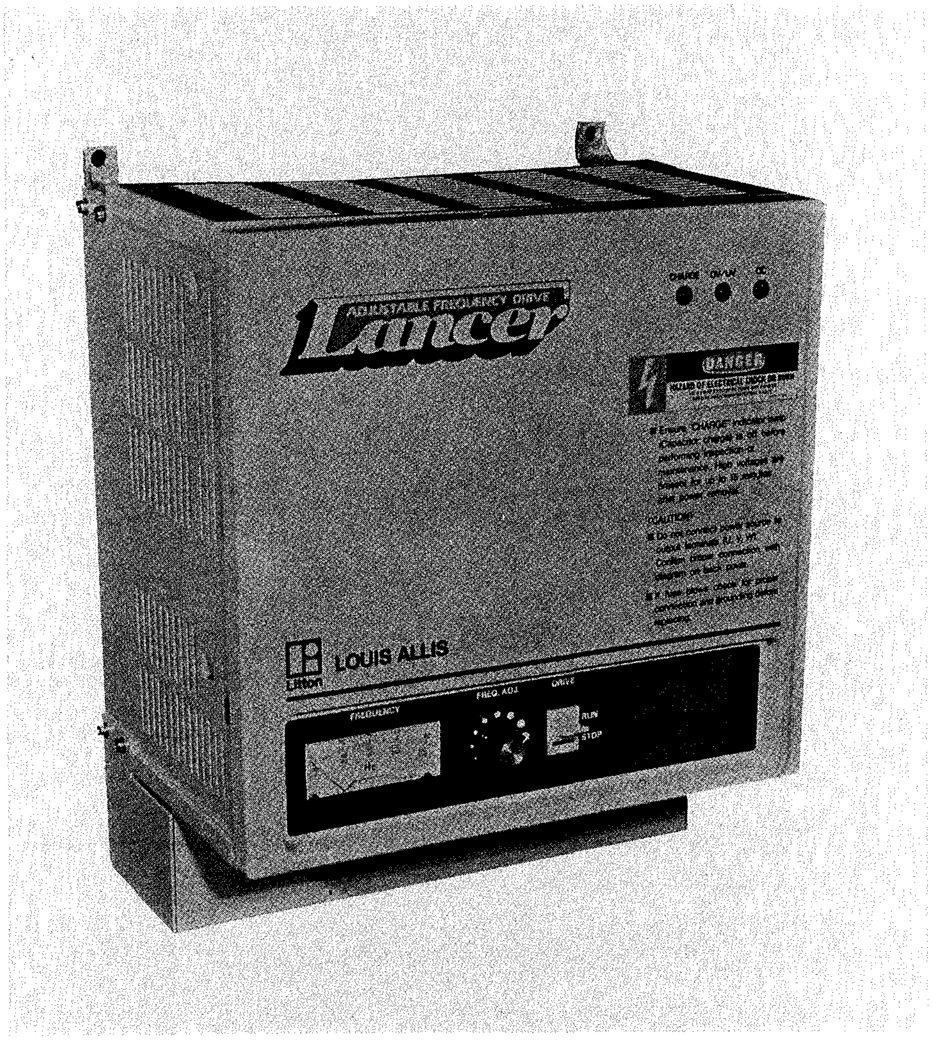
4S

LANCER® JR
TYPE L INVERTER

1.5 TO 5 KVA(1 TO 5 HP)
230 VOLT 3 PHASE



INSTRUCTION MANUAL

MagneTek
Drives & Systems

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FOREWORD

This instruction manual is concerned with installation, operation, and troubleshooting procedures for the Louis Allis Lancer® Jr, Type L general-purpose inverter. This is a sinusoidal wave PWM controlled voltage inverter rated at 1.5, 2, 3, and 5KVA (1, 2, 3, and 5 HP).

The inverter may be combined with a general-purpose induction motor to constitute a reliable variable-speed drive system. A few of the advantages are easy operation, high efficiency, and energy savings. Before operation, carefully read this manual and observe all precautions to ensure long trouble-free service of your inverter.

STANDARD SPECIFICATIONS

Standard specifications are listed in Table 1. Some specifications may vary for special or nonstandard inverters.

TABLE 1

Model and Ratings	Model Order #	92001K	92002S	92003Q	92004F
	Capacity (KVA)	1.5	2	3	5
	Input Current*(A)	6.75	9	13.5	22.5
	Rated Output Current (A)	4.5	6	9	15
Applicable Motor Power (HP) Max		1	2	3	5
Power Supply	Voltage Frequency	3-Phase, 230V 50/60 Hz.			
	Allowable Variation	Voltage +10% -5% Frequency ±2Hz			
Control Specifications	Control System	Sinusoidal Wave PWM Control			
	Output Voltage	3-Phase, 230V (maximum)			
	Output Frequency	3 to 80 Hz			
	Frequency Accuracy	±0.5% of Highest Frequency (at 25°C ±10°C)			
	Voltage/Frequency Ratio	3 to 60 Hz: V/F Constant 60 to 80 Hz: V Constant			
	Overload Capacity	150% for 1 Minute; 110% Continuous			
	Control Reference	0 to 12VDC ±15%			
	Acceleration/ Deceleration Time	1 to 20 seconds (acceleration and deceleration individually adjustable)			

(Table Continued)

* Input currents cited are maximum rms values, based upon conducting rated output currents with negligible source impedance. Where the source impedance is 3% or greater, based upon the drive KVA rating, or an input transformer sized for the particular drive is used (impedance 3% or greater), the input current will be less than or equal to the output current.

TABLE 1 (continued)

Operating Function	Starting	By Dry Contact (hold)
Protecting Functions	Protection	Stall prevention, overcurrent protection, short circuit protection, overvoltage protection, undervoltage protection, momentary power failure protection, burn-out prevention (fuse).
	Fault Detection	Fault relay form C contacts (250VAC 1A resistive). The relay will engage when overcurrent, short circuit, overvoltage, or undervoltage is detected.
	Display LED's	CHARGE - indicating charge on bus. OV/UV - indicating overvoltage or undervoltage. OC - indicating overcurrent.
Ambient Conditions	Place of Installation	Indoor
	Ambient Temperature	Std. 0-40°C; 0-50°C is possible if cover is removed.
	Relative Humidity	Less than 90%, Noncondensing
	Vibration	Less than 0.5G
Construction		NEMA 1, Non-dustproof
Instruments Installed on Operation Panel		Frequency Meter; Frequency Setting Potentiometer, (3K ohms, 1W); RUN-STOP Switch

PRINCIPLES OF OPERATION

Most AC induction motors in the past have been limited to fixed speeds. The LANCER JR provides a simulated (PWM) AC that varies the speed of the motor. A power transistor inverter is used with a microprocessor controlled regulator to accomplish the conversion.

Motor speed ratings usually show the motor base speed at 60 Hz operation. Slower speeds (below base speed) are produced by reducing both the voltage and the frequency of the output

Figure 1 shows the voltage varying with the frequency until base speed (60 Hz). Above base speed the voltage remains constant while frequency varies.

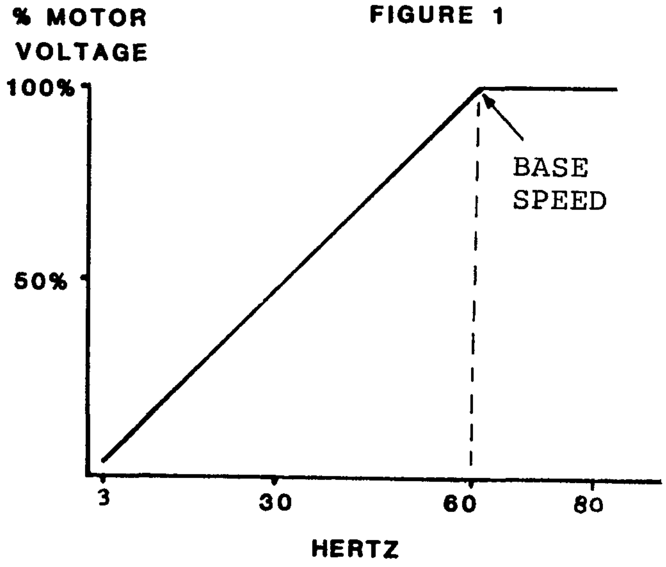


FIGURE 1

PWM (Pulse Width Modulated) inverters change the incoming power to DC and then pulse the DC into the motor leads to simulate AC. Figure 2 shows a representation of the LANCER JR output voltage waveform.

An AC waveform is superimposed on the pulse waveform for illustration

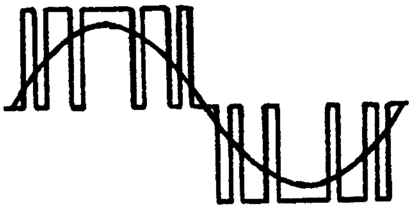


FIGURE 2

Pulse width is decreased for lower RMS voltage and increased for higher voltage. Lower frequencies have a greater number of pulses in one cycle. As the frequency increases, the microprocessor selects the optimum number of pulses per waveform.

Figure 3 shows a block diagram of the LANCER JR inverter.

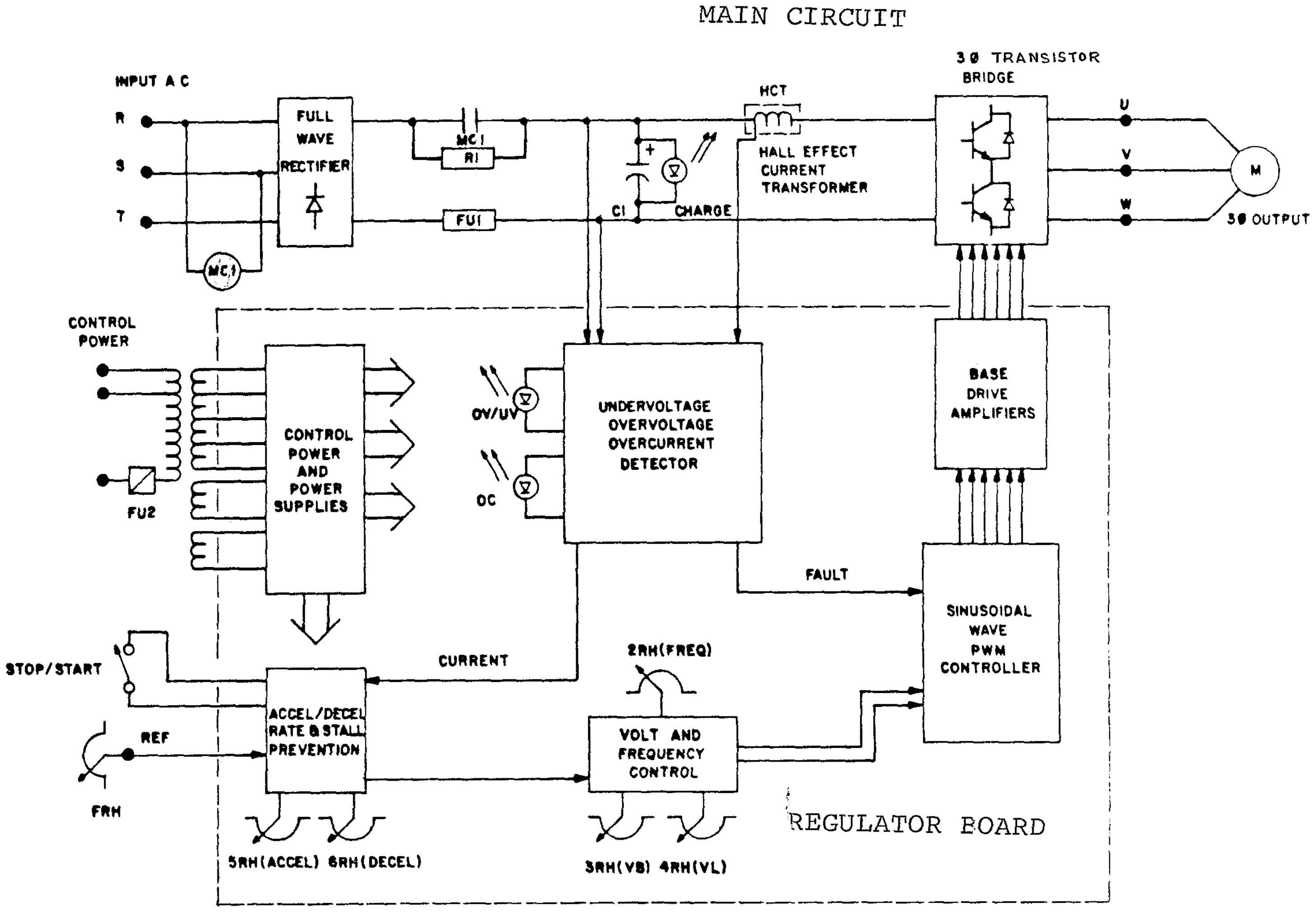


FIGURE 3

Figure 3 is divided into two parts; the MAIN CIRCUIT which handles the input and output power, and the REGULATOR BOARD which senses input information to direct the main circuit.

A. MAIN CIRCUIT

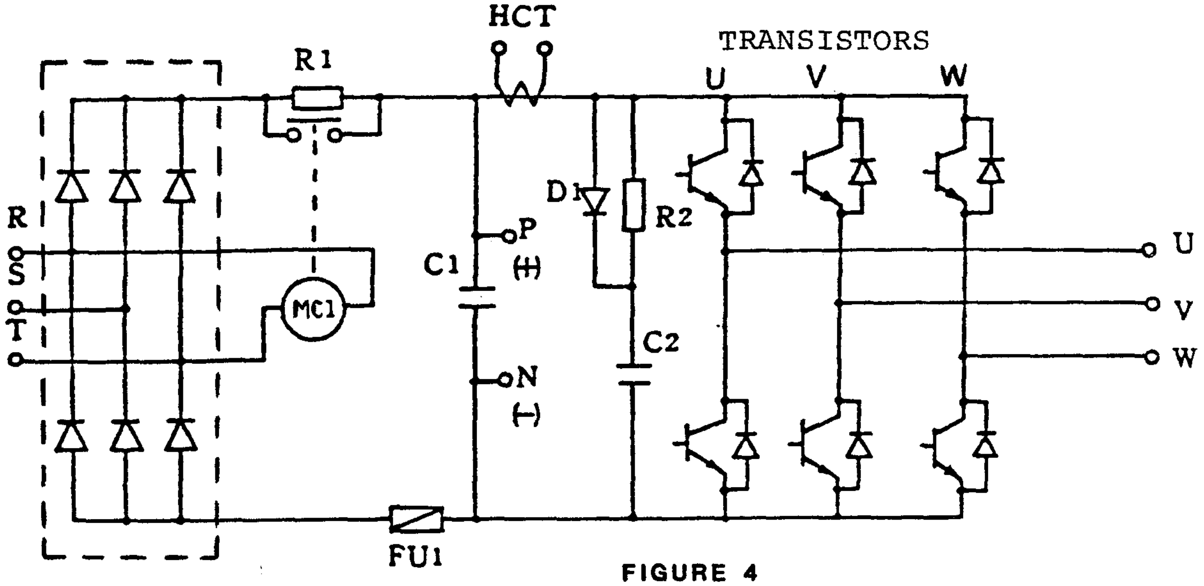


FIGURE 4

Input 3-phase power is rectified to a DC bus by the diode bridge. 1.5KVA units use two single-phase full-wave bridges with one arm idle as shown in Figure 5. 2, 3, and 5KVA units use six diodes in one sealed unit as shown in Figure 4.

