TECHNICAL MANUAL

GS AND DEPOT MAINTENANCE MANUAL
TEST, CRYOGENIC
REFRIGERATOR
AN/AAM-40
(NSN 4130-00-403-1007)
SERVICE KIT, REFRIGERANT
MK-1171/AAS-24
(NSN 4940-00-403-1007)

This copy is a reprint which includes current pages from Changes 1 and 2. The title was changed by Change 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY

FEBRUARY 1971

WARNING

DEATH or SERIOUS INJURY may result from HAZARDS in this equipment. READ and OBSERVE the following WARNINGS.

WARNING

DEATH or SERIOUS INJURY may result from contact with 3500 VDC existing within this equipment.

WARNING

DEATH or SERIOUS INJURY may result from contact with 115 VAC, 400-HZ, 3-PHASE power existing within this equipment.

WARNING

DEATH or SERIOUS INJURY may result from HIGH PRESSURES within this equipment. HOSE WHIP, FLYING OBJECTS, AND HIGH VELOCITY JET STREAMS may result from improper use of this equipment.

WARNING

DEATH or SERIOUS INJURY may result from HIGH PRESSURE within this equipment. Keep the CO_2 bottle in a cool location. Exposure to heat in excess of 160° F may result in unsafe pressure generated within the CO_2 bottle.

WARNING

Two men are required to lift the cyro test set maintenance group or the evacuation-charging group.

TECHNICAL MANUAL
No. 11-6625-2446-45

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *5 February 1971*

GS and Depot Maintenance Manual

TEST SET, CRYOGENIC REFRIGERATOR AN/AAM-40 (NSN 4130-00-197-6347) AND SERVICE KIT, REFRIGERANT MK-1171/AAS-24 (NSN 4940-00-403-1007)

			Paragraph	Page
CHAPTER	1.	INTRODUCTION	1-1-1-4	1-1
CHAPTER	2.	FUNCTIONING OF EQUIPMENT		
Section	I.	Block Diagram discussion	2-1, 2-2	2-1
	II.	Circuit discussion	2-3, 2-4	2-5
	II.	Functioning of electronic subassemblies	2-5-2-10	2-11-2-14
CHAPTER	3.	GENERAL SUPPORT MAINTENANCE		
Section	I.	General	3-1-3-3	3-1
	II.	Troubleshooting	3-4-3-6	3-2-3-13
	III.	Removal and replacement	3-7, 3-8	3-14
	IV.	Adjustment and alignment	3-9, 3-10	3-14
	V.	Repair	3-11, 3-12	3-14
	VI.	General support test procedures	3-13-3-15	3-15
CHAPTER	4.	DEPOT MAINTENANCE		
Section	I.	General	4-1-4-3	4-1
	II.	Depot troubleshooting	4-4- 4-7	4-1, 4-2
	III.	Depot removal and replacement procedures	4-8-4-12	4-4--4-10
	IV.	Depot adjustment and alignment	4-13, 4-14	4-18, 4-19
	V.	Repair	4-15, 4-16	4-19
	VI.	Depot test procedures	4-17-4-19	4-20
	VII.	Printed circuit board maintenance	4-20-4-22	4-20
CHAPTER	5.	DEPOT OVERHAUL STANDARDS	5-1-5-3	5-1
APPENDIX	A.	REFERENCES		A-1
INDEX				I-1

LIST OF ILLUSTRATIONS

Figure No.	Title	Page
2-1	Cyro test set vacuum system, block diagram	2-3
2-2	Control group unit 2, block diagram	2-4
2-3	Detector tester 3A1, block diagram	2-5
2-4	Equipment interconnection	2-6
2-5	Unit 2 filter assembly, schematic diagram	2-9
2-6	Detector tester 3A1, schematic diagram	2-10
2-7	Cryogenic high vacuum unit 1A1A2, schematic diagram	2-12
2-8	High voltage power supply 1A3, schematic diagram	2-13
2-9	Filter assembly 1A2, schematic diagram	2-15
2-10	Integrated circuit type SN52709L, schematic diagram	2-16
2-11	Cryo test set vacuum system, schematic diagram	2-17
4-1(1)	Power supply 1A1, parts location (part 1 of 3)	4-5
4-1(2)	Power supply 1A1, parts location (part 2 of 3)	4-6
4-1(3)	Power supply 1A1, parts location (part 3 of 3)	4-7
4-2	Leak detector 1A1A1, parts location	4-8
4-3	High vacuum unit 1A1A2, parts location	4-9
4-4	High voltage power supply 1A1A3, parts	4-10
4-5(1)	Vacuum pump group unit 1, parts location (part 1 of 3)	4-11
4-5(2)	Vacuum pump group unit 1, parts location (part 2 of 3)	4-12
4-5(3)	Vacuum pump group unit 1, parts location (part 3 of 3)	4-13
4-6(1)	Control group unit 2, parts location (part 1 of 2)	4-14
4-6(2)	Control group unit 2, parts location (part 2 of 2)	4-15
4-7	Detector tester 3A1, parts location	4-16
4-8(1)	Compressor unit 5, parts location (part 1 of 2)	4-17
4-8(2)	Compressor unit 5, parts location (part 2 of 2)	4-18
4-9	Leak detector 1A1A1, initial test setup	4-22
4-10	High vacuum power supply 1A3, initial test setup	4-24
4-11	High voltage power supply 1A3, initial test setup	4-27
4-12	Manifold parts location diagram	4-30
FO-1	Color code for military standard resistors, inductors, and capacitors	FO-1
FO-2	Vacuum pump group unit 1, block diagram	FO-2
FO-3	Vacuum pump group unit 1, schematic diagram	FO-3
FO-4	Control group unit 2, schematic diagram	FO-4
FO-5	Leak detector 1A1A1, schematic diagram	FO-5
FO-6	Compressor unit 5, schematic diagram	FO-6
FO-7	Filter assembly 1A2, parts location	FO-7
FO-8(1)	Vacuum pump group unit 1, wiring diagram (part 1 of 2)	FO-8
FO-8(2)	Vacuum pump group unit 1, wiring diagram (part 2 of 2)	FO-9
FO-9	Control group unit 2, wiring diagram	FO-10
FO-10	Cables, wiring diagrams	FO-11

LIST OF TABLES

Table No.	Title	Page
3-1	Test Equipment	3-1
3-2	Voltage Measurements	3-8
3-3	Resistance Measurements	3-9
3-4	Continuity Measurements	3-11
4-1	Test Equipment	4-1
4-2	Compressor Repair and Replacement Data	4-3
4-3	Transistor and Diode Voltage Measurements for 1A1A1	4-23
4-4	Operational Amplifier Voltage and Waveforms for 1A1A1	4-23
4-5	Transistor and Diode Voltage Measurements for 1A1A2	4-26
4-6	Transistor and Diode Voltage Measurements for 1A3	4-29

LIST OF CHARTS

Chart No.	Title	Page
3-1	Oscilloscope AN/USM-281A Control Settings	3-1
3-2	Troubleshooting Procedure	3-3
3-3	General Support Test Procedures	3-18
4-1	Depot Troubleshooting	4-2
4-2	leak Detector 1A1A1, Test Procedure	4-21
4-3	Leak Detector 1AIA1, Troubleshooting	4-22
4-4	High Vacuum Unit 1A1A2, Test Procedures	4-25
4-5	High Vacuum Unit 1A1A2, Troubleshooting	4-26
4-6	High Voltage Power Supply 1A3, Test Procedures	4-28
4-7	High Voltage Power Supply .1A3, Troubleshooting	4-29

CHAPTER 1
INTRODUCTION

1-1. Scope

a. This manual contains functioning of equipment, general support and depot maintenance for Test Set, Cryogenic Refrigerator AN/AAM-40 and Service Kit, Refrigerant MK-1171/AAS-24. General support and depot maintenance includes troubleshooting, removal and replacement, adjustment and alignment, repair and testing.

b. Operator and organizational maintenance procedures are contained in TM 11-6625-2446-12.

1-2. Indexes of Publications

a. Refer to the latest issue of DA Pam 310-4 to determine if there are new editions, changes, or additional publications pertaining to the equipment.

b. Refer to the latest issue of DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

NOTE

Applicable forms and records are covered in TM 11-6625-2446-12.

1-3. Reporting of Errors

You can help improve this manual by calling attention to errors and by recommending improvements and stating your reasons for the recommendations. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, NJ 07703. A replay will be furnished direct to you.

1-3.1. Reporting Equipment Improvement Recommendations

EIR's will be prepared using DA Form 2407, (Maintenance Request). Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed direct to Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, NJ 07703. A reply will be furnished direct to you.

1-4. Reference Designations

Reference designations for major components of Test Set, Cryogenic Refrigerator AN/AAM-40 and Service Kit, Refrigerant MK-1171/AAS-23 are listed in TM 11-6625-2446-12.

CHAPTER 2
FUNCTIONING OF EQUIPMENT

Section I. BLOCK DIAGRAM DISCUSSION

2-1. Overall Function

a. Test Set, Cryogenic Refrigerator AN/AAM40 (cryo test set) provides facilities for bench testing Refrigerator, Cryogenic HD-868/AAS-24 (refrigerator assembly) and Compressor, Rotary HD-841/AAS-24 (compressor), components of Detecting Set, Infrared AN/AAS-24 (infrared detecting set). The cryo test set contains the components necessary to purge or replenish the refrigerator assembly helium and carbon dioxide, detect leaks in the refrigerator vacuum jacket and purge or replenish the oil and helium in the compressor.

b. Service Kit, Refrigerant MK-1171/AAS-24 (refrigerant service kit) contains the components necessary to purge or replenish the refrigerator assembly helium and carbon dioxide.

2-2. Block Diagram

a. Vacuum Pump Group, Unit 1 (fig. FO-2).

(1) Ac power distribution. The 11'5 vac, 400Hz, 3-phase power is applied through power supply connector 1A1J2, through the filters (FL) and through circuit breaker 2 (CB2) to the contacts of 1A1K1 and the contacts of phase sensing relay 1A1K3. Phase A is applied to power supply transformer 1A1T2. Transformer 1A1T2 then applies 25 vac to leak detector 1A1A1. Phase sensing relay 1A1K3 senses the incoming power and if it is within tolerance and in proper phase rotation 1A1K3 operates to provide a path for 28 vdc when the power mode switch 1A1S1 is set to the OPR position. Setting the power mode switch 1A1S1 to the STBY position has no effect on the ac power distribution. Setting the power mode switch 1A1S1 to the OPR position causes relays 1A1K1 and 1A1K2 to operate and apply 115 vac to the cryo test set mechanical pump, the heaters, and circuit breakers CB3, 4, 5, and 6. Phase A is supplied to high voltage power supply 1A1A3. The 115 vac inputs to cryogenic high vacuum unit 1A1A2 are attenuated and one is rectified. The 15 vac output to 1A1T1 is stepped down to 1.2 vac then app;, .e t to cryogenic high vacuum unit 1A1A2. This input is attenuated to 0.6 vac for thermocouple gauge operation. Six 115 vac, single-phase inputs to cryogenic high vacuum unit 1AlA2 are attenuated to 30 vac for lamp operation. One 115 vac input generates 160 vdc for solenoid operation.

(2) Dc power distribution. The 28 vdc power is applied through jack 1A1J2, through the filters and CB1 to leak detector 1A1A1. Leak detector 1A1A1 provides a path to power mode switch 1A1S1. Setting the power mode switch 1A1S1 to STBY applies 28 vdc to light the STBY 1lamp and 30 vac to test lamps DS4, 5, 6, 7, 8, and 11. Setting the power mode switch to OPR lights the OPR lamp; the STBY lamp extinguishes. 28 vdc is applied through the phase sensing relay 1A1K3 to operate 1A1K1 and 1A1K2.

(3) Circuit breakers. When circuit breakers CB'4 through CB6 are set, 115 vac, single-phase power is applied to the MECH PUMP, FORELINE TRAP, and H VAC ASSY heaters and through cryogenic high vacuum unit 1A1A2 to light the MECH PUMP, FORELINE TRAP H VAC ASSY lamps. When CB7 is set, power is applied to the mechanical pump.

(4) Meters.

(a) MICRONS meter M11 measures the vacuum created in the lines by the mechanical pump.

(b) CURRENT/VOLTAGE meter M2 measures current representative of the vacuum in the vacuum chamber.

(c) LEAK DETECTOR meter M3 is a vernier used with meter M2. This meter shows the state of current in the chamber and lines in that it shows if the current is increasing or decreasing.

(5) Resistors. COARSE resistor 1A1R1 and FINE ZERO resistor 1A1R2 establish a zero input to leak detector 1A1A1. SENS resistor 1A1R3 varies the deflection sensitivity of LEAK DETECTOR M3.

(6) Switches. Power mode switch 1A1S1 controls the cryo test set mode of operation. START/RUN switch 1A1S2 lights either the START or RUN lamp and furnishes a bypass for the fuse in circuit breaker assembly CB3. PUMP SELECT switch 1A1S3 selects the appendage pump, the ion pump or both pump outputs from the high voltage power supply 1A1A3. METER RANGE switch 1A1S4 selects the proper series resistances to facilitate reading the CURRENT/VOLTAGE meter M2, and in addition applies the high voltage power supply 1A1A3 output voltage to meter M2 for monitoring.

(7) Leak detector, 1A1A1. Inputs to leak detector 1A1A1 are 28 vdc from 1A1J2, 25 vac from transformer 1A1T2, SENS potentiometer bias, fine zero from potentiometers 1A1R1 and 1A1R2, and the high voltage return from the unit under test. Outputs from 1A1A1 are 28 vdc to power mode switch 1A1S1, coarse zero bias to potentiometers 1A1R1, and 1A1R2, leak detection output to LEAK DETECTOR meter M3, attenuator connections for METER RANGE switch 1AIS4 and 28 vdc to leak detection ON lamp 1A1DS9.

(8) Cryogenic high vacuum unit, 1A1A2. Inputs to cryogenic high vacuum unit 1A1A2 are 115 vac and 1.2 vac. Outputs are 15 vac to transformer 1A1T1 which steps the voltage down to 1.2 vac. The 1.2 vac returns as an input to 1A1A2 and is attenuated to 0.6 vac to be applied to the thermocouple to drive MICRONS meter MI. Six 115-vac inputs are attenuated to 30 vac for lamps DS4, 5, 6, 7, 8, and 11 power and press-to-test function. One 115 vac single-phase input is full-wave rectified and the resulting 160 vdc output is applied to the mechanical pump solenoid valves 1L1 and 1L2.

(9) High voltage power supply, 1AIA3. Inputs to the high voltage power supply are 115 vac and 28 vdc. Outputs are 3250 +250 vdc and the current to CURRENT/VOLTAGE meter M3.

(10) Vacuum system (fig. 2-1). The vacuum system consists of the roughing pump, the ion pump, tubulation, and necessary valves to route the exhausted air.

b. Control Group, Unit 2 (fig. 2-2).

(1) Ac power distribution. The 115 vac, 400-Hz, 3-phase power is applied through control group control panel jack 2A1J2 and through the 2-2 Change 2 filters (FL) and circuit breaker 2 (CB2) to phase sensing relay 2A1K2 and the contacts of relay 2A1K1. When 2A1K1 operates, 115 vac is applied to COOLER switch 2A1S4, DETECTOR TEST switch 2A1S2, and COMPRESSOR switch 2A1S3 for operation of the cooler, the detector tester and the compressor. The phase sensing relay 2A1K2 operates to provide a path for 28 vdc only if input power is in tolerance and the phase rotation is correct. The three-phase power to the compressor is monitored by phase error indicator relay 2A1K3.

(2) Dc power distribution. The 28 vdc power is applied through control panel jack 2A1J1, through the filters, and through CB1 to the power mode switch 2A1S1. Setting the power mode switch 2A1S1 to STBY lights the STBY lamp and provides 28 vdc for the lamp test circuit for all lamps on unit 2. Setting the power mode switch 2A1S1 to OPR applies 28 vdc through the contacts of phase sensing relay 2A1K2 to operate relay 2A1K1, applies 28 vdc to COOLER switch 2A1S4 for lamp operation, applies 28 vdc to DETECTOR TEST switch 2A1S2 for power to the detector tester, applies 28 vdc to COMPRESSOR switch 2A1S3 to apply to the compressor for relay operation and applies 28 vdc to the phase error indicator relay 2A1K3 for NORMAL DS5 and REV PHASE DS8 operation.

(3) Lamps. The HIGH SPEED DS6 and LOW SPEED DS9 lamps indicate if the output to the cooler is for high speed or low speed operation. BIAS lamp I)S7 indicates that 28 vdc is applied to detector tester 3A1, but the ac power required to operate the chopper wheel in the detector tester is not present. BIAS/ CHOPPER lamp DS4 indicates that ac power is applied to the chopper motor 3A1B1. NORMAL lamp DS5 indicates that power to the cooler from the compressor has the proper phase rotation. REV PHASE lamp DS8 indicates a missing phase or improper phase rotation to the unit under test from the compressor. ERR lamp DS3 indicates a missing phase or improper phase rotation of the input power.

c. Detector Tester, 3A1 (fig. 2-3).

(1) Ac power distribution. The 115 vac, 400-Hz, 3-phase input power operates motor 3A1B1 which drives the chopper motor 3A1B1.

The chopper motor 3A1B1 drives the chopper wheel at 3000 rpm.

(2) Dc power distribution. The 28 vdc power input is regulated to approximately 1 volt and applied through the detector selector switch. This output is applied to each of eight detectors on the unit under test.

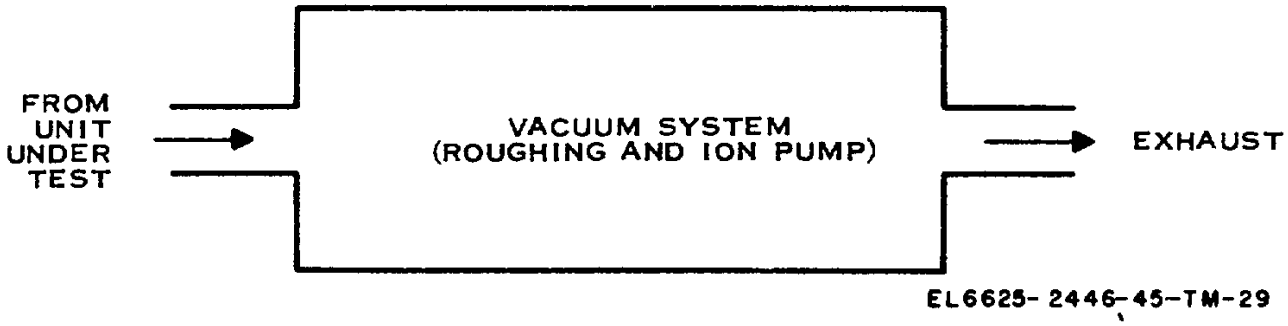


Figure 2-1. Cryo test set vacuum system, block diagram.

(3) Temperature sensing. The temperature sensing resistor on the unit under test is connected to test point 3A1J4 on the detector tester control panel. The resistance measured at this test point indicates the temperature in the chamber of the unit under test.

d. Compressor, Unit 5. For a block diagram discussion of the compressor, unit 5, refer to TM 11-5850-241-34/1.

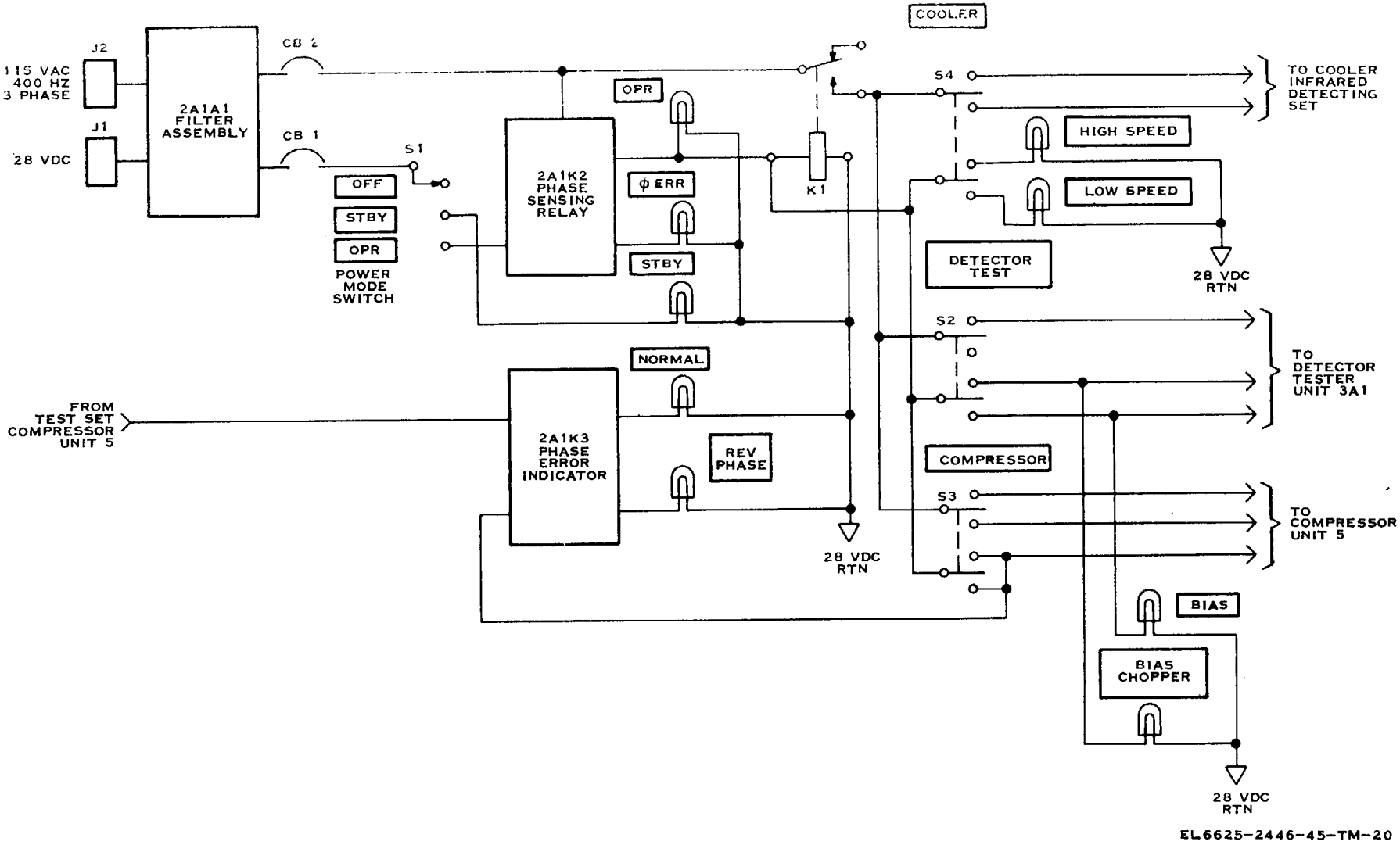


Figure 2-2. Control group unit 2, block diagram.

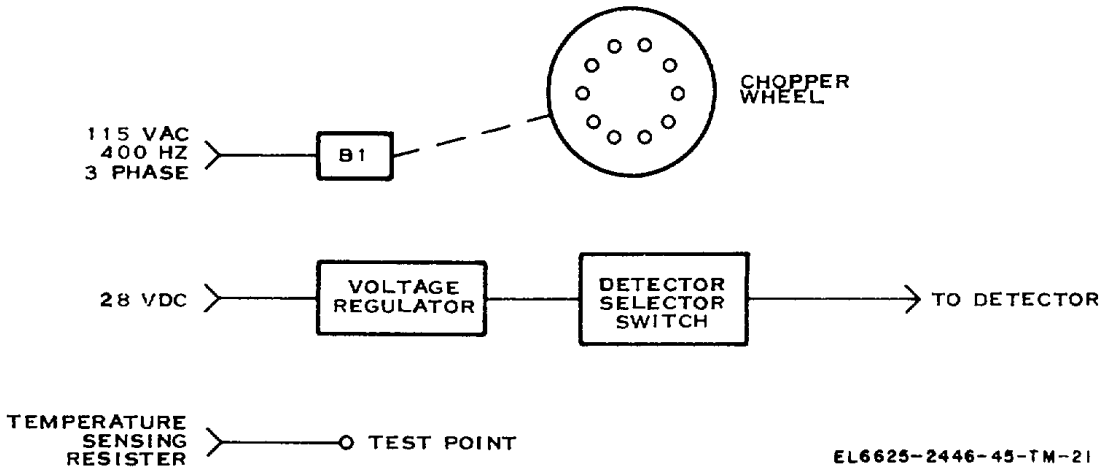


Figure 2-3. Detector tester 3A1, block diagram.

Section II. CIRCUIT DISCUSSION

2-3. Equipment Interconnection (fig. 2-4)

A complete cryo test set is formed by connecting the equipment as shown in figure 2-4.

2-4. Circuit Functioning

a. Vacuum Pump Group, Unit 1 (fig. FO-3).

(1) Ac power distribution.

(a) The 115 vac, 400-Hz, 3-phase power enters unit 1 of the cryo test set through power supply connector 1AlJ2-A, B, C, and D. The 115 vac is applied through circuit breaker CB2 to the open contacts of relay 1A1K1. Phase sensing relay 1A1K3 receives power from 1A1J2. Phase sensing relay 1A1K3 monitors the phase rotation of the ac power input and operates to provide a path for the 28 vdc power to operate relays 1A1K1 and 1A1K2. A missing or improper phase rotation causes relay K3 to restore and remove the dc path to relays K1 and K2. An additional path for 28 vdc is provided through the restored contacts to light the OERR (phase error) lamp DS3. Phase C of the input is applied to 1A1XA212 for the press-to-test 30 vac lamp circuitry for DS4, 5, 6, 7, 8, and 11. The 30 vac output at XA2-15 is applied to power mode switch 1A1S1B-C1.

(b) Setting the power mode switch to STBY applies 30 vac to the test connection (pin 3) of the 30 vac lamps. In STBY or OPR, lamps DS4, DS5, DS6, DS7, DS8, and DS11 have the 30 vac press-to-test power.

(c) Setting the power mode switch 1A1S1 to OPR operates relays 1A1K1 and 1A1K2. The 115 vac, 400-Hz, 3-phase power is applied through the closed relay contacts 1A1K1-A1 and A2; B1 and B2; and C1 and C2. The 3-phase power is applied through MECH PUMP ON/OFF circuit breaker 1A1CB7 and through the closed relay contacts 1A1K2-A1 and A2; B1 and B2; and C1 and C2, to power supply connector 1A1J3-P, R, and S. Phase A is applied through MECH PUMP HEATER CONTROLS ON-OFF circuit breaker 1AlCB6 and to 1A1XA2-9 to furnish 30 vac power from 1A1XA2-18 to light MECH PUMP lamp DS8. 115 vac, phase A is also applied to 1A1XA2-3 to furnish 15 vac to transformer 1A1T1-1. Transformer 1A1T1 applies 1.2 vac to 1A1XA2-4 and 6. A resistor divider network in cryogenic high vacuum unit 1AlA2 divides this voltage down to 0.6 vac. This 0.6-vac output at 1A1A2-5 and 7 is applied to 1A1J3-U and T for thermocouple 1TC1 excitation. 115 vac, phase A is applied to 1A1T2-1 and stepped down to 25 vac for application to 1A1XA1-8 and 10 for leak detector 1A1A1 operating power. The 115 vac, phase A is applied to 1AlXA2-20 to be rectified and filtered to provide 160 vdc to 1AlJ3--X and W for solenoid valve 1L1 and 1L2 operation. 115 vac, phase A is also applied to power supply connector 1AlJ3-E to apply power to the mechanical pump heater. 115 vac phase B is applied through ION PUMP ON-OFF circuit breaker 1A1CV3 to high voltage power supply 1A1A3 for development of the 3500 vdc for the ion pump and appendage pump operation. The 115 vac, phase B is applied to XA2-13 to furnish 30 vac power from ZA2-14 to light RUN lamp DS4 or START lamp DS5, depending upon the position of START/RUN switch 1AlS2. 115 vac, phase B is applied through HEATER CONTROLS FORELINE TRAP ON/ OFF circuit breaker 1AlCB5 to 1A1J3-F to power the foreline trap heater. 115 vac, phase B is

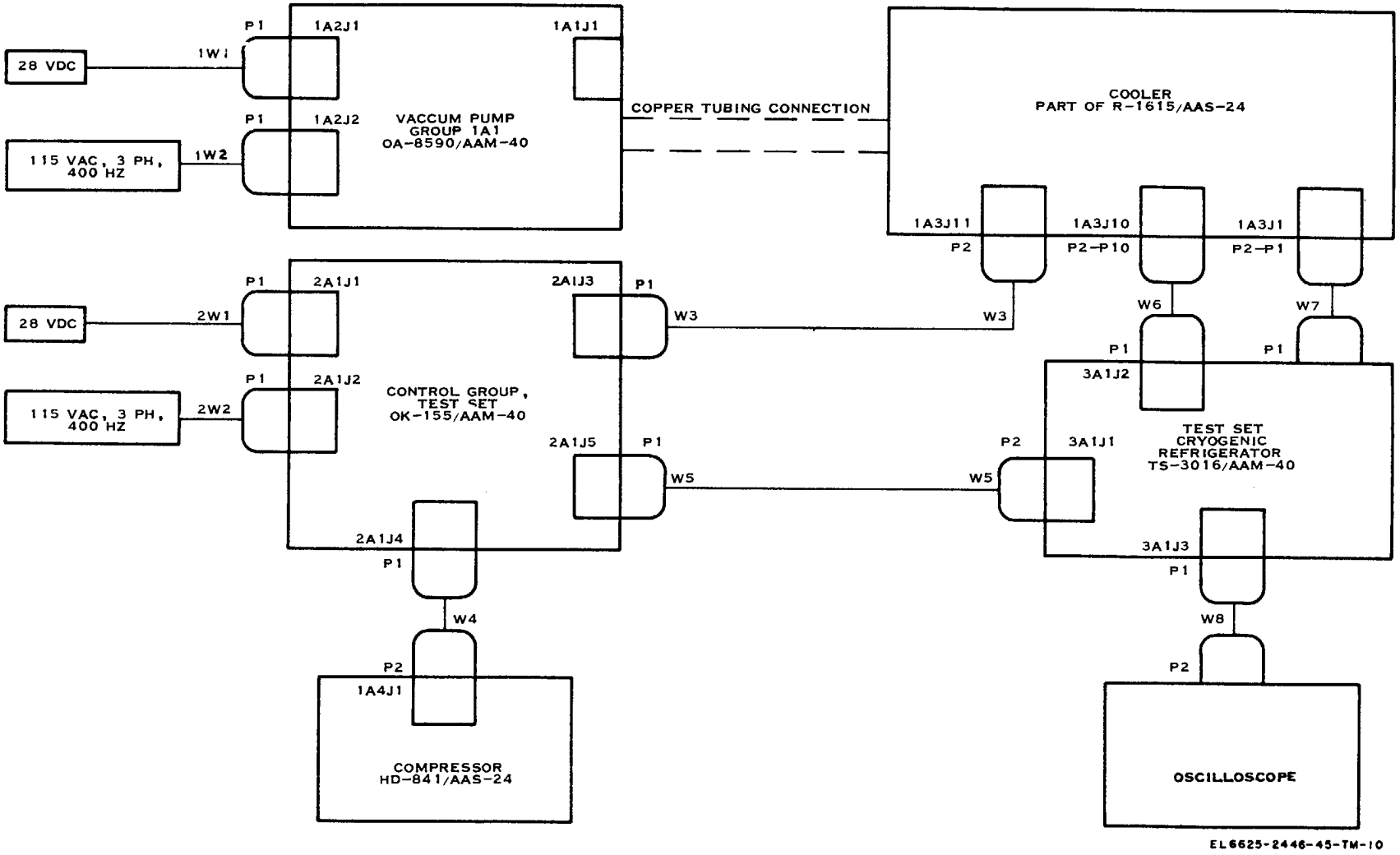


Figure 2-4. Equipment interconnection.

applied to lAIXA2-10 and 8 to be attenuated and apply 30 vac from 1A1XA2-12 and 19 to light FORELINE TRAP lamp DS7 and MECH PUMP ON lamp DS11. 115 vac, phase C is applied to ELAPSED TIME meter 1A1M4 and through H VAC ASSY HEATER CONTROLS ON-OFF circuit breaker 1AlCB4 to XA2-11 to provide 30 vac power from XA2-16 to light H VAC ASSY lamp DS6. Phase C is also applied to power supply connector 1A1J3-F to supply power to the foreline trap heater. Zener diodes CR4 through CR9 are provided for emi suppression.

