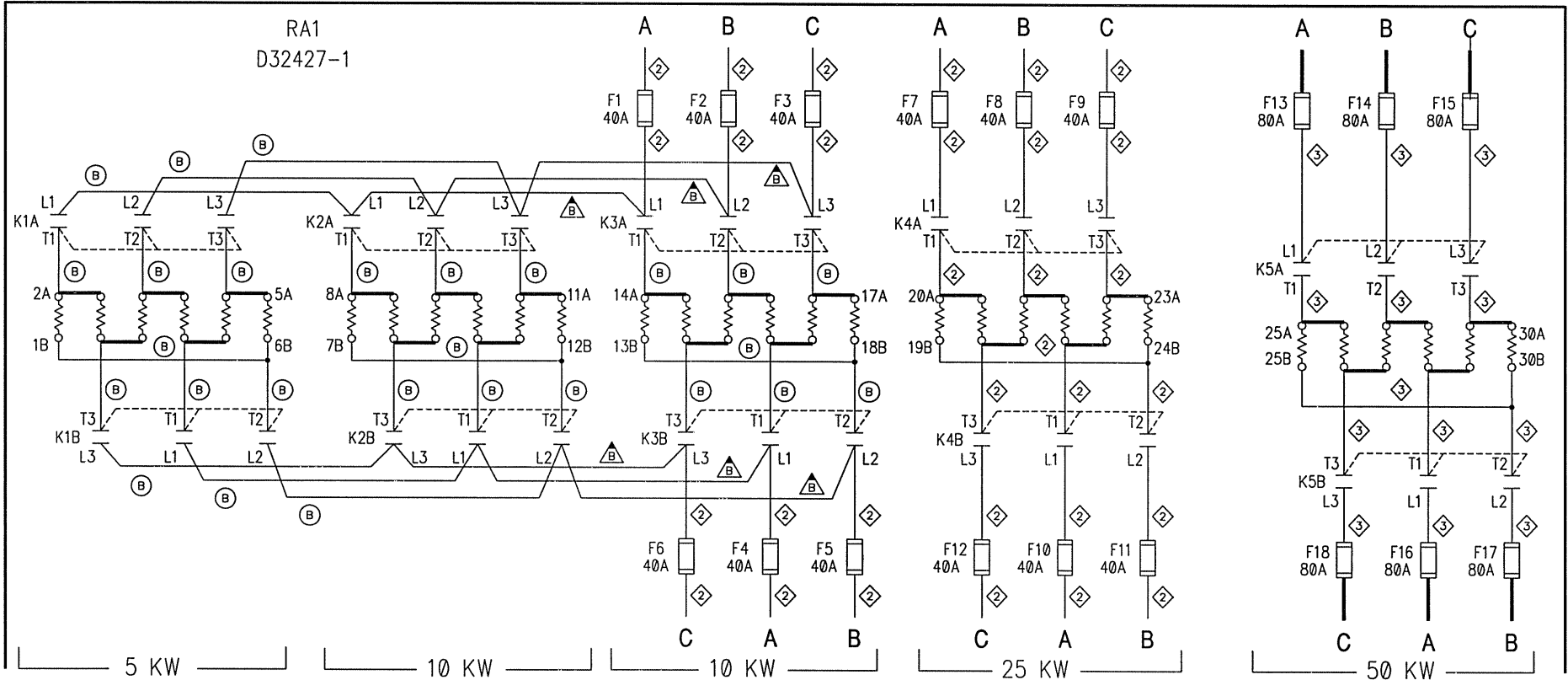
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SCHEMATIC/INTERCONNECTION
 DIAGRAM, LOAD BANK
 (700KW @ 240/480V, 3PH)

SIZE D CAGE NO. 01014 DWG. NO. D32465 REV B
 SCALE NONE MODEL LPV 700 SHEET 4

SIMILAR TO D30695 SHT3

REVISIONS				
ECN NO.	REV	DESCRIPTION	DATE	APPROVED



FROM SHEET 1

- PH A —
- PH B —
- PH C —

SEE SHEET 1 FOR WIRE CODE AND NOTES.
UNLESS OTHERWISE SPECIFIED THE ABOVE NOTES APPLY

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7900 E. PLEASANT VALLEY ROAD
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SCHEMATIC/INTERCONNECTION
DIAGRAM, LOAD BANK
(700KW @ 240/480V, 3PH)