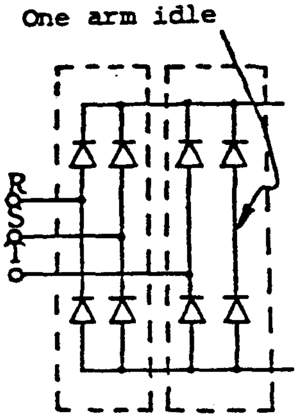


FIGURE 5

Resistor R1 and Contactor MC1 provide a soft charge to filter capacitor C1 when power is initially applied. C1 smooths AC ripple on the DC bus.

D1, R2, and C2 suppress voltage spikes caused by switching of the transistors.

FU1 is a DC semiconductor fuse sized to protect the DC bus from overcurrent.

HCT is a Hall-Effect current transformer detecting bus current. Figure 6 shows HCT cimensions and power connections.

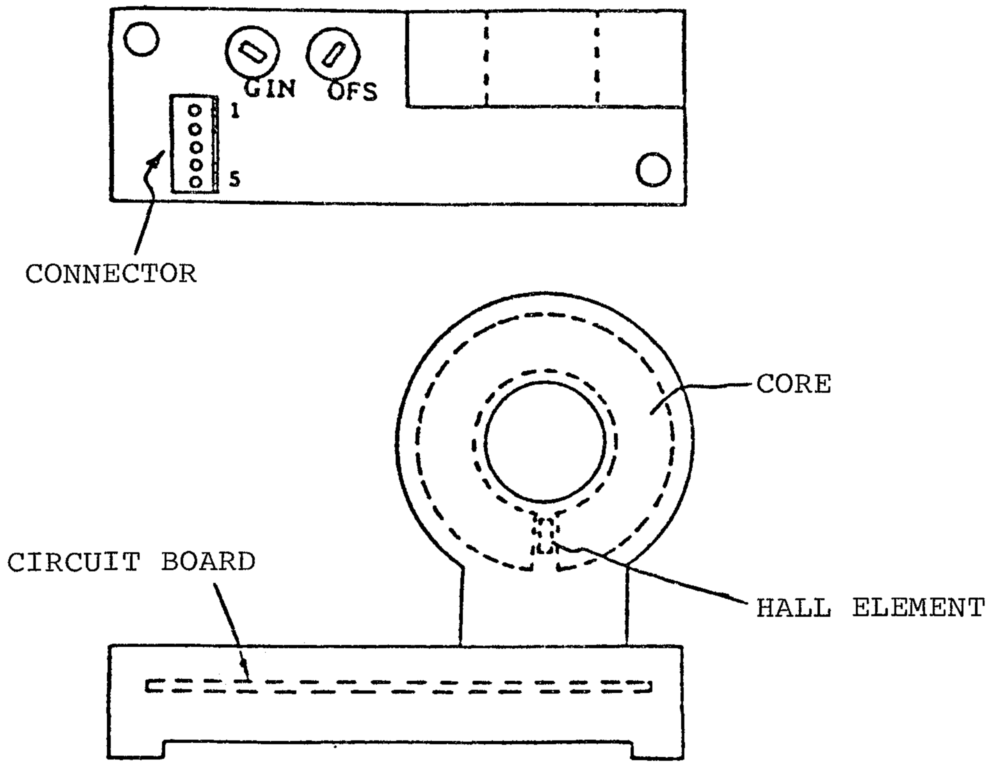


FIGURE 6

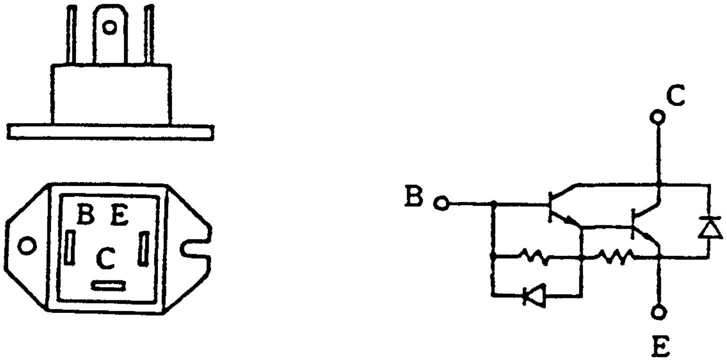
HCT is identical for all 1 through 5 horsepower inverters. Current scaling for proper feedback on different size units is accomplished by changing the number of turns of wire around the core. The correct number of turns for each inverter are 13 turns for the 1.5KVA/1HP, 10 turns for the 2KVA/2HP, 7 turns for the 3KVA/3HP and 4 turns for the 5KVA/5HP.

Each of the six transistors can be described as a N-P-N power darlington configuration shown in Figure 7.

Models for 2, 3, and 5KVA are in 2-in-1 type elements so external wiring is simplified.

1.5KVA

Characteristics of the transistor are high gain and fast switching speed.



2KVA
3KVA
5KVA

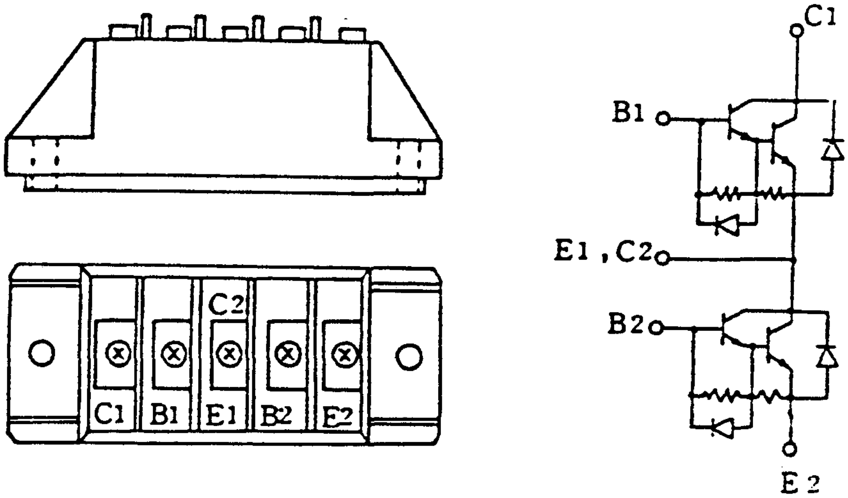


FIGURE 7

Transistors' Construction and Equivalent Circuit

Switching of the transistors is controlled by the Regulator Board.

Output waveforms are illustrated in Figure 8.

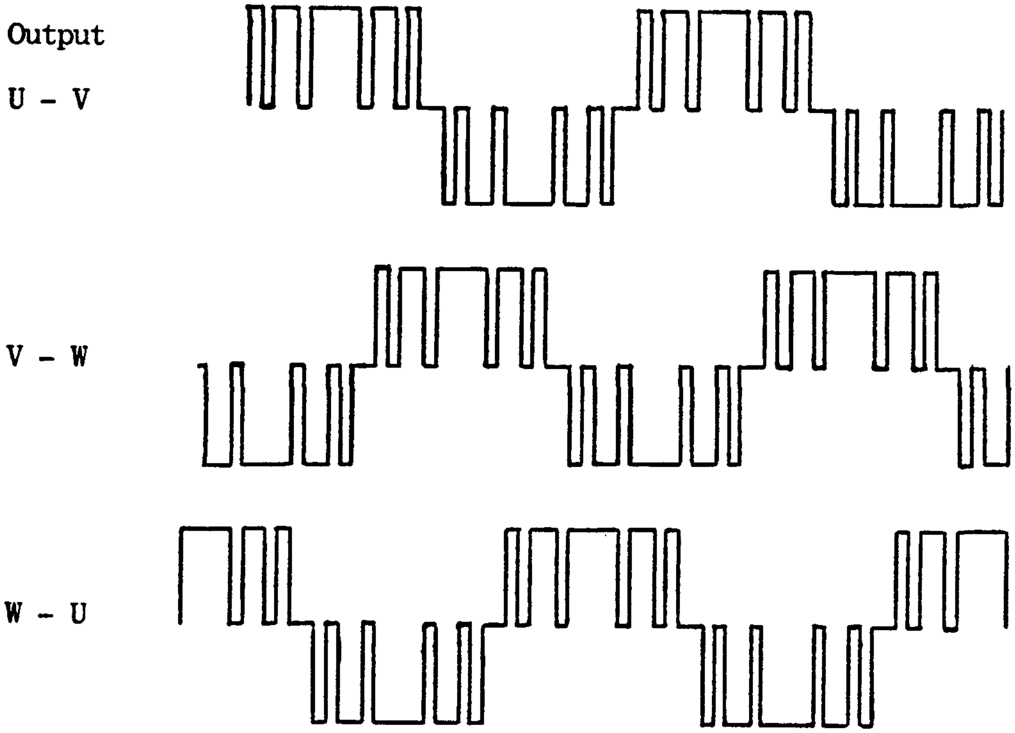


FIGURE 8

Proper 120° phase shift between output leads stays constant over the entire frequency range. Typical motor voltage and current at 60 hertz (full load) is shown in Figure 9. Note that although the voltage is pulses, the current waveform is near sinusoidal. Voltage is leading current, typical in induction motors.

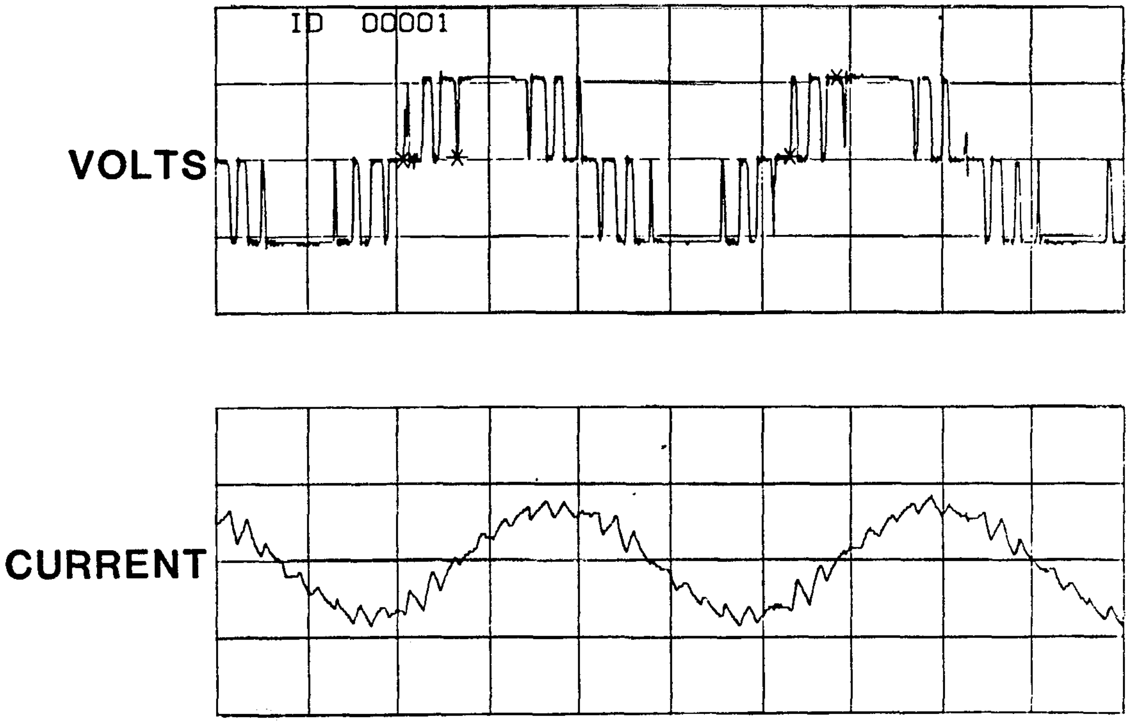


FIGURE 9

B. REGULATOR BOARD

The wiring diagrams at the end of this manual show a block diagram of Regulator Board functions and adjustments.

The Regulator Board accepts operator information and outputs base signals to control the transistors. Refer to the Control Circuit page of the wiring diagrams for the following descriptions:

Operator speed pot (frequency setting signal) is connected to P-P, REF, and COM. 0-10VDC at REF controls full range output of the inverter.

A frequency meter (1mA full scale) connected from FRQ to COM shows output frequency. 7RH potentiometer calibrates the meter.

ST (start), F (forward), and R (reverse) connected to -24 controls the start/stop function and direction of inverter output.

The HCT connects to the regulator board through connector CN8. Current feedback is present at pins 1 and 2.

Bus voltage feedback is sensed through connectors CN5-4 (positive) and CN4-2 (negative).

Fault relay (contacts at FLA, FLB, and FLC) latches on if a fault occurs. Power must be turned off to reset the fault.

A low speed relay may be used to detect inverter speed below 3 Hz. A 24V, 75mA (max) relay coil (connected from -24 to LOW) will de-energize when low speed is detected.

Figure 10 shows the accel and decel circuit. A step input reference is changed to a ramp output. Separate accel (5RH) and decel (6RH) potentiometers provide 1 to 20 seconds ramp time. Shorter or longer periods require changing capacitor C61 on the regulator board.

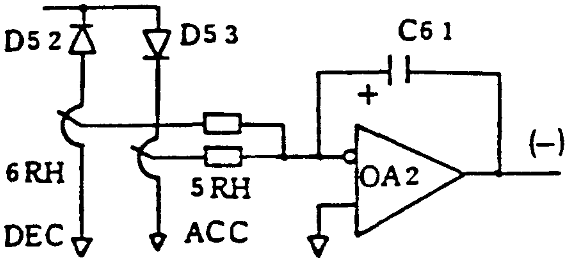


FIGURE 10

Adjustment potentiometers 3RH and 4RH adjust the inverter output voltage with respect to frequency. Commonly called the volts-per-hertz adjustments (V/Hz): 3RH (voltage boost, VB) adjusts voltage at lower frequencies.

Jumper J-5 is used to raise the V/Hz adjustment in decel only. Faster decel times without overvoltage trip can be adjusted. Higher V/Hz in deceleration causes higher currents in the motor and less regenerative energy on the bus.

Factory adjustment provides 0 to 80 Hz operation. Moving jumper J-3 from the 60 Hz to the 50Hz position automatically changes maximum output to 67 Hz. 2RH (FRQ) potentiometer adjusts maximum output frequency.

IC6 (figure 11) is an analog to digital conversion chip. The voltage signal is converted to a 4-bit code the microprocessor can understand. Connector CN9, pin 3 (measured to COM) is the voltage proportional to output voltage. 5V at CN9-3 means maximum output voltage. Voltage at this point will rise above 5V, but inverter output voltage will not increase.