(2) Dc power distribution.

(a) The 28 vdc power enters unit 1 through power supply connector 1AlJ2-E and F and is applied through 28 VDC circuit breaker CB1 to 1A1XA1-2. A path through leak detect-, 1A1A1 is supplied internally so that 28 vdc is present at XA1-4. The 28 vdc at XA1-4 is a!)plied to power mode switch 1A1S1A-C1 and C2 and to 1A1S1B-C2.

(b) Setting power mode switch 1A1S1 to STBY applies 28 vdc through power mode switch 1A1S1A-2 to light STBY lamp DS2 and applies 28 vdc power through diode CR3 to phase sequence relay 1A1K3-B2 to light ∅ERR lamp DS3, if the ac power is not in tolerance. The 28 vdc is applied through power mode switch lAlSIA6 to the test connection (pin 3) of 28 vdc lamps DS1, DS2, DS3, DS9, and DS10.

(c) Setting power mode switch 1A1S1 to OPR causes STBY lamp DS2 to extinguish and 28 vdc to be applied through 1A1S1A-3 to phase sensing relay 1A1K3-B2 to light ERR lamp DS3, if the ac power is not in tolerance, the 28 vdc power is applied through 1A1S1B-6 and through phase sensing relay 1A1K3-A2 and A1 to operate relays K1 and K2. 28 vdc power is applied to light OPR lamp DS1 and to PUMP SELECT switch 1A1S3-C1 and C2. 28 vdc power is applied to SENS switch/potentiometer 1A1R34 to furnish power to XA1-7 through leak detector 1A1A1, If the mechanical pump over temperature thermocouple switch 1S1 activates, ground return is removed from relay 1A1K2 and the relay restores. The 28 vdc is applied through 1A1K2-D2 and D3 to light TEMP OUT OF LIMITS lamp DS10. Setting PUMP SELECT switch 1A1S3 to APP applies 28 vdc from 1A1S3-1 to connector 1A1P1-D to select the appendage pump output from 'the high voltage power supply A3. Setting the PUMP SELECT switch 1A1S3 to MAIN applies 28 vdc from 1AlS35 to connector 1A1P1-E to select the ion pump output from the high voltage power supply 1A3. Setting the PUMP SELECT switch 1A1S3 to BOTH applies the ion pump and appendage pump signals to connector 1AlP1-E and D from high voltage power supply 1A3. ION PUMP ON/OFF circuit breaker 1A1CB3 provides power to high voltage power supply 1A3. A neutral path is available fromcircuit breaker 1A1CB3-4 to START/RUN switch 1A1S2-2. The neutral is available in the 1A1S2 START position to connector 1A1J3-L, through the ion pump thermal switch, and back to connector 1A1J3-M for application to 1A1CB3-5; by-passing the fuse in circuit breaker 1A1CB3. During the START cycle of the ion pump, excess current does not cause the fuse to melt because the fuse is bypassed. When the ion pump current has decreased, the START/RUN switch 1A1S2 is set to RUN which connects the fuse in the ion pump line to act as an over current protection device. The leak detector output at XA2-12 is approximately 6.7 vdc and is applied to COARSE and FINE ZERO potentiometers lAIR1 and 1AlR2 to establish the fine zero input at XA1-20. The sensitivity input at XA1-6 is established by adjusting SENS potentiometer 1A1R3. The leak detection output at XA2-5 drives LEAK DETECTOR meter 1A1M3.

b. Control Group, Unit 2 (figs. 2-5 and FO-4).

(1) Ac power distribution.

(a) The 115 vac, 400-Hz, 3-phase power input at 2A1J2-A, B, C, and D is applied through circuit breaker CB2, through coils L5 and L6, through filters FL-1, 2, 3, and 4, through coils L1 and L2, across capacitors C1, C2, and C3 to the open contacts of relay 2A1K1 and to phase sensing relay 2AlK2. Phase sensing relay K2 monitors the input ac power and when it is in tolerance and proper phase sequence, provides a path for 28 vdc to operate relay K1 and light lamps DS4 through DS9.

(b) Setting the power mode switch 2A1S1 to STBY has no effect on the ac distribution. No ac power is available in the test set until 2AlKl operates.

(c) Setting the power mode switch 2A1S1 to OPR causes relay K1 to operate and furnish phase A through the closed contacts of relay K1A1 and A2 to ELAPSED TIME meter 2A1M1. Phase A, B, and C is supplied from relay contacts K1-A1 and A2; B1 and B2; and C1 and C2 to COOLER switch 2A1S4, DETECTOR TEST switch 2A1S2, and COMPRESSOR switch 2A1S3. Setting COOLER switch 2A1S4 to LOW SPEED applies 115 vac, 400-Hz, 3-phase power to control panel connector 2AlJ3-A, E, and D and to the low speed

windings of the cooler helium pump motor. Setting the COOLER switch 2A1S4 to HIGH SPEED applies 115 vac, 400-Hz, 3-phase power to the high speed windings of the helium pump motor. Setting DETECTOR TEST switch 2A1S2 to BIAS/CHOPPER applies 115 vac, 400Hz, 3-phase power to control panel connector 2A1J5-A, B, and C to operate the detector tester motor 3A1B1. Setting COMPRESSOR switch 2A1S3 to NORMAL applies 115 vac, 400-Hz, 3phase power to control panel connector 2A1J4-A, B, and C to drive the compressor. Setting COMPRESSOR switch 2A1S3 to REV PHASE causes phases A and B to be reversed in the output to the compressor. Zener diodes CR6 through CR21 are used for emi suppression. Phase error indicator relay 2A1K3 monitors the 115 vac, 400-Hz, 3-phase power output from the compressor.

(2) *Dc power distribution.*

(a) 28 vdc is applied to control panel connector 2A1J1-A and B, through CB1, through coil L4, through filters FL5 and FL6, through coil L3, and across capacitor C4, through CR4, and to power mode switch 2A1SlA-C1 and C2 and 2AiSlB-C1 and C2. Ground return is established on all lamps at 2A1K1-X2, and at 2A1J4-F and 2A1J5-F.

(b) Setting the power mode switch 2A1S1 to STBY applies press-to-test power to pin 3 on all lamps. 28 vdc is applied from 2AlS1A-2 to light STBY lamp DS2. 28 vdc is applied through diode CR5 to relay 2A1K2-B2 to apply 28 vdc to light HERR lamp DS3 if the input ac power is not in tolerance.

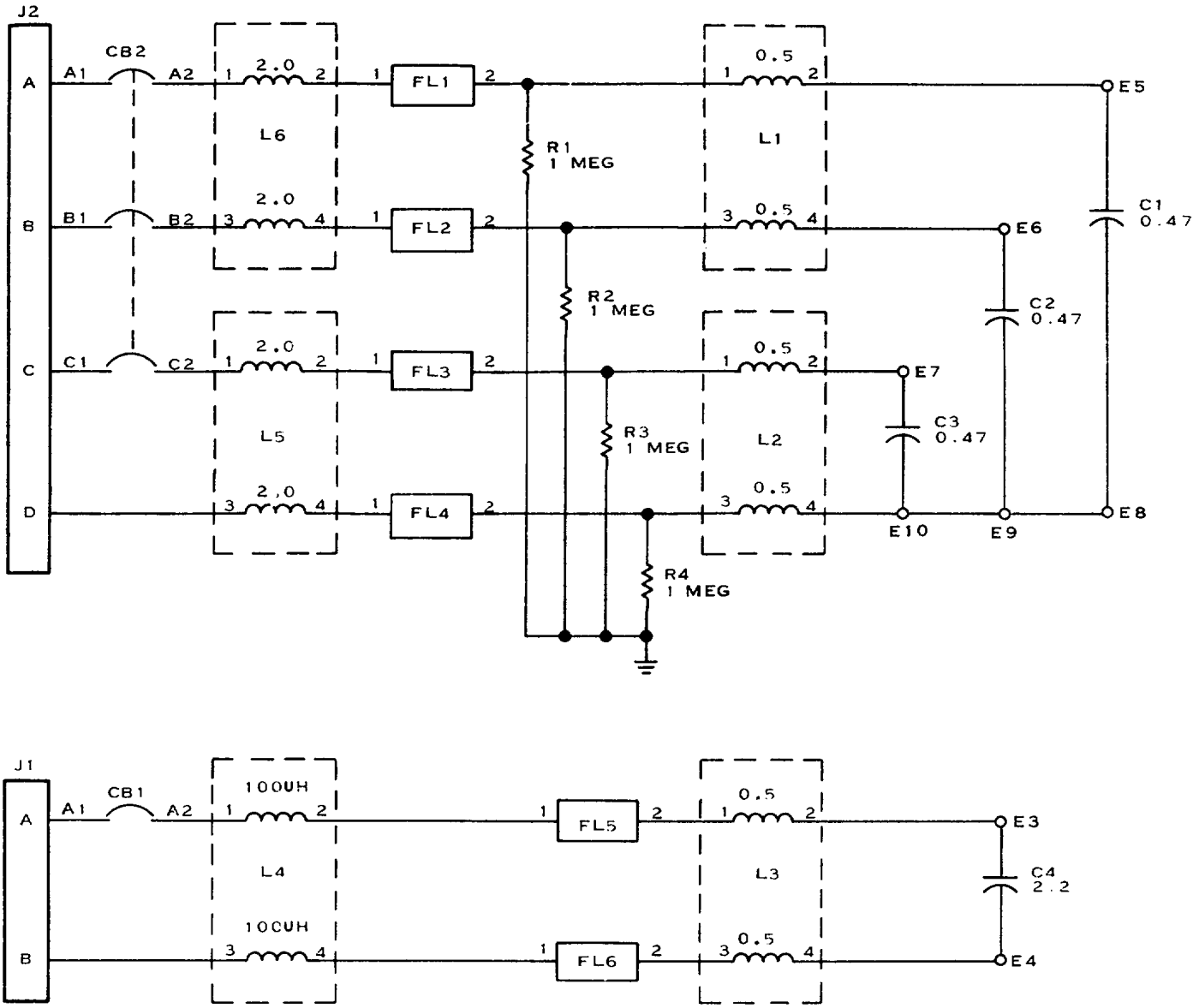
(c) Setting the power mode switch 2A1S1 to OPR applies 28 vdc from 2A1S1A3 to relay 2A1K2-B2 as in (b) above to light ERR lamp DS3 and removes 28 vdc from STBY lamp DS2. 28 vdc is applied from 2A1S1B-6 to relay 2A1K2A2. A path is provided through relay 2A1K2 to operate relay 2AlK1 if input ac power is in tolerance and proper phase. 28 vdc is applied to COOLER switch 2A1S4, DETECTOR TEST switch 2A1S2, COMPRESSOR switch 2A1S3, and OPR lamp DS1. Setting COOLER switch 2A1S4 to HIGH SPEED applies 28 vdc to light HIGH SPEED lamp DS6. Setting 2A1S4 to LOW SPEED applies 28 vdc to light LOW SPEED lamp DS9. Setting DETECTOR TEST switch 2A1S2 to BIAS applies 28 vdc to BIAS lamp DS7 and the detector tester. Setting 2A1S2 to BIAS CHOPPER applies 28 vdc to BIAS/CHOPPER lamp DS4 and the detector tester. Setting COMPRESSOR switch 2A1S3 to NORMAL or REV PHASE applies 28 vdc through 2A1J4-E to the compressor and 28 vdc through phase error indicator re2-8 Change 1 lay 2A1K3 to NORMAL lamp DS5 or REV PHASE lamp DS8.

c. Detector Tester, 3A1 (fig. 2-6). 115 vac, 400-Hz, 3-phase power is applied from control panel 2A1 to detector tester connector 3A1J1-A, B, and C. Zener diodes CR2 through CR7 provide emi suppression. The 3-phase power drives motor B1 and chopper wheel 3A1MP11MP1 at 3000 rpm. The 28 vdc power enters detector tester connector 3AlJ1-E and F and is applied to zener CR1 and series dropping resistor R1. The Zener voltage is impressed on potentiometer R2 through series protector resistor R3 to switch 3A1S1C1. This signal of approximately 1 volt is applied to each detector in turn by 3A1S1 through 3A1J2. Temperature sense resistor in the unit under test is connected to 3A1J4 (red) and the reading indicates the temperature of the vacuum chamber.

d. Compressor, Unit 5 (fig. FO-6).

(1) The 115 vac, 400-Hz, 3-phase power from control group unit 2 is applied through connector 5J1-A, B, and C to phase sensing relay 5K1. If the three phases are in tolerance and proper rotation, 5K1 operates and applies the input ac to the contacts of 5K2-A2, B2, and C2. When 5K2 operates, the input power is applied to the compressor motor 5B1, the fan motor 5B2, and the power correction capacitor 5C1. The power is returned through 5J1-L, M, and N to control group unit 2 for monitoring by phase error indicator 2A1K3. The ELAPSED TIME meter 5M1 is powered by phase C of the input power.

(2) The 28 vdc power from control group unit 2 is applied through 5J1-E, through the over temperature switch 5BIS1 in the compressor motor 5B1, and through fan motor plug 5B2P1 and out to operate relay 5K2. Should the compressor motor plug 5BlP1 or fan motor plug 5B2P1 be loose or the over temperature switch 5BIS1 sense a temperature of over 160° centigrade, the continuity path for 28 vdc is broken. Relay 5K2 cannot operate without the 28 vdc, and power cannot be applied to the compressor or fan motor. The 28 vdc power is also applied to the logic circuit composed of 5DS1 and relay 5K2. If the 28 vdc path is not continuous through the monitoring plugs and switch, the 28 vdc is applied through the FAIL line, and through the restored contacts of relay .5K2-D2, D3 to the 28 vdc return at 5J1-F. If the path is continuous, relay 5K2 operates, and a path through FAIL IND indicator 5DS1 and through the closed contacts of relay 5K2-D1, D2 to 5J1F is established for an operate indication. Pin 5J1-K is used with the airborne system only.



NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCES ARE IN OHMS, CAPACITANCES ARE IN UF, INDUCTANCES ARE IN UH.
2. FOR COMPLETE REFERENCE DESIGNATOR PREFIX WITH 2A1A1

EL-6625-2446-45-C1-TM-27

Figure 2-5. Unit 2 filter assembly, schematic diagram.

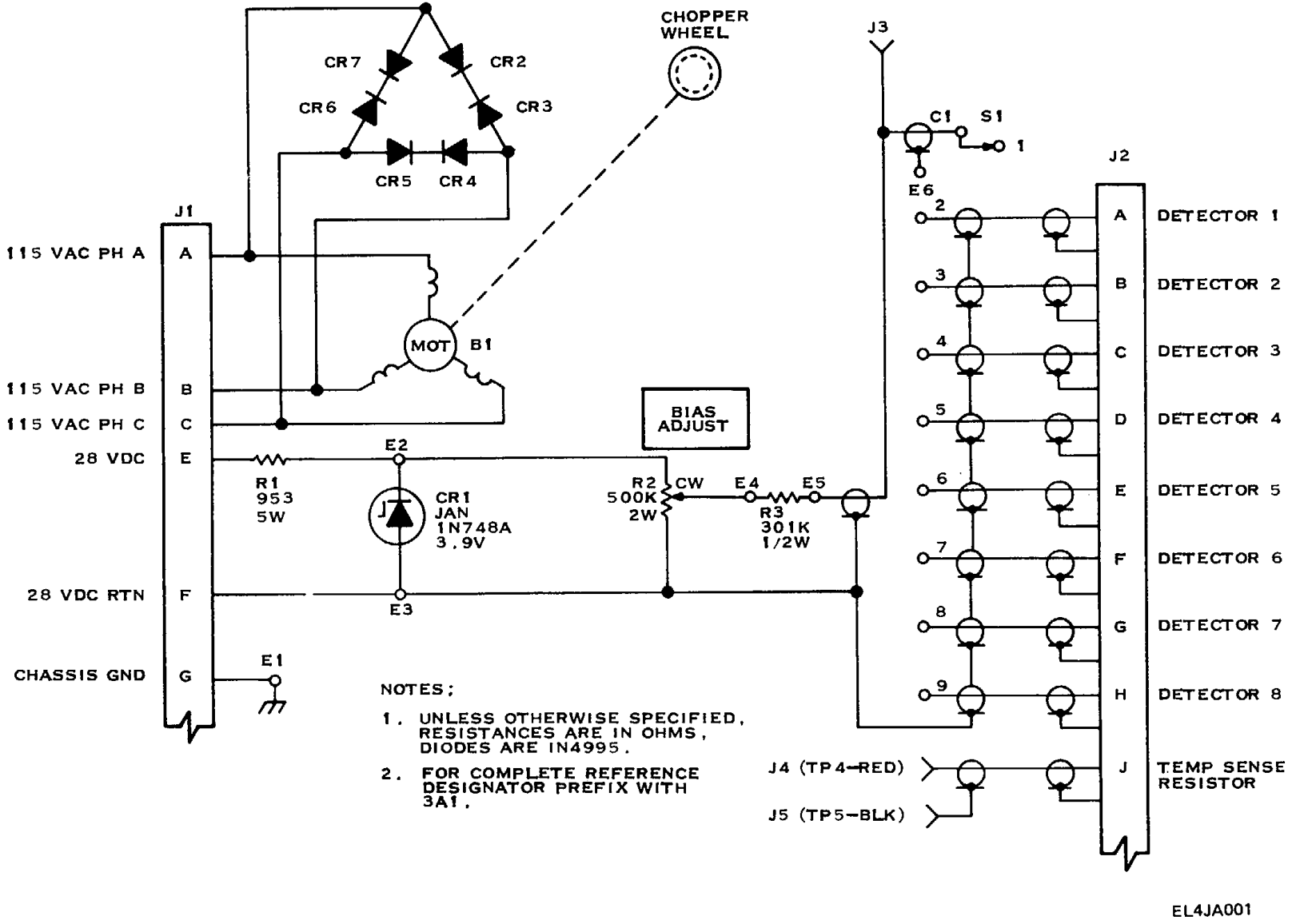


Figure 2-6. Detector tester 3A1, schematic diagram.

Section III. FUNCTIONING OF ELECTRONIC SUBASSEMBLIES

2-5. Leak Detector, 1A1A1 (fig. FO-5)

Leak detector 1A1A1 provides a path for the 28 vdc power which is applied to power mode switch 1A1S1; provides leak detection circuitry; and provides limiting resistors for meter range switch 1A1S4.

a. A 28 vdc path is furnished from P1-2 through diode CR1 to P1-4. Diode CR1 furnishes reverse current protection. 28 vdc power is routed through 1A1A1; therefore, this board must be plugged in before power can be applied to the cryo test set.

b. The leak detection circuitry drives LEAK DETECTOR meter M3 which indicates the difference in current in the ion pump and a reference voltage. The 25 vac input at P1-8 and 10 is impressed across the full-wave bridge composed of CR2 through CR5. The rectified output is applied to C1 and across Zener diodes CR6 and CR7 to develop a negative and positive 9.1 vdc. These voltages are used to power differential amplifier Z1. Voltage divider network R2 and R3 is tapped and 6.7 volts is applied to external resistors 1A1R1 and 1A1R2. The attenuated voltage is applied back to 1A1A1 at pin 20. The high voltage return for the ion pump is applied to P1-16 and through diode CR11 to P1-22. As the ion pump creates a higher vacuum, the ion pump current decreases. This current through CR8, and coupled through R5, to Z12 mixes with the fine zero feedback from variable resistors R1 and R2. The noninverting input Z1-3 is at ground potential and causes differential amplifier Z1 to have the amplified difference at Z1-6. This output is applied through lAlAlKl-A1 and A2 to P1-5 to LEAK DETECTOR meter M3. External sensitivity potentiometer lAIR3 is provided for ease of R1 and R2 adjustment and observation of M3.

c. SENS potentiometer 1A1R3 provides 28 vdc to P1-7 to operate relay 1A1A1K1.

d. Resistor R10 is provided for meter M2 protection. R11, 12, and 13 are provided for proper current limitation for the range selected. Diode CR11 is provided for meter M2 protection.

2-6. Cryogenic High Vacuum Unit, 1A1A2 (fig. 2-7)

Cryogenic high vacuum unit 1A1A2 provides operating power for units of the cryo test set.

a. The 115 vac input at P1-3 is applied through resistor R1 and Zener diodes CR1 and CR2. CR1 and CR2 develop 15 vac as an output at P1-1 to the primary of external transformer 1A1T1. Resistor R1 drops the excess voltage.

b. Transformer 1A1T1 furnishes 1.2 vac to P1-4 and 6. Resistors R2, 3 and 4 divide the 1.2 vac and provide 0.6 vac at P1-5 and 7 to apply to the mechanical pump thermocouple and meter M1.

c. 115 vac phase A, B and C is applied to pins 8, 9, 10, 11, 12, and 13. Capacitors C1 through C6 offer sufficient impedance to attenuate the input to 30 vac output at Pl-14, 15, 16, 17, 18, and 19.

d. 115 vac, phase A, at P1-20 is rectified by CR3 through CR6 and +160 vdc is applied to P1-22 as the output. Reference for this +160 vdc is P1-21.

2-7. High Voltage Power Supply, 1A3 (fig. 2-8)

High voltage power supply 1A3 provides 3250 +250 vdc for operating the appendage pump and the ion pump.

a. The input 115 vac power at J1-A and B is stepped up by transformer T1 and full-wave rectified by CR1 and applied across filter capacitor C1. The 3250 +250 vdc output is applied to the open contacts of relays K1 and K2.

b. The 28 vdc input from PUMP SELECT switch lAIS3 is applied to J1-D or E to operate relay K1 or K2 to apply 3250 +250 vdc to the ion or appendage pump at J2 or J3.

c. A sample of the 3250 +250 vdc is obtained from the voltage divider network composed of R1, 2, and 3 to apply to CURRENT/VOLTAGE meter 1AlM2.

2-8. Filter Assembly, 1A2 (fig. 2-9)

Filter assembly 1A2 removes transients from the applied power to prevent erratic operation of the cryo test set.

a. The 115 vac, 400-Hz, 3-phase input power is applied to 1A2J2-A, B, C, and E and through filter coils L1 and 3. The 115 vac is impressed across resistors R1, 2, 3, and 4; applied through filters FL-3, 4, 5, and 6; applied through coils L4, 5, 6, and 7 and across capacitors C1, 2, and 3 to output jack J3 for application to the cryo test set. Three-phase power is also applied to 1A2J2-G, H, J, and K to activate relay 1A1K3.

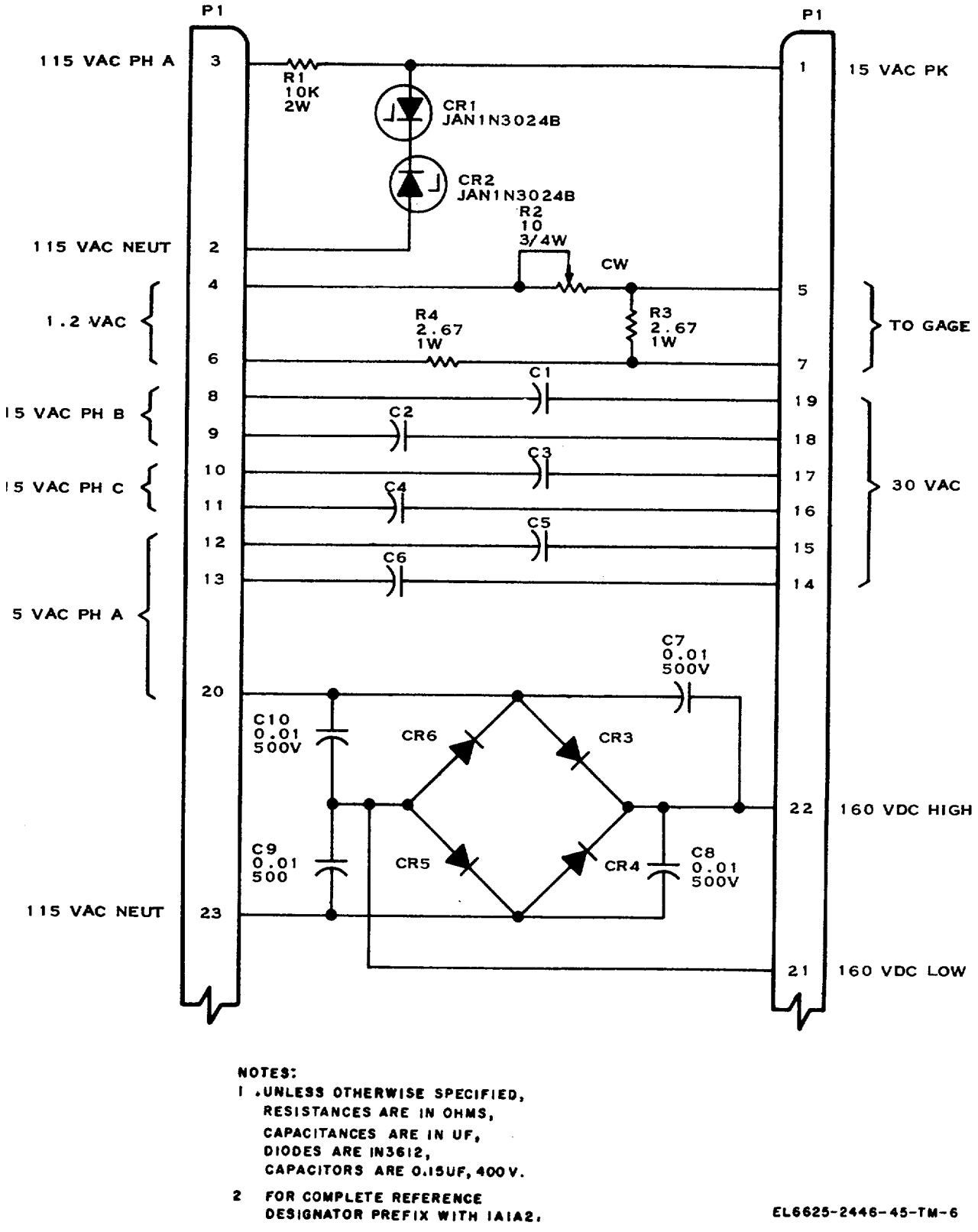


Figure 2-7. Cryogenic high -vacuum unit 1A1A2, schematic diagrams

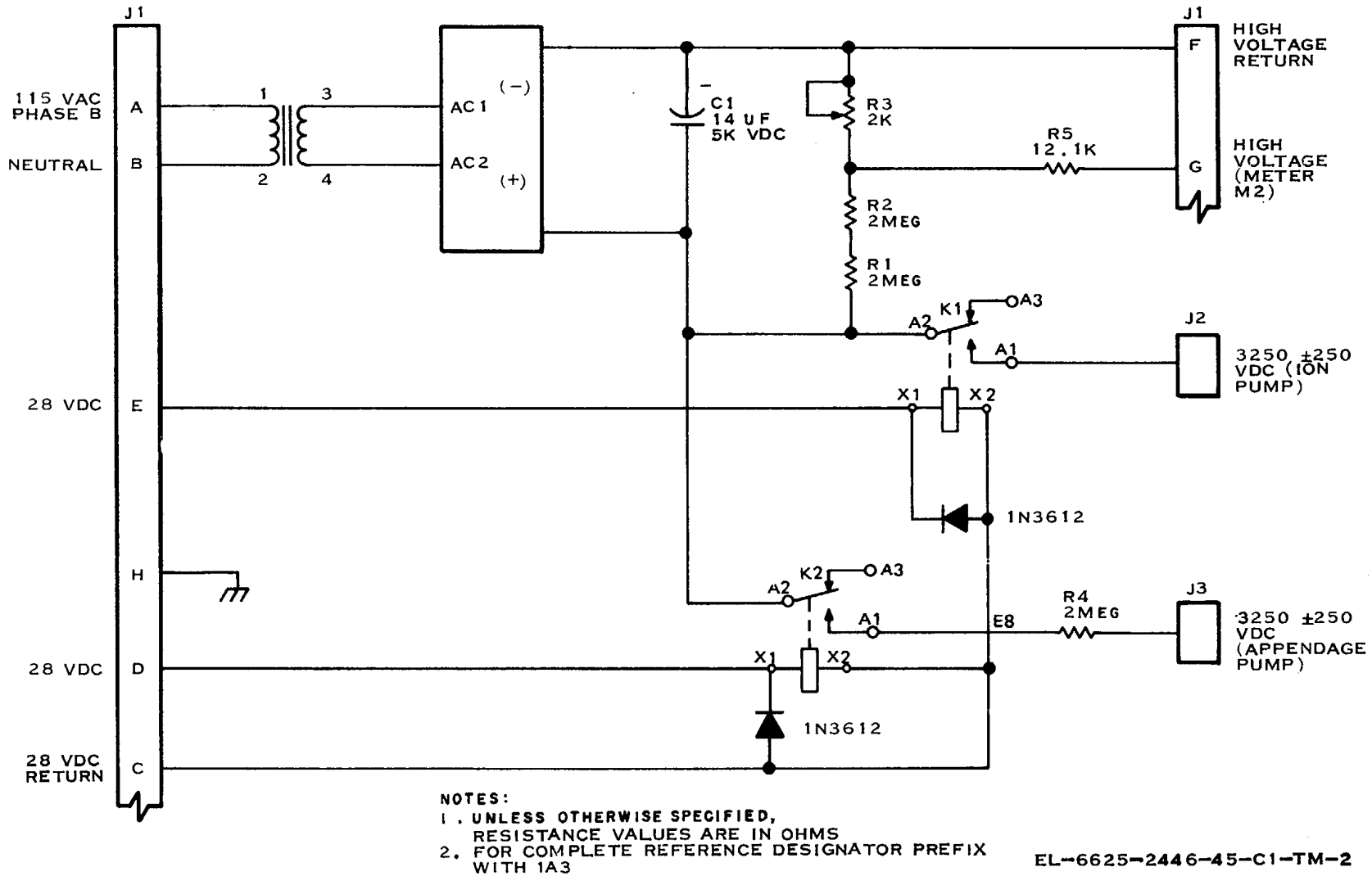


Figure 2-8. High voltage power supply 1A1A3, schematic diagram.

b. The 28 vdc power is applied to filter assembly connector 1A2J1-A and B; through coil L2 to filters FL-1 and 2; through coil L8 and across capacitor C4. The 28 vdc is present at 1A2J3-E and the 28 vdc return is at 1A2J3-F.

