87-900-850-01
December 1992

Instruction Manual

Turbo-V60 controller

Model 969-9503

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IV Maintenance

SAFETY SUMMARY

Operators and service personnel must be aware of all hazards associated with this equipment. They must know how to recognize hazardous and potentially hazardous conditions, and know how to avoid them.
The consequences of unskilled, improper, or careless operation of the equipment can be serious.
This product must only be operated and maintained by trained personnel. Every operator or service person must read and thoroughly understand operation/maintenance manuals and any additional information provided by Varian.

All warnings and cautions should be read carefully and strictly observed.

Address any safety, operation, and/or maintenance questions to your nearest Varian office.

The following format is used in this manual to call attention to hazards:

WARNING
Warnings are used when failure to observe instructions or precautions could result in injury or death.

CAUTION
Cautions are used when failure to observe instructions could result in damage to equipment, whether Varian-supplied or other associated equipment.

NOTE
Information to aid the operator in obtaining the best performance from the equipment.

1-1 General

The Turbo-V60 controller 969-9503 is a customized control unit, microprocessor-controlled, solid-state, frequency converter with self-diagnostic and protection features.

It incorporates all the facilities required for the automatic operation of the Turbo-V60 pump series. Remote start/stop, pump status signals, forepump start/stop, interlock control capability, are provided via auxiliary connectors.

1-2 Turbo-V60 controller description

The controller, factory-set for 120 Vac, 50-60 Hz input voltage, is a solid-state frequency converter which is driven by a single chip microcomputer and is composed of:

- Power transformer
- Left panel with input/output connector
- Right panel with pump connector and hand-held terminal connector
- PCB including: power supply and 3-phase output, analog and input/output section, microprocessor and digital section, display and keyboard circuits
- PCB external input/output interface.

The power supply and the 3-phase output converts the single phase (50-60 Hz) AC mains supply into a 3-phase, low voltage, medium frequency output which is required to power the Turbo-V pump.

The microcomputer generates the variable output frequency and controls the 3-phase output voltage according to the software and the gas load condition of the pump.

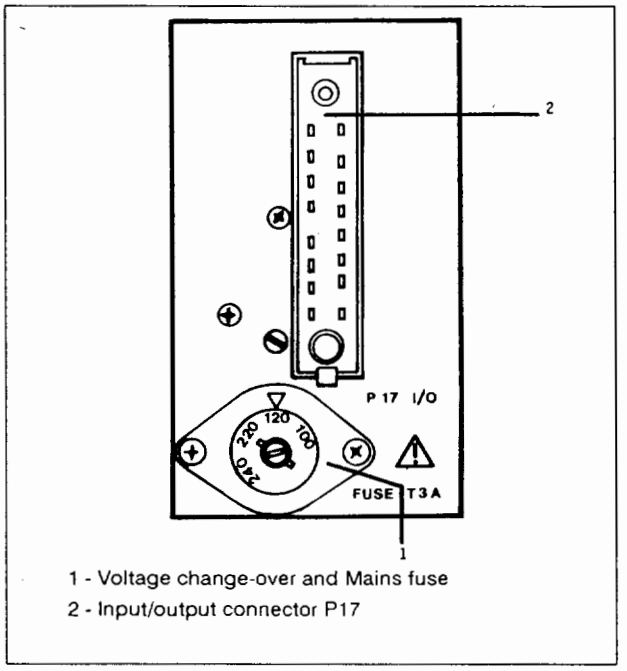
Moreover, it manages signals from sensors, input/output connection information to be displayed on the hand-held terminal, and gives outputs for a fully automatic operation.

A dedicated non-volatile RAM is used to

failure for a period of 10 years accumulated off time.

The controller can be operated by remote signals via the left panel connector and may be monitored/reprogrammed using the optional hand-held terminal via the right panel connector.

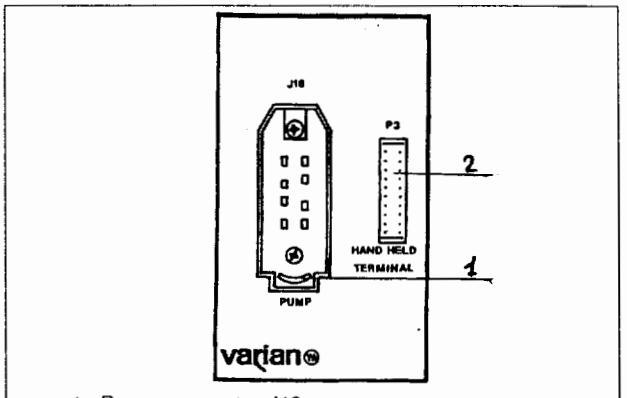
The Turbo-V controller left panel controls are shown in fig. 1-1.



1 - Voltage change-over and Mains fuse
2 - Input/output connector P17

Figure 1-1 - Left panel controls

The controller right panel controls are shown in fig. 1-2.



1 - Pump connector J16
2 - Hand-held terminal connector P3

1-3 Controller specifications

Input: Voltage Frequency Power	 100, 120, 220, 240 Vac ±10%, 1-phase 47 to 63 Hz 350 VA maximum
Output: Voltage Frequency Power	 56 Vac nominal ±10%, 3-phase 1167 Hz, ±2% 100 W maximum
Operating temperature	0°C to +40 °C
Storage temperature	-20°C to +70°C
Fuse (mains)	T3A (slow blow) disregarding the mains

Radio interference suppression	Conforms to VDE 0871 limit class B. Conforms to FCC 47CFR part 15 sub part J class A
Auxiliary connectors	P17 INPUT/OUTPUT mains and signals (pins) J16 pump connector (sockets) P3 hand-held terminal connector (pins)
Weight	4 Kg 8.8 lbs

1-4 Controller outline

The outline dimensions for the controller are shown in fig. 1-3.