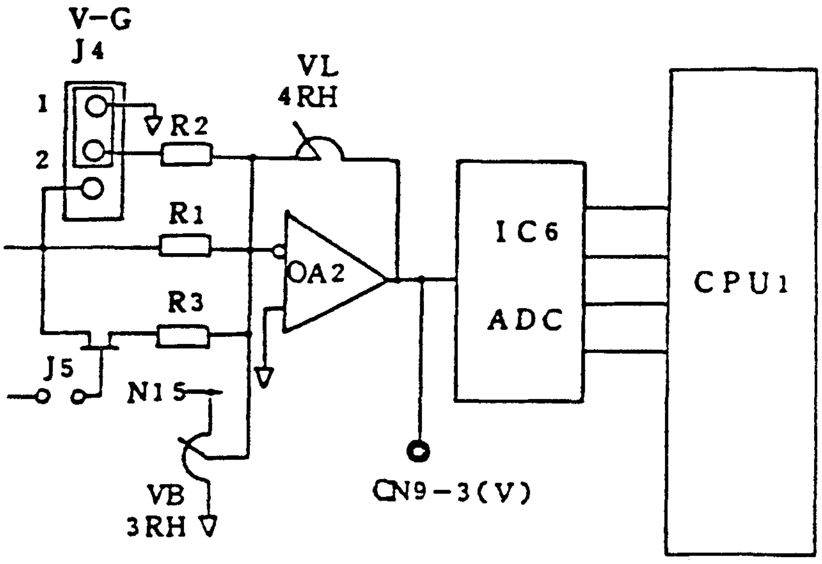


FIGURE 11

IC7 (figure 12) is a voltage-to-frequency conversion chip. Output of IC7 is a frequency pulse proportional to output frequency. With no jumper at J-1, CN9-2 has a frequency 1152 times inverter output frequency.

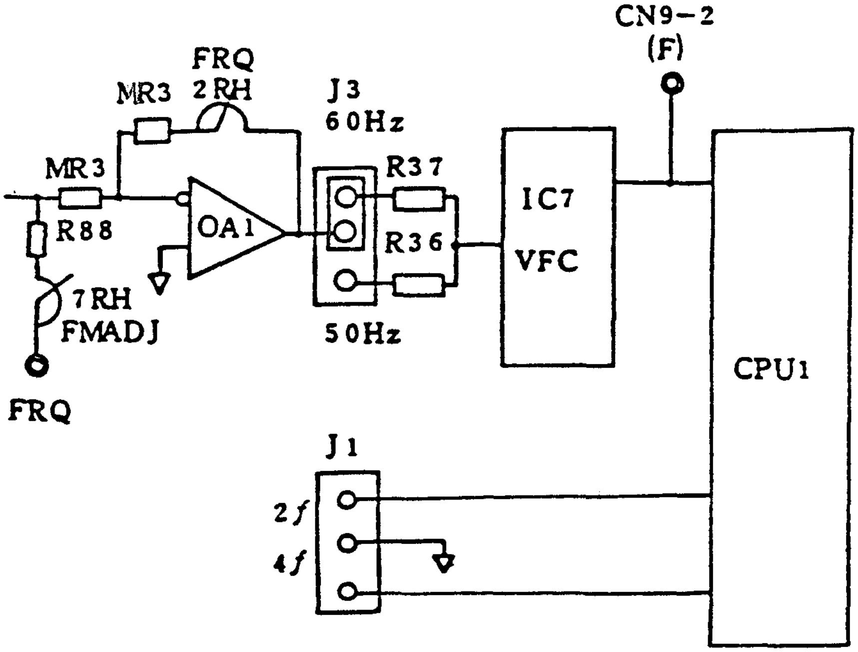


FIGURE 12

The current detector monitors bus current from the HCT. If bus current rises to 163%, stall prevention circuitry phases back both voltage and frequency until current decreases. 190% current shuts the transistor base drive off until current decreases. 240% current turns base drive off and latches the fault relay and OC overcurrent LED. Currents above 240% will blow out FU1. If FU1 is blown, inspect the main circuit for shorted transistors before replacing.

The microprocessor (CPU) develops base signals which are isolated and amplified by the base driver circuit. Transformer T1 provides isolated low voltage AC which is rectified and filtered for the base driver amplifiers. Connectors CN-1, 2, 3, and 4 connect the base pulses to the transistors.

C. APPLICATION

LANCER JR provides a high quality output voltage and current, but is not a perfect sine wave. Therefore, some increase in motor temperature, noise, and vibration may be noticed.

Special consideration must be taken when applying an inverter to an existing motor. At slower speeds, cooling is not as effective due to reduced fan RPM. Full load torque at slow speeds may damage the motor from overheating. In situations where the load requires high torque at slow speeds, the minimum speed must be raised for cooling effect. Figure 13 shows a curve plotting acceptable torque vs. speed (Hertz) for a typical motor operating on a LANCER JR (this type of motor is not specifically designed for variable speed operation on an inverter.

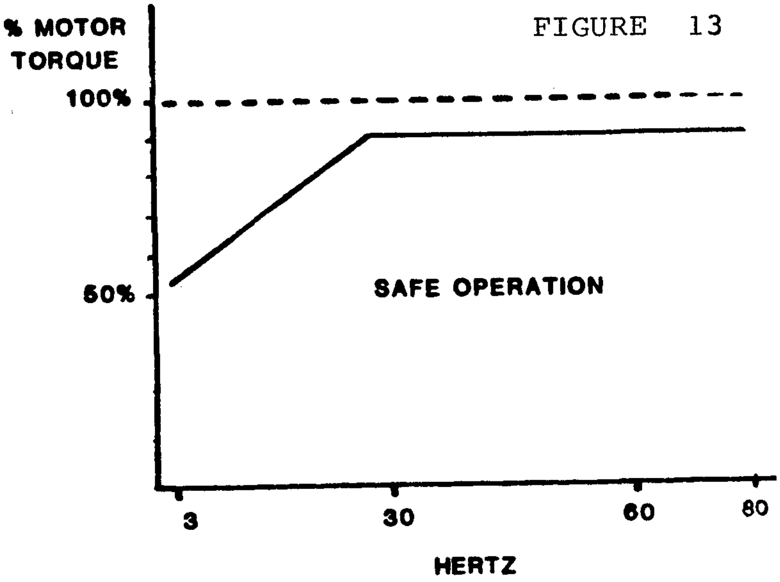


FIGURE 13

Note that for a safety margin, the curve shows no more than 90% motor rated torque. If torque requirements at slow speed continuously exceed levels shown in Figure 13, a motor rated for inverter operation can be substituted.

CAUTION

The inverter is shipped from the factory with a 3-80 Hz speed range capability. Note that the maximum output frequency attainable, with the FREQ. potentiometer on the Operation Panel turned fully CW, is 80 Hz. Fixed speed machinery may not run properly above the 60 Hz frequency normally supplied directly from the power line. Operation above 60 Hz may damage bearings or rotating parts. Slow speeds may not provide sufficient cooling for the motor, or lubrication on oil filled gear boxes or speed reducers. Manufacturer specifications may need to be consulted. These precautions should be looked at carefully to prevent any problems. It is most often the case, however, that the motor or motors on a fixed speed application can be directly applied to the LANCER JR, provided the mechanical limitations of the system are not exceeded. A procedure for readjusting the maximum output frequency from 80 Hz to 60 Hz is provided on page 17.

INSTALLATION PROCEDURES

A. INITIAL INSPECTION

Upon receipt of your LANCER JR, a careful inspection for shipping damage should be made. After uncrating, check:

1. Whether there are any parts which might be loose, broken or separated.
2. Whether the rated capacity shown on the nameplate is the same as specified on your order.

B. GENERAL REQUIREMENTS

Unless supplied in a special optional enclosure, the LANCER JR should be installed in an area where:

1. Cabinet mounting is upright with more than 2" clearance on the sides and more than 4" at top and bottom. Figure 14 shows dimensions of the LANCER JR type L. The 1.5KVA, 2KVA, 3KVA and 5KVA models are the same size.
2. Ambient atmosphere is free of dust, corrosive gases, high moisture content and temperature extremes.
3. Vibration is kept to a minimum.
4. Unit should be easily accessible for maintenance and troubleshooting.

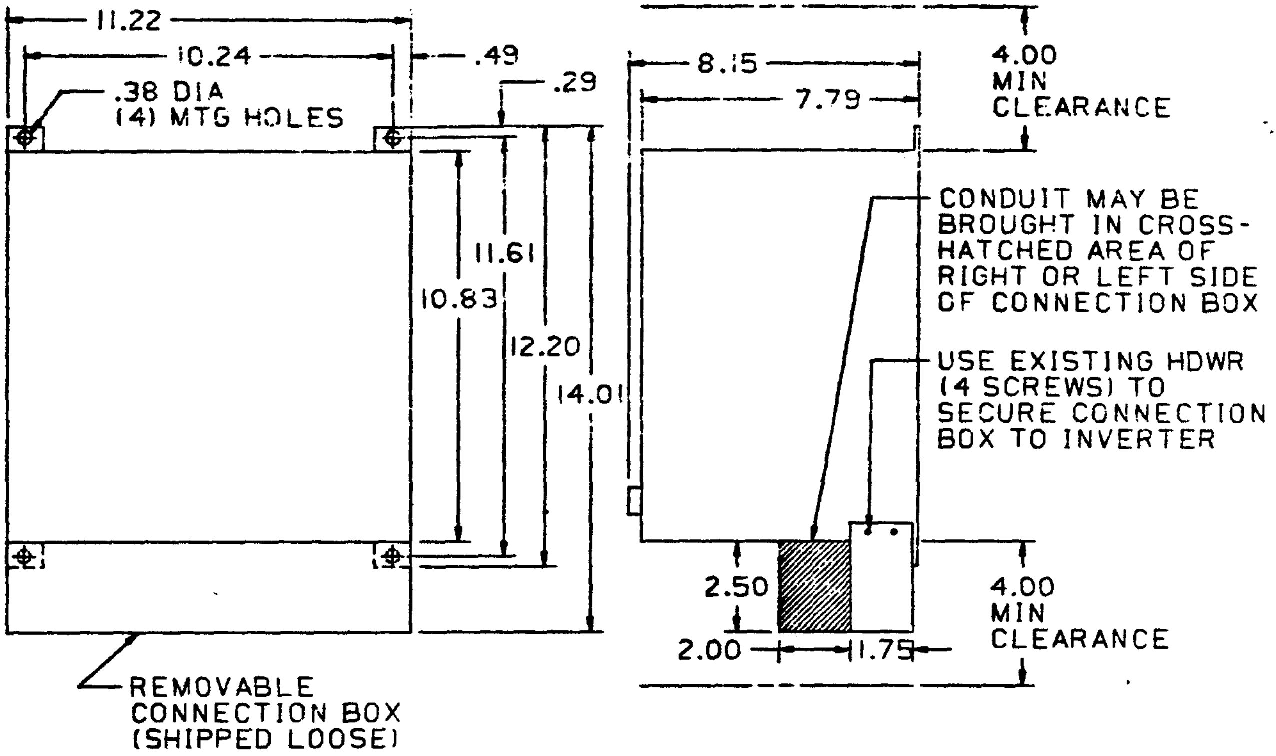
Installation and interconnection wiring must be done in conformance with the National Electrical Sode, regulations of the Occupational Safety and Health Administration, and/or other national, regional, or industry codes and standards.

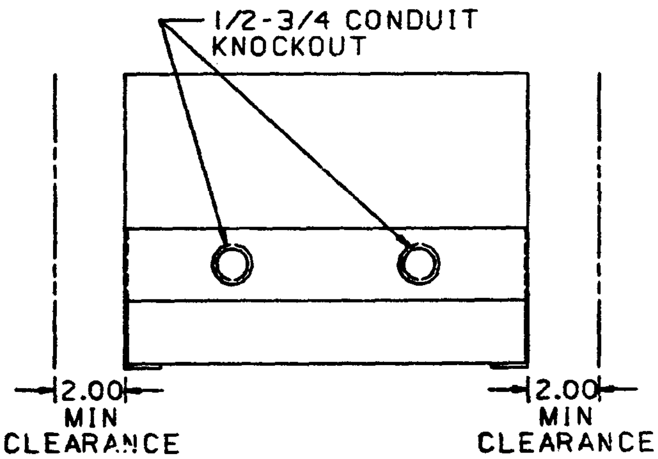
NOTE

In long cable runs, take care to prevent excessive voltage drop.

The leads used for speed reference, feedback, and other low level signals must be shielded cable and placed in conduit which is separate from conduit which is used for the motor armature, field and AC power.

Connect the shields of shielded cable at the Inverter end only. The far end of the shield is to be dressed neatly and left unconnected.





KVA	HP	VOLTS	MODEL	WEIGHT	
				LBS	KG
1.5	1	230	92001K	19	9
2	2	230	92002S	21	10
3	3	230	92003Q	21	10
5	5	230	92004F	21	10

NOTES:

1. DIMENSIONS ARE IN INCHES.

FIGURE 14 EXTERNAL VIEW AND DIMENSIONS

C. ELECTRICAL INTERCONNECTION

1. Standard (Recommended) Technique. Figure 15A is the standard Overall Schematic Diagram and Figure 15B is the Standard Interconnection Diagram. These figures depict the necessary components to obtain safe operation. Contactor MC3 is conjunction with pushbuttons, 1PB and 2PB, require manual restart after a power outage or voltage dip, and also after a motor or inverter fault. Figure 15B depicts the interconnections between the 230 volt input, the separately supplied motor control, the LANCER JR and the motor. Also, the necessary ground connections are depicted.