2-9. Integrated Circuit SN52709L (fig. 2-10)

Integrated circuit SN52709L is utilized as a differential amplifier in leak detector 1AiA1. The inverting input is designated (-) and the noninverting input is designated (+). Signals applied to the inverting input are inverted at the integrated circuit output, while signals applied to the noninverting input are reproduced at the integrated circuit output without inversion. The SN52709L is categorized as a high performance, general purpose amplifier with high impedance inputs and a low impedance output.

2-10. Vacuum System (fig. 2-11)

a. The roughing vacuum system consists of an electric motor driven mechanical pump; tabulation; airtight fittings and valves for routing the air from the units under purge or test and for isolating the roughing system from the high vacuum system. The roughing pump is capable of 10-3 torr. Close the isolation valve and open the roughing valve and the roughing port is available to evacuate the CO, chamber of the unit under test and the helium portion of the compressor and manifold. In this operation, the foreline trap is bypassed. Close the roughing valve and open the isolation valve and the mechanical pump is exposed to the high vacuum port through the foreline trap. The ballast valve permits drainage of accumulated moisture. The exhaust valve allows evacuated air to leave the mechanical pump. The solenoid valves assure no leakage of oil or vapor back into the lines when power is not applied to the mechanical pump. Electrical power to the mechanical pump electric motor is 115 vac, 400 Hz, 3 phase.

b. The ion pump is the highest vacuum portion of the vacuum system. The ion pump is capable of a vacuum of 10-8 torr with a starting point of 10-3 torr. Close the isolation valve and open the high vacuum valve to expose the ion pump to the high vacuum port and isolate the roughing pump from the high vacuum port. Electric power to the ion pump is 3250 + 250 vdc. The current in the ion pump is caused by ionized particle matter and is therefore directly proportional to unevacuated particles. The CURRENT/VOLTAGE meter monitors this current and the reading is consequently representative of the vacuum in the ion pump chamber.

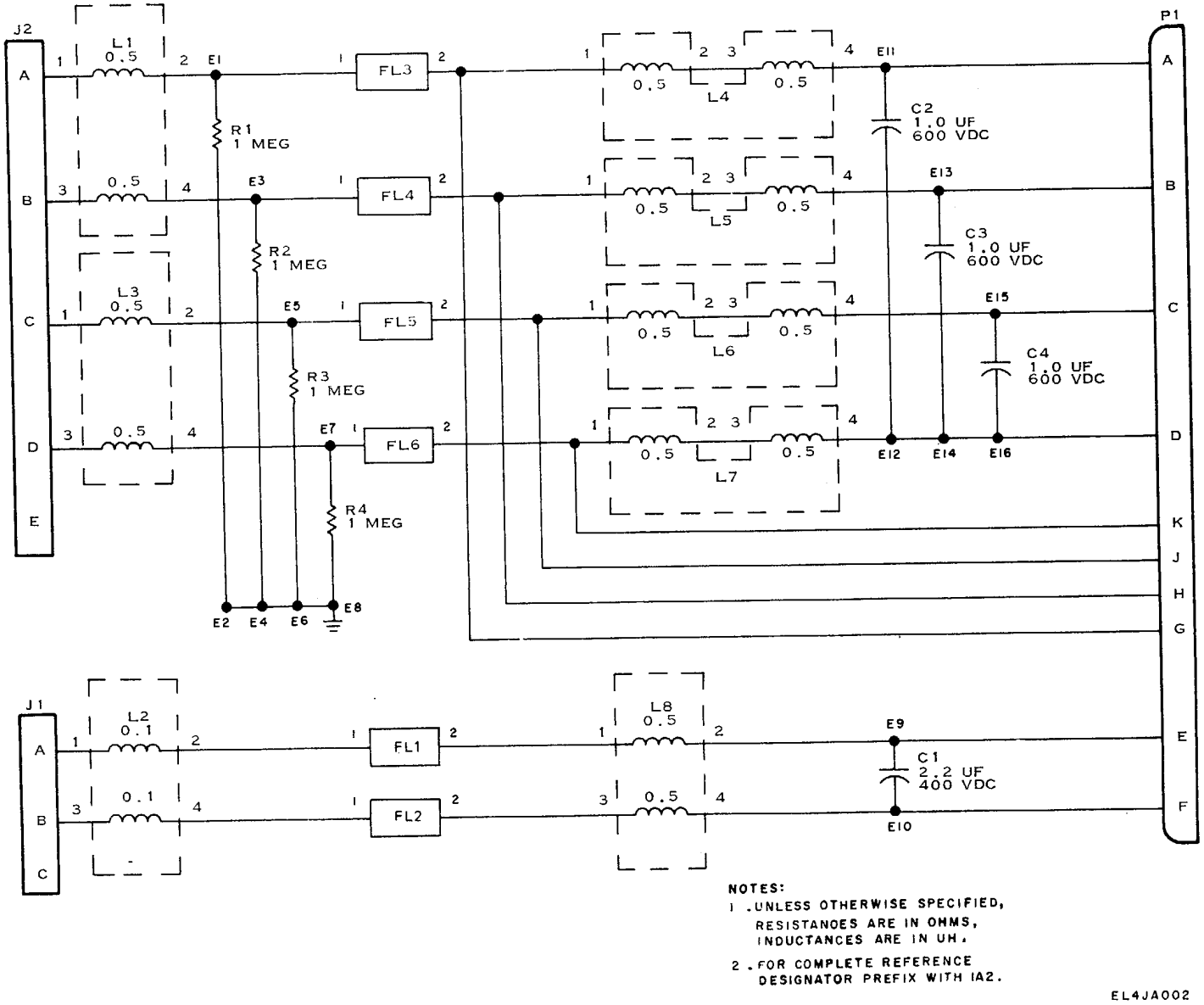
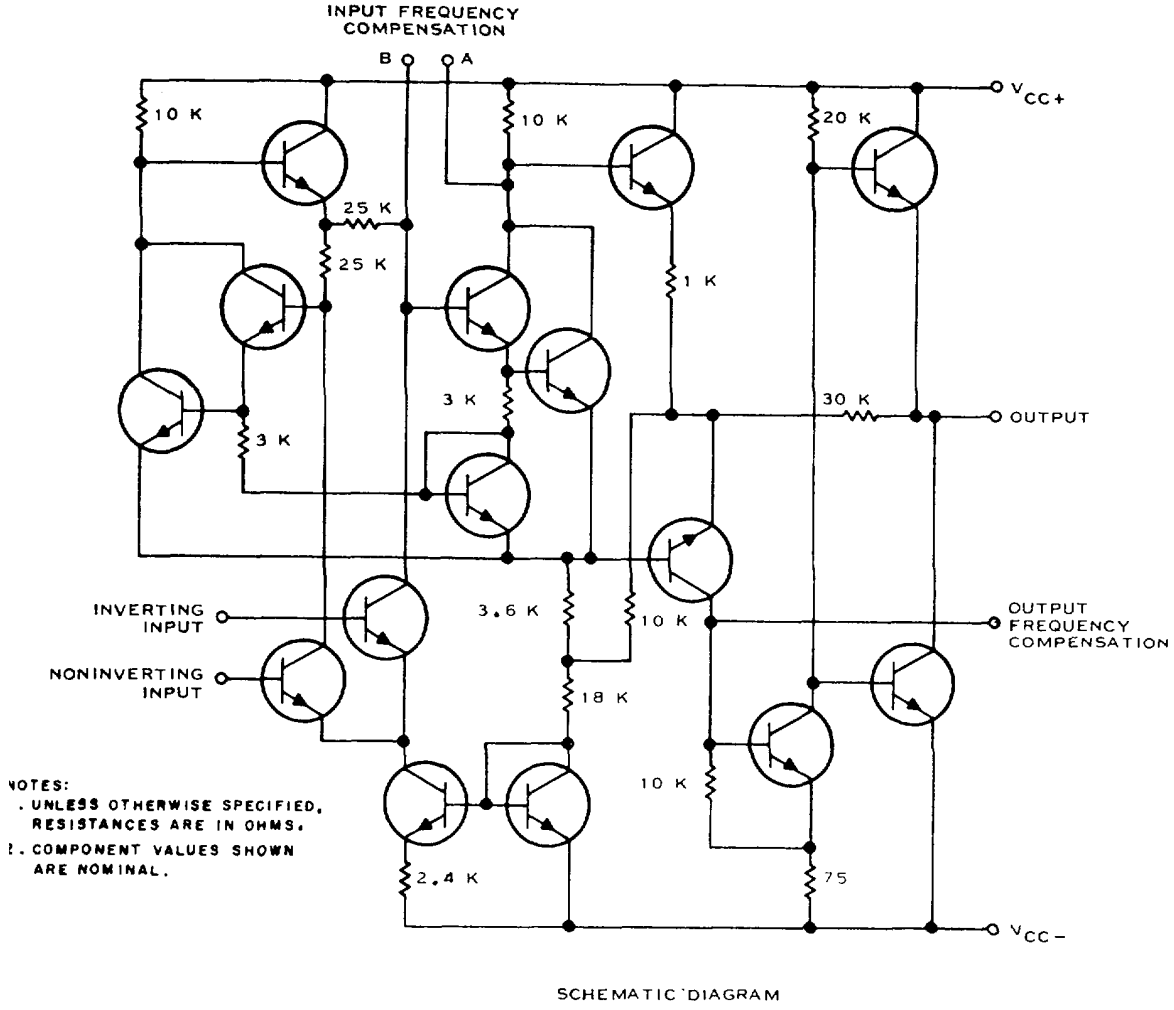


Figure 2-9. Filter assembly 1A2, schematic diagram.



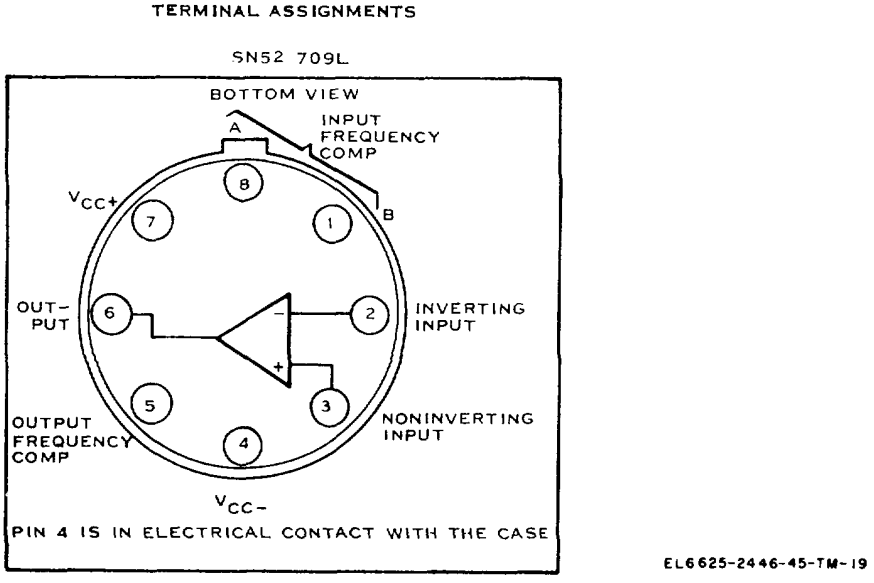


Figure 2-10. Integrated circuit, type SN52709L, schematic diagram.

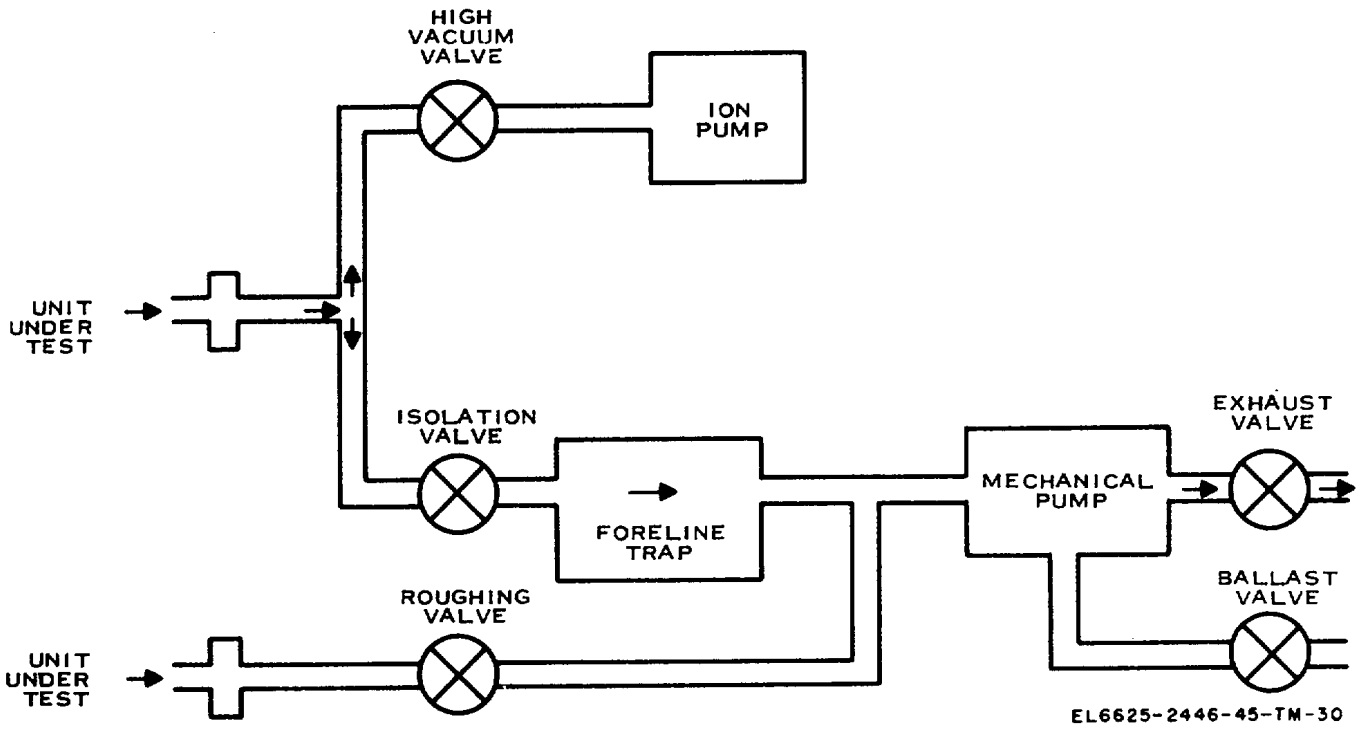


Figure 2-11. Cryo test set vacuum system schematic diagram.

CHAPTER 3
GENERAL SUPPORT MAINTENANCE
Section I. GENERAL

3-1. Level of Maintenance

This chapter provides general support maintenance procedures for Test Set, Cryogenic Refrigerator AN/AAM-40 and Service Kit, Refrigerant MK-1171/AAS-24. Included in this chapter are sections covering troubleshooting; removal and replacement; adjustment and alignment; repair; and general support testing.

3-2. Maintenance Forms and Records

Maintenance forms, records and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

3-3. Tools and Test Equipment

Tools and test equipment required for maintenance, other than those listed in TM 1166252446-12, are as follows:

a. Tools. The only tools required are a 55-watt soldering iron and Tool Kit, Electronic Equipment TK-105/G.

b. Test Equipment. Test equipment is listed in table 3-1.

Table 3-1. Test Equipment

Nomenclature	Common name
Oscilloscope AN/USM-281A.	Oscilloscope
Digital Voltmeter (Non-linear) Systems, Model X-2.	Digital Voltmeter (dvm)

c. Digital Voltmeter Preparation for Use. To prepare the digital voltmeter (dvm) for use, connect the power plug to a 115 vac power source. Connect the red lead to the HI connector on the dvm panel and the black lead to the LO connector on the dvm panel. Set the power switch to ON. Set the range switch to AUTO.

d. Oscilloscope Preparation for Use. To prepare the oscilloscope for use, connect the power lead to 115-vac power source. Connect the oscilloscope test probe to INPUT CH 1 and make a connection between ground on the oscilloscope and GND on the cryo test set. Set the POWER ON switch to the ON position. Position remaining controls as indicated in chart 3-1.

Chart 3-1. Oscilloscope AN/USM-081A Control Settings

Controls	Setting
FIND BEAM	Released.
INTENSITY	As required.
ASTIGMATISM	Use in conjunction with FOCUS to adjust for round beam.
FOCUS	Adjusts beam for sharpest trace.
TRACE ALIGN	Adjusts vertical centering.
SCALE	Adjust for scale illumination.
POWER (indicator)	Signifies POWER switch closed and the 23 vdc power supply is operating.
POWER (switch)	ON (applies ac power to oscilloscope).
HORIZONTAL POSITION	Adjusts horizontal position of display.
MAGNIFIER	X1.
DISPLAY	INT.
AC-DC	DC.
A POSITION	As required.
POLARITY	+
DISPLAY	A.
VOLTS/CM	1.
MAGNIFIER	S1.
CH '1 AG GND DC INPUT	DC.
MAIN VERNIER	CAL.
RESET	Released.
TRIGGER LEVEL	O0.
EXT +10, EXT, INT, LINE	INT.
-SLOPE +	DC.
ACS, ACF, AC, DC	DC.
TIM, E/OM	1 sec.
SWEEP MODE	AUTO.
CM DELAY	0.
VERNIER	CAL.
TRIGGER LEVEL	0.
INT, AUTO, EXT, EXT + 10.	AUTO.
-SLOPE +	+.
ACS, ACF, AC, DO	DC.

Section II. TROUBLESHOOTING

3-4. General Troubleshooting Instructions

Troubleshooting at the general support maintenance level includes all the techniques outlined for organizational maintenance, and any special or additional techniques required to isolate a defective part. The maintenance procedures are not complete in themselves, but supplement those described in TM 11-6625-2446-12. The systematic troubleshooting procedure, which begins with the operational and sectionalization checks that are performed at an organizational level, must be completed by means of localizing and isolating techniques. The paragraphs that follow provide procedures for sectionalizing troubles to a particular functional unit of the test set, and then to localize the trouble to a component of the functional unit unless the functional unit is replaced and later repaired at a higher level maintenance facility. Parts location information is provided in figures 4-1 through 4-8 and FO-7. Wiring diagram information and cable diagrams are provided in figures FO-8, FO-9, and FO-10. Color codes for resistors, inductors, and capacitors are provided in figure FO-1. The color code for wire shown on wiring diagrams is the same numerical code explained in figure FO-1.

3-5. Organization of Troubleshooting

a. General. The first step in troubleshooting is to sectionalize the fault (tracing the fault to a major functional unit). The second step is to localize the fault (tracing the fault to a defective part within that unit). Some faults, such as burned-out resistors, arcing, and shorted transformers can often be located by sight, smell, and hearing. The majority of faults, however, must be isolated by checking voltages and resistances, or by checking the equipment against the general support test procedure contained in section VI of this chapter.

b. Sectionalization. For ease of troubleshooting, the equipment may be thought of as consisting of functional entities, each related electrically but categorized separately by the function performed. The first step in troubleshooting is to locate the function, or functions, at fault by the following methods:

(1) Visual inspection. The purpose of the visual inspection is to locate faults without testing or measuring the circuits. All visual signs should be observed and an attempt made to sectionalize the fault to a particular function.

(2) *Operational test.* Operational tests frequently indicate the general location of trouble. In many instances the tests will help in determining the exact nature of the fault. The organizational quarterly preventive maintenance checks and service chart (TM 11-6625-2446-12) contains an operational test.

c. Localization. The tests listed in the following paragraphs will aid in localizing the trouble. First, localize the trouble to a single function, and then isolate the trouble within that circuit by waveform, resistance, and continuity measurements.

(1) Troubleshooting chart. When used with the associated voltage, resistance, and continuity tables and the waveform diagram, the troubleshooting information in chart 3-2 will aid the technician in localizing troubles to a component part. Defective components identified by performing the corrective action are replaced with a known reliable component unless repair or other disposition is noted. The corrective action column reference data tables, if required, for checking components; otherwise, refer to schematics and wiring diagrams when performing checks. The parenthetical reference in the malfunction column is intended to be used only when performing the general support test procedure. The referenced data items and test procedure steps will allow malfunction symptoms discovered during performance of the test procedure to be easily referenced in the troubleshooting chart.

Chart 3-2. Troubleshooting Procedure

NOTE

Steps 1 through 15 apply to vacuum pump group unit 1; steps 16 through 26 to control unit 2; steps 27, 28, and 29 to detector unit 3; and steps 30, 31, and 32 to compressor unit 5.

Malfunction	Probable cause	Corrective action
UNIT 1:		
1 ∅ERR lamp 1A1DS3 lights when power mode switch wiring. 1A1S1 is set to STBY. (chart 3-3, step 8).	a. Loss of 115 vac input power	a. Check CB2. Reset if tripped. Check
	b. 115 vac, 400-Hz, 3-phase input pow- er incorrect. power.	b. Check 115 vac, 400-Hz, 3-phase
2 ELAPSED TIME meter 1A11 does not operate with power mode switch 1A1S1 in OPR. ∅ERR lamp 1A1DS3 is not lighted.	a. Relay 1A1K1 defective.....	a. Check 1A1K1 (table 3-3, item 1).
	b. ELAPSED TIME meter 1A1M1 or wiring defective.	b. Check 1A1M1 and wiring.
3 STBY lamp 1A1DS2 is not lighted when power mode switch 1A1S1 is set to STBY (chart 3-3, step 8).	a. Defective circuit breaker 1A1CB1.....	a. Check 1A1CB1.
	b. Defective leak detector 11A1 ..... tween pins 2 and 4.	b. Check 1A1A1 for continuity be-
	c. Defective power mode switch 1A1S1	c. Check 1A1S1 (table 3-4, item 20).
	d. STBY lamp 1A1DS2 defective	d. Replace 1ALDS2.
4 OPR lamp 1A1DS1 is not lighted when power mode switch 1A1S1 is set to OPR (chart 3-3, step 9).	a. Refer to 3a, b, and c above.....	a. Refer to 3a, b, and c above.
	b. OPR lamp 1A1DS1 defective	b. Replace 1A1DS1.
5 START lamp 1A1DS5 is not lighted with RUN/START switch 1A1S2 in the START position and ON-OFF cir- cuit breaker 1A1CB3 in the ON position (chart 3-3, step 11). defective.	a. Input power incorrect	a. Check input power.
	b. Circuit breaker 1A1CB2 open.....	b. Reset 1A1CB2.
	c. Relay 1A1K1 defective.....	c. Check 1A1K1 (table 3--3, item 1).
	d. Circuit breaker 1A1CB3 defective.	d. Check 1A1CB3.
	e. Cryogenic high vacuum unit 1A1A2.....	e. Check 1A1A2.
	f. START/RUN switch 1A1S2 defec-	f. Check 1A1S2.tive.
	g. START lamp 1ADS5 defective.....	g. Replace 1A1DS5.
6 RUN lamp 1A1DS4 is not lighted with RUN/START switch 1A1S2 in the RUN position and ON-OFF cir- cuit breaker 1A1CB3 in the ON position (chart 3-3, step 19).	a. Refer to 5a through f above	a. Refer to 5a through f above.
	b. RUN lamp 1A1DS4 defective	b. Replace 1A1DS4.
7 H VAC ASSY lamp 1A1DS6 is not lighted with ON-OFF circuit breaker 1A1CB4 in the ON position (chart 3-3, step 12).	a. Defective circuit breaker 1A1CB4.....	a. Check lA1CB4 (table 3-4, itemn 9).
	b. Defective high vacuum unit 1A1A2.....	b. Check 1AlA2.
	c. H VAC ASSY lamp 1A1DS6 defec- tive.	c. Replace 1AI)DS6.
8 FORELINE TRAP lamp 1A1DS7 is not lighted with ON-OFF circuit breaker 1A1CE5 in the ON position defective. (chart 3-3, step 13).	a. Circuit breaker 1A1CH5 defective	a. Check 1A1CB5 (table 3-4, item 8).
	b. Defective high vacuum unit 1AA2.....	b. Check 1A1A2.
	c. FORELINE TRAP lamp 1A1DS	c. Replace lAlDS7.
9 MECH PUMP lamp 1A1DS8 is not lighted with the ON- OFF circuit breaker 1A1CB6 in the ON position (chart 3-3, step 14).	a. Circuit breaker 1A1CB6 defective.....	a. Check 1A1CB6 (table 3-4, item 7).
	b. Defective high vacuum unit 1A1A2.....	b. Check 1A1A2.
	c. MECH PUMP lamp 1AlDS8 defec	c. Replace 1A1DS8.

Malfunction	Probable cause	Corrective action
10 TEMP OUT OF LIMIT lamp 1A1DS10 is not lighted with 1A1J3 disconnected.	a. 28 vdc defective	a. Check 28 vdc input.
	b. Defective relay 1A1K2	b. Check 1AlK2 (table 3-4, item 19).
	c. TEMP OUT OF LIMIT lamp 1A1DS10 defective.	c. Replace 1AlDS10.
11 ON lamp 1AlDS11 is not lighted with ON-OFF circuit breaker 1AlCB7 in the ON position (chart 3-3, step 16).	a. Defective circuit breaker 1AlCB7	a. Check 1A1CB7 (table 3-4, items 7, 8, and 9).
	b. Defective relay 1A1K2	b. Check 1A1K2.
	c. Defective high vacuum unit 1A1A2	c. Check 1A1A2.
	d. ON lamp 1A1DS11 defective	d. Replace 1A1DS11.
Warning: DEATH or SERIOUS INJURY may result from contact with 3500 VDC existing within this equipment. The following steps involve measurements of and around 3500 vdc.		
12 Ion pump meter 1A1M2 indicates 0 volt with ion pump ON-OFF switch at ON and METER RANGE switch at 5KV.	a. Defective input to high voltage power supply 1A3. and B.	a. Check for 11.5 vac at 1A3P1-A
	b. Defective high voltage power supply 1A3.	b. Replace 1A3.
	c. Defective meter 1A1M2	c. Replace 1A1M2.
13 Ion pump meter 1A1M2 indicates greater than 0 but less than 1000 vdc with ion pump ON-OFF switch at ON and METER RANGE switch at 5KV.	a. Ion pump has lost vacuum roughing pump.	a. Establish rough vacuum with
	b. High voltage power supply is out of calibration. supply 1A3.	b. Calibrate high voltage power
14 Ion pump operation does not cause ion pump meter 1A1M2 current indication to decrease.	a. Defective ion pump	a. Replace ion pump.
	b. Defective leak detector 1A1A1	b. Replace 1A1A1.
15 Leak detector meter 1A1M3 does not respond to centering controls (chart 3-3, step 21).	a. Same as step 14b	a. Same as step 14b.
	b. Defective COARSE ZERO, FINE ZERO, or SENS control.	b. Check COARSE ZERO, FINE ZERO, and SENS controls.
UNIT 2:		
16 OPR lamp 2A1DS1 is not lighted when the power mode switch is set to OPR (chart 3-3, step 28).	a. Defective circuit breaker 2A1CB1	a. Check 2A1CB1. Reset if tripped. Replace if defective.
	b. Defective diode 2A1CR4	b. Check 2A1CR4.
	c. Defective power mode switch 2A1S1.	c. Check 2A1S1.
	d. Defective phase sensing relay 2A1K2.	d. Check for 27 +2 vdc at 2A1K2A-1.
	e. Defective OPR lamp 2A1DS1	e. Replace 2A1DS1.