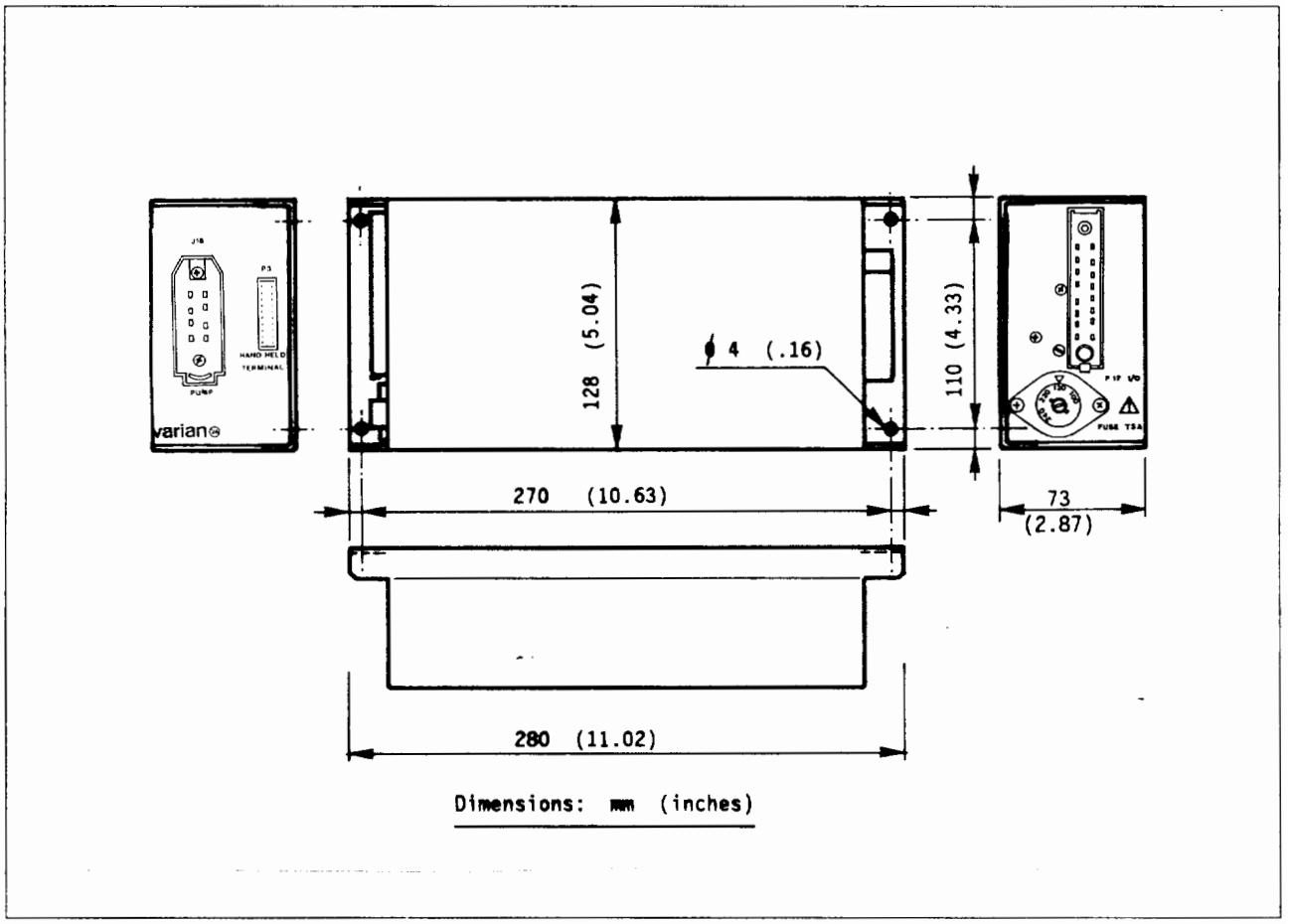


Figure 1-3 - Controller outline

2-1 General

Inspect the controller for any shipping damage.

WARNING

Connection to the mains must be made in accordance with the local law. Always connect the ground wire and use a properly grounded power socket to avoid electrical shock.

WARNING

High voltage developed in the controller can cause severe injury or death. Before servicing the unit, disconnect the input power cable.

NOTE

The Turbo-V controller must be positioned so that free air can flow through the holes.

2-1.1 Line voltage change over

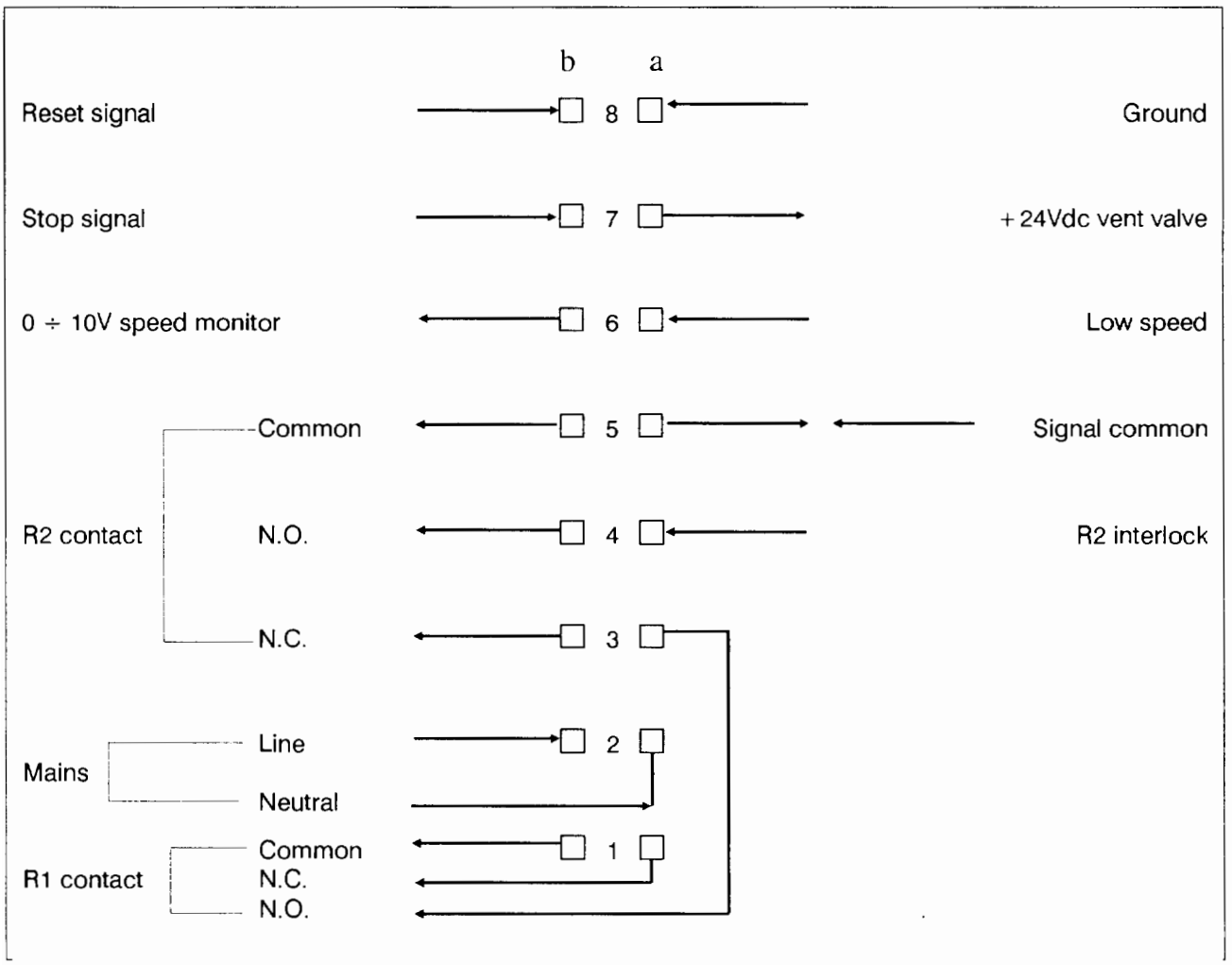
The controller is factory-set for 120 Vac operation.

If a change in line voltage operation is desired, proceed as follows:

- Disconnect the INPUT/OUTPUT connector J17.
- Select the desired operating voltage on left hand panel.
- Check voltage selector window for correct set and insert connector J17.