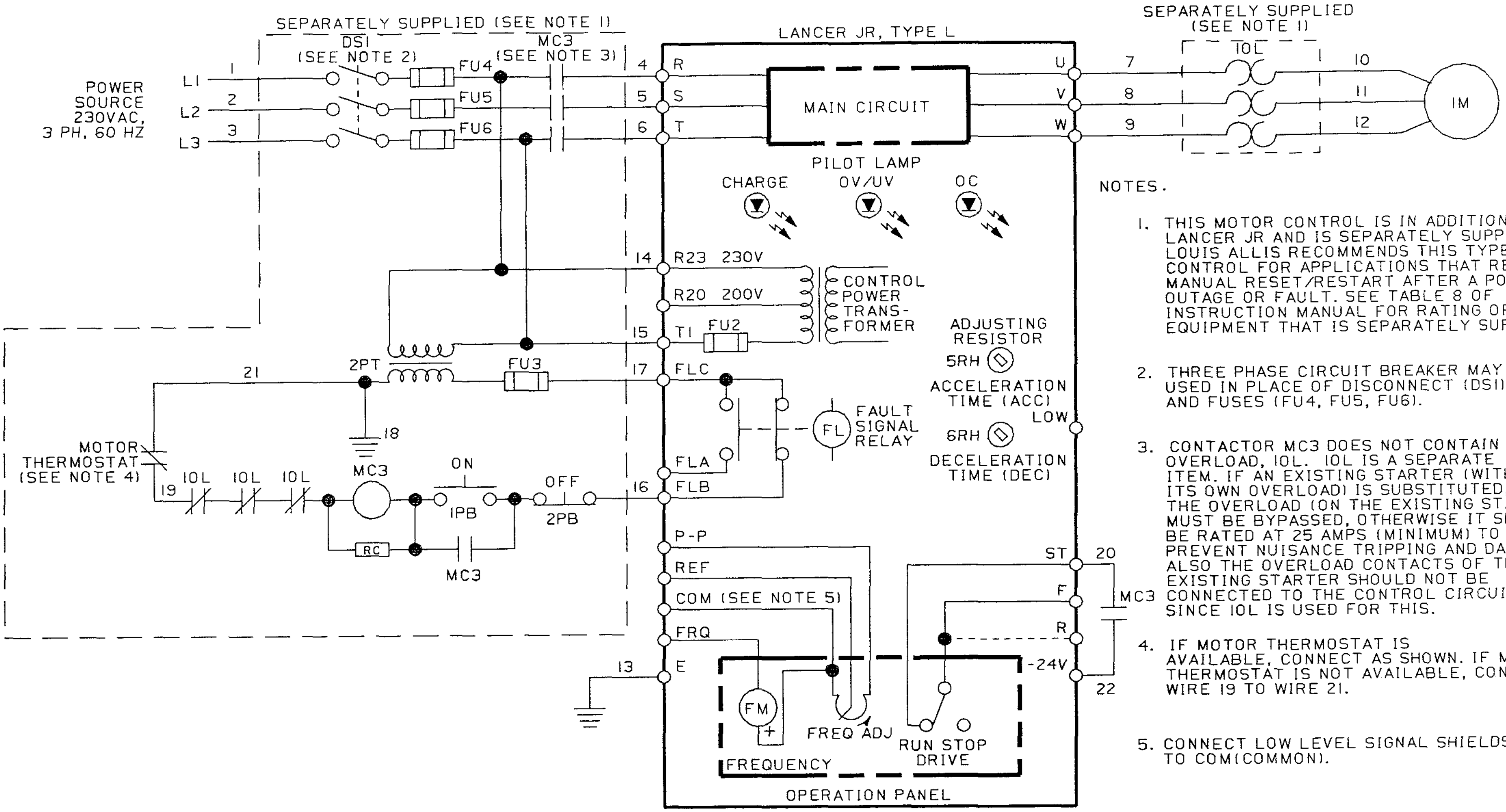
A fused disconnect, DS1 and FU4-FU6, or a 3 phase circuit breaker, CB1, must be provided on the incoming AC line to meet electrical codes. If an input isolation transformer is used, the fused disconnect or circuit breaker should be located between the transformer secondary and the LANCER JR. See Table 8 for sizing information.

A motor overload relay, 1OL, sized for motor protection should be installed between the inverter output and the motor. See Table 8 for sizing information. If the motor has an internal thermostat, it should be wired for inverter shutdown in series with the overload contacts, 1OL, and the MC3 coil in the separately supplied equipment.

2. Operation Without Input Contactor. Figure 18A is the Overall Schematic Diagram Without an Input Contactor and Figure 18B is the Interconnection Diagram Without an Input Contactor. This technique results in an automatic restart of the inverter/motor as soon as power is restored after an outage, or after the motor thermostat resets after an overtemperature condition. The overload, 1OL, should be the manual reset type to prevent automatic restart of the inverter/motor after the overload cools off and resets. Figure 18B depicts the interconnection between the 230 volt input, the separately supplied motor control, the LANCER JR and the motor. Also, the necessary ground connections are depicted.

A fused disconnect, DS1 and FU4-FU6, or a 3 phase circuit breaker, CB1, must be provided on the incoming AC line to meet electrical codes. If an input isolation transformer is used, the fused disconnect or circuit breaker should be located between the transformer secondary and the LANCER JR. See Table 8 for sizing information.

A motor overload relay, 1OL, sized for motor protection should be installed between the inverter output and the motor. See Table 8 for sizing information. If the motor has an internal thermostat, it should be wired for inverter shutdown in series with the overload contacts, 1OL, and the "-24V" terminal of the inverter.



NOTES.

1. THIS MOTOR CONTROL IS IN ADDITION TO THE LANCER JR AND IS SEPARATELY SUPPLIED LOUIS ALLIS RECOMMENDS THIS TYPE OF CONTROL FOR APPLICATIONS THAT REQUIRE MANUAL RESET/RESTART AFTER A POWER OUTAGE OR FAULT. SEE TABLE 8 OF INSTRUCTION MANUAL FOR RATING OF EQUIPMENT THAT IS SEPARATELY SUPPLIED.

2. THREE PHASE CIRCUIT BREAKER MAY BE USED IN PLACE OF DISCONNECT (DS1) AND FUSES (FU4, FU5, FU6).

3. CONTACTOR MC3 DOES NOT CONTAIN OVERLOAD, 1OL. 1OL IS A SEPARATE ITEM. IF AN EXISTING STARTER (WITH ITS OWN OVERLOAD) IS SUBSTITUTED, THE OVERLOAD (ON THE EXISTING STARTER) MUST BE BYPASSED, OTHERWISE IT SHOULD BE RATED AT 25 AMPS (MINIMUM) TO PREVENT NUISANCE TRIPPING AND DAMAGE. ALSO THE OVERLOAD CONTACTS OF THE EXISTING STARTER SHOULD NOT BE CONNECTED TO THE CONTROL CIRCUIT SINCE 1OL IS USED FOR THIS.

4. IF MOTOR THERMOSTAT IS AVAILABLE, CONNECT AS SHOWN. IF MOTOR THERMOSTAT IS NOT AVAILABLE, CONNECT WIRE 19 TO WIRE 21.

5. CONNECT LOW LEVEL SIGNAL SHIELDS TO COM(COMMON).

FIGURE 15A

STANDARD OVERALL SCHEMATIC DIAGRAM
230V LANCER JR TYPE L

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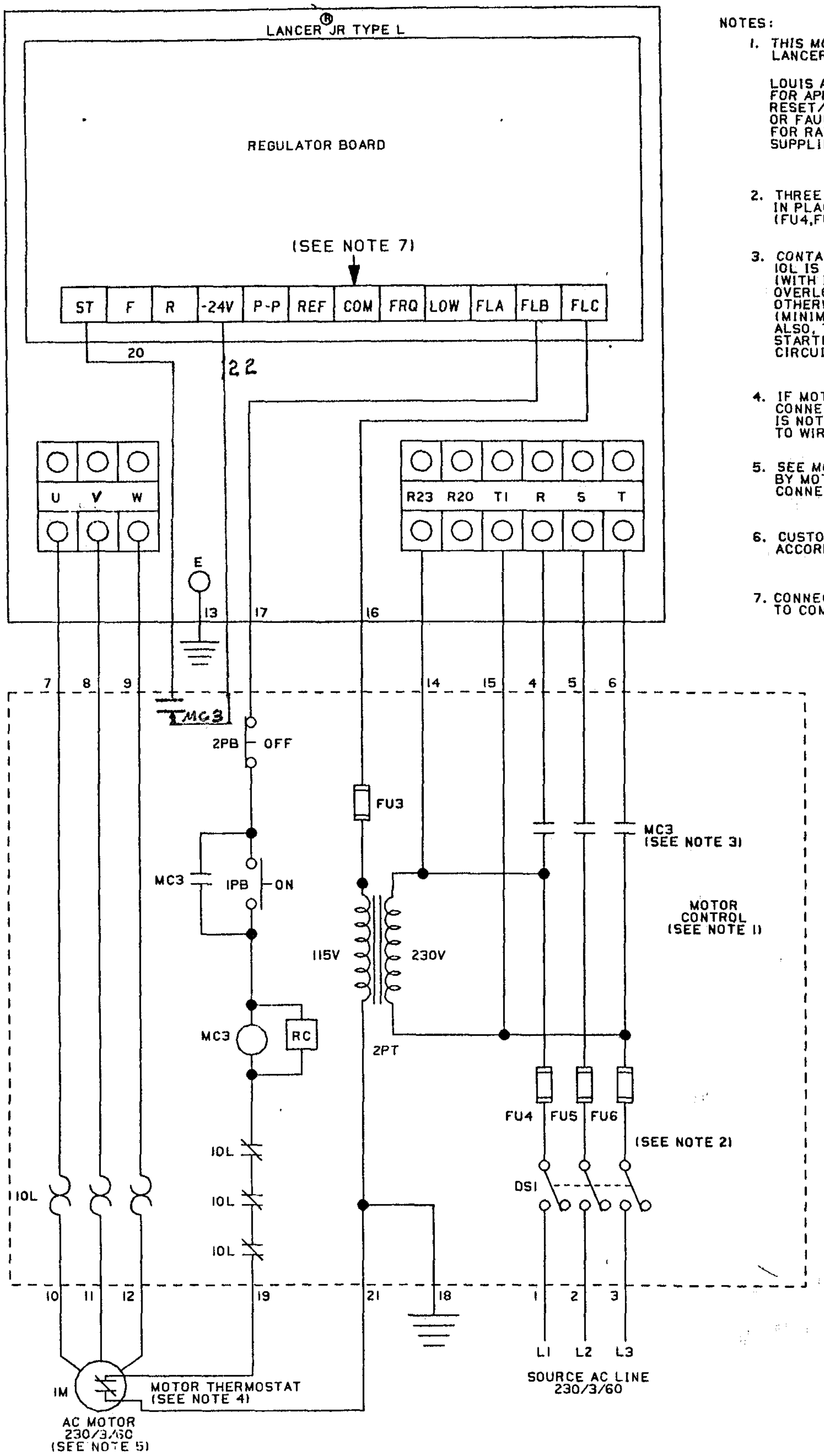

NOTES:

1. THIS MOTOR CONTROL IS IN ADDITION TO THE LANCER® JR AND IS SEPARATELY SUPPLIED

   LOUIS ALLIS RECOMMENDS THIS TYPE OF CONTROL FOR APPLICATIONS THAT REQUIRE MANUAL RESET/RESTART AFTER A POWER OUTAGE OR FAULT. SEE TABLE 8 OF INSTRUCTION MANUAL FOR RATING OF EQUIPMENT THAT IS SEPARATELY SUPPLIED.

2. THREE PHASE CIRCUIT BREAKER MAY BE USED IN PLACE OF DISCONNECT (DS1) AND FUSES (FU4,FU5,FU6).

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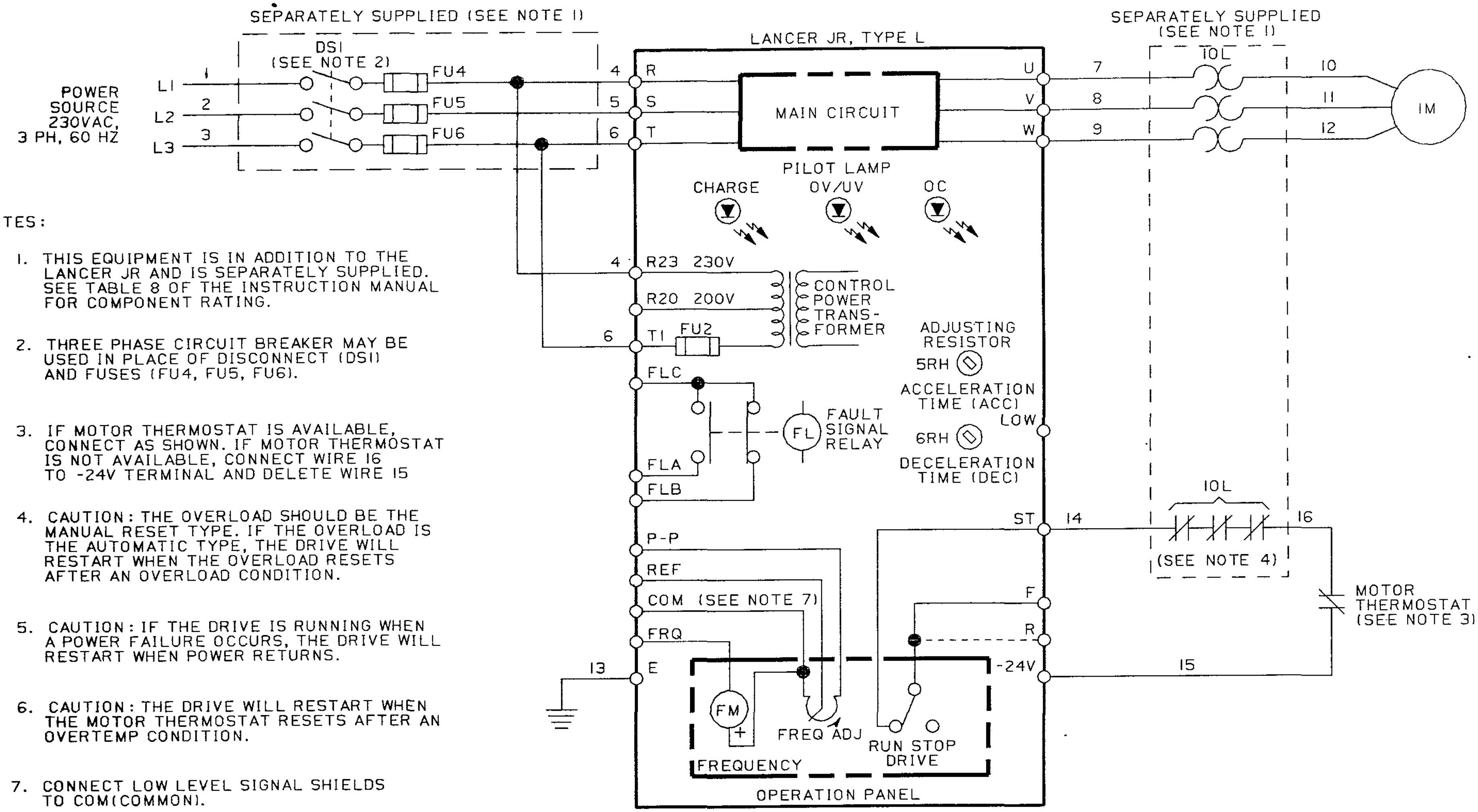
4. IF MOTOR THERMOSTAT IS AVAILABLE, CONNECT AS SHOWN. IF MOTOR THERMOSTAT IS NOT AVAILABLE, CONNECT WIRE 19 TO WIRE 21.