SIZE	CAGE NO.	DWG. NO.	REV
D	01014	D32465	B
SCALE NONE	MODEL	LPV 700	SHEET 5

Warranty

Warranty and Duration

For a period of one year after installation, or fifteen (15) months from date of shipment from our plant, whichever is shorter, Avtron warrants the equipment, except as hereinafter provided, to be free from harmful defects in material and workmanship. Notwithstanding any other term or provision in this Warranty, the warranty provided herein shall terminate unless buyer notifies Avtron, in writing, of a breach hereof within the warranty period; any claims not made within such period are waived by Buyer. The warranty provided herein applies only if Buyer complies with all the other terms and provisions of this Warranty.

Uses of Equipment

The warranty provided herein applies only if the equipment has been used in a normal and proper manner under recommended conditions. Notwithstanding any advice or assistance given to the Buyer by Avtron or its suppliers concerning the equipment or its use, Avtron makes no express or implied warranties or representations, except as herein expressly provided, with respect to the equipment or its use, and Avtron shall not be liable in contract, warranty or tort (including, without limitation, for negligence or strict liability) as a result of such advice or assistance. In addition, unless otherwise agreed in writing signed by a duly authorized representative of Avtron, no equipment covered by this warranty is intended to be used in connection with any nuclear facility or activity, and if so used, Avtron disclaims any and all liability for any damage resulting therefrom.

Notification of Breach

When claiming a breach of this Warranty, Buyer must promptly (within 10 days from the date of the discovery of the defect) notify Avtron in writing.

Equipment Disposition

Upon notification of a claimed breach of this Warranty, Avtron, at its discretion, will either authorize the return of the defective equipment or part thereof (transportation costs to be prepaid by Buyer) or provide a suitable replacement or authorize the Buyer in writing to effect repairs at Avtron's expense. In the event that the equipment returned as authorized is found to be defective and Avtron elects to repair or replace said equipment, Avtron will pay the transportation costs associated with the return of said equipment to Buyer. Avtron shall not however be liable for any customs, tariffs, duties or taxes incurred in shipping equipment pursuant to this Warranty. These shall be the responsibility of the Buyer.

Option of Avtron to Repair or Replace Equipment or to Issue Credit

Avtron's sole obligation under this Warranty shall be, at the option of Avtron, to replace or repair any defective equipment or part thereof or to issue a credit with respect to the defective equipment equal to the purchase price thereof less depreciation.

Equipment Excluded From Warranty

The warranty provided herein specifically excludes equipment and components that Avtron purchases and resells as part of a system, product or spare part order. The warranties provided to Avtron by the manufacturers of the foregoing equipment and components will, to the extent possible, be passed on to the Buyer. Copies of such warranties, if on file at Avtron, will be made available for inspection upon the request of Buyer. Equipment such as, but not limited to, computers, CRTs, operator interface modules, monitors, etc., normally have a short warranty period and should be covered by a continuous service contract generally available from the original manufacturer at a reasonable cost. Consumable items including, but not limited to, lamps, filters, fuses and motor brushes are excluded from all warranties. Other items or components may be excluded from this warranty if so noted in the governing purchase order or contract.

Resale or Lease of Equipment

In the event that the Buyer resells or leases equipment purchased from Avtron, the Buyer shall obtain the signed written agreement of the purchaser or lessee thereof that Avtron's only liability with respect to said equipment is as set forth in this Warranty. In the event that the Buyer fails to obtain such a signed written agreement, the Buyer agrees to indemnify Avtron against any claims, demands, judgments, suits, costs, liabilities and expenses (including reasonable attorney's fees) incurred by Avtron as a result of such failure.

Unauthorized Repairs

Unless otherwise agreed in writing signed by a duly authorized representative of Avtron, if the Buyer has repairs or modifications made to equipment covered by this Warranty by a person other than an authorized Avtron service representative, Avtron shall not be liable for any expenses incurred in connection therewith and the warranty provided herein shall automatically be terminated.

Governing Law; Saving Clause

This Warranty is part of the terms and conditions of the sale of the equipment covered hereunder and shall be governed by and enforced in accordance with the laws of the State of Ohio. Any provision hereof which is prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective to the extent of such prohibition or unenforceability without invalidating the remaining provisions hereof or affecting the validity or enforceability of such provision in any other jurisdiction.

Limitation of Liability

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