2-2 Input/Output connector

Input/output signals and mains must be connected to J17 mating connector (not provided). Make the connections with AWG 20 (0.5 mm^2) to the pins indicated in fig. 2-1, to obtain the desired capability.



2-2.1 Mains and input signals

Pin a8 GROUND power connection
Pin a2 MAINS neutral connection
Pin b2 MAINS line connection
Pin a5 SIGNAL COMMON connection for all input/output signals

Pins a6-a5 Remote LOW SPEED, requires a permanently closed contact (relay contact, transistor etc).
When the first time contact closes, the turbopump runs at low speed and when the contact opens, the turbopump reverts to high speed mode.

Pins a4-a5 R2 INTERLOCK, requires a permanent closed contact to set at infinite the run-up time.
After closure, when the contact is reopened, the run-up time is set to zero minutes.

Pins b7-a5 Remote STOP signal, requires a closed contact and it is used to stop the pump. When the contact is closed, the turbopump and the interconnected devices are stopped.

Pins b8-a5 Remote RESET, requires a momentarily closed contact for at least 0.5 seconds to reset the pump after failure.

2-2.2 Output signals

Pin a5 SIGNAL COMMON connection for all input/output signals.

Pins b6-a5 ANALOG OUPUT SPEED signal 0 to + 10 Vdc proportional to pump rotational speed 0 to 70000 RPM.

Pins a7-a5 VENT VALVE output voltage. + 24 Vdc without load; + 6.5 Vdc with vent valve load (430Ω).
The output voltage is present when the turbopump is started, and will remain present for about 5 more seconds after the turbopump is stopped or after a power failure.

2-3 J16 pump connector

The pin configuration of the cable that connects the controller to the pump using a 0.5 mm^2 (AWG 20) wires is shown in fig. 2-2.

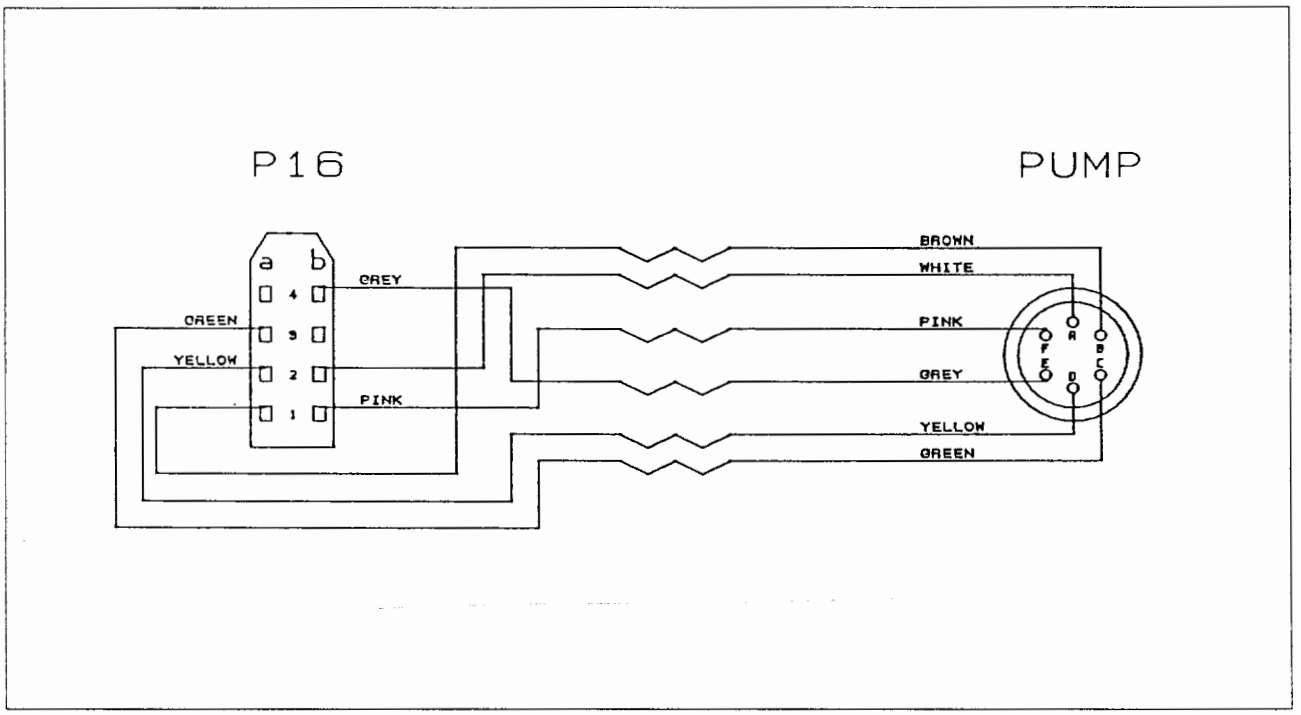


Figure 2-2 - Controller pump cable

3-1 General

Make all vacuum manifold and electrical connections and refer to Turbo-V pump instruction manual prior to operating the Turbo-V controller.

WARNING

To avoid injury to personnel and damage to the equipment, if the pump is laying on a table make sure it is steady.
Never operate the Turbo-V pump if the pump inlet is not connected to the system or blanked off.

The controller is factory set to operate via remote signals and other defaults selection has been made as per customer demands.
To modify the default values and to program the controller, connect the hand-held terminal to the Turbo-V controller.
If the hand-held terminal is used to monitor the pump operating conditions, follow para. 3-2 and 3-3; if reprogramming or trouble shooting is required, follow para. 3-5 and the following paragraphs.

3-2 Set-up

If the forepump and the vent device are not operated by the controller, close the vent valve and switch on the forepump.
Apply mains to the I/O connector. Voltage and frequency output will be at the maximum level; then the frequency will decrease to a value proportional to the pump rotational speed ($^1/_4$ of nominal frequency if the pump is completely stopped) and then it will accelerate until the normal condition has been reached.

3-3 Monitor mode

By pressing the CURRENT pushbutton, the display shows (e.g.):

I	=	0	.	0	0	A				P	=			0	W
X			.	.		K	R	P	M		X	X	°	C	

Figure 3-1

where:
I = is the DC current drawn by the pump range (0.00 to 9.99 Ampere)

P = is the DC power drawn by the pump (range 0 to 999 Watt)

KRPM = is the theoretical rotational speed of the pump as a function of the controller output frequency (range 17 to 99 KRPM)

°C = is the temperature of the outer ring of the upper bearing (range 00 to 99°C)

X = during operation a selected set point condition (1 or 2 contrast inverted) appears when the programmed threshold speed value is not reached (see paragraph 3-5 for detailed description).

By pressing twice the CYCLE NUMBER the display shows fig. 3-2.

X	X	X	X	C	Y	C	L	E		X	X	X	X	X	m
P	U	M	P		L	I	F	E		X	X	X	X	X	h

Figure 3-2

where:
CYCLE = are the cycles performed (range 0 to 9999)

m = is the elapsed time related to the cycle number displayed (range 0 to 99999 minutes)

PUMP LIFE = is the total operation time of the pump (range 0 to 99999 hours).