5. SEE MOTOR CONNECTION DIAGRAM (PROVIDED BY MOTOR MFR) FOR DETAILS FOR MOTOR CONNECTION AND DIRECTION OF ROTATION

6. CUSTOMER TO INSTALL WIRES 1 THRU 22 IN ACCORDANCE WITH LOCAL CODES.

7. CONNECT LOW LEVEL SIGNAL SHIELDS TO COM(COMMON).

FIGURE 15B STANDARD INTERCONNECTION DIAGRAM
230V LANCER JR TYPE L

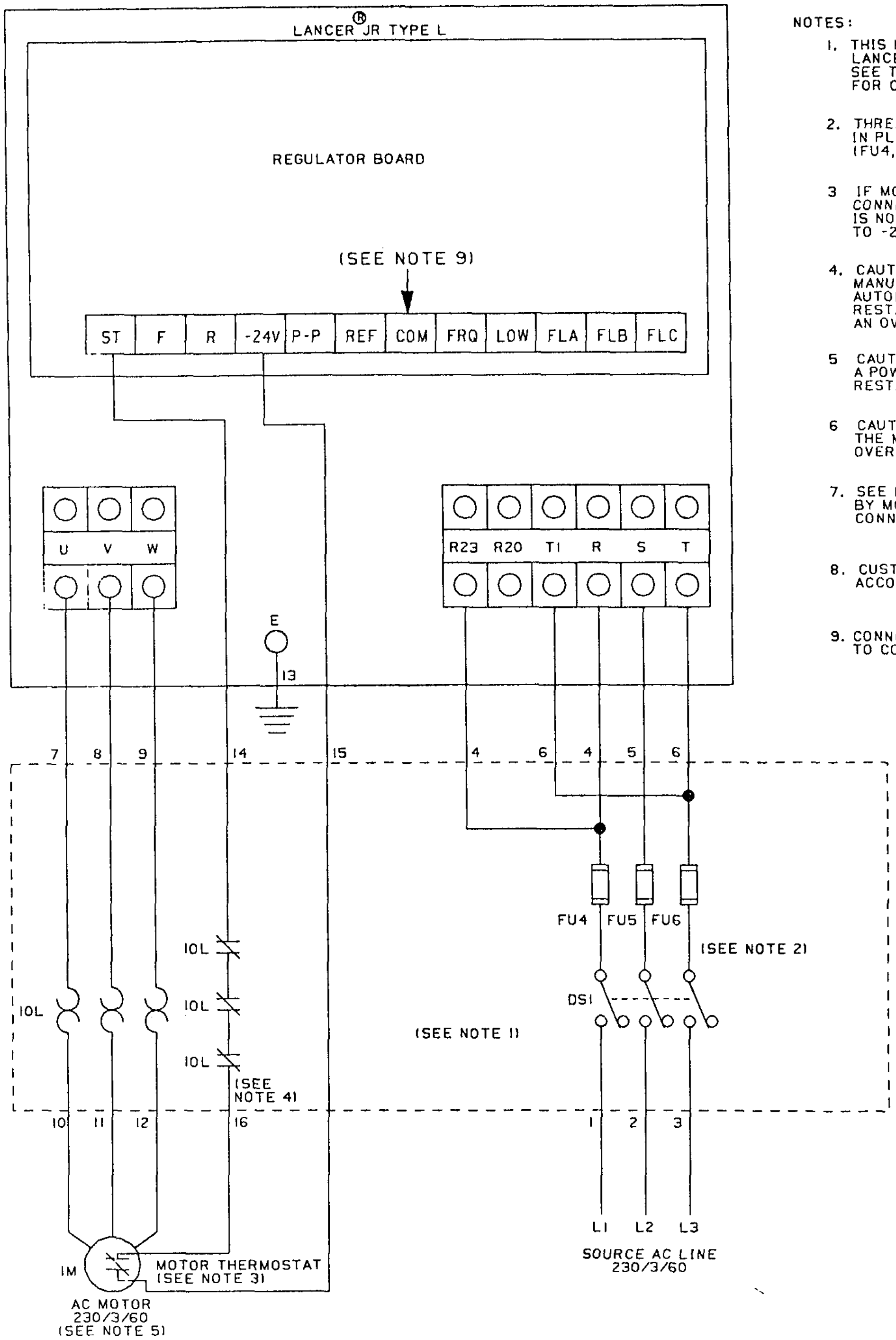


NOTES:

1. THIS EQUIPMENT IS IN ADDITION TO THE LANCER JR AND IS SEPARATELY SUPPLIED. SEE TABLE 8 OF THE INSTRUCTION MANUAL FOR COMPONENT RATING.
2. THREE PHASE CIRCUIT BREAKER MAY BE USED IN PLACE OF DISCONNECT (DS1) AND FUSES (FU4, FU5, FU6).
3. IF MOTOR THERMOSTAT IS AVAILABLE, CONNECT AS SHOWN. IF MOTOR THERMOSTAT IS NOT AVAILABLE, CONNECT WIRE 16 TO -24V TERMINAL AND DELETE WIRE 15
4. CAUTION: THE OVERLOAD SHOULD BE THE MANUAL RESET TYPE. IF THE OVERLOAD IS THE AUTOMATIC TYPE, THE DRIVE WILL RESTART WHEN THE OVERLOAD RESETS AFTER AN OVERLOAD CONDITION.
5. CAUTION: IF THE DRIVE IS RUNNING WHEN A POWER FAILURE OCCURS, THE DRIVE WILL RESTART WHEN POWER RETURNS.
6. CAUTION: THE DRIVE WILL RESTART WHEN THE MOTOR THERMOSTAT RESETS AFTER AN OVERTEMP CONDITION.
7. CONNECT LOW LEVEL SIGNAL SHIELDS TO COM(COMMON).

FIGURE 18A

OVERALL SCHEMATIC DIAGRAM
230V LANCER JR TYPE L WITHOUT INPUT CONTACTOR.



NOTES:

1. THIS MOTOR CONTROL IS IN ADDITION TO THE LANCER® JR AND IS SEPARATELY SUPPLIED SEE TABLE 8 OF INSTRUCTION MANUAL FOR COMPONENT RATING
2. THREE PHASE CIRCUIT BREAKER MAY BE USED IN PLACE OF DISCONNECT (DS1) AND FUSES (FU4,FU5,FU6)
3. IF MOTOR THERMOSTAT IS AVAILABLE, CONNECT AS SHOWN IF MOTOR THERMOSTAT IS NOT AVAILABLE, CONNECT WIRE 16 TO -24V TERMINAL AND DELETE WIRE 15
4. CAUTION: THE OVERLOAD SHOULD BE THE MANUAL RESET TYPE IF THE OVERLOAD IS THE AUTOMATIC RESET TYPE, THE DRIVE WILL RESTART WHEN THE OVERLOAD RESETS AFTER AN OVERLOAD CONDITION
5. CAUTION: IF THE DRIVE IS RUNNING WHEN A POWER FAILURE OCCURS, THE DRIVE WILL RESTART WHEN POWER RETURNS
6. CAUTION: THE DRIVE WILL RESTART WHEN THE MOTOR THERMOSTAT RESETS AFTER AN OVERTEMP CONDITION
7. SEE MOTOR CONNECTION DIAGRAM (PROVIDED BY MOTOR MFR) FOR DETAILS FOR MOTOR CONNECTION AND DIRECTION OF ROTATION
8. CUSTOMER TO INSTALL WIRES 1 THRU 16 IN ACCORDANCE WITH LOCAL CODES
9. CONNECT LOW LEVEL SIGNAL SHIELDS TO COM(COMMON)

FIGURE 18B INTERCONNECTION DIAGRAM
230V LANCER JR TYPE L, WITHOUT INPUT CONTACTOR.

D. PREPOWER CHECKS

Before applying power, check the following:

1. For any wiring errors or grounds.

2. Source voltage to ensure 230V +10% -5%.

3. Whether transformer T1 wiring is correct. 230V goes to terminals R23 and T1 only.

E. INITIAL OPERATION

1. Initial conditions before applying power:

   a) Freq. Adj. pot (speed adjustment) should be at minimum setting.

   b) Run/Stop switch in STOP position.

CAUTION

Motor should be uncoupled from load for these tests.

2. Apply power. Placing Run/Stop switch to RUN position and adjusting the speed pot slightly should start the motor turning. If motor runs backwards, stop inverter, turn off power, and reverse any two output leads U, V, W to correct direction.

3. Run speed to full speed slowly, watching motor operation. Leave setting at full speed. Place Run/Stop switch to STOP. Motor should decelerate without tripping off. Place Run/Stop switch back to ON. Motor should accelerate smoothly to full speed without tripping. Motor current should be checked at several different speed settings. Continuous currents above motor full load rating may burn the motor out.

F. ADJUSTMENT PROCEDURES

Before adjusting the LANCER JR, determine if factory adjustment is not satisfactory. The inverter is shipped calibrated for 3 to 80 Hz operation. If this speed range is not possible for the motor or machine, recalibration is necessary. If inverter stalling or shutdown occurs during normal machine operation, adjustment is necessary. Adjustment procedures are outlined on the following pages.

TABLE 3 ADJUSTMENT POTENTIOMETERS

RH No.	Symbol	Function Adjusting	Turning RH in Arrow Direction	Original Setting	Remarks
1RH	OV	Overvolt Level	Lowers Overvoltage Detecting	Optimum Level	
2RH	FRQ	Maximum Output Frequency	Raises Output Frequency	80 Hz	
3RH	VB	Low Frequency Voltage Boost	Raises Low Frequency Output Voltage		
4RH	VL	V/F Ratio	Increases V/F Ratio	230 at 60 Hz	
5RH	ACC	Acceleration Time	Increases Acceleration Time	Approx. 15 sec.	Adjustable 1 to 20 sec.
6RH	DEC	Deceleration Time	Increases Deceleration Time	Approx. 15 sec.	Adjustable 1 to 20 sec.
7RH	FMADJ	Frequency Meter	Increases Frequency Meter Pointer Swing	80 Hz	

WARNING!

ADJUSTING THE INVERTER WITH POWER ON REQUIRES SPECIAL PRECAUTIONS: ALL TEST EQUIPMENT SHOULD BE CONNECTED AND DISCONNECTED WITH POWER OFF. HIGH VOLTAGE EXISTS ON THE REGULATOR BOARD: ALL POTENTIOMETERS SHOULD BE ADJUSTED WITH INSULATED HANDLE SCREWDRIVERS. IMPROPER USE OF GROUNDED TEST EQUIPMENT MAY DAMAGE THE INVERTER. ENSURE THAT TEST EQUIPMENT, SUCH AS DIFFERENTIAL OSCILLOSCOPE, IS CONNECTED PROPERLY TO AVOID GROUNDING THE INVERTER. THE D.C. BUS REMAINS CHARGED FOR SEVERAL MINUTES AFTER POWER IS REMOVED.

READJUSTING MAXIMUM FREQUENCY

1. Changing frequency range does not require the motor to be connected. Most adjustments to frequency will be to limit to 60 Hz max operation. A frequency counter or oscilloscope connected to CN9-2 and COM will be necessary to determine the output frequency. An analog or digital voltmeter set for 10 volts D.C. should be connected at CN9-3 to COM. Run inverter to maximum speed with speed pot, inverter frequency meter (if used) should read 80 Hz. Adjust 2RH (FRQ) to desired maximum speed. The frequency counter or oscilloscope frequency divided by 1152 (no jumper on J1) will give true inverter output frequency. If inverter frequency meter is used, recalibrate using 7RH (FMADJ) to read new maximum frequency.

2. Changing maximum frequency requires readjustment to Volts/Hertz curve. Standard motors are designed for 230V @ 60 Hz. Set the speed pot for 60 Hz. If 60 Hz is maximum, set speed pot to maximum. Adjust 4RH for 5V at CN9-3. 3RH should be at minimum setting. The inverter is now calibrated to the new maximum speed with the proper V/Hz curve. Turn off power and connect motor.

3. Acceleration and deceleration (5RH and 6RH) must be adjusted with normal load on the motor. Fast acceleration with a heavy load may trip overcurrent. Fast deceleration may trip overvoltage. The factory setting of 15 seconds is usually good for most applications.

4. Motor stalling or rough running at low speeds can be corrected with 3RH (VB). Voltage boost gives more voltage at slow speeds. Care should be used when adjusting 3RH, too much voltage boost can heat up the motor and/or cause overcurrent tripping. When 3RH is adjusted, 4RH volts/hertz needs readjusting. Both adjustments interact, so several adjustments may be necessary to get the proper V/Hz ratio. Figure 19 shows a graph of V/Hz and how the adjustments change the V/Hz ratio.

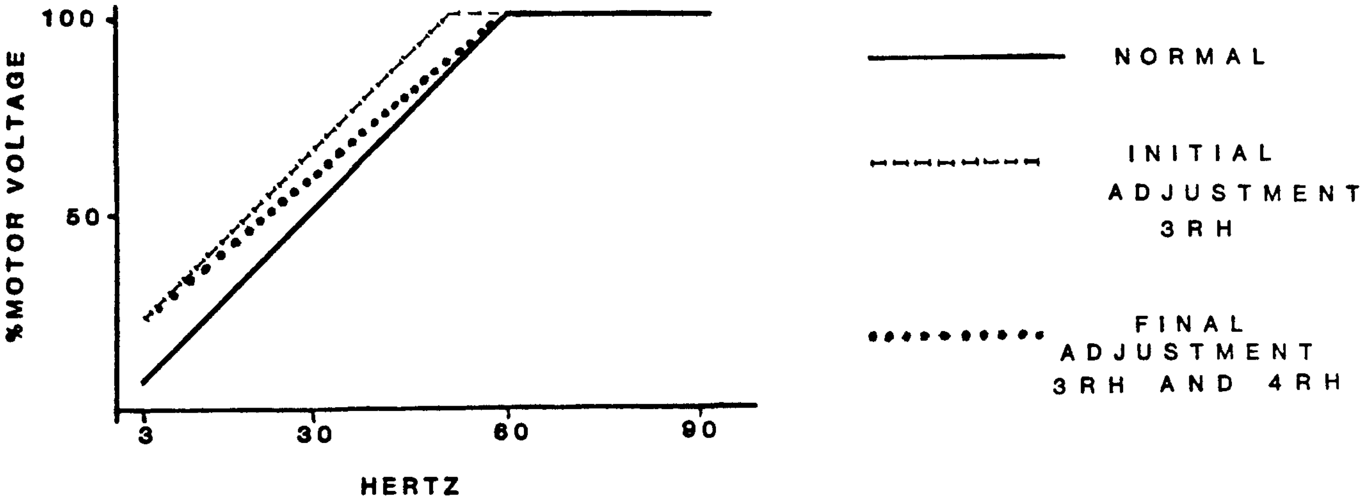


FIGURE 19

5. Overvoltage level (1RH) is factory adjusted for safe operation. It should never be readjusted.

6. After completion of adjustments, check motor current at several different operating speeds. Continuous currents above the motor nameplate (rated) current may damage the motor.

TROUBLESHOOTING

Improper adjustment, wiring or inverter malfunction can cause the fault relay to latch. To reset a fault, power must be turned off for five seconds and then back on. Figure 20 is a troubleshooting flow chart in the event the motor doesn't run. Table 4 shows some trouble indications and causes.

WARNING!

WHEN TROUBLESHOOTING WITH POWER ON, CARE MUST BE TAKEN TO AVOID ELECTRIC SHOCK. IMPROPER USE OF GROUNDED TEST EQUIPMENT MAY DAMAGE THE INVERTER. ENSURE THAT TEST EQUIPMENT, SUCH AS DIFFERENTIAL OSCILLOSCOPE, IS CONNECTED PROPERLY TO AVOID GROUNDING THE INVERTER. THE D.C. BUS REMAINS CHARGED FOR SEVERAL MINUTES AFTER POWER IS REMOVED.