Malfunction	Probable cause	Corrective action
17 STBY lamp 2A1DS2 is not lighted when the power mode switch is set to STBY. (chart 3-3, step 27). 2A1S1.	a. Refer to 16a and 16b above.....	a. Refer to 16a and b above.
	b. Defective power mode switch	b. Check 2A1S1.
	c. Defective STBY lamp 2A1DS1.....	c. Replace 2A1DS1.
18 ∅ERR lamp 2A1DS3 is lighted in STBY.	a. Defective 115 vac, 400-Hz,..... 3-phase power source.	a. Check power source.
	b. Defective circuit breaker 2A1CB2.....	b. Check 2A1CB2.
	c. Defective phase sensing relay ..... 2A1K2.	c. Check 2A1K2 (table 3-3, item 37).
	d. Defective diode 2A1CR5	d. Check 2A1CR5 (table 3-3, item 20).
	e. Defective phase sensing relay ..... 2A1K2 contacts.	e. Check for 27 2 vdc at 2A1K2B-3.
	f. Defective OERR lamp 2A1DS3.....	f. Replace 2A1DS3.
19 BIAS CHOPPER lamp 2A1DS4 does not light with DETEC-TOR TEST switch 2A1S2 set in the BIAS CHOPPER position (chart 3-3, step 32).	a. Refer to 18a through e above..... check for 27 +2 vdc at 2A1K2A-1.	a. Refer to 18a through d above and
	b. Refer to 16a through d above	b. Refer to 16a through d above.
	c. Defective DETECTOR BIAS switch..... 2A1S2-1	c. Check 2A1S2.
	d. Defective BIAS CHOPPER lamp ..... 2A1DS4.	d. Replace 2A1DS4.
20 NORMAL lamp 2A1DS5 does not light with COM-PRESSOR switch 2A1S3 set in the NORMAL position (chart 3-3, step 29).	a. Refer to 16a through d above	a. Refer to 16a through d above.
	b. Refer to 18a through e above	b. Refer to 18a through d above and check for 27 +2 vdc at 2A1K2A-1.
	c. Defective COMPRESSOR switch ..... 2A1S3.	c. Check 2A1S3 (table 3-4, item 54).
	d. Defective phase error indicator ..... relay 2A1K3.	d. Check 2A1K3 (table 3-3, item 38).
	e. Defective NORMAL lamp 2A1DS5.....	e. Replace 2A1DS5.
21 HIGH SPEED lamp 2A1DS6 does not light with COOLER switch 2A1S4 set in the HIGH SPEED position (chart 3-3, step 29).	a. Refer to 16a through d above	a. Refer to 16a through d above.
	b. Refer to 18a through e above	b. Refer to 18a through d above.
	c. Defective COOLER switch 2A1S4	c. Check 2A1S4.
	d. Defective HIGH SPEED lamp ..... 2AlDS6.	d. Replace 2AlDS6.

Malfunction	Probable cause	Corrective action
22 BIAS lamp 2A1DS7 does not light with DETECTOR TEST switch 2A1S2 set in the BIAS position (chart 3-3, step 34).	a. Refer to 16a through d above	a. Refer to 16a through d above.
	b. Refer to 18a through e above	b. Refer to 18a through d above.
	c. Defective DETECTOR TEST switch 2A1S2.	c. Check 2A1S2.
	d. Defective BIAS lamp 2A1DS7	d. Replace 2A1DS7.
23 REV PHASE lamp 2A1DS8 does not light with phase error introduced at compressor (chart 3-3, step 44).	a. Refer to 20a through d above	a. Refer to 20a through d above.
	b. Defective REV PHASE lamp 2A1DS8.	b. Replace 2A1DS8.
24 LOW SPEED lamp 2A2DS9 does not light with COOLER switch 2A1S4 set in the LOW SPEED position (chart 3-3, step 30).	a. Refer to 21a through c above	a. Refer to 21a through c above.
	b. Defective LOW SPEED lamp 2A1DS9.	b. Replace 2A1DS9.
25 CHOPPER wheel in unit 3A1 operates, but no 28 vdc is present at 2A1J5E; BIAS CHOPPER lamp 2A1DS4 is lighted.	Diode 2A1CR2 is open	Replace 2A1CR2.
26 DETECTOR TEST switch 2A1S2 is set in BIAS position; BIAS lamp is lighted; 28 vdc is not present at 2A1J5-E.	Diode 2A1CR3 is open	Replace 2A1CR3.
UNIT 3:		
27 Chopper wheel does not turn (chart 3-3, step 32).	a. Defective input power	a. Check 115 vac, 400-Hz, 3-phase input power.
	b. Defective motor 3AB1	b. Replace 3AlB1.
28 No dc excitation voltage at 3A1J3 (chart 3-3, step 33).	a. No 28 vdc input	a. Check input 27 +2 vdc at 3A1J1-E.
	b. Open resistor 3A1R1	b. Check 3A1R1 (table 3-3, item 39).
	c. Shorted zener 3A1CR1	c. Check 3A1CR1 (table 3-2, item 33).
	d. Open resistor 3A1R2	d. Check 3A1R2 (table 3-3, item 40).
	e. Open resistor 3A1R3	e. Check 3A1R3 (table 3-3, item 41).
29 Any one dc excitation not present at 3A1J2-A through H.	Defective DETECTOR SELECTOR switch 3AlS1.	Check 3A1S1 (table 3-4, items 68 through 75).
UNIT 5:		
30 Compressor does not operate; GO/FAIL indicator 5DS1 shows a GO condition (chart 3-3, step 39	a. Defective power input	a. Check 115 vac, 400-Hz, 3-phase input power.
	b. Defective phase sensing relay 5K1	b. Check 5K1 (table 3-3, item 42).
	c. Defective relay 5K2	c. Check 5K2 (table 3-3, item 43).
	d. Defective compressor	d. Replace compressor.

Malfunction	Probable cause	Corrective action
31 GO/FAIL indicator 5DS1 shows a FAIL condition.	a. Connector 5B2J1 not secure	a. Tighten 5B2J1.
	b. Connector 5B1J2 not secure	b. Tighten 5B1J1.
	c. Defective 28 vdc input	c. Check 27 +2 vdc input at 5J1-E.
	d. Defective relay 5K2	d. Check 5K2 (table 3-3, item 43).
	e. Defective over-temperature switch	e. Replace over temperature switch, 5B1S1.
32 Fan B2 does not operate (chart 3-3, step 39).	a. Refer to 30a, b, and c above	a. Refer to 30a, b, and c above.
	b. Defective fan	b. Replace fan.

(2) *Waveform measurements*. Significant waveforms are discussed in chapter 4.

(3) *Voltage and resistance measurements*. The digital voltmeter, Nonlinear System, model X-2, is used for taking voltage and resistance readings on the chassis. Multimeter TS-352 B/U is available if required. Voltage measurements are listed in table 3-2 and resistance measurements are listed in table 3-3. The Item column is provided so specific measurements can be easily referenced. The Component checked column designates which component can be checked by using the data provided for that item. The dvm probe connections LO and HI columns specify where the HI probe and LO probe are connected to check the corresponding item component. The Test set control setting Control and Position columns designate test unit control settings which must be made prior to observing the dvm indication for the item checked. The dvm indication (volts) dc and ac column on the voltage measurement table (table 3-2) contains the dc or ac voltage obtained for the item component checked. The Dvm indication (ohms) on the resistance measurement table (table 3-3) contains the resistance obtained for the item checked. Unless otherwise specified, tolerances are +10 percent. All voltage measurements are made with 28 vdc and 115 vac three-phase circuit breakers at ON and power mode switch at OPR. All resistance measurements are made with power removed and pcb 1A1A1 and 1AlA2 removed. Chassis mounted components requiring resistance checks must be isolated from associated circuitry to avoid erroneous readings.

CAUTION

When making voltage measurements of transistors, use tape or sleeving to insulate the test probe, except for the extreme tip, to prevent accidental shorting of the test probes to the chassis (even a momentary short circuit can damage the transistor).

Table 3-2. Voltage Measurements

NOTE

Items 1 through 11 apply to vacuum pump group unit 1; items 12 through 32 to control unit 2; and items 33 through 39 to detector unit 3.

Item	Component checked	Dvm probe connection		Test set control setting		Dvm indication (volts)	
		LO	HI	Control	Position	Ac	Dc
	UNIT 1:						
1	Filter Assembly 1A2.	1A2E12	1A2E11			115 ±11.5	
2	Filter Assembly 1A2.	1A2E14	1A2E13			115 ±11.5	
3	Filter Assembly 1A2.	1A2E16	1A2E15			115 ± 11.5	
4	filter Assembly 1A2.	1A2E10	1A2E9				27 ± 2.0
5	1A1T1	T1-1	T1-2			15 ± 1.5	
6	1A1T1	T1-3	T1-4			1.2 ± 1.0	
7	1A1T2	T2-1	T2-2			115 ± 11.5	
8	1A1T2	T2-3	T2-4			25(+5, -3)	
9	1A1CR1	CR1 anode	CR1 cathode				27 ± 2.0
10	1A1CR2	CR2 anode	CR2 cathode				27 ± 2.0
11	1A1CR3	CR3 anode	CR3 cathode				27 ± 2.0
	UNIT 2:						
12	2A1CR1	CR1 anode	CR1 cathode				27 ± 2.0
13	2A1CR2	CR2 anode	CR2 cathode				0.5 ± 0.2
14	2A1CR3	CR3 anode	CR3 cathode				0.5 ± 0.2
15	2A1CR4	CR4 cathode	CR4 anode				0.74 ± 0.2
16	2A1CRS	CR5 anode	CRS cathode				26.7 ± 0.2
17	2A1CR6	E26	E24	COMPRESSOR	NORMAL	90 ± 10	
18	2A1CR7	E26	E22	COMPRESSOR	NORMAL	90 ± 10	
19	2A1CR8	E27	E22	COMPRESSOR	NORMAL	90 ± 10	
20	2A1CR9	E27	E23	COMPRESSOR	NORMAL	94 ± 10	
21	2A1CR10	E25	E23	COMPRESSOR	NORMAL	90 ± 10	
22	2A1CR11	E25	E24	COMPRESSOR	NORMAL	90 ± 10	
23	2A1CR12	E8	E7	COOLER	HIGH SPEED	77 ± 8	
24	2A1CR13	E8	E9	COOLER	LOW SPEED	43 ± 5	
25	2A1CR14	E11	E10	COOLER	HIGH SPEED	77 ± 8	
26	2A1CR15	E11	E12	COOLER	HIGH SPEED	43 ± 5	
27	2A1CR16	E14	E13	COOLER	LOW SPEED	77 ± 8	
28	2A1CR17	E14	E15	COOLER	LOW SPEED	43 ± 5	
29	2A1CR18	E17	E16	COOLER	HIGH SPEED	77 ±-8	
30	2A1CR19	E17	E18	COOLER	HIGH SPEED	43 ± 5	
31	2A1CR20	E20	E19	COOLER	LOW SPEED	77 ± 8	
32	2A1CR21	E20	E21	COOLER	LOW SPEED	43 ± 5	
	UNIT 3:						
33	3A1CR1	CR1	CR1 (-)	DETECTOR TEST	BIAS CHOPPER		3.9 ± 0.3
34	3A1CR2	E8	E7	DETECTOR TEST	BIAS CHOPPER	80 ± 10	

Item	Component checked	Dvm probe connection		Test set control setting		Dvm indication (volts)	
		LO	HI	Control	Position	Ac	Dc
35	3A1CR3	E8	E9	DETECTOR TEST	BIAS CHOPPER	80 ± 10	
36	3A1CR4	E10	E9	DETECTOR TEST	BIAS CHOPPER	80 ± 10	
37	3A1CRS	E10	E11	DETECTOR TEST	BIAS CHOPPER	80 ± 10	
38	3A1CR6	E12	E11	DETECTOR TEST	BIAS CHOPPER	80 ± 10	
39	3A1CR7	E12	E7	DETECTOR TEST	BIAS CHOPPER	80 ± 10	

(4) Continuity checks. Routine continuity checks between various points in the circuitry can be made by using the digital voltmeter or the multimeter and the wiring diagrams; however, a list of continuity checks is provided in table 3-4 to insure a complete continuity check of the circuitry without reference to the wiring diagram. The continuity measurements table *Item* column is provided so specific measurements can be easily referenced. The *dvm probe connections LO* and *HI* columns specify where the dvm LO probe and HI probe are connected to check the corresponding item continuity measurements. The *Test unit control setting Control and Position* columns designate test unit control settings which must be made prior to observing the dvm indication for the item circuitry checked. The *Remarks* column contains information of a special nature pertinent to checking continuity for the specific corresponding item. Continuity is defined as a continuous path with a resistance of less than 2 ohms unless otherwise noted. All measurements are made with power off and circuit breakers open.

Table 3-3. Resistance Measurements

NOTE

Items 1 through 14 apply to vacuum pump group unit 1; items 15 through 36 to control unit 2; items 37, 38 and 39 to detector unit 3; and item 40 to compressor unit 5.

Item	Component checked	Dvm probe connection		Test set control setting		Dvm indication (volts)
		LO	HI	Control	Position	
	UNIT 1:					
1	1A1K	1AK1-X2	1AK1-X1			290 ±30
2	1A1K2	1A1K2-X2	1A12-X1			290 ± 30
3	1A1R2	1A1R1A-1	1A1R2A-3			25 ± 2.5k
		lA1R2A-1	1A1R2A-2	COARSE	CCW	0.25 ± 0.25
		1A1R2A-2	1A1R2A-3	COARSE	CCW	25 ± 2.5K
		1A1R2B-4	1A1R2B-6	COARSE	CCW	25 ± 2.5k
		1A1RB-4	1A1R2B-5	COARSE	CCW	0.25 ± 0.25
		1AR2B-5	1A1R2B-6	COARSE	CCW	25 ± 2.5k
4	1A1R1	1A1R2-1	1A1R1-3			10 ± 1k
		1A1R2-1	1A1R1-2	FINE	CCW	0.1 ±-0.1
		1A1R2-2	1A1R1-3	FINE	CCW	10 -± 1k
5	1A1R3	1A1R3-1	1A1R3-3	SENS	CW	250k
	1A1R3-1	1A1R3-3	SENS	CCW		0.25 ± 0.25
6	1ACR1	1A1CR1-1	1A1CR1-2			Less than 100k
	1A1CR1-2	1ACR-1				Greater than 1 meg
7	1A1CR2	1A1CR2-1	1A1CR2-2			Less than 100k
	1A1CR2-2	1A1CR2-1				Greater than 100k
8	1A1CR3	1A1CR3-1	1A1CR3-2			Less than 100
	1A1CR3-2	1A1CR3-1				Greater than 100k
9	1A1CR4	1A1CR4-1	1A1CR4-2			Less than 100
		1A1CR4-2	1ACR4-1			Greater than 100k
10	1A1CR5	1A1CR5-1	1A1CR5-2			Less than 100
		1A1CR5-2	1A1CR5-1			Greater than 100k
11	1A1CR6	1A1CR6-1	1A1CR6-2			Less than 100
	1AICR6-2	1A1CR6-1				Greater than 100k
12	1A1CR7	1A1CR7-1	1A1CR7-2			Less than 100
		1A1CR7-2	1ACR7-1			Greater than 100k
13	1A1CR8	1A1CR8-1	1A1CR82			Less than 100
	1A1CR8-2	1A1CR8-1				Greater than 100k

Item	Component checked	Dvm probe conn. LO	Dvm probe conn. HI	Test set control setting Control	Test set control setting Position	Dvm indication(ohms)
14	1A1CR9	1A1CR9-1	1A1CR9 2			Less than 100
		1A1CR9-2	1A1CR9-1			Greater than 10Ok
	1A1A1K	A2	1A1DS2-2	Power mode sw1tch 1A1S1	OPR	Less than 100
	UNIT 2.					
15	2AK	2A1K1-X2	2A1K1-X1			290 +30
16	2A1CR1	2A1CR1-1	2A1CR1-2			Less than 100k
		2A1CR1-2	2A1CR1-1			Greater than 100k
17	2A1CR1	2A1CR2-1	2A1CR2-2_			Less than 100
		2A1CR2-2	2A1CR2-1			Greater than 100k
18	2A1CR3	2A1CR3-1	2A1CR3-2			Less than 100
		2A1CR3-2	2A1CR3-1			Greater than 100k
19	2A1CR4	2A1CR4-1	2A1CR4-2			Less than 100
		2A1CR4-2	2A1CR4-1			Greater than 100k
20	2A1CR5	2A1CR5-1	2A1CRS-2			Less than 100
		2A1CR5-2	2A1CR5-1			Greater than 100k
21	2A1CR6	2A1CR6-1	2A1CR6-2			Less than 100
		2A1CR6-2	2A1CR6-1			Greater than 00k
22	2A1CR7	2A1CR7-1	2A1CR7-2			Less than 100
		2A1CR7-2	2A1CR7-1			Greater than 100k
23	2A1CR8	2A1CR8-1	2A1CR8-2			Less than 100
		2A1CR8-2	2A1CR8-1			Greater than 100k
24	2AlCR9	2A1CR9-1	2A1CR9-2			Less than 100
		2A1CR9-2	2A1CR9-1			Greater than 100k
25	2A1CR10	2A1CR10-1	2A1CR1-2			Less than 100
		2A1CR10-2	2A1CR10-1			Greater than 100k
26	2A1CR1	2A1CR11--1	2A1CR11-2			Less than 100
		2A1CR11-2	2A1CR11-1			Greater than 100k
27	2A1CR12	2A1CR12-2	2A1CR12-2			Less than 100
		2A1CR12-2	2A1CR12-1			Greater than 100k
28	2A1CR13	2A1CR13-1	2A1CR13-2			Less than 100
		2A1CR13-2	2A1CR13-1			Greater than 100k
29	2A1CR14	2A1CR14 -1	2A1CR14-2			Less than 100
		2A1CR14-2	2A1CR14-1			Greater than 100k
30	2A1CR15	2A1CR15-1	2A1CR15-2			Less than 100
		2A1CR15-2	2A1CR15 -1			Greater than 100k
31	2A1CR16	2A1CR16-1	2A1CR16-2			Less than 100
		2A1CR16-2	2A1CR16-1			Greater than 100k
32	2A1CR17	2A1CR17-1	2A1CR17-2			Less than 100
		2A1CR17-2	2A1CR17-1			Greater than 100k
33	2A1CR18	2A1CR18-1	2A1CR18-2			Less than 100
		2A1CR18-2	2A1CR18-1			Greater than 100k
34	2A1CR19	2A1CR19-1	2A1CR19- 2			Less than 100
		2A1CR19-2	2A1CR19--1			Greater than 100k
35	2A1CR20	2A1CR20-1	2A1CR20-2			Less than 100
		2A1CR20-2	2A1CR20-1			Greater than 100k
36	2A1CR21	2A1CR21-1	2A1CR2-2			Less than 100
		X1CR21-2	2A1CR21-1			Greater than 100k
	UNIT 3					
37	3A1R1	3A1R1-1	3A1R1-2			953 $\pm$ 100
38	3A1R2	3A1R2-1	3A1R2-2	3A1R2	ccw	500 $\pm$ 50k
		3A1R2-2	3A1R2-3		cw	less than or = 2
39	3A1R3	E4	E5			300 $\pm$ 30k
	UNIT 5.					
40	5K2	5B2J1-1	5J1-F			290 $\pm$ 30

Table 3-4. Continuity Measurements

NOTE

Items 1 through 46 apply to vacuum pump group unit 1; items 47 through 63 to control unit 2; items 64 through 77 to detector unit 3; and items 78 through 88 to compressor unit 5.

Item	Dvm probe connection		Test unit control settings		Remarks
	LO	HI	Control	Position	
	UN1T 1				
1	1A1J2-A	1A1K3-¢A 1A1K1 -A2	115 VAC 3ϕ circuit breaker 1A1CB2.	ON	
2	1A1J2-B	1A1K3-ϕB 1A1K1-B2			
3	1A1J2-C	1A1K3--¢C 1A1K1-C2 1A1XA2- 12			
4	1A1J2-D	1A1M4(-)	ION PUMP circuit breaker 1A1CB3	ON	
			START/RUN switch 1A1S2.	START	
		1A1XA2-2 and 23 1A1E7 1A1J3-H and N 1A1T1-2 1A1T2-2 1A1CB3-3 1A1P1-B 1A1J3-M 1A1DS11-1 1A1DS7-1 1A1DS6-1 1A1DS8--1 1A1DSS-1 1A1DS4-1 1A1TB1-2			
5	1A1J2-E	1A1XA1-2	28 VDC circuit breaker 1A1CR1.	ON	
6	1A1J2-F	1A1TB1-1 1A1K1-X2 1A1P1-C 1A1XA1-1 1ALJ3-K 1A1DS1-1 1A1DS2-1 1A1DS3-1 1AlDS10-1			
7	1A1J3-E	1A1XA2-9			
		1A1XA2-3	HEATER CONTROLS MECH PUMP circuit breaker 1A1CB6.	ON	
		1A1K1-AL	HEATER CONTROLS MECH PUMP circuit breaker 1A1CB6.	ON	
		1A1K2-A2	1A1CB6 and CB7	ON	
	1A1TB1-3	1A1CB6		ON	
	1A1T2-1	1A1CB6		ON	

Item	Dvm probe connection LO	Dvm probe connection HI	Test unit control settings Control	Test unit control settings Position	Remarks
8	1A1J3-F	1A1XA2-10			
		1A1XA2-13	FORELINE TRAP circuit breaker 1A1CBS.	ON	
			ION PUMP circuit breaker 1A1CB3.	ON	
		1A1K1-B1	FORELINE TRAP circuit breaker 1 A1CB5.	ON	
		1A1K2--B2	FORELINE TRAP circuit breakers 1A1CBS & 1A1CB7.	ON	
		1A1P1-A	FORELINE TRAP circuit breakers 1A1CB3 & 1A1CBS5.	ON	
9	1A1J3-G	1XA2-L1			
			HVAC ASSY circuit breaker lA1CB4.	ON	
		1A1K2-C2	HVAC ASSY circuit breakers 1A1CB4 & 1A1CB7.	ON	
		1A1A4(+)	HVAC ASSY circuit breakers 1A1CB4.	ON	
10	1A1J3-J	1A1K2-X2			
11	1A1J3-P	1A1E2			
12	1A1J3-R	1A11E3			
		1A1K2-B1			
		1A1XA2-8			
13	1A1J3-S	1A1E5			
		1A1XA2--20			
		1A1K2-A1			
14	1A1J3-T	1A1M1(+)			
15	1A1J3-U	1A1XA2 -5			
16	1A1J3-V	1A1XA2-6			
		1A1T1-4			
17	1A1J3-	1A1XA2-21			
18	1A1J3--X	1A1XA2-22			
19	1A1K3- A1	1A1DS10-2			
		1A1K2-X1			
		1A1DS1-2			
		1A1S3-C1 and C2			
		1A1XA1-7	SENS potentiometer 1A1R3.	ON	
		1A1K1-X1			
20	1A1K3-A2	1A1XA1-4	Power mode switch (PMS) 1A1S1.	OPR	
		1A1S1A-3 and 6	PMS 1A1S1	ON	
		1A1DS1-3	PMS 1A1S1	ON	
		1A1DS2-3	PMS 1A1S1	ON	
		1A1DS3-3	PMS 1A1S1	ON	
		1A1DS10-3	PMS 1A1S1	ON	
		1AK3-B2	PMS 1A1S1	ON	
21	1A1K3-133	1A1DS3-2	PMS 1A1S1	ON	

Item	Dvm probe connection		Test unit control settings		Remarks
	LO	HI	Control	Position	
22	1A1XA2-15	1A1S1B-2	PMS 1A1S1	STBY	
		1A1DS6-3	PMS 1A1S1	STBY	
		1A1DS7-3	PMS 1A1S1	STBY	
		1A1DS4-3	PMS 1A1S1	STBY	
		1A1DSS-3	PMS 1A1S1	STBY	
		1A1DS8-3	PMS 1A1S1	STBY	
		1A1DS11-3	PMS 1A1S1	STBY	
23	1A1XA2-1	1A1T1-1			
24	1A1XA2-4	1A1T1-3			
25	1A1XA2-7	1A1M1 (-)			
26	1A1XA2-14	1A1DS5-2			
27	1A1XA2-16	1A1DS6-2			
28	1A1XA2-17	1A1DS7-2			
29	1A1XA2-18	1A1DS8-2			
30	1A1XA2-19	1A1DS11-2			

Item	Dvm probe connection LO	Dvm probe connection HI	Test unit control settings Control	Test unit control settings Position	Remarks
32	1A1XA1-5	1A1M3 (-)			
33	1A1XA1-6	1AIR3-3			
34	1A1XAI-8	1A1T2-3			
35	1A1XA1-10	1A1T2-4			
36	1A1XA1-12	1A1R2B-4			
37	1A1XA1-14	1A1EI 1A1M3(+)			
38	1A1XA1-16	1A1M2(+)	Meter range switch 1A1S4	50 MA position.	
39	1A1XAI-18	IA1M2(-)			
40	1A1XA1-19	1A1S4-2 and 8			
41	1A1XA1-20	1A1R1-2			
42	1A1XA1-21	1A1S4-3 and 9			
43	1A1XA1-22	1A1P1-F 1A1S4-5			
44	1A1XA1-23	1A1S4-4 and 10			
45	1A1E1	1AIR3-1 and 2 1A1R2-3			
46	IAIXA2-14	1A1DS4-2	START/RUN switch 1A1S2.	RUN	
UNIT 2					
47	2A1J2-A	2A1K1-A2	115 VAC 0 circuit breaker CB2.	ON	
		2A1K2-OA	COOLER switch 2A1S4.	HIGH SPEED	
			DETECTOR TEST switch 2A1S2.	BIAS CHOPPER	
48	2A1J2-B	2A1K1-B2	COMPRESSOR switch 2A1 S3.	NORMAL	
		2A1K2-OB			
49	2AIJ2-C	2A1K1-C2 2A1K2-OC			
50	2A1J2-D	2A1K2-N 2AJ14-D 2AL13-F 2A1K3-N 2A1E9 2A1E12 2A1E15 2A1E18 2A1E21			
51	2A1J1-B	2A1DS1-1 2A1DS2-1 2A1DS3-1 2A1DS4-1 2A1DS5-l 2A1DS6-1 2A1DS7-1 2A1DS8-1 2A1DS9-1 2A1J4-F 2A1J5-F 2A1KI-X2			
52	2A1K1-AI	2A1J3-A 2A1J5-A 2A1J4-A 2A1E23 2A1S3-7 2A1M1(+) 2A1E7			

Item	Dvm probe connection LO	Dvm probe connection HI	Test unit control settings Control	Test unit control settings Position	Remarks
53	2A1K1-B1	2A1J3-C 2A1JS-B 2A1J4-B 2A1E22 2A1S3-10 2A1E10			
54	2A1K1-C1	2A1J3-B 2A1J5-C 2A1J4-C 2A1E24 2A1E16			
55	2A1J4-1	2A1K3-0A			
56	2A1J4-M	2A1K3-0B			
57	2A1J4--N	2A1K3-0C			
58	2A1J4-E	2A1DS8-2			
59	2A1K3-A1	2A1DS5-2			
60	2A1K1-A1	2A1J3-A 2A1J4-B	COOLER switch 2A1S4. DETECTOR TEST switch 2A1S2. COMPRESSOR switch 2A1S3.	LOW SPEED B1AS REV PHASE	
61	2A1K1-B1	2A1E13 2A1J3-E 2A1J4-A	COMPRESSOR	REV PHASE	
62	2A1K1-C1	2A1E19 2A1J3-D 2A1J4-C	COMPRESSOR	NORMAL	
63	2A1K2-A1	2A1DS9-2 2A1DS7-2 2A1J4-E			
	UN1T 3				
64	3A1J1-A	3A1TB1-1			
65	3A1J1-B	3A1TB1-2			
66	3A1J1-C	3A1TB1-3			
67	3A1J1-1	3A1CR1-(anode) 3A1R2-1			
68	3A1J3	3A1J2-A	DETECTOR SELECTOR switch 3A1S1.	1	
69	3A1J3	3A1J2-B	3A1S1	2	
70	3A1J3	3A1J2-C	3A1S1	3	
71	3A1J3	3A1J2-D	3A1S1	4	
72	3A1J3	3A1J2-E	3A1S1	5	
73	3A1J3	3A1J2-F	3A1S1	6	
74	3A1J3	3A1J2-G	3A1S1	7	
75	3A1J3	3A1J2-H	3A1S1	8	
76	3A1J3	3A1E5			
77	3A1J4 *UNIT 5*	3A1J2-J			
78	5K1-A	5K1-A3			
79	5K1-B	5K1-B3			
80	5K1-C	5K2-C3			
81	5K1-L	5K2-A1 5B1J1-J 5B2J1-A 5C1-3			

Item	Dvm probe connection LO	Dvm probe connection HI	Test unit control settings Control	Test unit control settings Position	Remarks
82	5J1-M	5C1-2 5K2-B1 SB1J1-K 5B1J1-B			
83	5J1-N	5C1-1 5K2-C1 5M1-1 5B1J1-1 5B2J1-C			
84	5J1-D	5M1-2 5C1 -4			
85	5J1-F	SCR4-(anode) 5K2-X2 5CR3-(anode) 5DS1-GRN			
86	5J1-E	5CR3-(cathode) 5CR2-(cathode) SDS1-BLK SB1J1-E			
87	5CR1-(+) 5CR1-(-) 5CR1-(-) 5CR1-(-)	5J1-K 5CR2-(anode) 5DS1-RED 5K2-D1			
88	5J1-E	5K2-X1			Compressor 5B1P1 and fan SB2P1 connected.