3-4 Program mode

3-4.1 FRONT / REMOTE / 232 selection

By pressing CYCLE NUMBER and PUMP CURRENT pushbuttons together for at least 2 seconds, the processor enters in a routine where it is possible to program the controller. In this routine, the CYCLE pushbutton is used for choosing/changing the value or condition: the PUMP CURRENT pushbutton is used to enter and confirm the value.

At any time it is possible to come back to fig. 3-1 by pressing the CYCLE and PUMP CURRENT pushbuttons at the same time for at least 2 seconds.

The display shows:

F	R	O	N	T	/	R	E	M	O	T	E	/	2	3	2
S	E	L	E	C	T	I	O	N	:	X	X	X	X	X	X

Figure 3-3

where:
XXXXXX = means the word FRONT, REMOTE, or RS232 depending on the last selection.
Select the FRONT panel operation if the front panel command is used.
After choosing the desired selection by pressing the CYCLE pushbutton, press the PUMP CURRENT pushbutton to enter the value.

The display shows:

					R	S	2	3	2					
B	A	U	D		R	A	T	E		X	X	X	X		

Figure 3-4

where:
XXXX = means 600, 1200, 2400, 4800, 9600 baud rate for the host computer or printer communication.
If necessary, select the desired value by pressing the CYCLE NUMBER, then enter the value by pressing the PUMP CURRENT pushbutton.

The display shows:

R	S	2	3	2		H	O	S	T	/	P	R	I	N	T
S	E	L	E	C	T	I	O	N	:		X	X	X	X	X

Figure 3-5

where:
XXXXX = means HOST or PRINT.
Select HOST or PRINT by pressing the CYCLE pushbutton.

With the RS 232 connected, a bidirectional communication is established by selecting HOST. Data are sent to an external computer every time the external computer asks for the values.

The data available are:

- Pump/controller operating condition
- Cycle time
- Pump life
- Pump temperature
- Pump current
- Pump voltage
- Controller output frequency
- Cycle number
- R1 condition
- R2 condition

If PRINT is selected and a printer is connected on RS 232 line, a unidirectional communication is established and every minute the data are sent to the printer, even if the pump is not running.

The set of data available are:
- Pump speed KRPM
- Pump temperature
- Pump current A
- Pump power W
- R1 condition
- R2 condition

Confirm the selection by pressing the PUMP CURRENT pushbutton.

The display will be as shown in fig. 3-6.

3-4.2 Monitor relay programming

S	P	E	E	D		T	H	R	E	S	H	O	L	D	
S	E	L	E	C	T	I	O	N	:	X	X	K	R	P	M

Figure 3-6

where:
XXKRPM = is the switch point of relay R1 at the preset turbopump speed, adjustable from 00 to 99 KRPM.

The speed threshold will condition the R1 and R2 operation (see fig. 3-7) and it is factory set to 40 KRPM.

Select the first number by pressing the CYCLE NUMBER pushbutton, then enter the value by pressing the PUMP CURRENT pushbutton.

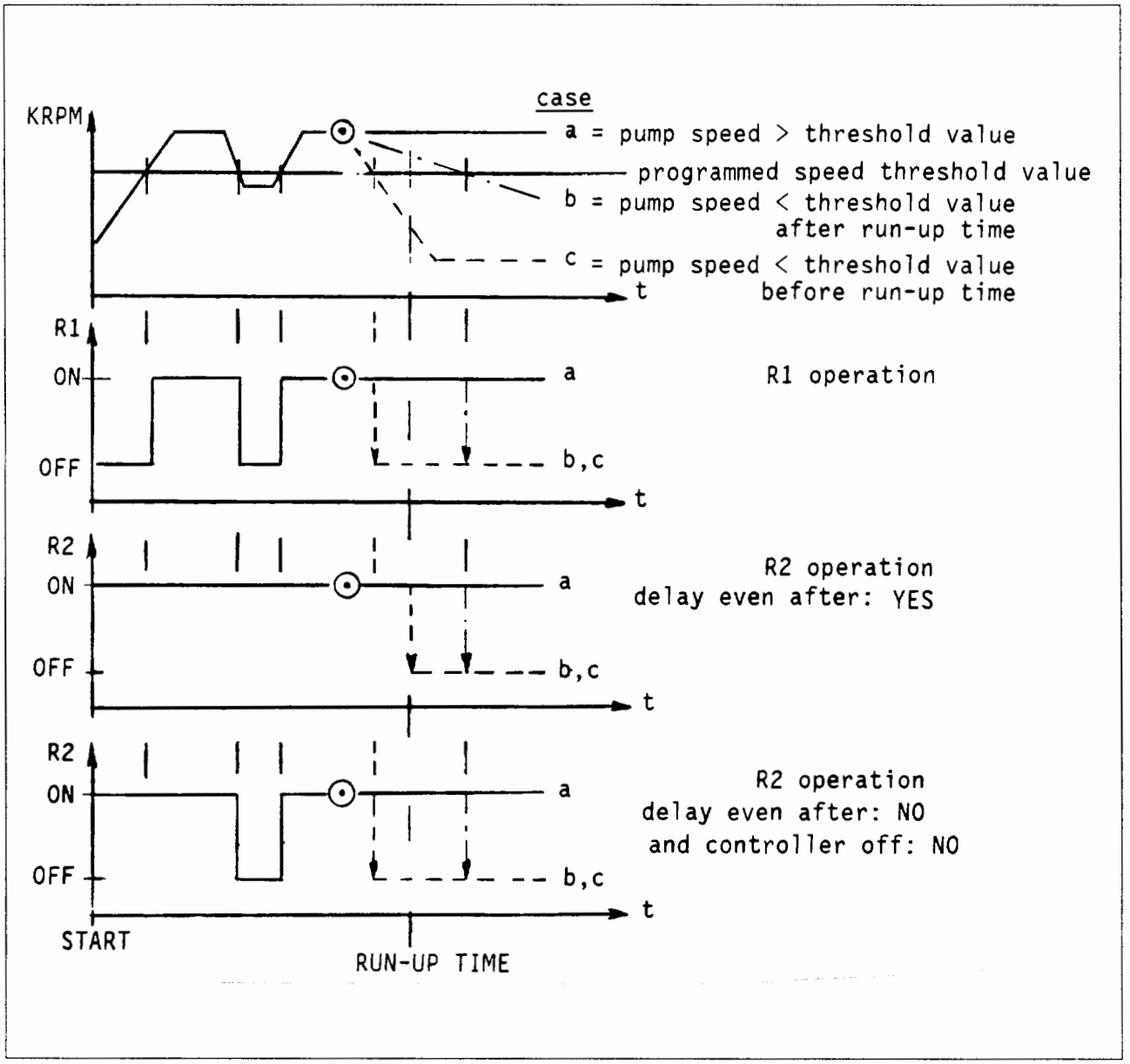


Figure 3-7

Do the same for the second number.
After pressing the PUMP CURRENT the second time, the display will be as shown in fig. 3-8.