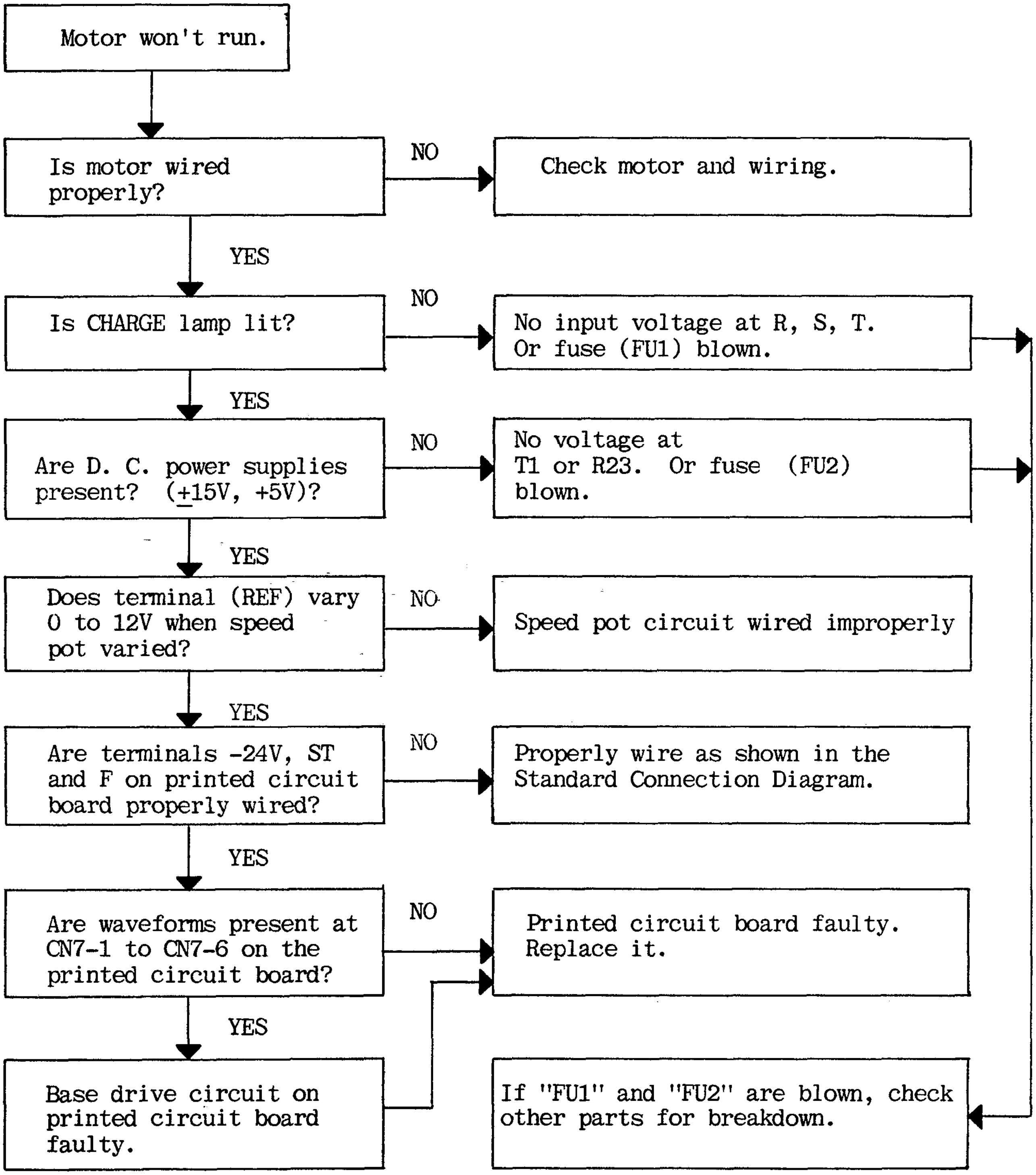


FIGURE 20 Troubleshooting Flow Chart When Motor Won't Run

TABLE 4

Trouble Indications and Causes

INDICATION	POSSIBLE TROUBLE
LED OC Lights	Inverter KVA and motor horsepower not correctly sized. Wire shorted or grounded. Overload or abrupt load variations. Accel and Decel time too short. Internal inverter problem.
LED OV/UV Lights	Input voltage too high or low. Momentary power failure. Decel time too short.
DC Bus Fuse (FU1) Blown	Inverter main circuit problems, possibly bad Power Transistor or Capacitor C1.
Control Circuit Fuse (FU2) Blown	T1 control circuit power trouble.

A. MAIN CIRCUIT TROUBLESHOOTING

CAUTION

Always remove power before connecting or disconnecting test equipment leads.

WARNING!

THE D.C. BUS REMAINS CHARGED FOR SEVERAL MINUTES AFTER POWER IS REMOVED.

Inverter tripping O.C. or an open bus fuse (FU1) are indications of possible main circuit problems.

Input fuse blowing or circuit breaker tripping are indications the input bridge rectifier is shorted.

Figure 21 shows procedures for checking shorted transistors (most common transistor failure). Input diodes may be checked in the same manner at R, S, T. A shorted device will show low resistance (0-10 ohms). Table 5 shows transistor testing for other types of breakdown.

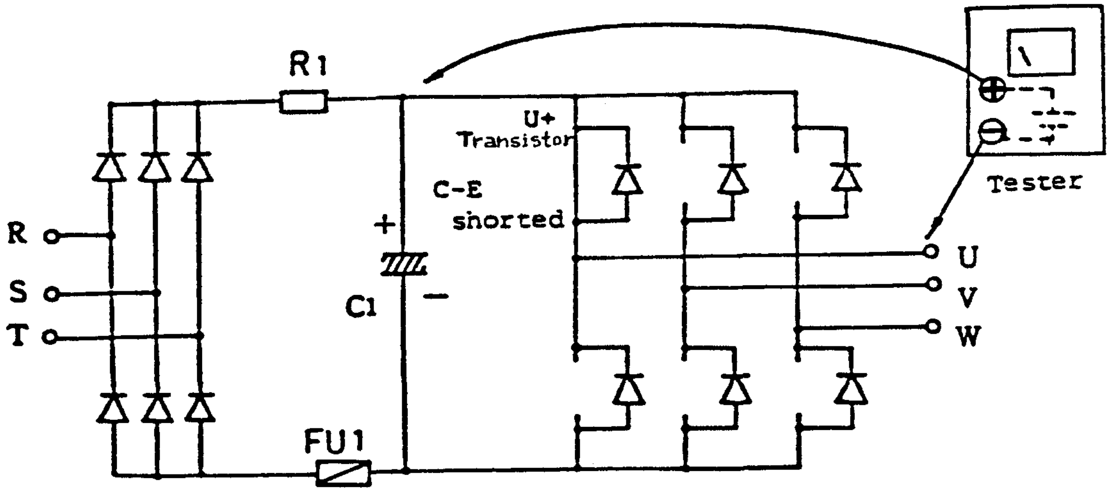
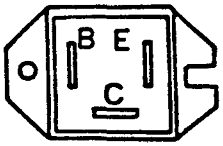
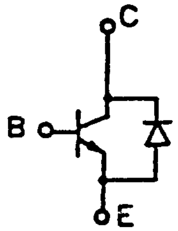
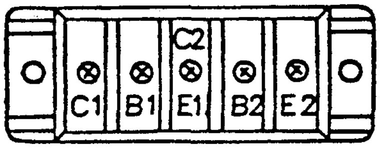
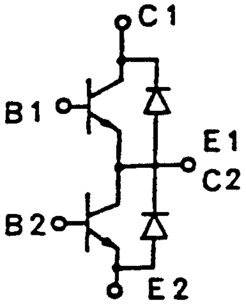


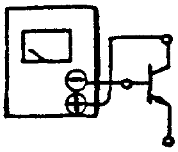
FIGURE 21

TABLE 5

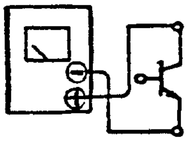
Transistor Test Procedure

NAME	SHAPE	EQUIVALENT CIRCUIT
MG15G1AL1 (for 1.5 KVA)		
	C: Collector B: Base E: Emitter	
MG20G2CL1 (for 2KVA) MG30G2CL1 (for 3KVA) MG50G2CL1 (for 5KVA)		

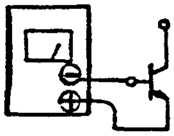
The ohmmeter should be on R x 1K scale. If a reading is in doubt, compare with a known good transistor. Resistance values shown are for a good transistor.



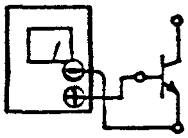
More than 50 kilohms



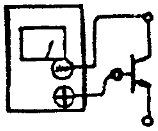
More than 50 kilohms



More than 50 kilohms



Less than 500 ohms



Less than 500 ohms

When replacing a power transistor, be sure to apply a thin coat of a heat-conductive silicon compound to the back surface.

Tighten the power transistor uniformly on the right and left.

B. REGULATOR BOARD TROUBLESHOOTING

CAUTION

Always remove power before connecting
or disconnecting test equipment leads.

WARNING!

THE D.C. BUS REMAINS CHARGED FOR SEVERAL
MINUTES AFTER POWER IS REMOVED.

Regulator board problems can be caused by miswiring. Table 6 shows typical waveforms associated with good operation.

Transistor failure sometimes damages the base amplifier circuit. Checking the base amplifiers after transistor replacement is a good pratice:

1. Remove voltage at R, S, and T, but keep control voltage at R23 and T1.

2. Run the inverter and check base pulses with an oscilloscope. The ground lead of the scope should be connected to the emitter and the probe on the base. Connectors CN-1 to CN-4 provide access for measurement, see Figure 23. Check all six base amplifier voltages. Figure 22 shows normal levels for proper operation.

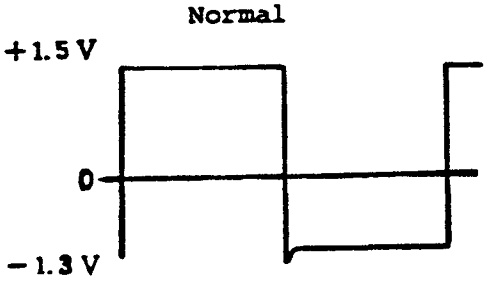


FIGURE 22

TABLE 6

Regulator Board Functions and Waveforms

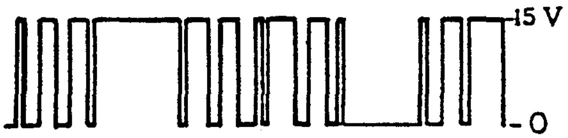
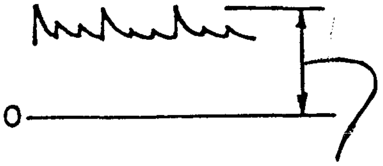
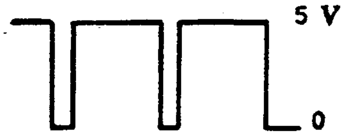
Test Point	Function	Waveform Example
CN7-1 to 6 +U +V +W -U -V -W	Base Drive Circuit Input Signal	PWM Signal of Sinusoidal Wave Distribution 
CN9-1 I	Current Feedback Rate	Waveform repeated every 60°.  Approx. 3.5V (under 100% load)
CN9-2 F	Voltage/Frequency Converter Circuit Output Pulse	Pulse having a frequency 1152 times the inverter output frequency.  About 50% duty.
CN9-3 V	Voltage Control Circuit Amplifier Output Voltage	Varies from 0 to 10.7V with frequency setting resistor varied from 0 to maximum.
CN9-4 P15	Control Voltage +15V.	DC voltage of +15V.
CN9-5 N15	Control Voltage -15V.	DC voltage of -15V.
CN9-6 P5	Control Voltage +5V.	DC voltage of +5V.
CN9-7 0	Control Voltage 0V.	0V. COMMON

FIGURE 23

Connector Connections

Each connector's lead connections are shown below.

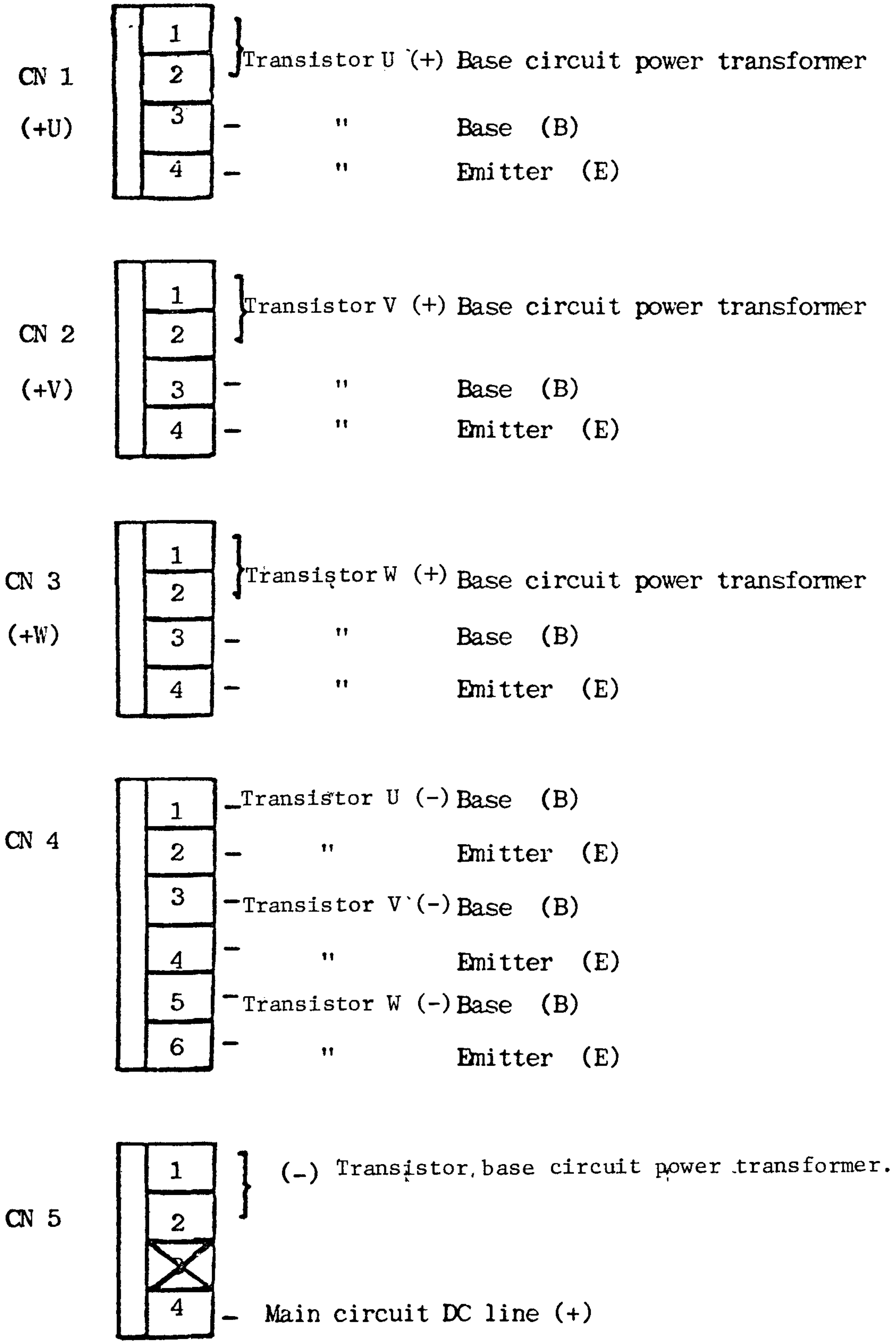
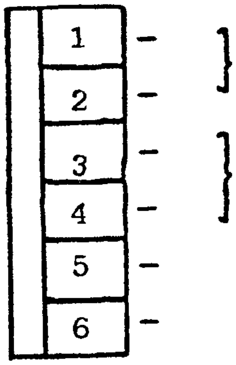