(5) *Intermittent troubles*. When trouble-shooting, the possibility of intermittent troubles should not be overlooked. This trouble often can be made to appear by tapping or jarring the equipment. Check wiring and connections.

3-6. Interunit Troubleshooting

a. Defective Signal Monitoring. Failure to monitor a selected voltage or signal may be caused by defective external test equipment. If an operational check fails to sectionalize trouble to a defective unit or a defective major functional area, follow the procedures given in (1), (2), and (3) below.

(1) *External test equipment check*. All external test equipment should function properly. Perform operational checks on each unit of external test equipment as described in the applicable test equipment manual.

(2) *Control unit check.* All major functional areas of the control units should function properly, including the active circuits (semiconductor circuits) and controls.

(a) *Active circuits.* If any of the transistor or diode circuits are suspected of causing a malfunction, isolate the trouble by using voltage and resistance measurements with external test equipment.

(b) *Controls*. To verify that all controls are functioning properly, perform continuity measurements (table 3-4) while the controls are rotated through each position.

(3) *Control unit connectors check.* The continuity measurements will aid in determining whether a connector is contributing to the malfunction.

b. Checking Cable Assemblies. All interconnecting cable assemblies should be checked for signs of insulation deterioration and for opens and shorts near the connectors. Check connectors for bent or deformed pins and for signs of arcing.

Section III. REMOVAL AND REPLACEMENT

3-7. Removal

All parts may be removed using standard tools and maintenance procedures. The control unit of the vacuum pump group is removed by disengaging the screws along the edge of the panel, sliding the chassis out to the stops, disconnecting the electrical connectors, pressing the slide locks and sliding the chassis from the unit. The control unit of the control group may be removed by disengaging the screws along the edge of the panel and sliding the chassis from the case. Access to the printed circuit boards is gained by removing the four screws securing the printed circuit board cover and removing the cover. Refer to parts location diagrams when removing parts and subassemblies.

3-8. Replacement

All parts may be replaced using standard tools and maintenance procedures. The control unit of the vacuum pump group is replaced by matching the chassis slides to the slides of the unit, connecting the electrical connectors, sliding the control unit all the way in and securing the panel screws. The control unit of the control group is replaced by placing the chassis back into the case and securing the screws along the edge of the panel. Refer to parts location diagrams when replacing parts and subassemblies.

Section IV. ADJUSTMENT AND ALIGNMENT

3-9. Adjustment Procedures

Adjustment procedures are not required.

3-10. Alignment Procedures

Alignment procedures are not required.

Section V. REPAIR

3-11. Parts Replacement Techniques

All parts are easily accessible and can be replaced without special procedures. The following general precautions apply to the equipment.

a. Use the pencil-type 55-watt soldering iron supplied with Tool Kit, Electronic Equipment TK-105/G for removal and repair of chassis mounted components. If the iron is to be used with alternating current, use an isolating transformer between the soldering iron and the line. Do not use a soldering gun; damaging voltages can be induced in components.

b. When soldering transistor or diode leads, solder quickly; whenever wiring permits, use a heatsink (such as long-nosed pliers) between the soldered joint and the transistor or diode. Use approximately the same lead length and dress as used originally.

c. Wiring diagram information and cable diagrams in figures FO-8, FO-9, and FO-10 should be referred to as required to insure correct part replacements.

3-12. Parts Substitution

Do not substitute parts indiscriminately. Substitute parts only when the trouble has been isolated to a specific stage and the defective part has been localized.

Section VI. GENERAL SUPPORT TEST PROCEDURES

3-13. Purpose and Instructions

a. Test procedures contained in this section are to be used for general support maintenance to determine the acceptability of repaired equipment. These procedures set forth specific requirements that repaired equipment must meet before it is returned to the using organization.

b. Perform each test in sequence; do not vary the sequence. For each step, perform all the actions required in the Control settings column; then perform each specific test procedure and verify in against the performance standard.

3-14. Test Equipment Required for Testing
All test equipment required to perform the testing procedures of this section is listed in table 3-1.

3-15. Test Procedure
General support test procedures are contained in chart 3-3.

Chart 3-3. General Support Test Procedures

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
1	DVM		Prepare dvm for use	Refer to paragraph -
2	.....	...Unit 1 Ballast valve- Fully cw Exhaust valve Fully cw Note Do NOT open these valves to test for being closed. Roughing valve: Fully cw Isolation valve: Fully cw High vacuum valve: Fully cw Power mode switch 1A1S1: OFF 28 VDC circuit breaker 1A1CB1: OFF 115 VAC 30 circuit breaker 1A1CB2: OFF		3-3c
3	.....	...MECH PUMP circuit breaker 1A1CB7: OFF		
4	.....	...MECH PUMP HEATER CONTROLS circuit breaker 1A1CB6: OFF		
5	.....	...FORELINE TRAP HEATER CONTROLS circuit breaker 1A1CB5: OFF		
6	.....	...H VAC ASSY HEATER CONTROLS circuit breaker 1A1CB4: OFF		
7	.....	...METER RANGE switch 1A1S4: 5 KV		
8	.....	...PUMP SELECT switch 1A1S3 MAIN		
9	.....	...START, RUN switch 1A1S2 START		
10	.....	...ION PUMP ON OFF circuit breaker CB3- OFF		
11	.....	...ZERO COARSE potentiometel 1A1R1 Miidrange		
12	.....	...FINE ZERO potentiometer 1A1R2: Midrange		
13	.....	...SENS potentiometer 1AIR3 Ccw just past "click "		

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
14	.....	.....	Check continuity as in table 3-4, items 1 through88.	
15	.....	.....	Check resistance values, table 3-3, items 1 through 40. Connect cable 1Wl between connector 1A2J1 and the 28 vdc power source. Connect cable 1W2 between connector 1A2J2 and the 115 vac, 400-Hz, 3-phase power source.	
16	.....	...28 VDC circuit breaker 1AICB1: ON		
17	.....	...115 VAC 3p circuit breaker 1A1CB2: ON		
18	.....	...Power mode switch 1A1S1: STBY	.....	STBY lamp 1A1DS2 lights. No other lamps light.
19	.....	...Power mode switch 1A1S: OPR	.....	STBY lamp 1A1DS2 extinguishes. OPR lamp 1A1DS1 lights. No other lamp lights.
20	.....	.....	Check voltage measurements as in table 3-2, items 1 through 1 1'.	
21	.....	...ION PUMP ON/OFF circuit breaker 1A1CB3: OFF		
22	.....	...EXHAUST VALVE: fully ccw (open)		
23	.....	...MECH PUMP circuit breaker 1A1CB7: ON	.....	MECH PUMP ON lamp 1A1DS11 lights.
24	.....	...ISOLATION VALVE: fully ccw (open)		
25	.....	...HIGH VACUUM VALVE: ccw (open)		
26	.....	...MECH PUMP HEATER CONTROLS-circuit breaker 1A1CB6; ON	.....	MECH PUMP lamp 1A1DS8 lights.
27	.....	...H VAC ASSY HEATER CONTROLS circuit breaker 1A1CB4:ON	.....	H VAC ASSY lamp 1A1DS6 lights.
28	.....	...FORELINE TRAP HEATER CONTROLS circuit breaker 1A1CB5: ON	.....	FORELINE TRAP lamp 1A1DS7 lights.

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
29	.....	...MECH PUMP MICRON METER: wait for meter to reach CAL area		
30	.....	...H VAC ASSY HEATER CONTROLS circuit breaker 1A1CB4:OFF	.....	HVAC ASSY lamp 1 AlDS6 " extinguishes.
31	.....	...FORELINE TRAP HEATER - CONTROLS circuit breaker 1A1 CB5:OFF	.....	FORELINE TRAP lamp 1A1DS7 extinguishes.
32	.....	...HIGH VACUUM VALVE: cw (closed)		
33	.....	...ION PUMP ON/OFF circuit breaker 1A1CB3:ON	.....	START lamp mA1DS5 lights. ION PUMP meter, 2, eventually indicates 3250*250 vdc.
34	.....	...BALLAST VALVE: open, then close finger tight (cw).		
35	.....	...MECH PUMP METER: wait for meter to reach less than 10 MA, switch RUN/START to RUN.	.....	RUN lamp 1A1DS4 lights. START lamp 1A1DS5 extinguishes.
36	.....	...ISOLATION VALVE: closed (cw).		
37	.....	...MECH PUMP HEATER CONTROLS circuit breaker 1A1CB6: OFF	.....	MECH PUMP lamp 1A1DS8 extinguishes.
38	.....	...MECH PUMP circuit breaker 1A1CB7:OFF	.....	MECH PUMP ON lamp 1A1DS11 extinguishes.
39	.....	...HIGH VACUUM VALVE: slowly open valve, making sure current does not exceed 10 MA		
40	.....	...SENS potentiometer 1A1R3: cw just beyond "click."	Adjust COARSE potentiometer 1A1R1 and FINE potentiometer 1A1R2 until LEAK DETECTOR meter lA1M3 indicates zero.	

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
41	.....	.....	Adjust SENS potentiometer 1A1R3 clockwise in small increments and adjust COARSE and FINE potentiometer to keep meter 1A1M3 zeroed. Continue until SENS potentiometer is fully clockwise and LEAK DETECTOR meter 1A1M3 indicates zero. (Verify 1A1M3 indicating needle moves to the right as pressure lowers. If high vacuum exists, 20-30QA, M3 may not move.)	LEAK DETECTOR meter 1A1M3 indicates zero and SENS potentiometer 1A1R3 is fully clockwise.
42	.....	.....SENS potentiometer 1A1R3 ccw beyond "click" to off.		
43	.....	...HIGH VACUUM VALVE: cw (closed)		
44	.....	...ION PUMP ON-OFF circuit breaker 1A1CB3: OFF	.....	RUN lamp 1AlDS4 extinguishes.
45	.....	...ION PUMP START/RUN switch 1A1S2: START		
46	.....	...Power mode switch 1A1S1: Off ..... 28 VDC circuit breaker 1A1CB1: OFF 115 VAC 30 circuit breaker 1A1CB2: OFF Unit 2:	Disconnect all unit 1 cables.	
47	.....	...All switches to OFF	Connect cable 2W1 between connector 2A1J1 and the 28 vdc power source. Connect cable 2W2 between connector 2A1J2 and the 115 vac, 400-Hz, 3-phase power source.	
48	.....	...DETECTOR TESTER BIAS ADJUST potentiometer 3A1R2: Fully ccw	Connect cable W5 between 2A1J5 and 3A1J1. Connect cable W4 between 2A1J2 and J1 of the rotary compressor.	
49	.....	...DETECTOR TESTER DETECTOR SELECTOR switch 3A1S1: OFF		

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
50	.....	...COOLER switch 2A1S4 HIGH HIGH SPEED	.....	SPEED lamp 2A1DS6 lights.
51	.....	...COOLER Switch 2AIS4 LOW SPEED	.....	HIGH SPEED lamp 2DS6 extinguishes.
52	.....	...COOLER witch 2AIS4 OFF	.....	LOW SPEED lamp 2ADS9 extinguishes,
53	.....	...DETECTOR TESTER DETECTOR SELECTOR switch 3A1S1: 1 DETECTOR TEST switch 2A1S2. BIAS CHOPPER	.....	BIAS CHOPPER lamp ADS4 lights. Motor 3AIB1 turns chopper wheel.
54	Dvm FUNCTION switch: DC RANGE switch AUTO		..... Connect HI probe of dvm to 3A1J3 conductor; LO probe to 3A1J3 shield. BIAS ADJUST potentiometer 1l1R2 to obtain performance standard.	Dvm indicates 1.0 ±0.2 vdc.
55	.....	...DETECTOR TEST switch 3A1S2 BIAS extinguishes.	.....	BIAS CHOPPER lamp 2A1DS4 ' BIAS lamp 2A1DS7 lights. Chopper motor - stops. Dvm indicates 1.0 +0.2 vdc.
56	.....	...DETECTOR TEST switch 2AS2: OFF DETECTOR SELECTOR switch 3A1S1: OFF BIAS ADJUST potentiometer 3A1R1: Fully ccw	Disconnect dvm	BIAS lamp 2ADS7 extinguishes.
57	.....	..... Note. Exercise care when installing test manifold. Tighten supply and return fittings simultaneously so gas will not escape from compressor or test manifold.	Check test manifold gauges. Insure all valves are closed.	Manifold gauges indicate greater than 170 psig.
58	.....	...	Connect the compressor gas supply and gas return fitting to test manifold.	

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
59	.....	...Set the valves as indicated: Helium regulator valve:l/4 turn ccw Manifold return valve: Fully ccw Charging valve: Fully cw, Helium Isolation valve: Fully cw Caution: Do NOT operate compressor with both the supply gauge and the return gauge reading the same. For test purposes, use return pressure of 160 psig.		
60	.....	...COMPRESSOR switch 2A1S3: NORMAL	Regulate helium regulator for a return pressure of 160 +20 psig (return gauge is between valves 2 and 3).	NORMAL lamp 1A1DS5 lights. Compressor motor and fan operate.
61	.....	.....	Regulate helium pressure until return gauge reads 50 +10 psig.	Supply gauge pressure increases slightly.
62	.....	.....	Regulate helium regulator	Adjust to 160 ±20 psig return pressure.
		Note. For the remainder of the test, disregard supply and return gauge readings.		
63	.....	...COMPRESSOR switch 2A1S3: REV PHASE (spring loaded-hold in position)	.....	NORMAL lamp 2A1DS5 extinguishes. REV PHASE lamp 2A1DS8 lights. FAIL IND on compressor indicates GO. Compressor motor and fan turn off.
64	.....	...COMPRESSOR switch 2A1S3: OFF	Disconnect compressor fan connector 5B2J1	REV PHASE lamp 2A1DS8 extinguishes
65	.....	...COMPRESSOR switch 2A1S3: NORMAL	.....	REV PHASE lamp 2AIDS8 lights. FAIL IND on compressor indicates FAIL
66	.....	...COMPRESSOR switch 2A1S3: OFF	.....	REV PHASE lamp 2A1DS8 extinguishes. FAIL IND on compressor indicates FAIL.
67	.....	.....	Connect fan connector 5B2J1. Disconnect compressor motor connector 5BlJ1.	
68	.....	...COMPRESSOR switch 2A1S3: NORMAL.	.....	REV PHASE lamp 2A1DS8 lights. Compressor FAIL IND indicates FAIL.
69	.....	...COMPRESSOR switch 2A1S3: OFF	Connect compressor motor connector 5B1J1.	REV PHASE lamp 2AlDS8 extinguishes. Compressor FAIL IND indicates FAIL.

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
70	.....	...COMPRESSOR switch 2A13: NORMAL.	.....	Compressor FAIL IND indicates GO. Compressor motor and fan operate. NORMAL lamp 2A1DS5 lights.
71	.....	...COMPRESSOR switch 2A1S3: OFF. Power mode switch 2A1S1: OFF. 28 VDC circuit breaker 2A1CB1: OFF 115 VAC - 30 circuit breaker 2A1CB2: OFF Refrigerant Service Kit:	Disconnect cables	NORMAL lamp 2A1DS5 extinguishes. Compressor motor and fan stop. FAIL Indicator indicates GO. OPR lamp C 2A1DS1 extinguishes.
72	.....	...Helium bottle	Open the shut off valve (ccw). Operate regulator valve to regulate low pressure.	265 20 psig.
73	.....	.....	Close shut off valve (cw). Close regulator valve (cw).	
74	.....	...C02 Bottle	Open the shutoff valve (ccw)	Greater than 400 psig.
75	.....	.....	Close shutoff valve (cw).	

CHAPTER 4

DEPOT MAINTENANCE

Section I. GENERAL

4-1. Scope of Depot Maintenance

This chapter provides depot maintenance procedures for the cryo test set and the refrigerant service kit. Included in this chapter are sections covering: troubleshooting; removal and replacement; adjustment and alignment; repair; depot testing; and printed circuit board maintenance.

4-2. Depot Maintenance Forms and Records

Depot maintenance forms, records, and reports which are used by maintenance personnel are listed in and prescribed by TM 38-750.

4-3. Depot Tools and Test Equipment

Tools and test equipment required for depot maintenance of the cryo test set and the refrigerant service kit, other than those listed in TM 116625-2446-12 are as follows:

a. Tools. Tool Kit, Electronic Equipment I TK-105/G.

b. Test Equipment. Test equipment is listed in table 4-1.

Table 4-1. Test Equipment

Equipment	Applicable publication
Multimeter TS-352B/U	TM 11-6625-615
Oscilloscope AN/USM-281A	TM 11-6625-1703-15
Voltmeter, Digital, (Non Linear Systems Model X-2).	
Test Set, Electronic Circuit Plug-In Unit AN/AAM-39.	TM 11-6625-1S22-12

Section II. DEPOT TROUBLESHOOTING

4-4. Depot Troubleshooting Instructions

Troubleshooting at the depot maintenance level includes all the techniques outlined for organizational and general support maintenance and any special or additional techniques required to isolate a defective part. The maintenance procedures are not complete within themselves, but supplement those described in TM 11-6625-2446-12 and in chapter 3 of this manual. The systematic troubleshooting procedure, which begins with the operational and sectionalized checks that are performed at the organizational and general support level must be completed by means of further localizing and isolating techniques. The paragraphs that follow provide such procedures for localizing and isolating malfunctioning items. Parts location information is provided in figures 4-1 through 4-8, 4-12, and FO-8.

4-5. Methods of Troubleshooting

a. General. The first step in troubleshooting is to sectionalize the fault (tracing the fault to a major functional unit). The second step is to localize the fault (tracing the fault to a defective component within that unit). Some faults such as burned-out resistors, arcing, and shorted transformers can often be located by sight, smell, and hearing. The majority of faults, however, must be isolated by checking voltages and resistances, or by checking the equipment against the general support test procedure contained in chapter 3, section VI.

b. Sectionalization. For ease of troubleshooting, the equipment may be thought of as consisting of functional entities, each related electrically but categorized separately by the function performed. The first step in troubleshcooting is to locate the function, or functions, at fault by the following methods:

(1) *Visual inspection.* The purpose of the visual inspection is to locate faults without testing or measuring the circuits. All visual signs should be observed and an attempt made to sectionalize the fault to a particular function or if possible, to a particular component.

(2) *Operational Test.* Operational tests frequently indicate the general location of trouble. In many instances the tests will help in determining the exact nature of the fault. The organizational quarterly preventive maintenance checks and services chart (TM 11-6625-244612) contains an operational test.

c. Localization. The tests listed in the following paragraphs will aid in localizing the fault. First, localize the fault to a single function, and then isolate the fault within that circuit by waveform, resistance, and continuity measurements.

(1) *Troubleshooting chart.* When used with the associated voltage, resistance, and continuity tables and the waveform diagram, the troubleshooting information in chart 4-1 will aid the technician in localizing troubles to a component part. Defective components identified by performing the corrective action are replaced with a known reliable component unless repair or other disposition is noted. The corrective action column references data tables, if required, for checking components; otherwise, refer to schematics and wiring diagrams when performing checks.

(2) *Waveform measurements.* Oscilloscope AN/USM-281A is used for observing waveforms at appropriate test points.

(3) *Voltage and resistance measurements.* The digital voltmeter, nonlinear systems, model X-2, is used for taking voltage and resistance readings. Multimeter TS-352E/U is available if required. Voltage and resistance data is listed in the appropriate printed circuit board or electronic component section. For proper use of equipment, refer to chapter 3.

(4) *Continuity checks.* Continuity checks are complete in chapter 3.

(5) *Intermittent troubles*. When troubleshooting, the possibility of intermittent troubles should not be overlooked. This trouble can often be made to appear by tapping or jarring the equipment. Check wiring and connections.

4-6. Maintenance, Repair, and Time-Change Items Table 4-2 and the following paragraphs contain general instructions for cryo test set maintenance. The time-change items and general repair instructions should guide the maintenance team to more fully complete the maintenance task.

Chart 4-1. Troubleshooting Procedure

Malfunction	Probable cause	Corrective action
Vacuum Pump Assembly, Unit i:		
1 Unit does not pump down to 10- torr	a. Valves improperly positioned or faulty.	a. Check valves for position and leakage.
	b. Tabulation leak	b. Check tabulation.
	c. Gasket leak Note. Replace all copper gaskets whenever tabulation is recommended.	c. Check gaskets.
	d. Improper connection of OFHC tubing.	d. Check OFHC tubing.
	e. Mechanical pump faulty	e. Check for oil level and proper operation.
2 Unit does not pump down to 10-' torr.	a. Refer to a through d above	a. Refer to a through d above.
	b. Faulty ion pump **Note. Contamination in lines can cause this malfunction. Insure that line4 are clean and free of contamination.**	b. Check ion pump.
Detector Tester, 3A1:		
1 Chopper wheel binds	a. Warped chopper wheel	a. Repair chopper wheel.
	b. Bent chopper wheel	b. Replace chopper wheel.
2 Chopper wheel does not rotate	a. Mechanical connections improper	a. Check connections.
	b. Motor does not rotate	b. Check motor.

Malfunction	Probable cause	Corrective action
3 Poor detector response from the unit under test.	a. Mirror dirty	a. Clean mirror.
	b. Mirror improperly aligned	b. Align mirror.
	c. Mirror scratched or broken	c. Replace mirror.
Compressor:		
1 Supply pressure below 230 psig	Defective compressor pump 5MP17	Replace 5MP17.
2 Refrigerator does not cool properly.	a. Defective fan assembly 5MP20	a. Check flow and direction of air.
	b. Line stoppage in heat exchanger	b. Replace heat exchanger.
3 Unit fails to start	a. Power is off	a. Apply power.
	b. Incorrect or disconnected wiring to the compressor.	b. Inspect wiring, connectors, sockets and plugs. Repair or replace as necessary.
	c. Electrical harness wiring faulty	c. Refer to b above.
4 Compressor runs, but is very noisy	a. Insufficient helium	a. Add dry, clean helium gas.
	b. Compressor pump is running back- ward.	b. Check electrical wiring.
	c. Compressor pump is defective	c. Replace pump (para 4-12).
5 Slow cooldown	a Fan running backward or not running at all.	a. Inspect wiring, connectors, socket, and plugs. Check continuity (table 3-4, items 81 through 91).
	b. Compressor fan not getting enough air.	b. Check clearance around compressor fan.
	c. Heat exchanger fins dirty	c. Clean fins.
	d. Low supply pressure caused by low- charging pressure.	d. Add clean, dry helium gas.
	e. Unusually high ambient temperature.	e. Reduce ambient temperature.
	f. System contamination caused by contaminated gas. dry helium.	f. Evacuate and recharge with clean,
	g. System contamination caused by carryover of liquid oil or oil vapor (check for presence of oil in supply connection at refrigerator).	g. Replace pump and absorber.
	h. Gas leakage	h. Locate and connect any leaks.
	i. Compressor pump defective	i. Replace pump (para 4-12).

a. Toolkit.

(1) Salvage and straighten damaged wrenches.

(2) Replace a missing or damaged knob or setscrew on the valve timing tool.

(3) Replace any missing items.

(4) Refer to TM 11-6625-2446-12, maintenance and operating supplies list (app. B), section III for replacement of expendable items.

(5) Repair any structural damage to the pinch-off tool or mount. Insufficient pinch can be caused by binding of the pinch-off blade on the guides, leakage of fluid, or poor pump. Check the guides, the fluid, the pump and mechanical connections on the pump. Repair or replace damaged items. If the blade does not return after pressure is released, check guides for binding and springs for strength.

b. Manifold. Manifold maintenance techniques are contained in the following steps.

CAUTION

Remove valve seats before brazing. Avoid excess heat to prevent damage to parts. After brazing, remove all oil, grease, flux, dirt, scale, or foreign matter that might contaminate the helium gas. Once the manifold is clean, evacuate and replenish with helium to 150 psig.

(1) The helium regulator valve, all caps, coupling halves, and gages are threaded and can be loosened and removed. All other tubulation is

brazed in place and, if damaged, must be cut away. The component from which the damaged part is removed must be machine-tooled to accept the replacement part. The new part must be brazed in place. Refer to figure 4-12 for part location information.

(2) Periodically replace any lost or broken knobs, worn needle valves or fittings, and lost or damaged gage covers.

(3) Replace O-rings between coupling halves and adapters when replacing coupling halves.

Table 4-2. Compressor Repair and Replacement Data

Item	Replacement criteria
Absorber	Replace after 500 hours of operation and whenever there is oil carryover from the separator. Replace O-rings, gaskets, or self-sealing couplings if leaking or damaged.
Base	Replace base if there is evidence of cracked welds or other damage that makes continued use inadvisable.
Fan	Replace after 2000 hours or when defective.
Flow restrictor	Replace after 2000 hours or when defective.
Heat exchanger	Replace if brazed joints leak welded mounting tabs are fractured, fan mounting nuts have stripped threads, or vanes are badly damaged.
Oil separator	Replace if threaded fittings damaged, soldered fittings are cracked (small cracks can be repaired) there are dents larger long or welds are leaking.
O-rings	Replace all O-rings during overhaul.
Pressure gage	Replace gauge if broken or inaccurate.
Pump	Replace after 2000 hours. Return to manufacturer for overhaul.
Seals and gaskets (copper).	Replace when leaking or fitting is disassembled.

c. Receiver Optics Plate. If the receiver optics plate is damaged, straighten and refinish. Replace the mounting pads.

d. Oil Tank. There is no maintenance capability on the oil tank. Return to vendor for recharging.

e. Service Kit.

(1) Check all fittings, knobs, valves, hoses, and gauges. Replace as necessary.

(2) Replace any lost knobs or other parts.

(3) Replenish CO2 by weight and helium by pressure.

4-7. Selective Troubleshooting

a. Defective Signal Monitoring. Failure to monitor a selected voltage, signal, or indication may be caused by defective external test equipment. If an operational check fails to sectionalize trouble to a defective unit follow the procedures given in (1), (2), and (3) below.

(1) External test equipment check. All external test equipment should function properly. Perform operational checks on each unit of external test equipment as described in the applicable test equipment manual.

(2) Control units check. All major functional areas of the control units should function properly, including the active circuits (semiconductor circuits) and the controls.

(a) Active circuits. If any of the transistor or diode circuits are suspected of causing a malfunction, isolate the trouble by using pressure and temperature or voltage and resistance measurements with external test equipment.

(b) Controls. To verify that all electrical controls are functioning properly, perform continuity measurements (table 3-4) while the controls are rotated through each position.

(3) Connectors check. The continuity measurements will aid in determining whether a connector is contributing to the malfunction.

b. Checking Cable Assemblies. All interconnecting cable assemblies should be checked for signs of insulation deterioration and for opens and shorts near the connectors. Check connectors for bent or deformed pins and for signs of arcing.

Section III. DEPOT REMOVAL AND REPLACEMENT PROCEDURES

4-8. General

Removal and replacement procedures for items of the cryo test set are provided in the following paragraphs. All parts may be removed using standard tools and maintenance by the step-bystep procedure. Figures 4-1 through 4-8, 4-12, and FO-7 show parts location of items -and hardware associated with the item.

4-9. Vacuum Power Group, Unit 1, Removal and Replacement Procedures

a. Power Supply PP-6527/AAM-40, 1A1 (fig. 4-1).

(1) Remove the 14 screws securing the power supply 1A1 access panel and remove the panel; remove the left side access panel.

(2) Loosen the 16 screws securing power supply 1A1 and slide out to the stops.

(3) Disconnect connector plugs 1AlJ2 and J3 from the rear of power supply 1A1. Disconnect 1AlP1 and P2 from 1A1A3.

(4) Press the slide releases and remove power supply 1A1 from unit 1.

(5) To replace power supply 1A1, position the slides on the slide guides and slide 1A1 approximately one-half way into unit 1.

(6) Pull power supply 1A1 out until the drawer stops engage.

(7) Connect connector plugs 1A1J2 and J3 to power supply 1A1 and connect 1A1P1 and 1A1P2 to A11A3.

(8) Push power supply 1A1 all the way in and tighten the 16 screws around the perimeter of the control panel.

(9) Replace all access covers and secure screws.

b. Mechanical pump, 1MP13MP52 (fig. 4-5).

(1) Remove power supply 1A1 access panel 1A1 and the left side and right side access panels to allow access to mechanical pump 1MP13MP52. (1.1) Open the roughing valve fully counterclockwise.

(2) Disconnect the three electrical connections to the mechanical pump.

(3) Disconnect the exhaust and ballast valve lines from the pump at the swedge lock fittings.

(4) Disconnect the inlet to the pump at the flange below the solenoid valve 1L2.

(5) Remove the six bolts securing mechanical pump assembly 1MP13MP52 to isolator shock mounts 1MP1341 through 1MP1346.

(6) Tilt mechanical pump 1MP13MP52 to gain access to mechanical pump 1MP13MP52 holddown bolts (4); remove the four bolts

CAUTION

When removing, handling, or transporting the mechanical pump, do not invert. Oil can escape from the pump when inverted.

(7) Slide mechanical pump 1MP13MP52 off of the electric motor 1Bl shaft and remove pump.

(8) To replace mechanical pump 1MP13MP52, slide mechanical pump 1MP13MP52 shaft onto electric motor gearbox 1B1MP1 coupling.

(9) Secure mechanical pump 1MP13MP52 to the motor mount with the four bolts.