R	U	N	-	U	P		T	I	M	E				
S	E	L	:		X	X	h		X	X	m		X	X	s

Figure 3-8

where:
RUN-UP TIME = is the interval time from start to speed threshold value in hours, minutes, seconds. Select from 00 to 99 hours, and from 00 to 59 minutes or seconds.

Select the run-up time according to the chamber volume and/or operating cycle feature (see also fig. 3-7) by pressing the CYCLE NUMBER pushbutton to select the desired number, then press the PUMP CURRENT to enter the data.

The run-up time is factory set to 00h 08m 00s.

When the last digit is entered, the display will be as shown in fig. 3-9.

D	E	L	A	Y		E	V	E	N		A	F	T	E	R
	T	H	R	E	S	H	O	L	D	:			X	X	X

Figure 3-9

where:
XXX = YES or NO.
By pressing the CYCLE NUMBER pushbutton, select YES or NO.
If YES is selected, R2 energizes from the start of the turbopump and deenergizes after the run-up time when the pump rotational speed becomes lower than the programmed speed threshold value.

If NO is selected, R2 energizes from the start of the turbopump and - after the rotational speed of the pump exceeds for the first time - the speed threshold value the R2 deenergizes once the pump speed becomes lower than the programmed speed threshold value (see fig. 3-7).

The function is factory set to YES.

After selection, press PUMP CURRENT to confirm; the display will be as shown in fig. 3-10.

C	O	N	T	R	O	L	L	E	R		O	F	F		
W	H	E	N		R	2		O	F	F	:		X	X	X

Figure 3-10

where:
XXX = YES or NO.

If YES is selected when R2 deenergizes the controller, and the interconnecting devices are automatically switched off.

This function is factory set to YES.

After selecting, press PUMP CURRENT to confirm; the display will be as shown in fig. 3-11.

3-4.3 Reset command

P	U	M	P		L	I	F	E		X	X	X	X	X	h
			R	E	S	E	T	?		X	X	X			

Figure 3-11

where:
PUMP LIFE = is the elapsed operating time range 000 to 99999 hours

RESET XXX = YES or NO.

If YES is selected, the pump life shall be reset to 000. After selecting YES, press the PUMP CURRENT to enter the command and the display shows fig. 3-1.

NOTE

When PUMP LIFE is reset to 000, the CYCLE number is also reset to 000.

3-5 Starting the pump

If the forepump and vent device are not operated by the controller, close the vent valve and switch on the forepump.

NOTE
With the FRONT panel operation selected, the REMOTE and RS 232 operations are inoperative; conversely, the CYCLE NUMBER and PUMP CURRENT push buttons are always active, even when the operating mode selected is REMOTE or RS 232.

Press the START pushbutton or use the remote or RS 232 start signal: the display will be as shown in fig. 3-12.

P	U	M	P		I	S		S	T	A	R	T	I	N	G
1	2			X	X		K	R	P	M					

Figure 3-12

where:
1 2 = contrast inverted identifies the set point condition:

1 is displayed when relay R1 is de-energized.

2 is displayed when relay R2 is energized.

XX KRPM = indicates the actual theoretical rotational speed of the pump as a function of the controller output frequency (range 17 to 99 KRPM)

After START command, voltage and frequency output will be at the maximum level, then the frequency will decrease to a value proportional to the pump rotational speed (1/4 of nominal frequency if the pump is completely stopped).

The pump will accelerate to its normal rotational speed and when this speed is reached the display will be as shown in fig. 3-13, even if any previous display selection was made, and the normal condition has been reached.

N	O	R	M	A	L		O	P	E	R	A	T	I	O	N
				X	X		K	R	P	M					

Figure 3-13

where:
XX = indicates the rotational speed.

During acceleration of the pump or during any operating condition, it is always possible to select the other parameters to be displayed (PUMP CURRENT or CYCLE NUMBER pushbuttons).
If this is the case when the pump reaches the normal speed, the display reverts to fig. 3-13.

3-6 Operating the pump

During the acceleration period, if the system has a vacuum leak or the pressure in the pump/chamber is high (from 1 mbar to atmosphere), the pump continues to operate indefinitely.

If the gas load at the turbopump inlet flange continues to stay high for the first minute from start, the power drawn by the turbopump increases up to the maximum value to reach normal operation. This will occur either in NORMAL operation or with the LOW SPEED selected.

After about 1 minute from start, or during normal operation, the pump current decreases automatically. The Turbo-V pump is slowed down proportionally to the gas load at least until it reaches about 25% of the nominal speed and the display shows fig. 3-14 even if any previous display selection was made.

		H	I	G	H			L	O	A	D				
1	2			X	X		K	R	P	M					

Figure 3-14

As soon as the gas load decreases, the pump will automatically accelerate to reach normal operation.

The pump can be stopped at any rotational speed and can be restarted at any rotation speed from either the front panel buttons or the remote connections.
The controller automatically synchronizes the output to the rotational speed of the pump and then accelerates up to the nominal speed.

3-7 Low speed operation

NOTE
With the FRONT panel operation selected, the remote and RS 232 operations are inoperative; conversely, the CYCLE NUMBER and PUMP CURRENT pushbuttons are always active, even when the operating mode selected is REMOTE or RS 232.

This feature is provided for operating the pump at moderate high pressure with high gas throughput. To operate in this low speed mode, engage the LOW SPEED pushbutton, either before starting the pump or after it is operating.

If LOW SPEED is selected before starting the pump, the display will be as shown in fig. 3-15.

P	U	M	P		R	E	A	D	Y	:		P	U	S	H
	S	T	A	R	T		B	U	T	T	O	N		L	S

Figure 3-15

where:
LS = means low speed mode is selected.

After starting, an **LS** appears on the right bottom corner of display of figures 3-12, 3-13, 3-14.

With normal LOW SPEED operation, the pump will run at about $^{2}/_{3}$ of its normal speed and achieves a base pressure somewhat higher than the standard specifications. If the gas load becomes higher, the display reverts to fig. 3-14 (with LS on right corner), the controller output frequency and voltage start to decrease automatically, and the Turbo-V pump is slowed down proportionally to the gas load until it reaches about 25% of the nominal speed.

If the LOW SPEED mode is selected after normal operating condition is reached, the display will be as shown in fig. 3-16 while the approaching the low speed value.

A	P	P	R	O	A	C	H	I	N	G			L	S	
				X	X		K	R	P	M				L	S

Figure 3-16

When the low speed mode is deselected the display will be as shown in fig. 3-14 and the pump starts to accelerate to its rotational speed. When this is reached, the display will be as shown in fig. 3-13.

3-8 Pump shut down

With the FRONT panel operation, press the front panel STOP pushbutton; the power from the turbopump is removed and the pump will begin to slow down and the display will be as shown in fig. 3-15.

When a stop signal is provided via a remote contact, the display will be as shown in fig. 3-17.