FIGURE 23 (continued)

CN 6



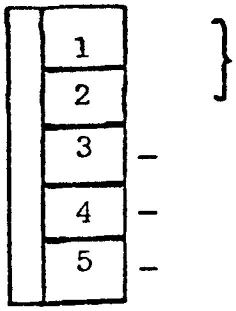
Power transformer for +5 V

Power transformer for +15 V

Power transformer Common

Grounding terminal

CN 8
(for HCT)



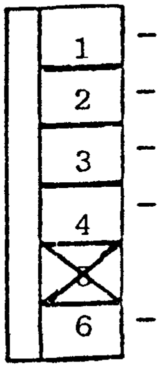
HCT output

HCT circuit board -15 V

" Common

" +15 V

CN 10
(for TG
feedback)



+15 V

Input signal from main circuit board

Optional circuit board output signal

Common

-15 V

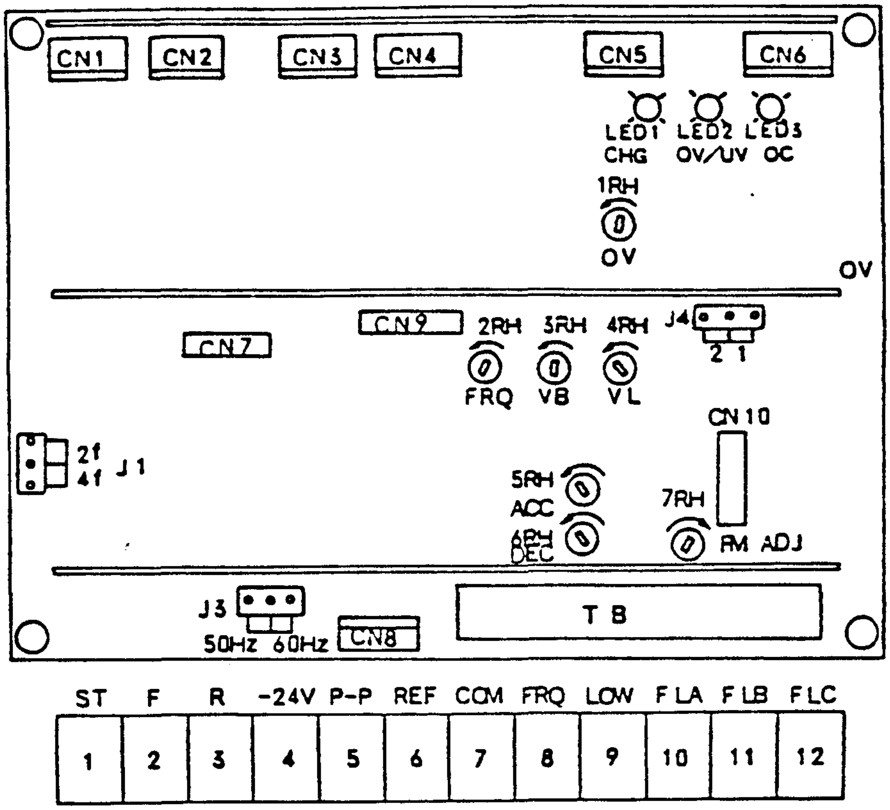


FIGURE 25

Printed Circuit Board Parts Arrangement Diagram with Enlarged View of Terminal Board

Signal	Function
ST	Connect to terminal "-24V", and the inverter is ready for starting operation.
F;R	Forward and reverse command input terminals. Connect either one to terminal "-24V".
P-P	Frequency setting 3K ohms potentiometer output terminal, generating 12V with respect to "COM".
COM	Control circuit OV.
FRQ	Frequency meter output terminal. 0 to 1mA gives full scale reading.
REF	Frequency setting potentiometer output terminal, generating 0 to 12V with respect to "COM".
LOW	Low-speed detecting signal terminal (open collector output 75mA maximum). Connect a relay between LOW and terminal "-24V" for detecting low speed.
FLA	N.O. contact between FLA and FLC closes if a failure occurs.
FLB	N.C. contact between FLB and FLC opens if a failure occurs.

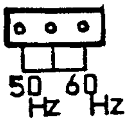
Jumper Connection

Inverters come jumpered as shown below.

See Figure 25 for the jumper location. The function of the jumper is shown in Figure 26.

FIGURE 26

Description of Jumper

No.	Symbol on Board	Function	Connection Before Shipment
J3		60 Hz: Maximum Output Frequency 80 Hz 50 Hz: Maximum Output Frequency 67 Hz	Position 60 Hz

C. TRANSFORMER T1 TROUBLESHOOTING

CAUTION

Always remove power before connecting or disconnecting test equipment leads.

WARNING!

THE D.C. BUS REMAINS CHARGED FOR SEVERAL MINUTES AFTER POWER IS REMOVED.

Fuse FU2 blowing can indicate a wiring problem, a bad transformer, or a bad Regulator Board. The Main Circuit page of the wiring diagrams shows transformer connections and output voltages.

MAINTENANCE AND STORAGE

If the inverter is stored, it should be kept in a clean dry location free of temperature extremes. Storage for longer than six months without power requires reconditioning of the filter capacitor:

1. Apply bus voltage for a few seconds and check capacitor temperature.
2. Repeat step 1 several times monitoring capacitor temperature. If capacitor gets warm, allow it to cool before repeating.
3. Capacitor is reconditioned when a constant bus voltage causes no heating.

Periodically check the operating inverter for cleanliness. Keep the cooling heatsink free of debris. Check connections (with power off) for tightness. Proper maintenance and operation will allow the inverter to give long troublefree service.

SPARE PARTS

Recommended spare parts for the LANCER JR are listed in Table 7. Note that on fuses and power transistors, more than one set are recommended.

Table 8 shows Louis Allis part numbers for recommended motor control components, including circuit breakers, contactors and overcurrent (O.L.) relays. If multiple motors are used on one inverter, each motor should have an overcurrent relay for proper protection. The multiple relays should be wired in series for inverter shutdown.

TABLE 7 SPARE PARTS

SYMBOL	NAME	MODEL 92001K	MODEL 92002S	MODEL 92003Q	MODEL 92004F
PCB	Regulator Board	ARNI-829A	ARNI-829B	ARNI-829B	ARNI-829C
FU1	Bussman Fuse	KLM-8	KLM-15	KLM-20	KLM-30
FU2	Glass Type Fuse	AGC-2/ 250V	AGC-2/ 250V	AGC-2/ 250V	AGC-2/ 250V

TABLE 8

230V Inverter HP Rating	* Inverter Input Current (Amps)	FUSED DISCONNECT				CIRCUIT BREAKER, 600V (1CB)			Contactor (MC3)			230VAC Motor Full Load Current (Amps)	O.L. Relay (10L) (Size 1) P/N	O.L. Heater, Qty (3)	
		30 Amp Disconnect (DS1) P/N	Fuse Block P/N	Fuse (250 VAC Qty(3) (FU4, FU5, FU6)		Current Rating Amps	Inter. Capacity Sym. Amps	P/N	Size	Rating	P/N			Current Range Amps	P/N
				Current Rating Amps	P/N										
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	.29- .36	5P37-0127	.30 - .38	5P4-0200
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	.45- .56	5P37-0127	.47 - .59	5P4-0201
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	.57- .71	5P37-0127	.60 - .75	5P4-0202
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	.72- .86	5P37-0127	.76 - .90	5P4-0203
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	.87-1.00	5P37-0127	.91 - 1.05	5P4-0204
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	1.01-1.14	5P37-0127	1.06 - 1.20	5P4-0205
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	1.15-1.32	5P37-0127	1.21 - 1.39	5P4-0206
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	1.33-1.52	5P37-0127	1.40 - 1.60	5P4-0207
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	1.53-1.61	5P37-0127	1.61 - 1.69	5P4-0208
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	1.62-1.84	5P37-0127	1.70 - 1.93	5P4-0209
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	1.85-2.10	5P37-0127	1.94 - 2.21	5P4-0210
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	2.11-2.41	5P37-0127	2.22 - 2.53	5P4-0211
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	2.42-2.74	5P37-0127	2.54 - 2.88	5P4-0212
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	2.75-3.12	5P37-0127	2.89 - 3.28	5P4-0213
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	3.13-3.49	5P37-0127	3.29 - 3.66	5P4-0214
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	3.50-3.98	5P37-0127	3.67 - 4.18	5P4-0215
1	6.75	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	4.00-4.55	5P32-0127	4.19 - 4.78	5P4-0216
2	9.0	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	4.56-4.91	5P32-0127	4.79 - 5.16	5P4-0217
2	9.0	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	4.92-5.59	5P37-0127	5.17 - 5.87	5P4-0218
2	9.0	5P209-0022	5P209-0023	15	5P17-0040	15	18,000 @240VAC	5P12-0257	0	600V, 20A	5P32-0019	5.60-6.19	5P37-0127	5.88 - 6.5	5P4-0219
3	13.5	5P209-0022	5P209-0023	30	5P17-0014	30	18,000 @240VAC	5P12-0258	0	600V, 20A	5P32-0019	6.2 -7.0	5P37-0127	6.51 - 7.39	5P4-0220
3	13.5	5P209-0022	5P209-0023	30	5P17-0014	30	18,000 @240VAC	5P12-0258	0	600V, 20A	5P32-0019	7.1 -8	5P37-0127	7.40 - 8.41	5P4-0221
3	13.5	5P209-0022	5P209-0023	30	5017-0014	30	18,000 @240VAC	5P12-0258	0	600V, 20A	5P32-0019	8.1 -9	5P37-0127	8.42 - 9.49	5P4-0222
5	22.5	5P209-0022	5P209-0023	50	5P17-0028	50	18,000 @240VAC	5P12-0259	1	600V, 30A	5P32-0020	9.1 -10	5P37-0127	9.50 -10.50	5P4-0223
5	22.5	5P209-0022	5P209-0023	50	5P17-0028	50	18,000 @240VAC	5P12-0259	1	600V, 30A	5P32-0020	10.1-10.4	5P37-0127	10.6 -10.90	5P4-0224
5	22.5	5P209-0022	5P209-0023	50	5P17-0028	50	18,000 @240VAC	5P12-0259	1	600V, 30A	5P32-0020	10.5-11.6	5P37-0127	11.0 -12.2	5P4-0225
5	22.5	5P209-0022	5P209-0023	50	5P17-0028	50	18,000 @240VAC	5P12-0259	1	600V, 30A	5P32-0020	11.7-12	5P37-0127	12.3 -12.6	5P4-0226
5	22.5	5P209-0022	5P209-0023	50	5P17-0028	50	18,000 @240VAC	5P12-0259	1	600V, 30A	5P32-0020	13 -13.4	5P37-0127	13.7 -14.1	5P4-0227
5	22.5	5P209-0022	5P209-0023	50	5P17-0028	50	18,000 @240VAC	5P12-0259	1	600V, 30A	5P32-0020	13.5-15.2	5P37-0127	14.2 -16.0	5P4-0228

* Input currents cited are maximum rms values, based upon conducting rated output currents with negligible source impedance. Where source impedance is 3% or greater, based upon the drive KVA rating, or an input transformer sized for the particular drive is used (impedance 3% or greater), the input current will be less than or equal to the output current.