(10) Secure the tray to the shock mounts with the six bolts.

(11) Connect the inlet with the six bolts.

(12) Connect the exhaust and ballast valve lines to the pump at the swedgelock fittings.

(13) Connect the three electrical plugs to the mechanical pump.

(14) Secure the left side and right side access panels and the power supply 1A1 access panel.

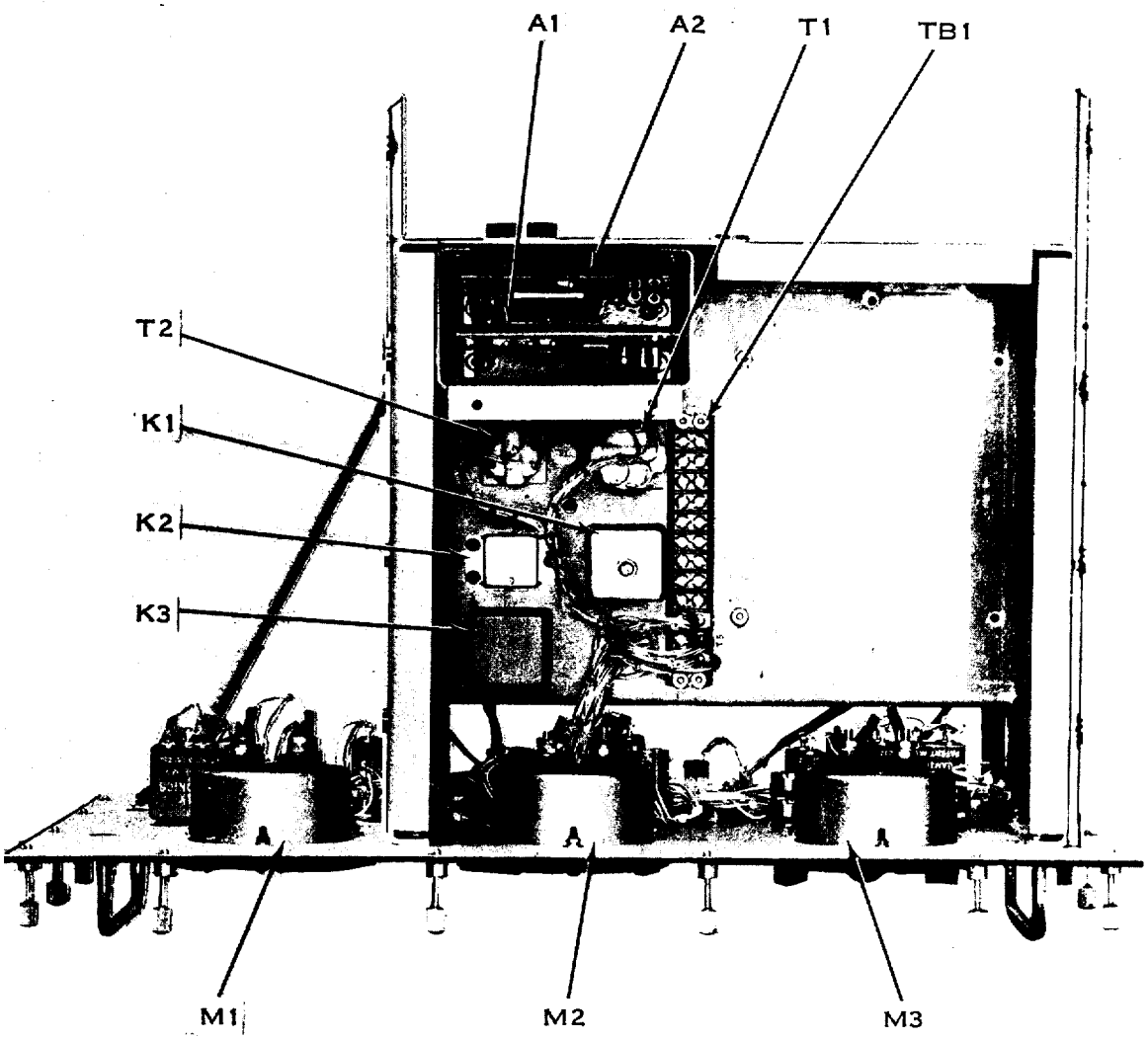


Figure 4-1 (1). Power supply 1A1, parts location (part 1 of 3)

(15) Close the roughing valve fully clockwise and pen the exhaust valve fully counterclockwise.

(16) Connect test set to primary power source. Set o v, -t mode switch to OPR and mechanical pump ON1I F switch to ON.

(17) After I hour, set mechanical pump ON-OFF switch to OFF and power mode switch to OFF.

(18) Close exhaust valve fully clockwise and disconnect primary power from test set.

c. Ion Pump, 1MP13MP52 (fig. 4-5).

(1) Remove power supply access panel 1A1 and the left side and right side access panels to allow access to bottom part of ion pump IMP13MP52.

(2) Open the isolation valve first and then the high vacuum valve fully counterclockwise.

(3) Disconnect the four electrical connections from ion pump 1MP13MP52 and the high voltage line.

(4) Disconnect the ion pump at the first flange.

(5) Remove the four screws securing ion pump 1MP13MP53 to vacuum group unit 1.

(6) Remove ion pump 1MP13MP52.

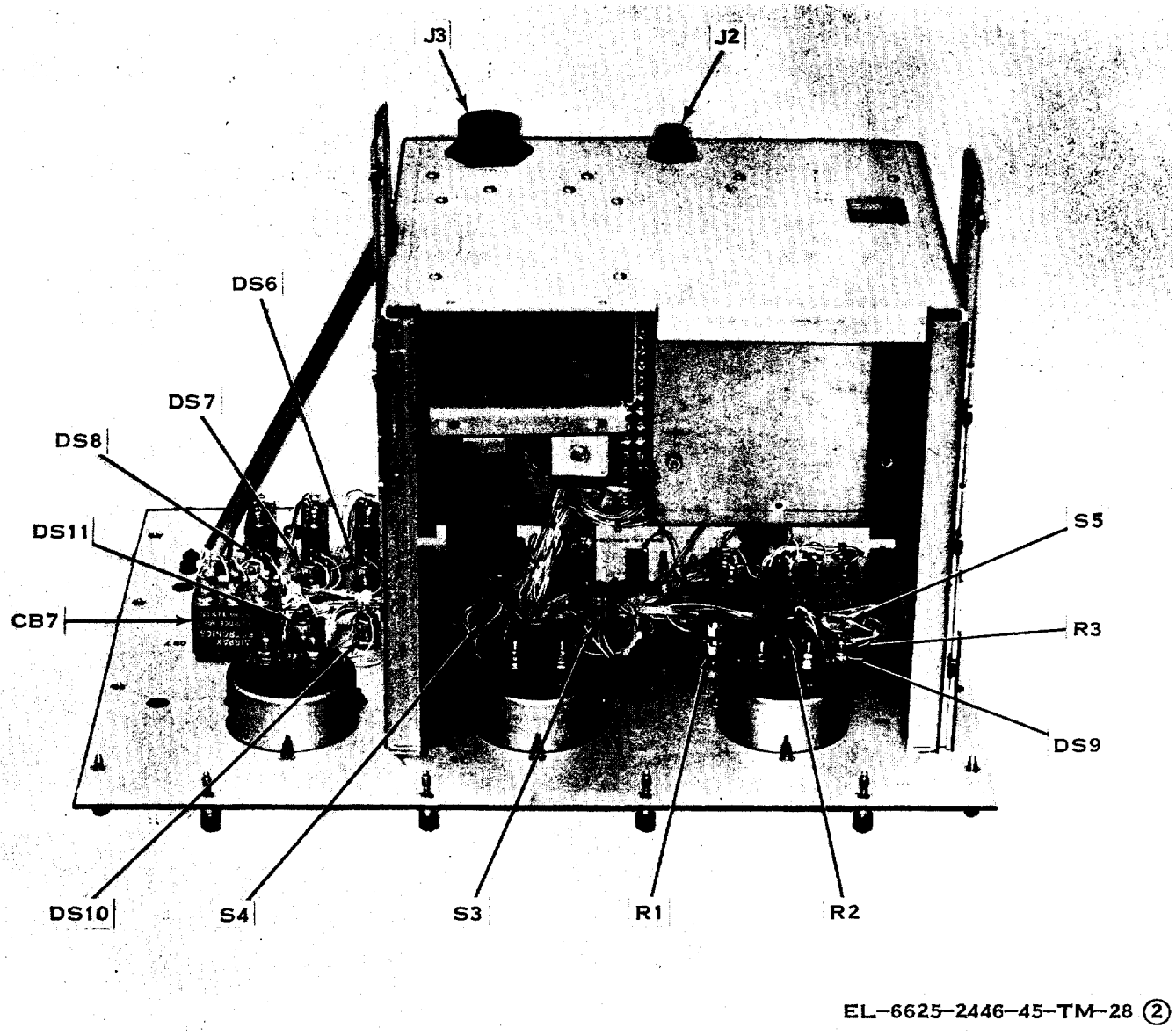


Figure 4-1(2). Power supply 1A1, parts location (part 2 of 3).

(7) To replace ion pump 1MP13MP52, replace ion pump 1MP13MP53 and secure to vacuum pump group 1 with four screws.

(8) Connect inlet flange.

(9) Connect the four electrical connections and the high voltage line.

(10) Install power supply 1A1 access panels and the left side and right side access panels.

(11) Open the isolation valve and high vacuum valve fully clockwise.

(12) Open exhaust valve fully counterclockwise.

(13) Connect primary power to test set and set power mode switch to OPR and 115 vac and 28vdc switch to ON.

(14) Set FORELINE TRAP heater switch to ON and mechanical pump ON-OFF switch to ON.

(15) After 1 hour, set FORELINE TRAP switch to OFF.

(16) After 15 minutes, close isolation valve and high vacuum valve and set mechanical pump ON-OFF switch to OFF. Close the exhaust valve fully clockwise.

(17) Set ion pump START/RUN switch to START and PUMP SELECT switch to MAIN.

(18) Observe ION PUMP meter. When it indicates 10mA, switch the ion pump switch to ON and switch the START/RUN switch to RUN. When it indicates less that 100uA, set ion pump ON-OFF switch to OFF.

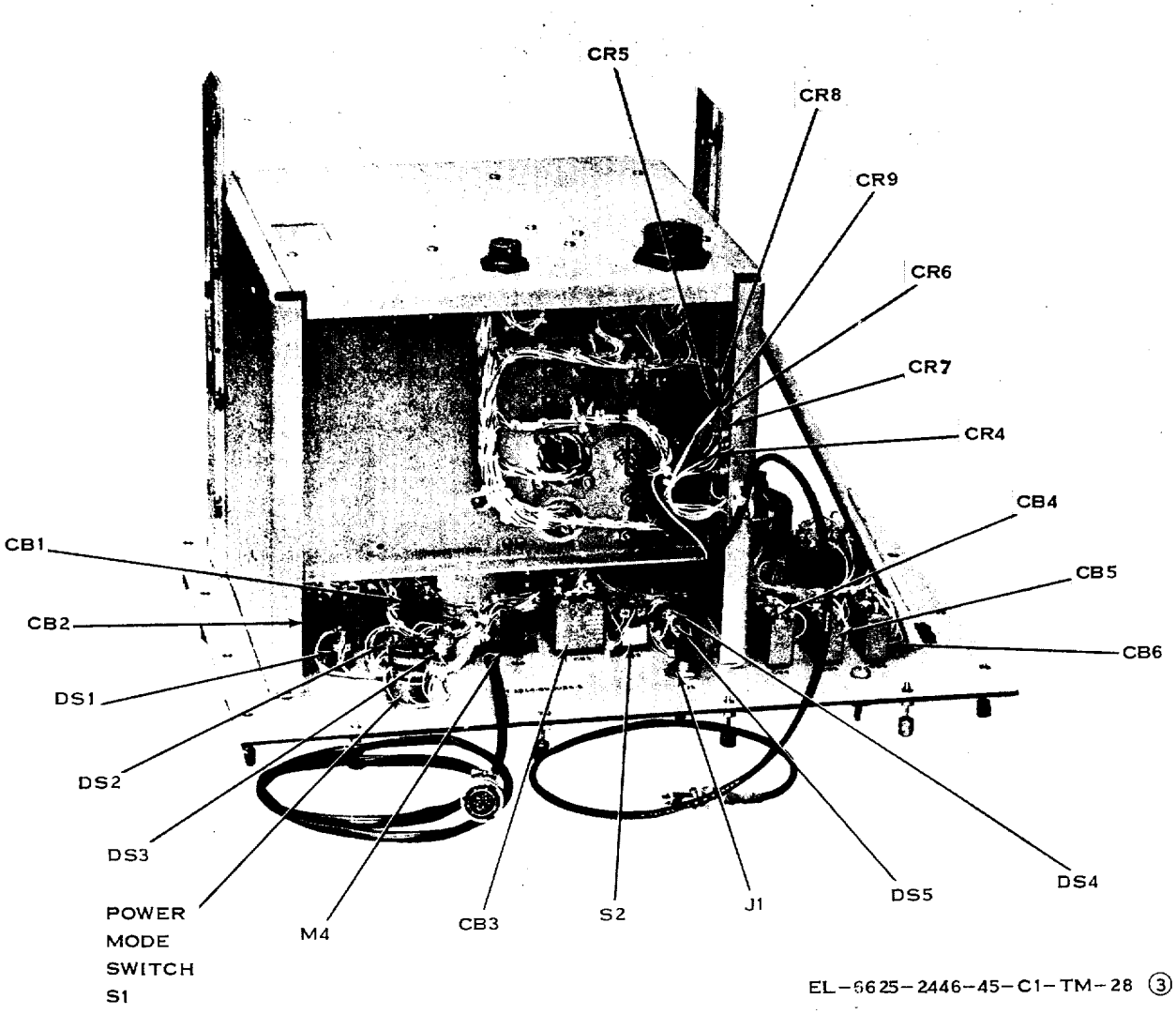


Figure 4-1(3). Power supply 1A1, parts location (part 3 of 3).

(19) Set power mode switch to OFF and disconnect primary power from the test set.

4-10. Control Group, Unit 2, Removal and Replacement procedures (fig. 4-6)

a. Loosen the 9 screws securing the control unit to the case.

b. Lift the control unit from the case.

c. To replace the control unit, lower it into the case, and tighten the 9 screws.

4-11. Maintenance Group, Unit 3, Removal and Replacement Procedures (fig. 4-7)

a. Detector Tester Chopper Wheel, 3A1MPII.

(1) Remove the 20 screws securing top plate 3A1MP30.

(2) Remove top plate 3A1MP30.

(3) Remove three screws securing chopper wheel, 3A1MP11 to bushing 3A1MP10 wheel 3A1MP11.

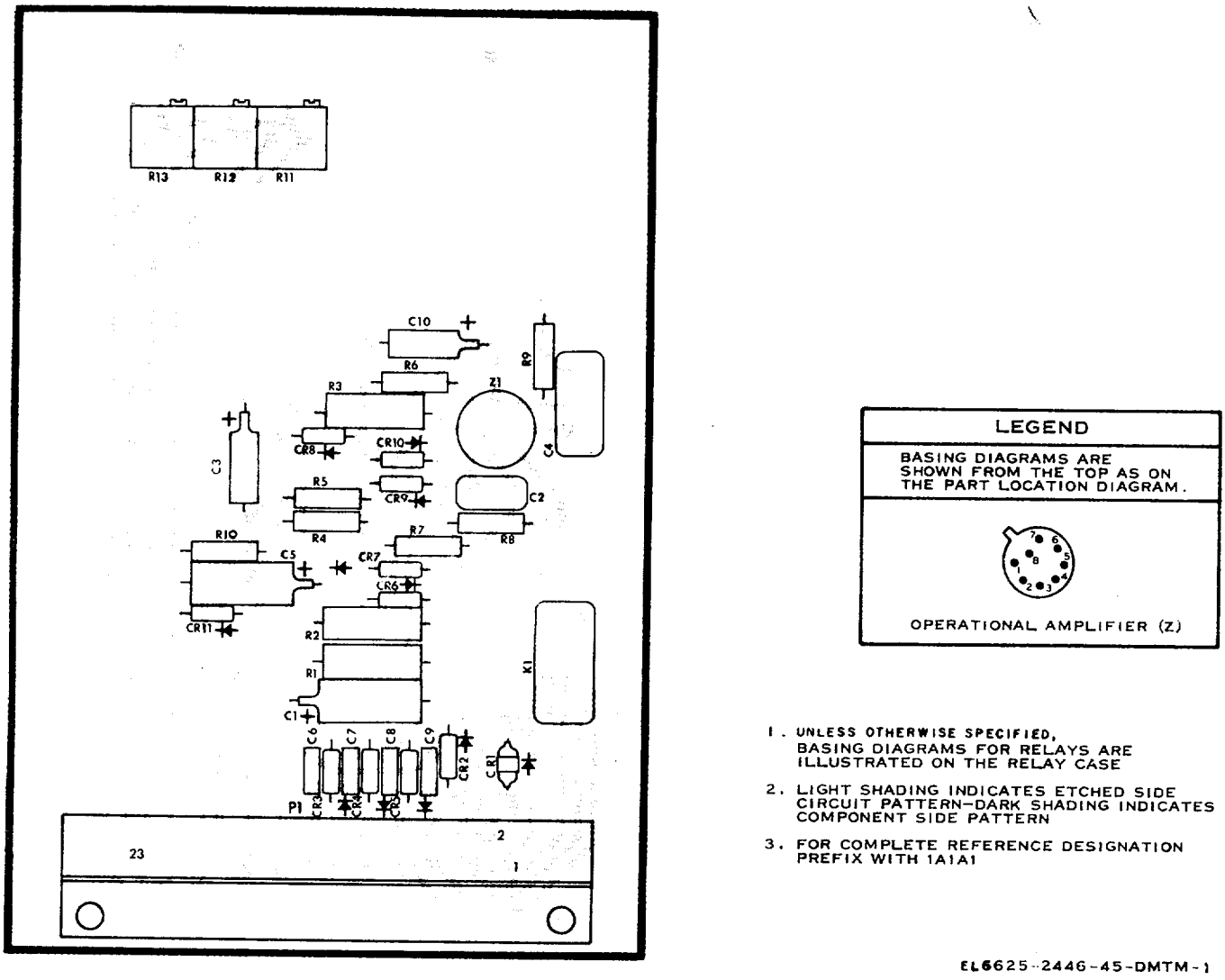


Figure 4-2. Leak detector, 1A1A1, parts location.

(4) To replace the chopper wheel, install chopper wheel 3A1MP11; insert and secure the three screws.

CAUTION

Operate chopper wheel and check for wobble or warp. The permissible vertical movement of the edge of the wheel is 1/32 inch.

(5) Position top plate 3A1MP30; insert screws and secure.

CAUTION

Do not allow cradle plate 3A1MP23 to touch chopper wheel 3A1MP11 while installing top plate 3A1MP30.

b. Detector Tester Motor, 3A1B1.

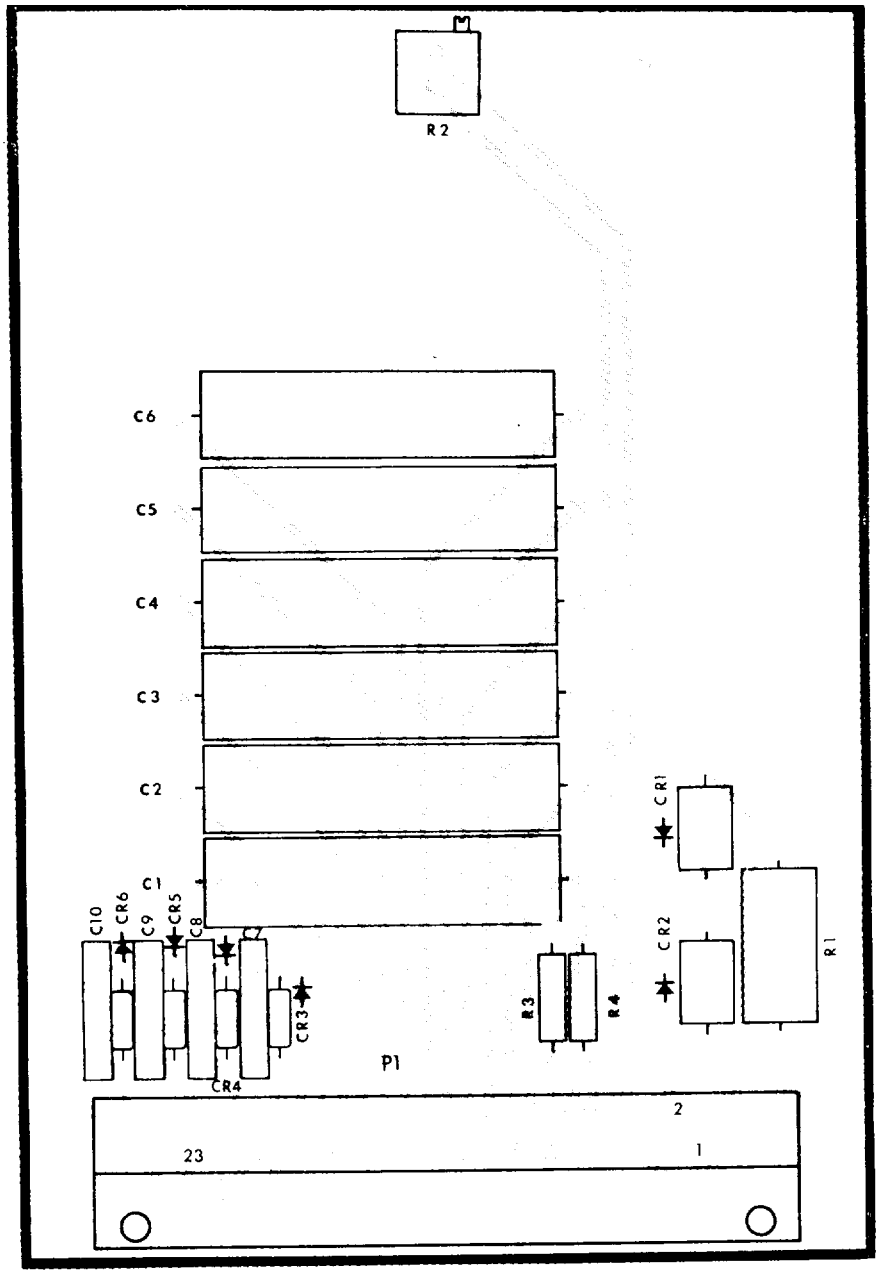
(1) Perform removal of chopper wheel 3A1MP11 (*a* above).

(2) Remove the 14 screws securing left plate 3A1MP26 and remove left side plate 3A1MP26.

(3) Unsolder the three motor wires from the diode matrix 3A1CR2 through CR7.

(4) Remove the 10 screws securing back plate 3A1MP21.

(5) Remove the 8 remaining screws securing intermediate plate 3A1MP25 to right side 3A1MP27 and front assembly 3A1MP14MP16 and remove intermediate plate 3A1MP25.



NOTE

1. LIGHT SHADING INDICATES ETCHED SIDE CIRCUIT PATTERN—DARK SHADING INDICATES COMPONENT SIDE PATTERN
2. FOR COMPLETE REFERENCE DESIGNATION PREFIX WITH 1A1A2

EL6625-2446-45-DMTM-2

Figure 4-3. High vacuum unit 1A1A2, parts location.

(6) Remove the four screws securing motor 3A1B1 to intermediate plate 3A1MP25; remove bushing 3A1MP10 from the motor shaft.

(7) To replace the detector tester motor, place bushing 3A1MP10 onto the motor shaft and position motor 3A1B1 on intermediate plate 3A1MP25.

(8) Position intermediate plate 3A1MP25 onto right side plate 3A1MP27 and front assembly 3A1MP14MP16; insert and secure the 8 screws.

(9) Position chopper wheel 3AIMPI I onto bushing 3A1MP10 and insert and secure the three screws.

CAUTION

Operate chopper wheel 3A1MP11 and check for wobble or warp. The permissible vertical movement of the edge of the wheel is + 1/32 inch.

(10) Position back plate 3A1MP21 on the dowel pins; insert and secure the 10 screws.

(11) Solder motor 3A1BI wires to diode matrix 3A1CR2 through CR7.

(12) Position left side plate 3A1MP26; insert 14 screws and tighten.

(13) Position top plate 3A1MP30; insert screws and tighten.

CAUTION

Do not allow cradle 3A1MP23 to touch chopper wheel 3A1MP11 while installing top plate 3A1MP30

c. Detector Selector Mirror, 3A1MP15.

(1) Remove the 20 screws securing base plate, 3A1MP22 and tilt the base plate downward.

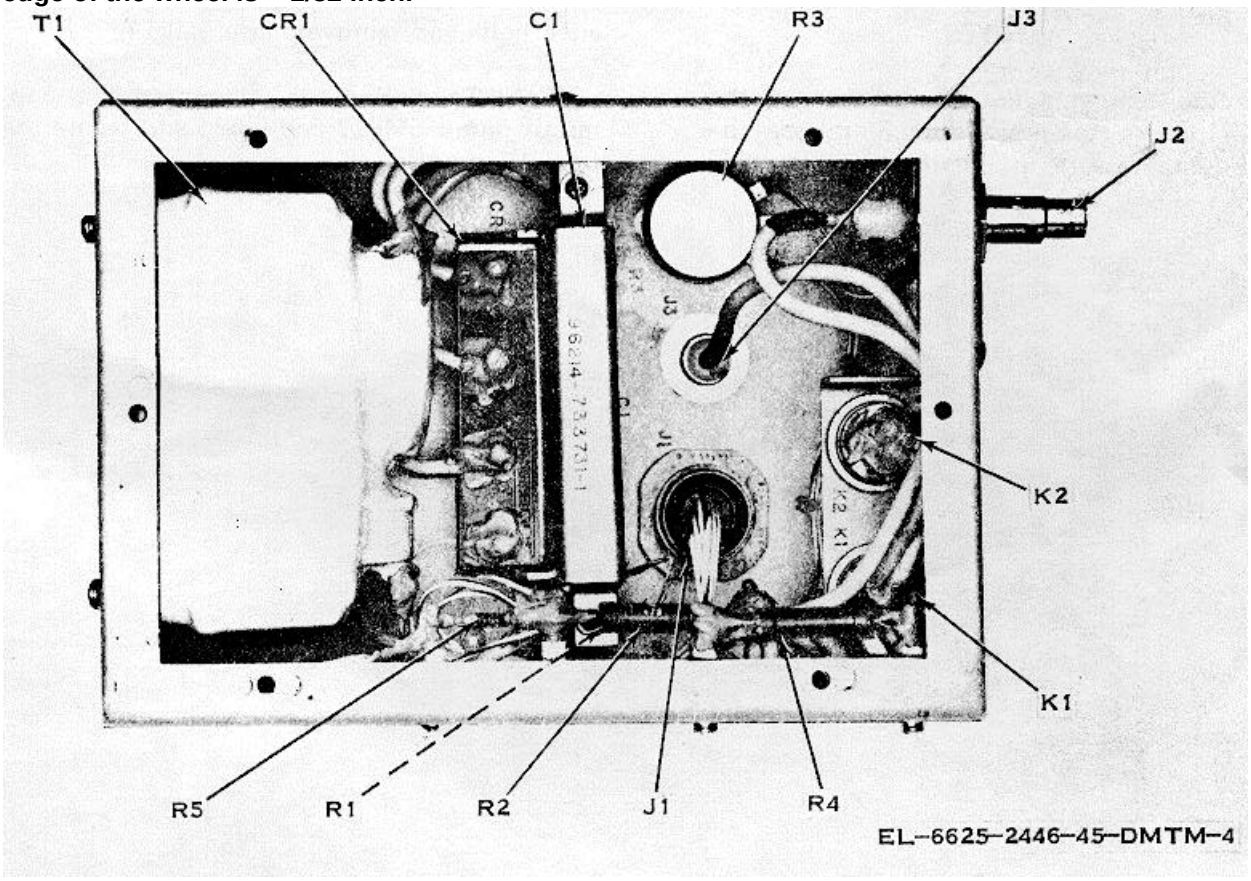


Figure 4-4. High voltage power supply 1A1A3, parts location

CAUTION

Exercise care when tilting base plate 3A1MP22. Do not apply force to electrical connections on base plate 3A1MP22.

(2) Screw mirror pivot 3AlMP19 clockwise until mirror is free.

(3) To replace detector selector mirror, position mirror in place and screw mirror pivot 3A1MP19 counterclockwise until mirror adjustment plate 3A1MP20 rests on adjustment pins 3A1MP16, 17, and 18.

(4) Position base plate 3AlMP22; insert screws and tighten.

4-12. Evacuation and Charging Group, Unit 4, Removal and Replacement Procedures (fig. 4-8)

NOTE

Before removing any component on the compressor assembly unit 5, release the helium pressure in the lines by attaching manifold 4MP8 and slowly opening the isolator valve. When replacement is complete, evacuate the manifold 4MP8 and compressor assembly unit 5, using vacuum pump group unit 1 attached to the isolator valve. When evacuation is complete, close the isolator valve and replenish the helium through the charging valve of manifold 4MP8. Helium is available in the service kit.

a. Compressor Pump, Unit 5.

(1) Disconnect compressor pump motor connector 5B1J1 from connector 5B1P1.

(2) Remove the four Allen bolts each securing the three gas supply lines to the heat exchanger.

(3) Disconnect the two gas return lines from pump 5MP17.

(4) Remove the four pump retaining allen bolts and remove pump 5MP17.

(5) To replace the compressor pump, install pump 5MP17 and insert and secure the four Allen bolts.