	E	X	T	E	R	N	A	L		S	W	I	T	C	H
				b	7		C	L	O	S	E	D			

Figure 3-17

3-9 Power failure

In the event of a power failure (momentary or long term) the Turbo-V controller will stop the turbopump and all the interconnected pumps/devices. The Turbo-V vent valve device, if used, will vent the turbopump only if the power failure is longer than the preset delay time.
When power is restored, the Turbo-V controller automatically restarts the interconnected devices and turbopump in the proper sequence.

Figure 3-12 is displayed until normal operation is achieved.

3-10 Remote control mode operation

If remote signals are used to operate the controller, it must be programmed for remote operation (see paragraph 3-4.1).
As soon as the remote operation is selected the pump will start automatically if b7 stop signal is not applied.

START/STOP and LOW SPEED front panel pushbuttons are inoperative, while the CYCLE NUMBER and PUMP CURRENT pushbuttons are always active.

3-11 RS 232 control mode operation

If the RS 232 option is installed and the controller has been programmed for RS 232 operation, the controller may be driven by a computer and when ready to operate the display will be as shown in fig. 3-18.

P	U	M	P		R	E	A	D	Y	:		U	S	E	
R	S	2	3	2		L	I	N	E						

Figure 3-18

The START/STOP, LOW SPEED functions are under computer control, while the CYCLE NUMBER and PUMP CURRENT front panel pushbuttons are always active.

3-12 Fault messages

For a certain type of failure, the contoller will self diagnose the error.
To investigate or troubleshoot the turbopump/controller, connect the hand-held terminal and follow the instructions below.

NOTE

If the pump is not connected the display will be as shown in fig. 3-19.

C	H	E	C	K		C	O	N	N	E	C	T	I	O	N
			T	O		P	U	M	P						

Figure 2-21

Check connection between controller and pump, then press START RESET push button twice to start the pump.

NOTE

If the upper bearing/pump temperature exceeds 60°C, the pump is shut off, and the display will be as shown in fig. 3-20.

F	A	U	L	T	:			P	U	M	P				
	O	V	E	R	T	E	M	P	.						

Figure 3-20

The message will stay on until the temperature decreases below threshold value. Press the STOP RESET pushbutton twice to start the pump.

NOTE

If the controller transformer temperature exceeds 90°C, the pump is shut off, and the display will be as shown in fig. 3-21.

F	A	U	L	T	:	C	O	N	T	R	O	L	L	E	R
	O	V	E	R	T	E	M	P	E	R	A	T	U	R	E

Figure 3-21

The message will stay on until the temperature decreases below threshold value.Press the STOP RESET pushbutton twice to start the pump.

NOTE

If in normal condition the current drawn by the pump is higher than programmed (1.5A), the pump and the interconnected devices are switched off and the display will be as shown in fig. 3-22.

F	A	U	L	T	:									
T	O	O		H	I	G	H		L	O	A	D		

Figure 3-22

Check that pump rotor is free to rotate then press the STOP RESET pushbutton twice to start the pump.

NOTE
If the output connection is shorted or the pump rotor is locked, the display will be as shown in fig. 3-23.

F	A	U	L	T	:									
S	H	O	R	T		C	I	R	C	U	I	T		

Figure 3-23

Check connections and shortages between pump and controller, then press the STOP RESET pushbutton twice to start the pump.

NOTE
If the pump rotational speed decreases below the programmed speed threshold value, and the controller OFF is selected, when R2 deenergizes (ref. to fig. 3-10), the display will be as shown in fig. 3-24.

F	A	U	L	T	:									
R	2		D	E	L	A	Y		O	V	E	R		

Figure 3-24

Check for system leaks or gas load conditions, then apply the reset signal b8 to restart the pump.

4-1 General

Replacement controllers are available on an advance exchange basis through Varian, but, if necessary, information are provided to aid the operator in determining malfunctions and corrective steps to be taken.

WARNING

Voltages developed in the unit are dangerous and maybe fatal. Service must be performed by authorized personnel only.

4-2 Controller test

a) Equipment required

- Hand-held terminal.
- Digital voltmeter (DVM) true RMS.
- Dummy load: 3 x 48Ω, 50W each or 3 x 78Ω, 50W each.
- Potentiometer 50KΩ, $^1/_4$W minimum.

b) Test set up

- Remove the pump connector from the turbopump.
- Disconnect the Turbo-V controller connectors (J17 and P16).
- Remove the cover from the Turbo-V controller.
- Set potentiometer to 30KΩ and connect it as directed in fig. 4-1.
- Connect the hand-held terminal, check the line voltage selector and connect J17 I/O connector, and select the FRONT panel operation.

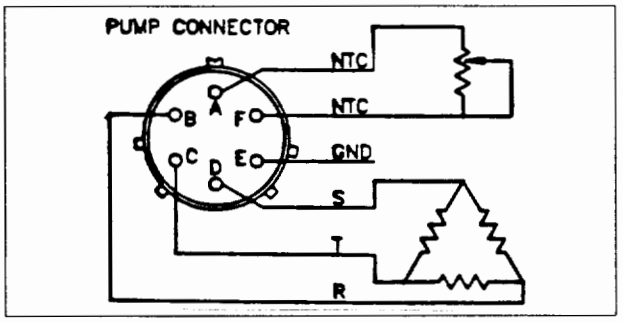


Figure 4-1 - Dummy load connections

4-2.1 Power supply test

a) DC voltage test

Check the DC voltages referring to test points indicated in fig. 4-2. Refer also to figg. 4-3 and 4-4. The meter should read:

- + 5Vdc ±5%
- ±12 Vdc ±5%
- Ground reference = case of Q3.

On the controller front panel, push the START pushbutton and check:

- 54 Vdc ± 10% between TP3(-) and TP5(+) (fig. 4-2).

b) AC three-phase output voltage test

Connect P16 and on the pump connector connect the DVM in turn between:
pins B and C, B and D, C and D.

The meter should read 44 Vac ± 15%; a different value of 0.4 Vac is tolerable between phase and phase.

c) Data check

On the hand-held terminal, press the CURRENT pushbutton and check:

- Current 0.00A
- Power 0.00W
- Speed 70KRPM
- Temperature 25°C ±2°C

On hand-held terminal, press STOP and remove J17 from the controller.