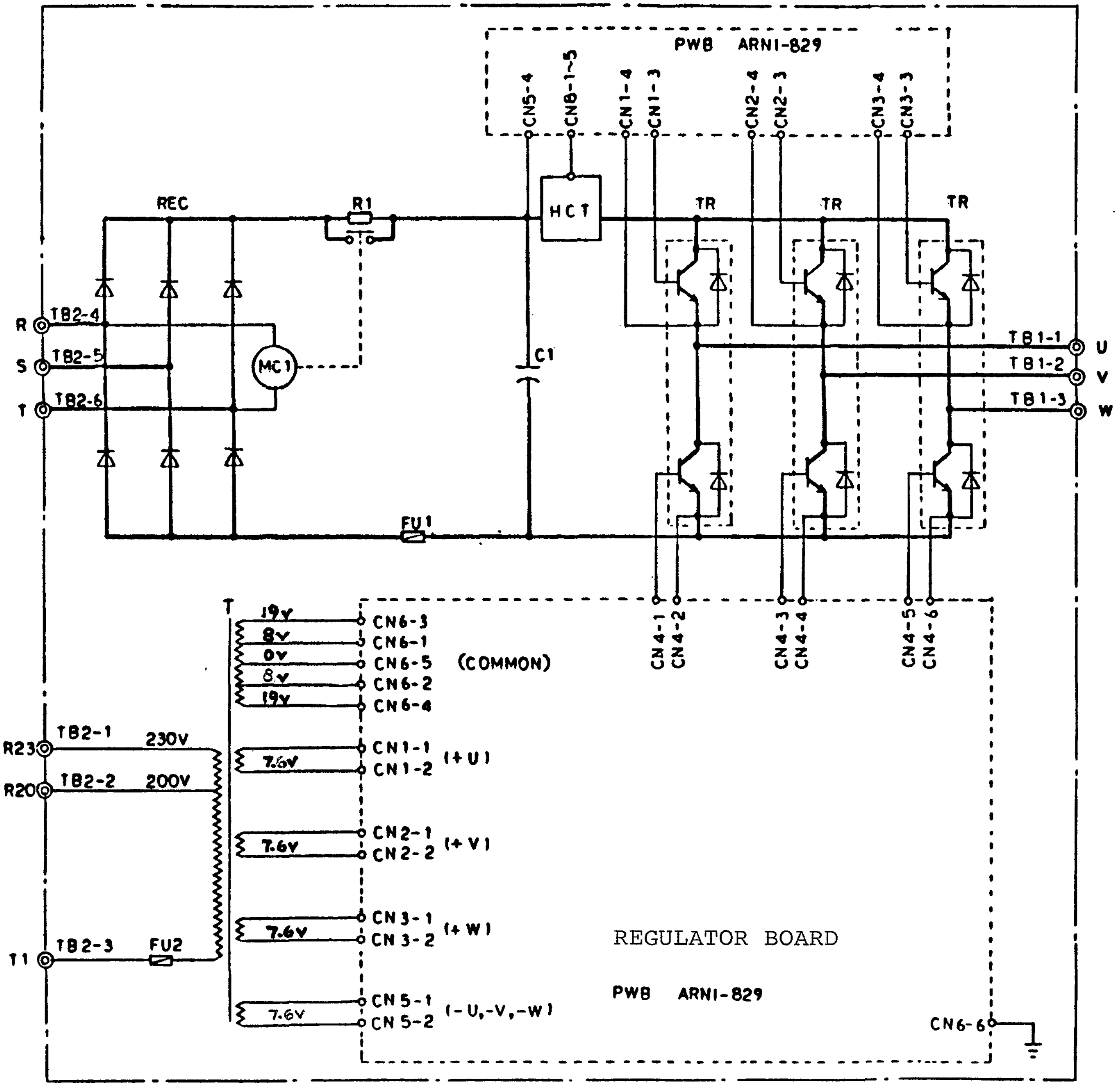


FIGURE 27 WIRING DIAGRAM-MAIN CIRCUIT

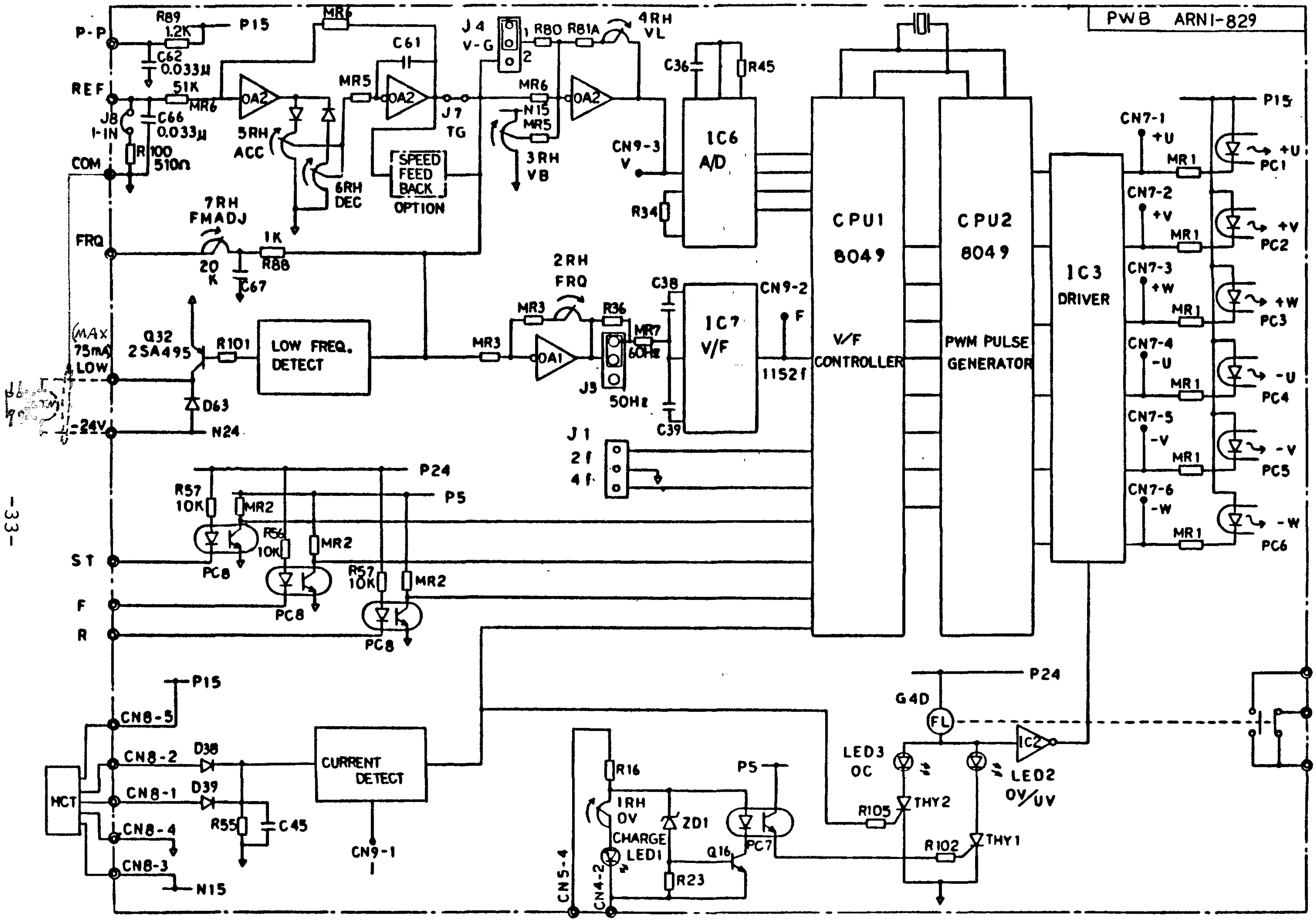


FIGURE 28 WIRING DIAGRAM-REGULATOR BOARD: SHEET 1-CONTROL CIRCUIT

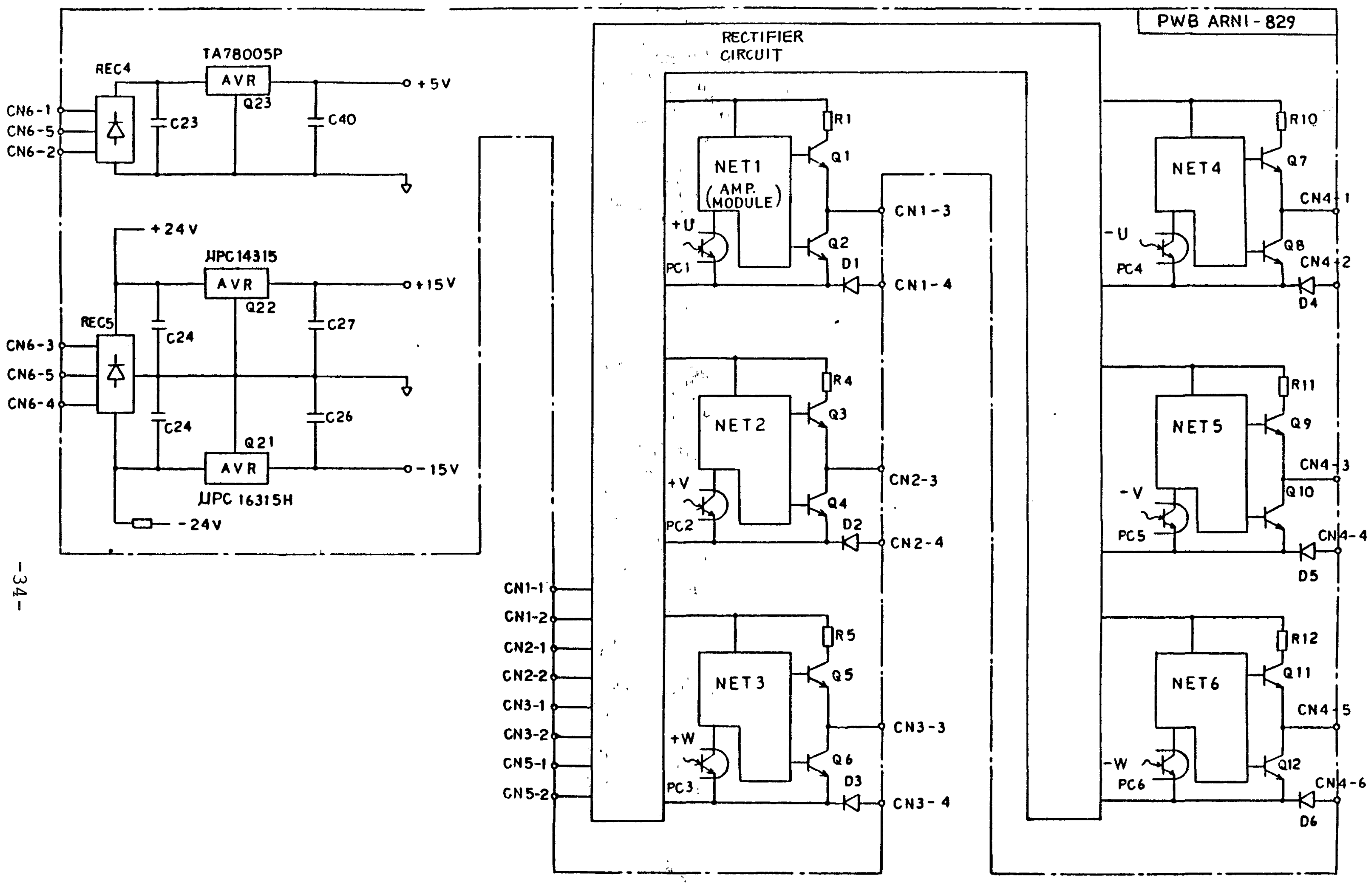
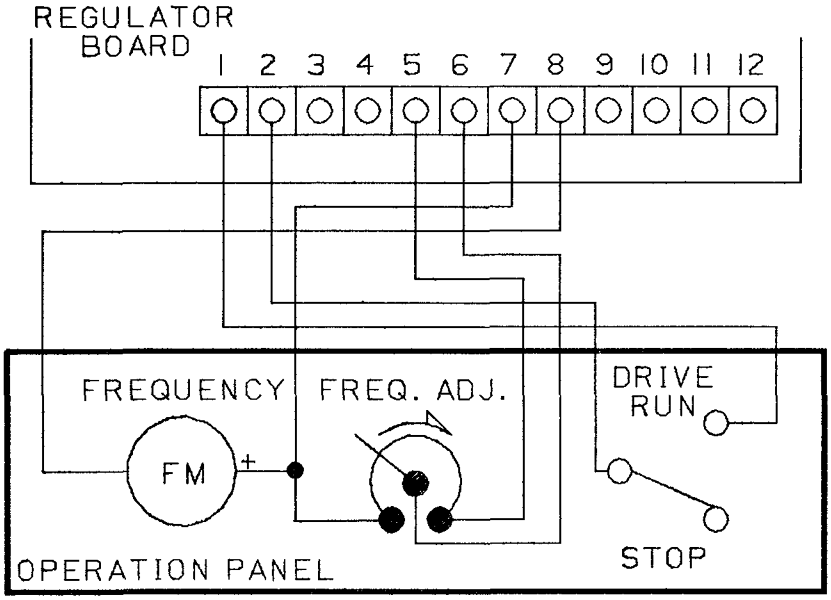


FIGURE 28 WIRING DIAGRAM-REGULATOR BOARD: SHEET 2-BASE REGULATORS



OPERATION PANEL WIRING
(FACTORY CONNECTIONS)

FROM CONTROL		TO REG. BRD. TERM.
FREQUENCY METER	−	8 (FRQ)
	+	7 (COM)
FREQ. ADJ. POT	CCW	7 (COM)
	WIPER	6 (REF)
	CW	5 (P-P)
DRIVE RUN/STOP SWITCH	COMMON	2 (F)
	RUN	1 (ST)

FIGURE 29 CONTROL PANEL CONNECTION DIAGRAM

The connection diagram of regenerative power discharging unit is shown in Figure 1.

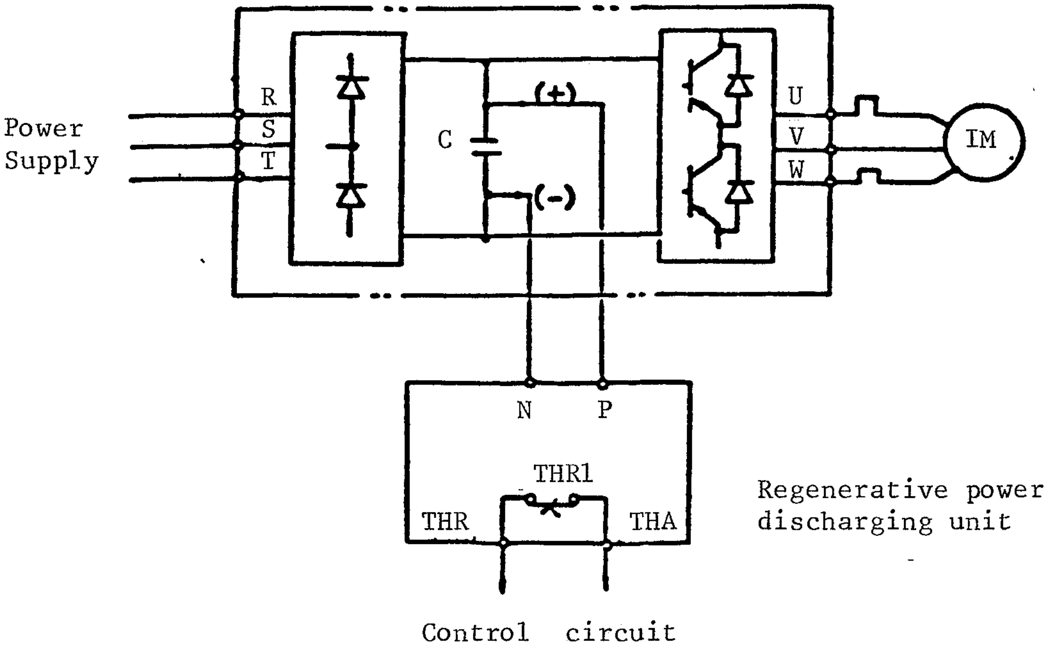
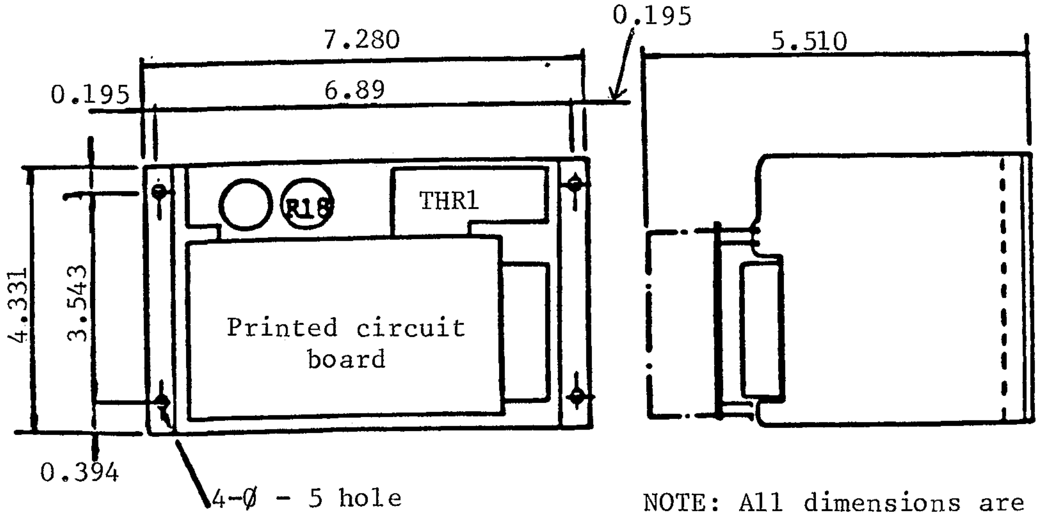


Figure 1 Connection Diagram of Regenerative Power Discharging Unit

The external dimensions of regenerative power discharging unit are shown in Figure 2.



NOTE: All dimensions are in inches

Figure 2 External Dimensions of Regenerative Power Discharging Unit

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