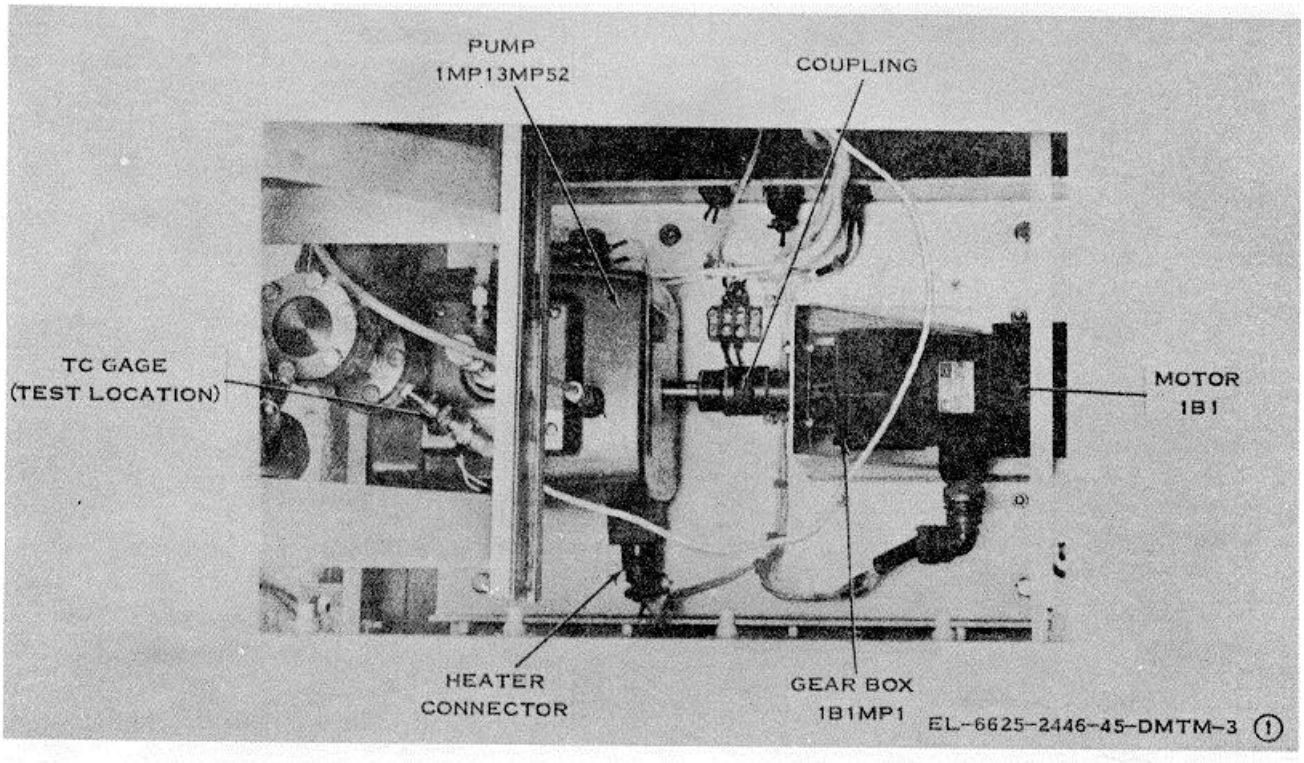


Figure 4-5 (1). Vacuum pump group unit 1, parts location (part 1 of 3).

(6) Connect the two gas return lines to pump 5MP17.

(7) Insert and secure the four Allen bolts on the three gas supply lines to the heat exchanger.

(8) Connect compressor pump motor connector 5B1P1 to the compressor pump.

b. Fan Assembly 5MP20.

(1) Disconnect connector 5B2J1 from 5B2P1.

(2) Remove the four Allen bolts securing the electrical fan assembly 5MP20 connector.

(3) Remove the four retaining Allen bolts securing fan assembly 5MP20 heat exchanger 5MP25.

(4) Exercise care and slide the fan assembly from heat exchanger 5MP25.

(5) To replace the fan assembly, slide fan assembly 5MP20 into heat exchanger 5MP25.

(6) Secure the fan assembly 5MP20 to the heat exchanger 5MP25 with the four Allen bolts.

(7) Secure the electrical connector to heat exchanger 5MP25 with the four Allen bolts.

(8) Connect electrical connector 5B2J1 to connector 5B2P1.

c. Heat Exchanger 5MP25.

(1) Perform fan assembly 5MP20 removal procedure (para 4-12b).

(2) Remove the two Allen bolts securing the power factor correction capacitor 5C1.

(3) Disconnect the four gas lines from the heat exchanger 5MP25.

(4) Remove the six holddown Allen bolts securing heat exchanger 5MP25 to base plate 5MP3.

(5) Remove heat exchanger 5MP25.

(6) To replace the heat exchanger, install heat exchanger 5MP25 and secure with the six holddown Allen bolts.

(7) Connect the four gas lines.

(8) Mount power factor correction capacitor 5C1.

(9) Install fan assembly 5MP20 (para 4-12b).

d. Adsorber 5MP1.

(1) Loosen the retaining nut on the gas supply line.

(2) Loosen the female coupling securing the rear of adsorber 5MPI to adsorber support 5MP2.

(3) Lift the adsorber from compressor pump, unit 5.

(4) To replace the adsorber, place the adsorber in position on the compressor pump, unit 5.

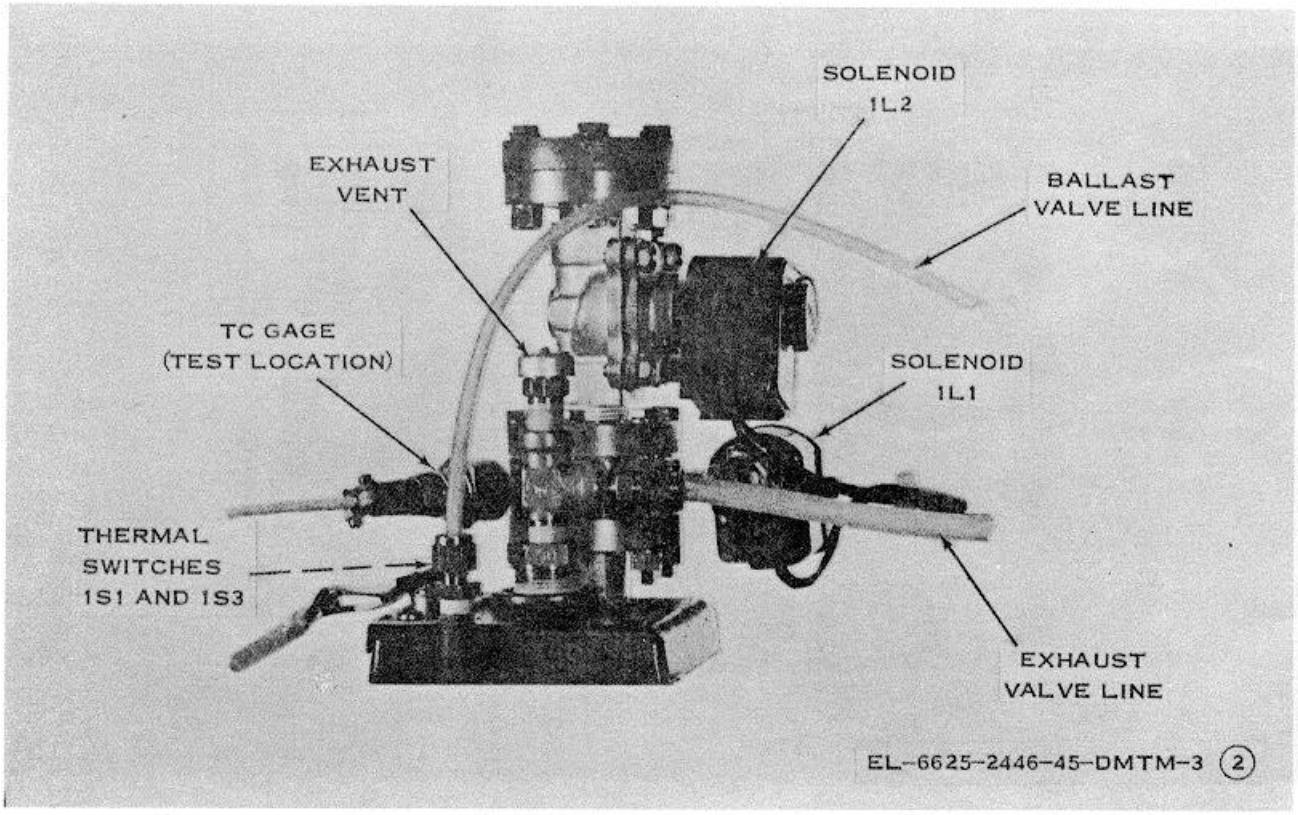


Figure 4-5 (2). Vacuum pump group unit 1, parts location (part 2 of 3).

(5) Secure the female connector to the rear of adsorber 5MP1.

(6) Tighten the retaining nuts on the gas supply line.

e. Oil Separator 5MP40.

(1) Remove the four Allen bolts securing the gas line from heat exchanger 5MP25.

(2) Loosen the female connector on the oil return line from oil separator 5MP40 to compressor pump 5MP17.

(3) Perform the removal procedure for adsorber 5MP1 (para 4-12d).

(4) Remove the four nuts securing absorber support 5MP2 to compressor base plate 5MP3.

(5) Remove the female fitting to return pressure gage 5M2.

(6) Remove the four Allen bolts securing oil separator 5MP40 to compressor base plate 5MP3.

NOTE

Exercise care when removing oil separator 5MP40 from base plate 5MP3. The rubber grommets around pressure gages 5M1 and 5M2 allow sufficient movement of oil separator 5MP40. DO NOT apply excessive leverage to pressure gages 5MI or 5M2 in the removal or replacement procedure.

(7) Loosen the pressure gages 5MI and 5M2 from oil separator 5MP40 and slide through the grommets away from the oil separator.

(8) Remove oil separator 5MP40 from base plate 5MP3.

(9) Remove absorber support 5MP2 from oil support 5MP2 to oil separator 5MP40.

(10) To replace oil separator, secure absorber support to oil separator.

(11) Position oil separator 5MP40 on base plate 5MP3, and secure with the four Allen bolts.

(12) Thread the pressure gages 5MI and 5M2 onto oil separator 5MP40 and tighten. Be careful to orient the gages properly so they may be read easily.

(13) Connect the female fitting to return pressure gage 5M2.

(14) Secure the oil return line to compressor pump 5MP17.

(15) Secure the gas line from heat exchanger 5MP25 to the top of oil separator 5MP40 with the four Allen bolts.

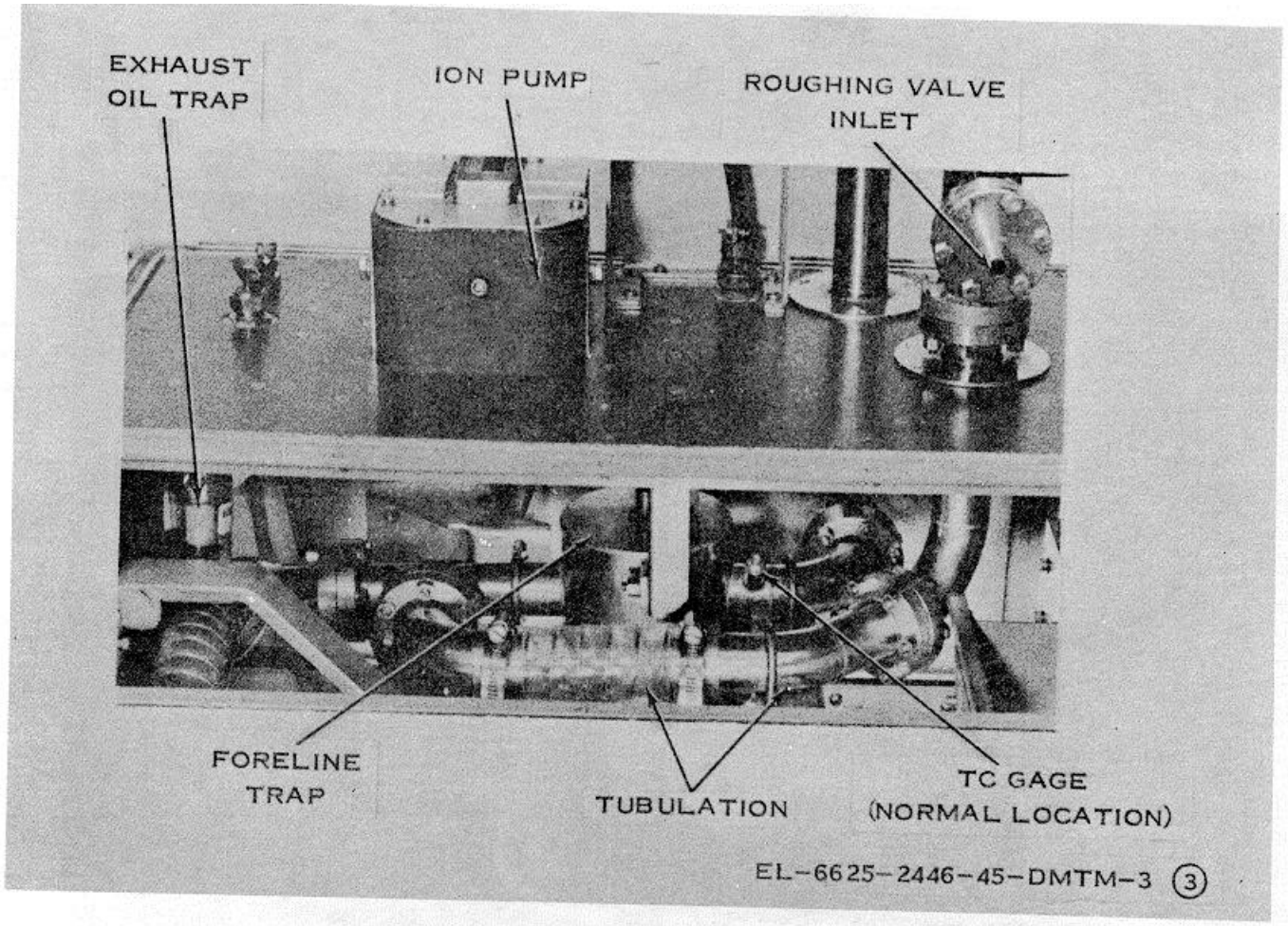


Figure 4-5 (3). Vacuum pump group unit 1, parts location (part 3 of 3).

(16) Secure absorber support 5MP2 to compressor base plate 5MP3.

(17) Perform absorber 5MPI replacement procedure (para 4-12d).

f. Manifold Assembly, 4MP8.

(1) Relieve pressure slowly with the isolator valve.

(2) To remove either valve stem or coupling, use proper size wrench to remove item.

(3) To replace either the valve stem or coupling, install either the valve stem or the coupling and secure.

(4) Close isolator valve and connect helium bottle to charging valve; pressurize to 250 psig; close charging valve; crack isolator to relieve pressure to 50 psig, close isolator valve. Repeat seven times. Pressurize to 255 + 25 psig. Close charging valve and remove the helium bottle.

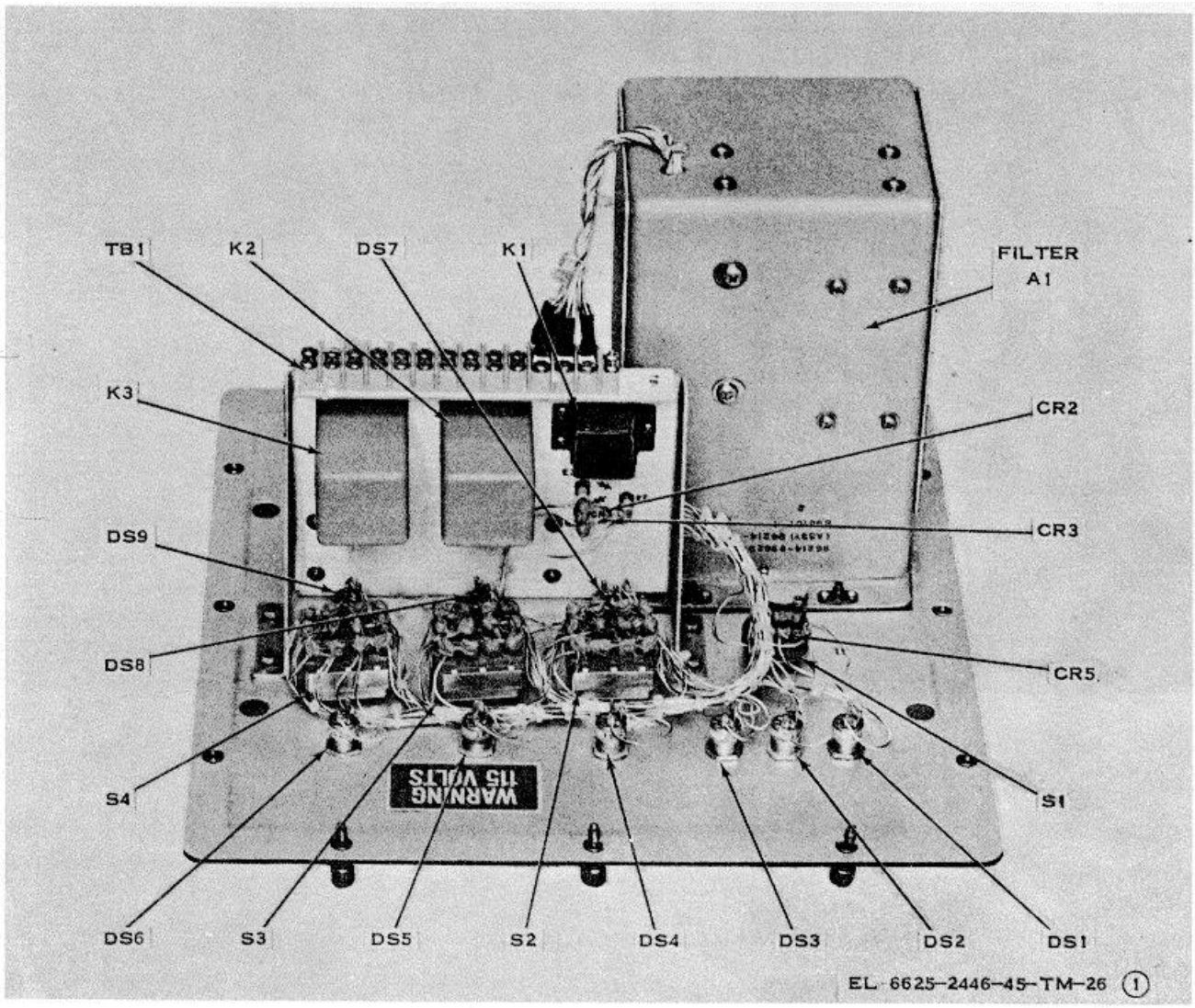


Figure 4-6 (1). Control group unit 2, parts location (part 1 of 2).

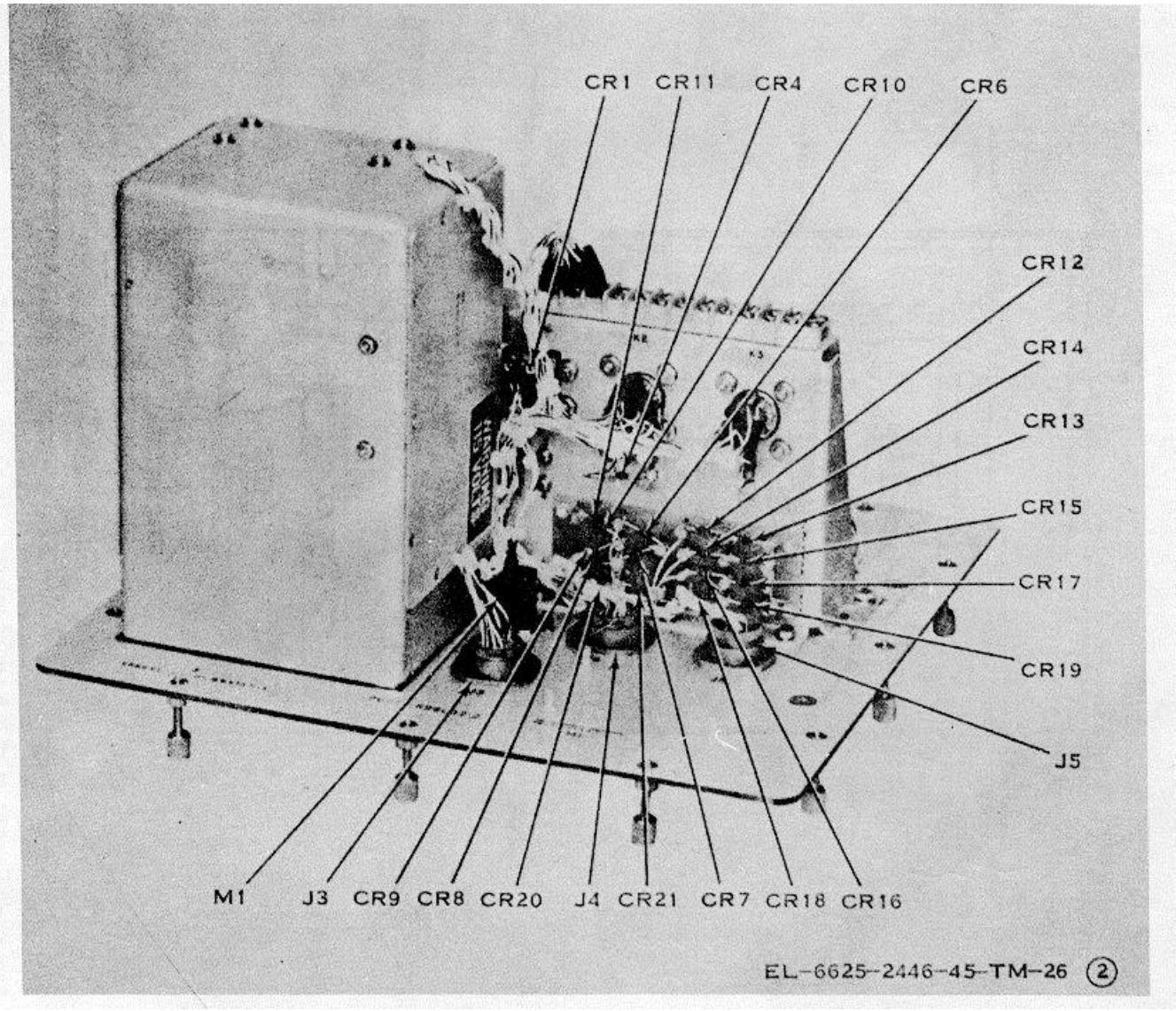


Figure 4-6 (2). Control group unit 2, parts location (part 2 of 2).

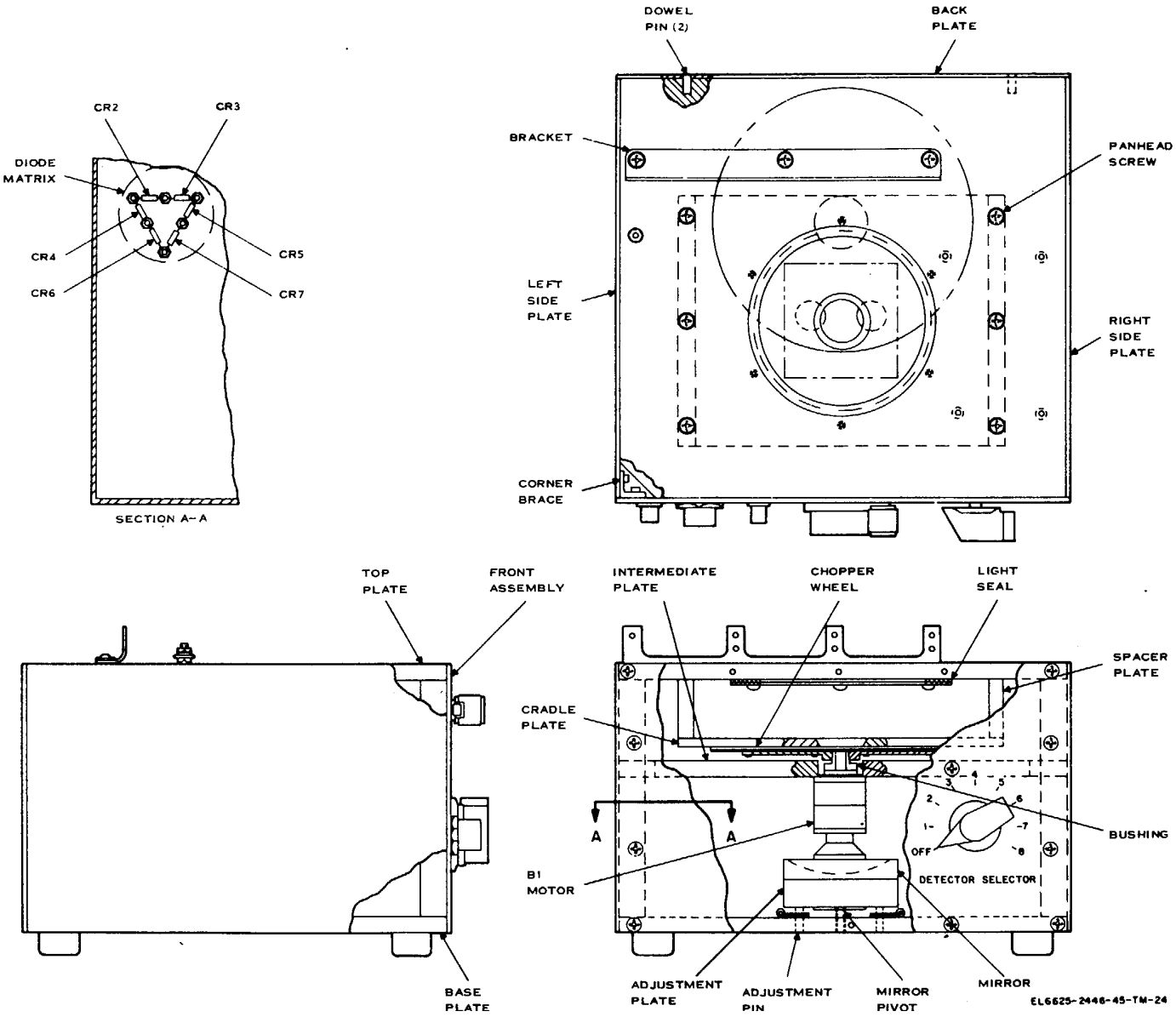


Figure 4-7. Detector tester 3A1, parts location.

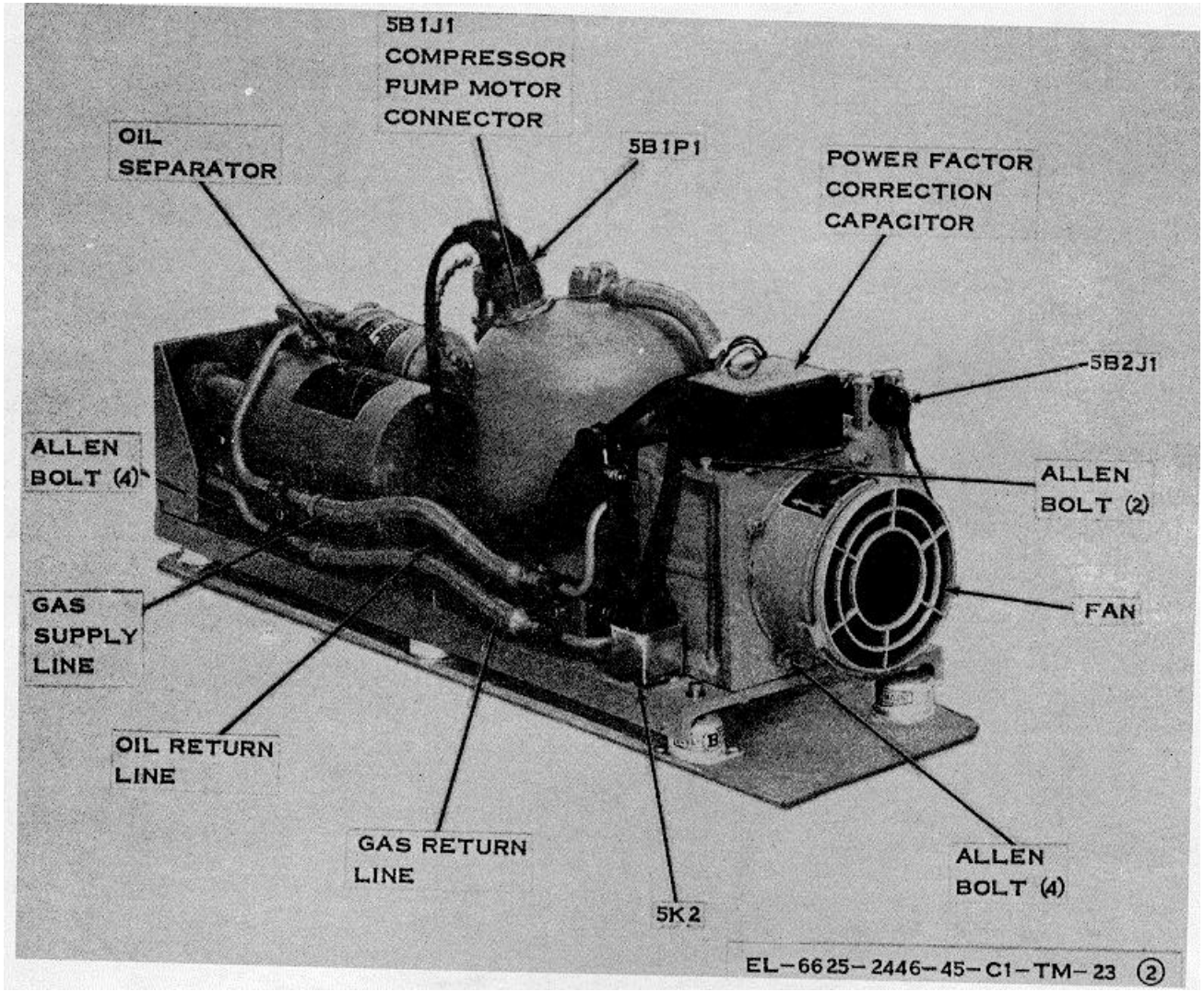


Figure 4-8 (1). Compressor unit 5, parts location (part 1 of 2).