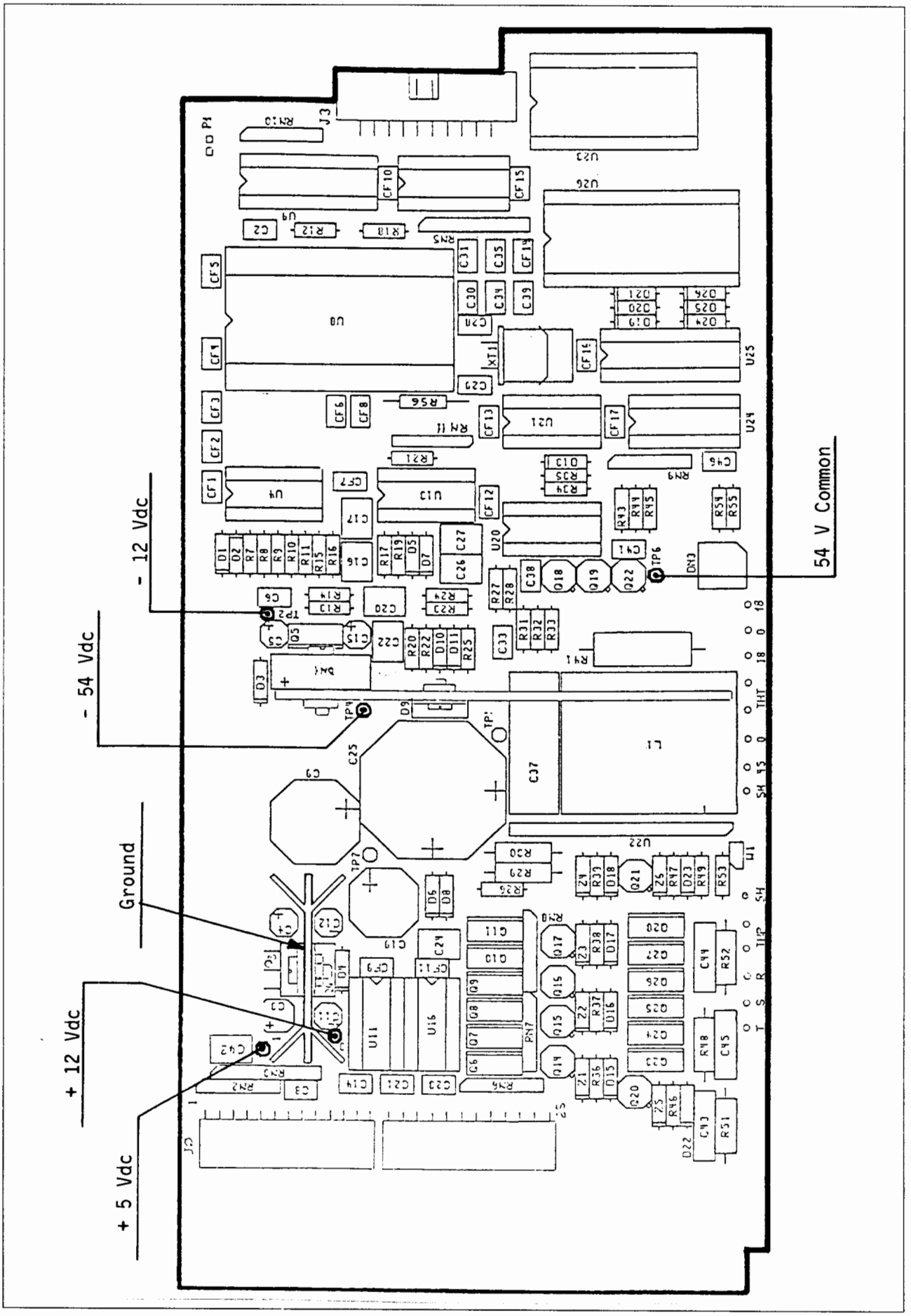


Figure 4-2 - PCB layout

4-2.2 Test with dummy load

- Connect the 48Ω or the 78Ω dummy loads to the pump connector pins B, C, D, as shown in fig. 4-1.
- Disconnect the potentiometer, set it to 10KΩ, and then reconnect it.
- Connect the power cable.
- On the hand-held terminal push the START and CURRENT pushbuttons and check the front panel display as shown in the following table.

	During start-up		After 90 seconds	
	With 48Ω dummy load	With 78Ω dummy load	With 48Ω dummy load	With 78Ω dummy load
Current ±10%	1.62 A	1.1 A	1 A	1 A
Power ±10%	80 W	58 W	30 W	48 W
Speed ±4 KRPM	17	70	40	63
Temperature ±2°C	52°C	52°C	52°C	52°C

- Check the 3-phase ac output voltage.
  After start up it should be:
  36 Vac with 78Ω dummy load and
  21 Vac with 48Ω dummy load.

On the hand-held terminal, press the STOP pushbutton and remove J17 from the controller.

4-2.3 Pump over-temperature test

- Disconnect the potentiometer, set it to 5KΩ and then reconnect it.
- Disconnect the dummy loads.
- Connect J17.
- On the hand-held terminal push the START pushbutton, then press the CURRENT pushbutton.
  The temperature reading should be 71°C ± 2°C.
  All the other values should be zero.
- Check the 3-phase ac output voltage.
  It should be zero.
- On the hand-held terminal, press STOP and remove J17 from the controller.

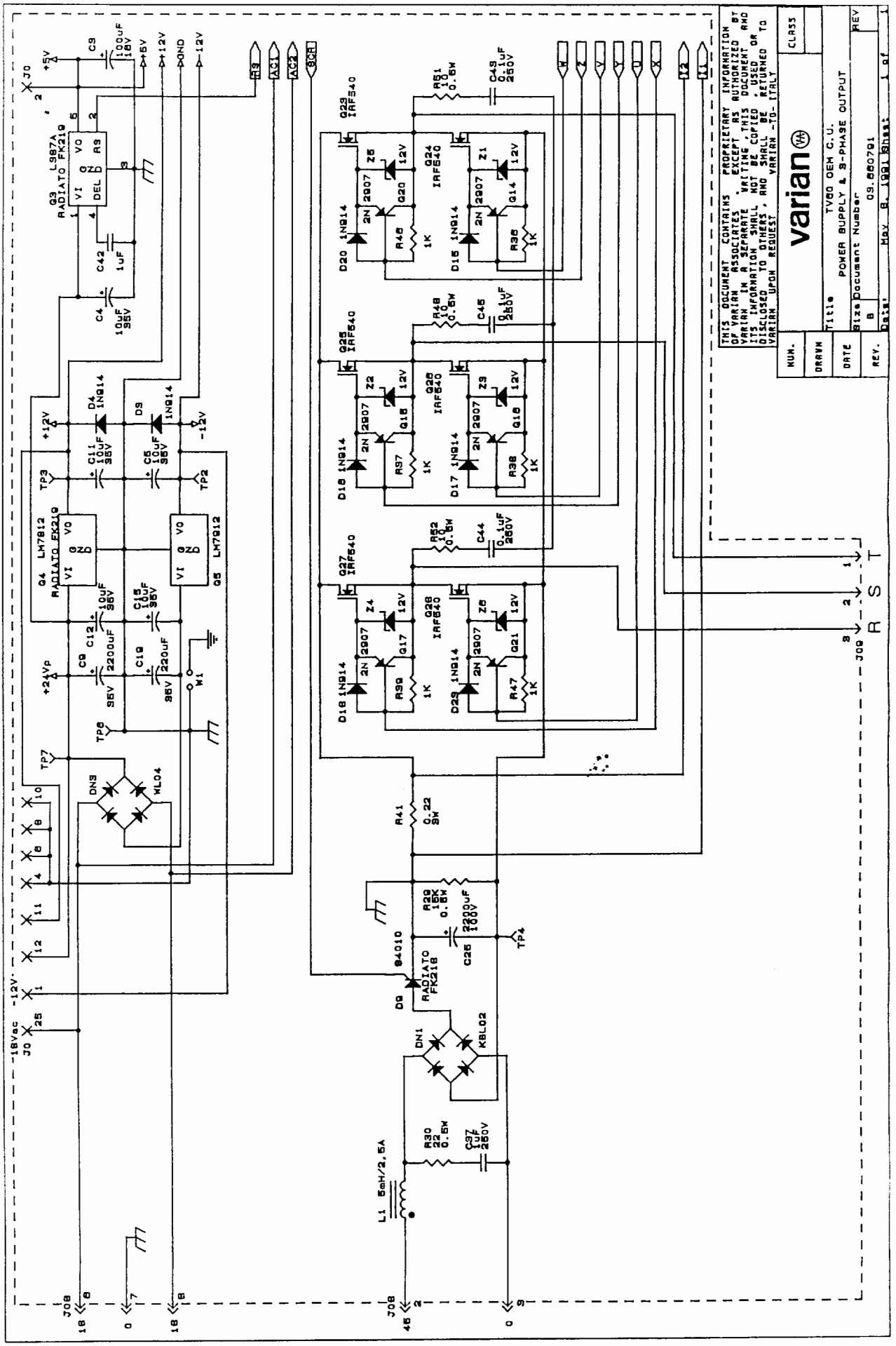
4-2.4 Functional test

Perform the functional test with the turbopump, taking care to check the ramp sequence and start up time.

After test, on the hand-held terminal press STOP and select the REMOTE operation. Disconnect J17 and remove the hand-held terminal.

4-3 Accessories and Spare Parts

Description	Part number
Input/output mating connector	969-9855
Controller to pump cable (3 meters long)	969-9863L0300


varian
TV60 OEM C.U.
POWER SUPPLY & 3-PHASE OUTPUT
09.660701
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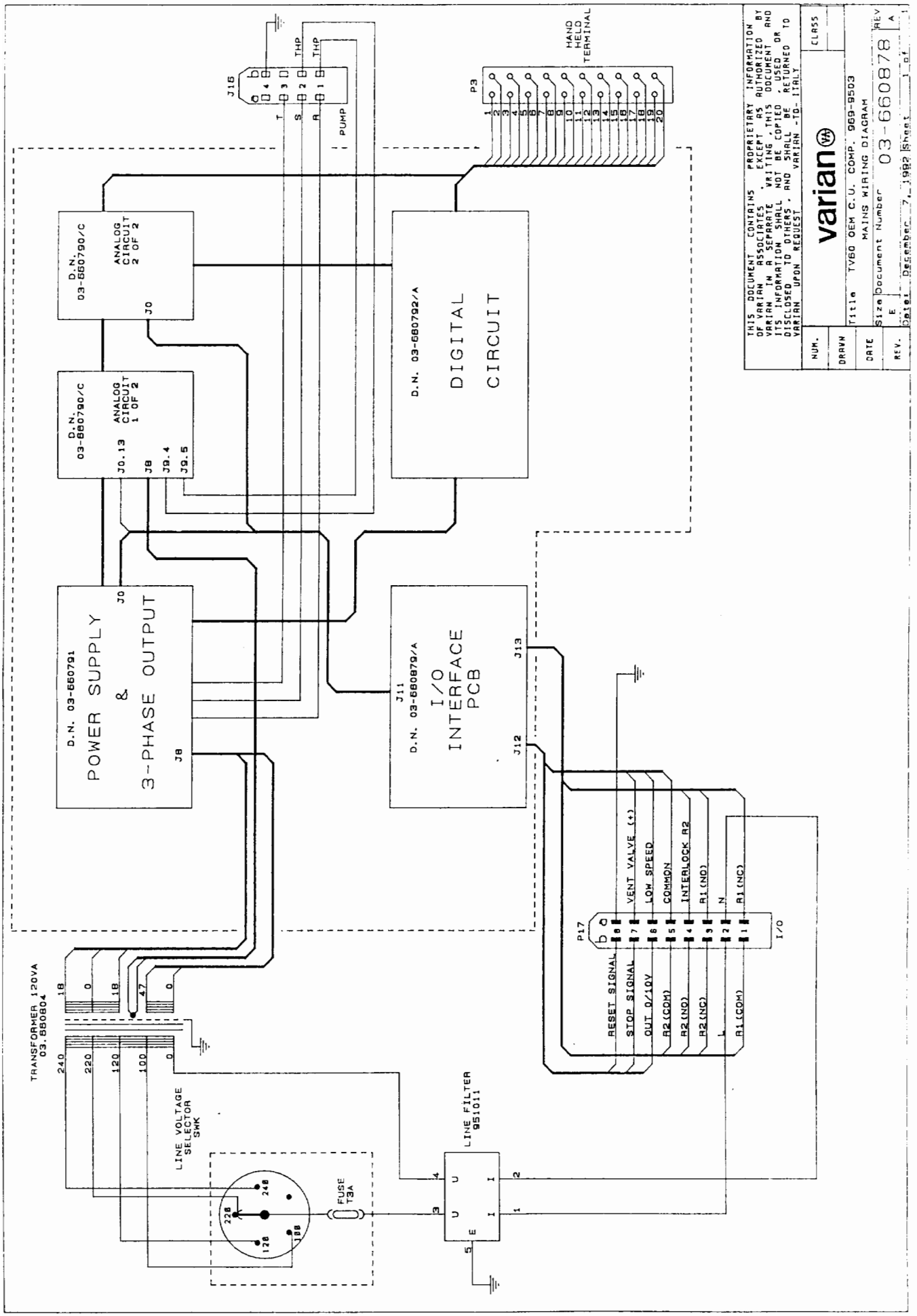
-18Vac
+21Vp
+12V
-12V
+5V
GND
RST
LM7812
LM7912
IRF540
2N2907
1N914
RADIATO FK219
RADIATO FK218
WL04
KBL02
L1 5mH/2.5A

Figure 4-3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NUM.
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DATE
REV.
CLASS
Title TV60 OEM C.U. COMP. 969-9503
MAINS WIRING DIAGRAM
Size E
Document Number 03-660878
REV A
Date December 7, 1992 Sheet 1 of 1
D.N. 03-660791
POWER SUPPLY & 3-PHASE OUTPUT
J0
J8
D.N. 03-660879/A
I/O INTERFACE PCB
J11
J12
J13
D.N. 03-660792/A
DIGITAL CIRCUIT
D.N. 03-660790/C
ANALOG CIRCUIT 1 OF 2
J0.13
J8
J9.4
J9.5
D.N. 03-660790/C
ANALOG CIRCUIT 2 OF 2
J0
J16
THP
THP
T
S
R
PUMP
P3
HAND HELD TERMINAL
P17
I/O
RESET SIGNAL
STOP SIGNAL
OUT 0/10V
R2 (COM)
R2 (NO)
R2 (NC)
R1 (COM)
VENT VALVE (+)
LOW SPEED
COMMON
INTERLOCK R2
R1 (NO)
N
R1 (NC)
TRANSFORMER 120VA
03.860804
240
220
120
100
0
18
0
18
47
0
LINE VOLTAGE SELECTOR SWK
FUSE T3A
LINE FILTER 951011

Figure 4-4