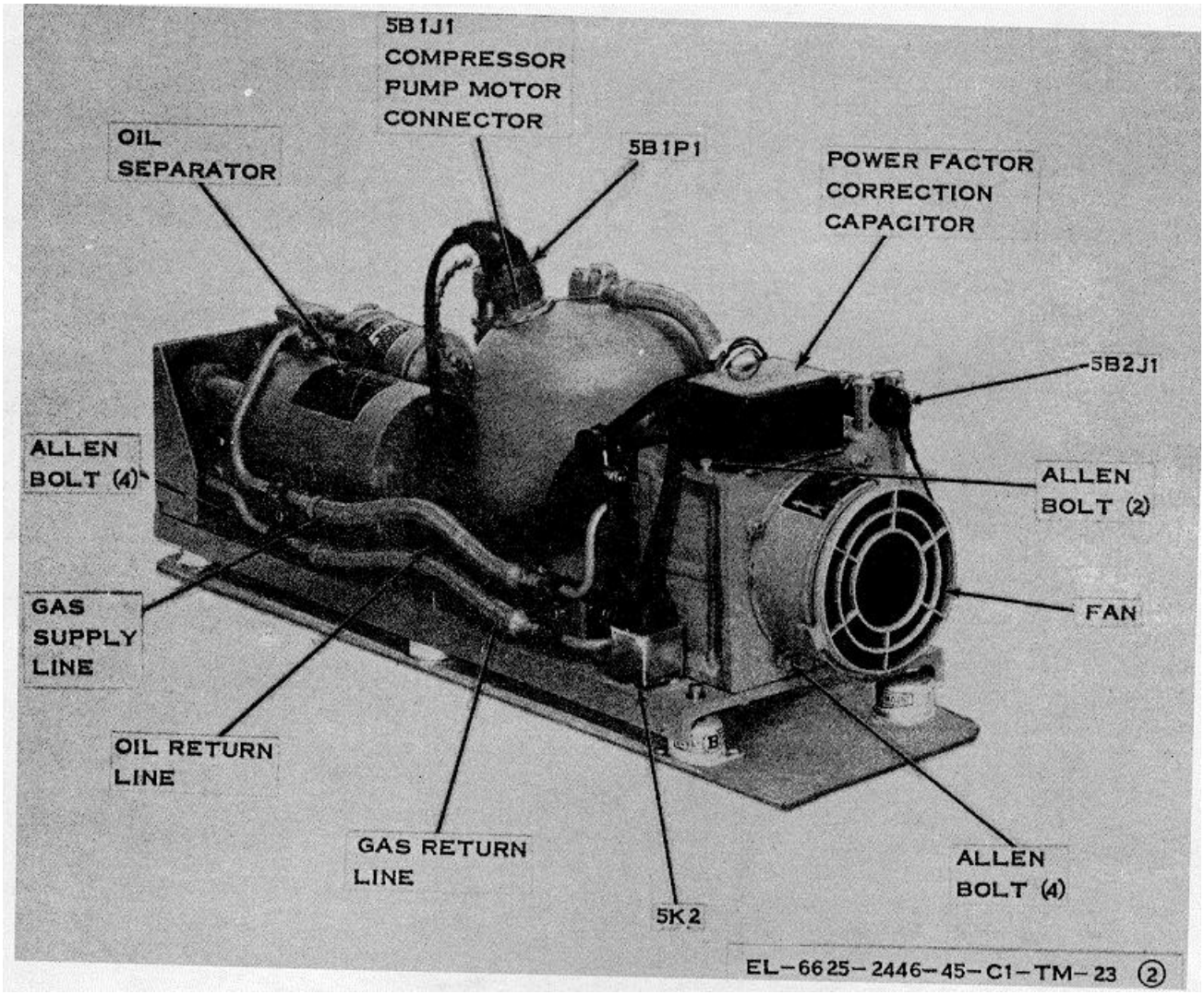


Figure 4-8 (2). Compressor unit 5, parts location (part 2 of 2).

Section IV. DEPOT ADJUSTMENT AND ALIGNMENT

4-13. Adjustment Procedure

a. Initial Preparation.

(1) Slide power supply 1A1 out to the stops to gain access to the printed circuit board cover. Remove four screws and lift off printed circuit board cover to gain access to printed circuit boards 1A1A1 and 1A1A2.

(2) Remove left side access panel from high vacuum unit to gain access to high voltage power supply 1A3.

(3) Perform the starting procedure outlined in TM 11-6625-2446-12.

(4) Remove power from the cryo test set when removing or replacing printed circuit boards or connecting test equipment.

WARNING

DEATH or SERIOUS INJURY may result from contact with 3500-vdc power existing within this test set.

b. Test Equipment.

(1) Power Supply PP-2309A/U.
(2) Multimeter TS-352B/U.
(3) Resistance Bridge ZM-16/U.

c. Adjustments.

(1) Remove power from test set and disconnect 1A1P1 from high voltage power supply 1A3J1.

(2) Adjust power supply for 5 vdc and connect positive terminal to one terminal of resistance bridge.

(3) Adjust resistance bridge for 999, 999 ohms and connect the other terminal to the control panel chassis.

(4) Connect negative terminal of power supply to 1AlP1-F.

(5) Set METER RANGE switch 1A1S4 to 50 μA.

(6) Slowly decrease the decade resistor until CURRENT/VOLTAGE meter M2 indicates 50 μA.

(7) Set METER RANGE switch to 500 μA and adjust 1A1A1-R13 for an indication of 50 μA on the CURRENT/VOLTAGE meter.

(8) Slowly decrease the decade resistor until CURRENT/VOLTAGE meter indicates 500 μA.

(9) Set METER RANGE switch to 5MA and adjust 1A1A1-R12 for an indication of 500 μA on the CURRENT/VOLTAGE meter.

(10) Slowly decrease the decade resistor until CURRENT/VOLTAGE meter indicates 5 MA.

(11) Set METER RANGE switch to 50 MA and adjust 1A1A1-R11 for an indication of 5 MA on the CURRENT/VOLTAGE meter.

(12) Turn off power supply. Disconnect power supply and decade resistor from test set.

(13) Connect 1A1P1 to 1A3J1.

(14) Set power mode switch 1A1S1 and ion pump power circuit breaker 1A1CB3 to OFF. Set ion pump START/RUN switch 1A1S2 to START.

(15) Remove 1A1P2 from high voltage power supply 1A3J2.

(16) Use W3 cable to connect multimeter to 1A3J2. Connect multimeter COMMON to high voltage power supply 1A3 chassis.

WARNING

DEATH or SERIOUS INJURY may result from 3500 VDC present at multimeter inputs.

(17) Set multimeter range switch to 6000 VDC.

(18) Set METER RANGE switch 1A1S4 to 5KV.

(19) Set power mode switch to OPR. Set ion pump power circuit breaker to ON.

(20) Adjust 1A3R3 until the indication on the CURRENT/VOLTAGE meter M2 is the same as the indication on the multimeter.

(21) Set ion pump power circuit breaker to OFF. Set power mode switch to OFF.

(22) Remove multimeter from 1A3J2 and connect 1A1P2 to 1A3J2.

(23) On high vacuum unit, open ISOLATION VALVE and HIGH VACUUM VALVE.

(24) Set mechanical pump circuit breaker 1AlCB7 to ON.

(25) Set METER RANGE switch to 5KV. Once 2000vdc.is present, close the HIGH VACUUM VALVE on the high vacuum unit and set the METER RANGE switch to 50 MA.

(26) Set the ion pump power circuit breaker to ON.

(27) After the ion pump starts, close the ISOLATION VALVE.

(28) Adjust 1A1A2-R2 until MICRONS meter M1 indicates in the green area (about 5 microns).

(29) Set mechanical pump circuit breaker to OFF.

(30) Allow ion pump to run until CURRENT/VOLTAGE meter indicates less than

500μA; then set ion pump power circuit breaker to OFF.

(31) Remove power from the cryo test set. Disconnect the cables.

(32) Reinstall printed circuit board cover.

(33) Reinstall left access panel on high vacuum unit.

4-14. Alignment Procedures

Alignment procedures are not required.

Section V. REPAIR

4-15. Parts Substitution

Do not substitute parts indiscriminately. Substitute parts only when the trouble has been isolated to a specific stage and the defective part has been localized.

4-16. Parts Replacement Techniques

All parts are easily accessible and can be replaced without special procedures. The following general precautions apply to the equipment:

a. Use a pencil-type soldering iron with a 55-watt maximum capacity to prevent damage to transistors and similar components. If the iron is to be used with alternating current, use an isolating transformer between the soldering iron and the line. Do not use a soldering gun; damaging voltages can be induced in components.

b. When soldering transistor or diode leads, solder quickly; whenever wiring permits, use a heatsink (such as long-nosed pliers) between the soldered joint and the transistor or diode. Use approximately the same lead length and dress as used originally.

c. When disconnecting mechanical components which have pressure or vacuum inside, listen for escaping or in rushing gas. Either of these conditions can cause an unsafe disconnect. In either instance if a hissing sound ensues, stop and troubleshoot to discover the malfunction before proceeding.

d. When working with tubulation or any of the vacuum assembly exposed to rarefaction, practice stringent cleanliness procedures. The slightest contaminant (such as a fingerprint) can cause excessive time for evacuation. When replacing tubulation, the heater tape must be used to remove impurities from the new material.

e. Wiring diagrams, cable diagrams and parts location diagrams should be referred to, to insure proper part location and replacement.

Section VI. DEPOT TEST PROCEDURES

4-17. Purpose and Instructions

a. Test procedures contained in this section are to be used for depot maintenance to determine the acceptability of repaired equipment. These procedures set forth specific requirements that repaired equipment must meet before it is returned to the using organization.

b. Perform each test in sequence; do not vary the sequence. For each step, perform all the actions required in the control settings column; then perform each specific test procedure and verify it against the performance standard.

4-18. Test Equipment Required for Testing

All test equipment required to perform the testing procedures of this section are listed in table 4-1.

4-19. Depot Test Procedure

The depot test procedure is the same as the general support test procedure. Refer to paragraph 3-15 for procedure and to paragraph 4-6 for additional data.

Section VII. PRINTED CIRCUIT BOARD MAINTENANCE

4-20. General Instructions

Printed circuit board maintenance consists of testing and troubleshooting printed circuit boards to define malfunctioning part or parts. Refer to chapter 3 for repair and removal and replacement techniques.

4-21. Test Equipment Required

The test equipment required for performance of specific tests listed. under the test procedure for each printed circuit board.

4-22. Test Procedures

a. Test Procedure for Leak Detector 1A1A1.

(1) Test equipment required.

(a) AN/AAM-39 (module test cart)

(b) Oscilloscope.

(c) Function generator (used with AN/ AAM-39).

(d) Digital voltmeter (dvm).

(2) Initial test connections and control settiings.

(a) Refer to TM 11-6625-1822-12 for preparation for use and the starting procedure for the AN/AAM-39.

WARNING

The test set POWER SUPPLY power mode switch shall be set to the STBY position when installing or removing the unit under test or the patchboard from the test set. HIGH VOLTAGE is present when the power mode switch is set to the OPR position.

(*b*) On the AN/AAM-39, set all other controls to NORMAL, OFF, position 1, or maximum ccw, as applicable.

(*c*) Install patchboard No. 98 1A231 in the patchboard receiver on program panel 1 A5.

(*d*) Connect the AN/AAM-39, interconnecting box No. 1, oscilloscope, function generator, and dvm in the test setup shown in figure 4-9.

(*e*) Insert the unit under test into TEST CONNECTOR "B" of interconnecting box No. 1.

(*f*) Adjust function generator for a 60-Hz, 6 +0.5-volts peak-to-peak square wave.

(3) *Procedure*. Test leak detector 1A1AI by procedures in chart 4-2.

Chart 4-2. Leak Detector 1A1A1, Test Procedure

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
1	AN/AAM-39: POWER SUPPLY power mode switch: OPR	.....	Observe dvm	Dvm indicates 29.4 t2A vdc.
2	Same as step No. 1	.....	Connect dvm HI to test point B12 on interconnecting box No. 1.	Dvm indicates 2.4 ±0.8 vdc.
3	AN/AAM-39: CONTROL NO. 2 S4: ON.	.....	Observe oscilloscope	Oscilloscope displays a 1.4 +0.6 v p-p square wave centered about 0-volt baseline.
4	AN/AAM-39: CONTROL NO. 2 S3: ON.	.....	Observe oscilloscope	Oscilloscope -display will be 1.6 + 0.6v pp centered about -1.6volt baseline.
5	Same as step No. 4	.....	Connect dvm HI to test point B3 on interconnecting bor No. 1.	Dvm indicates 29.5 t.3 vdc.
6	AN/AAM POWER SUPPLY power mode switch: STBY	.....	Connect dvm LO to test point B18 and dvm HI to test point B22 on interconnecting box No. 1.	Dvm indicates 2.74 t+.137 k-ohms.
7	.....	.....	Perform AN/AAM-39 stopping procedure (TM 11-662-1822-12).	

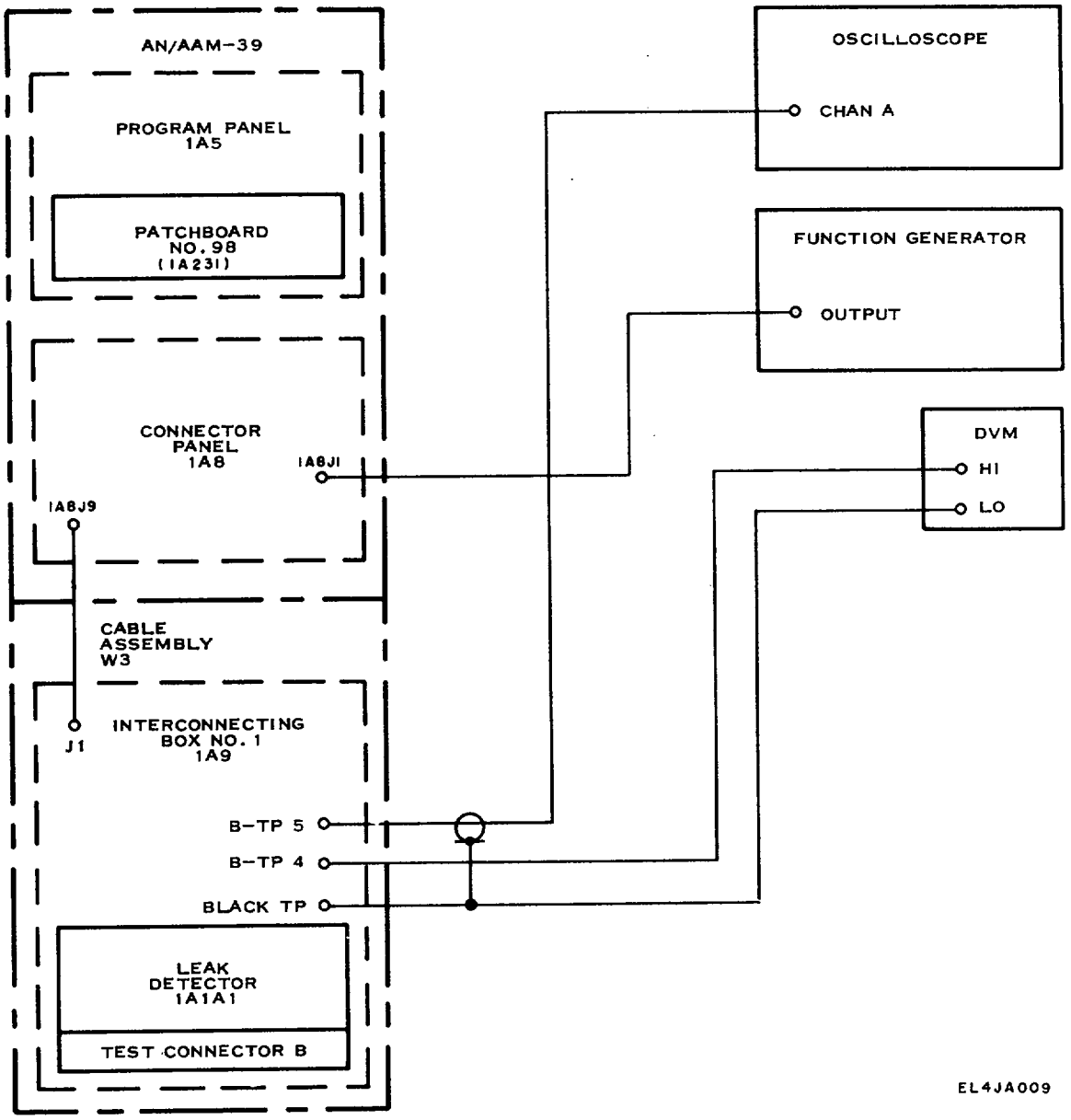


Figure 4-9. Leak detector 1A1A1, initial test setup.

b. Troubleshooting. Troubleshooting data for leak detector 1A1A1 is given in chart 4-3.

c. Voltage, Resistance, and Waveform Data.

(1) Transistor and diode voltage and resistance data. The voltage and resistance data for all transistors and diodes on 1A1A1 is given in table 4-3. All voltages are taken with respect to dc return. A dash indicates a nonexistant or insignificant reading. Figure 4-2 shows component location and base diagrams.

Chart 4-3. Leak Detector 1A1A1, Troubleshooting

Malfunction	Probable cause	Corrective action
1 In test procedure, step No. 1, dvm indication incorrect.	Diode CRI defective	Replace CR1.
2 In test procedure, step No. 2, dvm indication incorrect.	Diode CR2, CR3, CR4, CR5, or associated circuitry defective.	Check CR2, CR3, CR4, CR5, and associated circuitry. Replace defective part.

Malfunction	Probable cause	Corrective action
3 In test procedure, step No. 3, or step No. 4, oscilloscopt display incorrect.	Ic Z1 or associated circuitry defective.	Check Z1 and associated circuitry. Replace defective part.
4 In test procedure, step No. 5, dvm indication incorrect.	Relay K1 defective	Replace K1.
5 In test procedure, step No. 6, dvm indication incorrect.	Resistor R10 defective	Replace R10.

Table 4-3. Transistor and Diode Measurement for 1A1A1

	Volts DC		
Ref des	E/D/Ca	B/B1/G	Co/B2/S/A
CR2	34.8	-	0.0
CR3	34.8	-	0.0
CR4	0.0	-	-34.8
CR5	0.0	-	-34.8
CR8	0.0	-	0.0
CR9	0.0	-	0.0
CR10	0.0	-	0.0
CR11	0.0	-	0.0

(2) Amplifier ic voltage data. The voltage data for the operational amplifier used on 1J1A1 is given in table 4-4, with initial control settings indicated in chart 4-2, step no. 4. All voltage readings are with respect to dc return. A dash indicates a nonsignificant waved.

d. Adjustment Procedure.

(1) Set up the test equipment, as indicated in the test procedure (a above), for step No. 6, chart 4-2 of the procedure.

(2) Connect dvm HI to test point B22 and dvm LO to test point B23 on interconnecting box No. 1. Adjust R11 on 1A1A1 for dvm indication of 2.9 ±O.1 ohm.

(3) Connect dvm LO to test point B21 on interconnecting box No. 1. Adjust R12 on 1A1A1 (fig. 4-2) for dvm indication of 32.7 + 1.5 ohm.

(4) Connect dvm LO to test point B19 on interconnecting box No. 1. Adjust R13 on 1A1A1 for dvm indication of 387 ± 6 ohm.

(5) Refer to TM 11-6625-1822-12 and perform AN/AAM-39 stopping procedure.

e. Test Procedure for High Vacuum Unit 1A1A2.

(1) Test equipment required.

(a) AN/AAM39.

(b) Oscilloscope.

Table 4-4. Operational Amplifier Voltages and Waveforms for 1A1A1

		Pin number					
Ref des	**Measurements**	**2**	**3**	**4**	**6**	**7**	**8**
Z1	Vdc	.....	0.0	---	---	---	---
	Waveform	0.14 v P-p square wave			1.4v p-p square wave	---	---

(*c*) Digital voltmeter (dvm).

(2) Initial test connections and controls settings.

(*a*) Refer to TM 11-6625-1822-12 for preparation for use and the starting procedure for the AN/AAM39.

WARNING

The test set POWER SUPPLY power mode switch shall be set to the STBY position when installing or removing, the unit under test or the patchboard from the test set. HIGH VOLTAGE is present when the power mode switch is set to the OPR position.

(*b*) On the AN/AAM39, set all other controls to NORMAL, OFF, position 1, or maximum ccw, as applicable.

(*c*) Install patchboard No. 94 1A227 in the patchboard receiver on 1A5.

(*d*) Connect the AN/AAM-9, interconnecting box No. 1, oscilloscope, and dvm in the test setup shown in figure 4-10).

(*e*) Insert the unit under test into TEST CONNECTOR "B" of interconnecting box No. 1.

(3) *Procedure.* Test high vacuum unit 1A1A2 by procedures in chart 4-4.

f. Troubleshooting. Troubleshooting data for high vacuum unit 1A1A2 is given in chart 4-5.

g. Voltage, Resistance, and Waveform Data. The voltage and resistance data for all transistors and diodes on 1A1A2 is given in table 4-5. All voltages are taken with respect to dc return. A dash indicates a nonexistant or insignificant reading. Figure 4-3 shows component location and base diagrams.

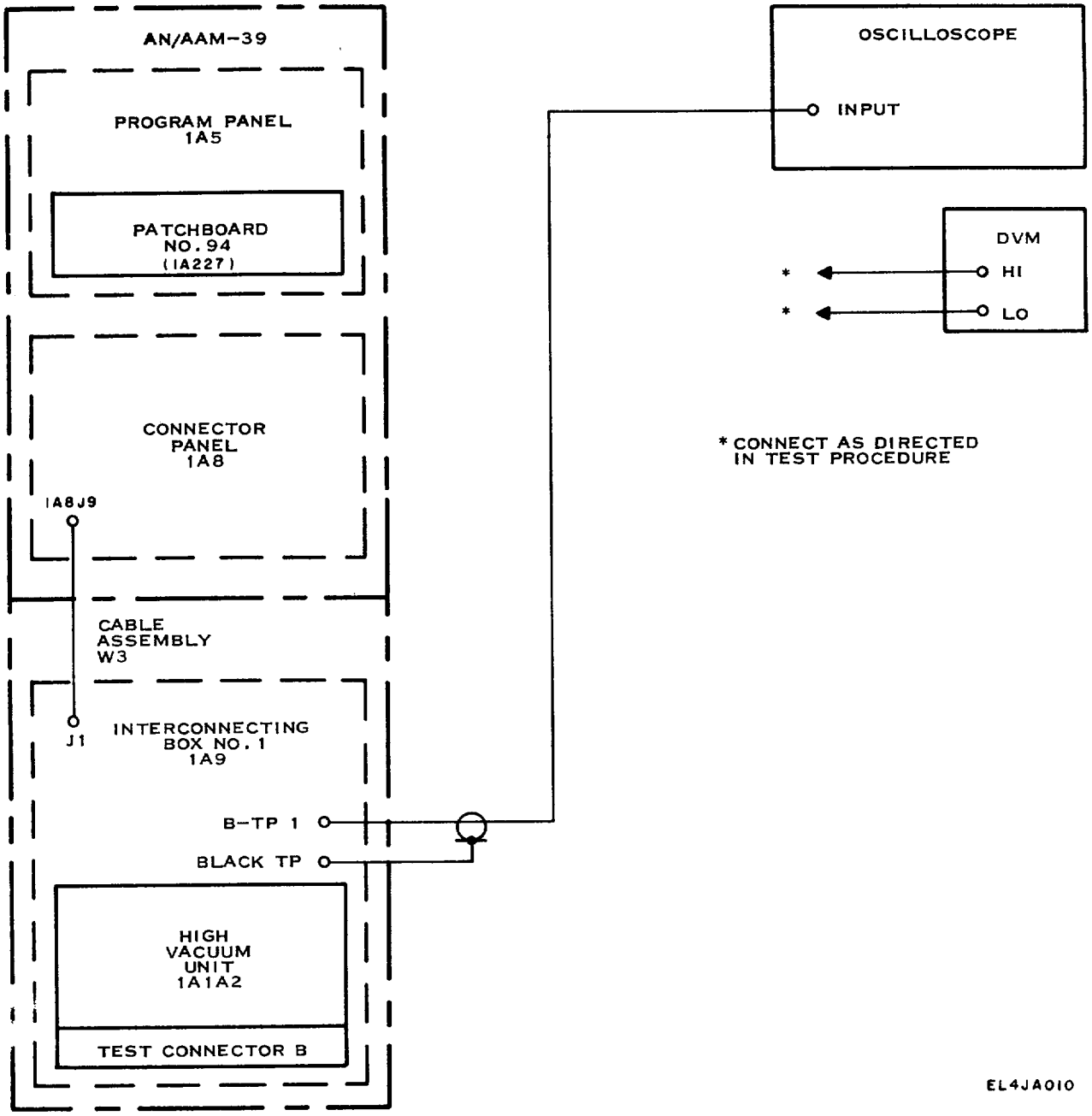


Figure 4-10. High vacuum unit 1A1A2, initial test setup.

Chart 4-4. High Vacuum Unit 1A1A2, Test Procedure

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
1	AN/AAM-9: POWER SUPPLY power mode switch: OPR	.....	Observe oscilloscope	Oscilloscope displays a 30 v p-p waveform centered about 0-vdc baseline.
2	AN/AAM-9: POWER SUPPLY power mode switch: STBY.	.....	Connect dvm LO to test point B6 and dvmn H to test point b7 on interconnecting box No. 1.	Dvn indicates 2.6 ± 0.3 ohms.
3	Same as step No. 2 interconnecting box No. 1.	.....	Connect dvmr T, to test cinrt B, 5 on	Dvm indicates 2.6 ± 0.3 ohms.
4	AN/AAM9: POWER SUPPLY power mode switch: OPR.	.....	Place S2 on control NO. 1 in each of positions 1 through 6. Observe FAULT lamp on LOA, D NO. 2 for each position.	FAULT lamp will light in each position.
5	Same as step No. 4	.....	Connect dvrr. LO to test point B21 and dvm TI' to test point B2 on interconnecting box No1.	Dvm indicates 160 ± 20 vdc.
6	.....	.....	Perform AN,/AAM, A3M stopping procedure (TM 1 i1822-13).	

Chart 4-5. High Vacuum Unit IA1A1, Troubleshooting

Malfunction	Probable cause	Corrective action
1 In test procedure, step No. 1, oscilloscope display incorrect.	Diodes CR1, CR2 or associated circuitry defective.	Check CR1, CR2 and associated circuitry. Replace defective part.
2 In test procedure, step No. 2, dvm indication incorrect.	Resistor R4 defective	Replace R4.
3 In test procedure, step No. 3, dvm indication incorrect.	Resistor R3 defective	Replace R3.
4 In test procedure, step No. 4, FAULT lamp incorrect for any position of S2.	One of capacitors C1 through O6 defective.	Determine faulty capacitor from table below. Replace defective part. Position of Sf where FAULT lamp indication incorrect — Defective capacitor Position 1 ..... C6 Position 2 ..... C5 Position 3 ..... C4 Position ..... C3 Position 5 ..... C2 Position 6 ..... C1
5 In test procedure, step No. 5, dvm indication incorrect.	Diode CR3, CR4, CR5, CM6, or associated circuitry defective.	Check CR3, CR4, CR6, CR6, and associated circuitry. Replace defective part.

h. Adjustment Procedure.

(1) Set up the test equipment, as indicated in the test procedure (a above), for step No. 2, Chart 4-4 of the procedure.

(2) Connect dvm LO to test point B4 and dvm HI to test point B5 on interconnecting box No. 1.

(3) Adjust R2 on 1AIA2 for dvm indication of 5.2 ± 0.4 ohm.

(4) Refer to TM 11-6625-1822-12 and perform AN/AAM-39 stopping procedure.

i. Test Procedure for High Voltage Power Supply 1A3.

(1) *Test equipment required.*

(a) AN/AAM39.

(b) High Voltage Probe.

(c) Digital Voltmeter.

(2) Initial test connections and controls settings.

(a) Refer to TM 11-6625-1822-12 for preparation for use and the starting procedure for the AN/AAM39.

Table 4-5. Transistor and Diode Voltage Measurement for 1A1A2

Ref des	Volts		
	E/D/Ca	B/B1/G	Co/B2/S/A
CR3	160	--	0
CR4	160	--	0.0
CR5	0.0	--	-160
CR6	0.0	--	-160

WARNING

The test set POWER SUPPLY power mode switch shall be set to the STBY position when installing or removing the unit under test or the patchboard from the test set. HIGH VOLTAGE is present when the power mode switch is set to the OPR position.

(b) On the AN/AAM-39, set all other controls to NORMAL, OFF, position 1, or maximum ccw, as applicable.

(c) Install patchboard No. 95 1A228 in the patchboard receiver on program panel 1A5.

(d) Connect the AN/AAM-39, interconnecting box No. 1, voltmeter, and high voltage probe in the test setup shown in figure 4-11.

(e) Using cable assembly 665630, connect the unit under test to TEST CONNECTOR "C" of interconnecting box No. 1.

(f) On AN/AAM-39, CONTROL NO. 2, place S3 and S4 to ON.

(g) Connect high voltage probe ground to black TP on interconnecting box No. 1.

WARNING

Dangerous voltages are present at several test points on 1A3. Do not touch any part of 1lA3 during test cycle.

(3) *Procedure.* Test high voltage assembly 1AlA3 by procedure in chart 4-6.

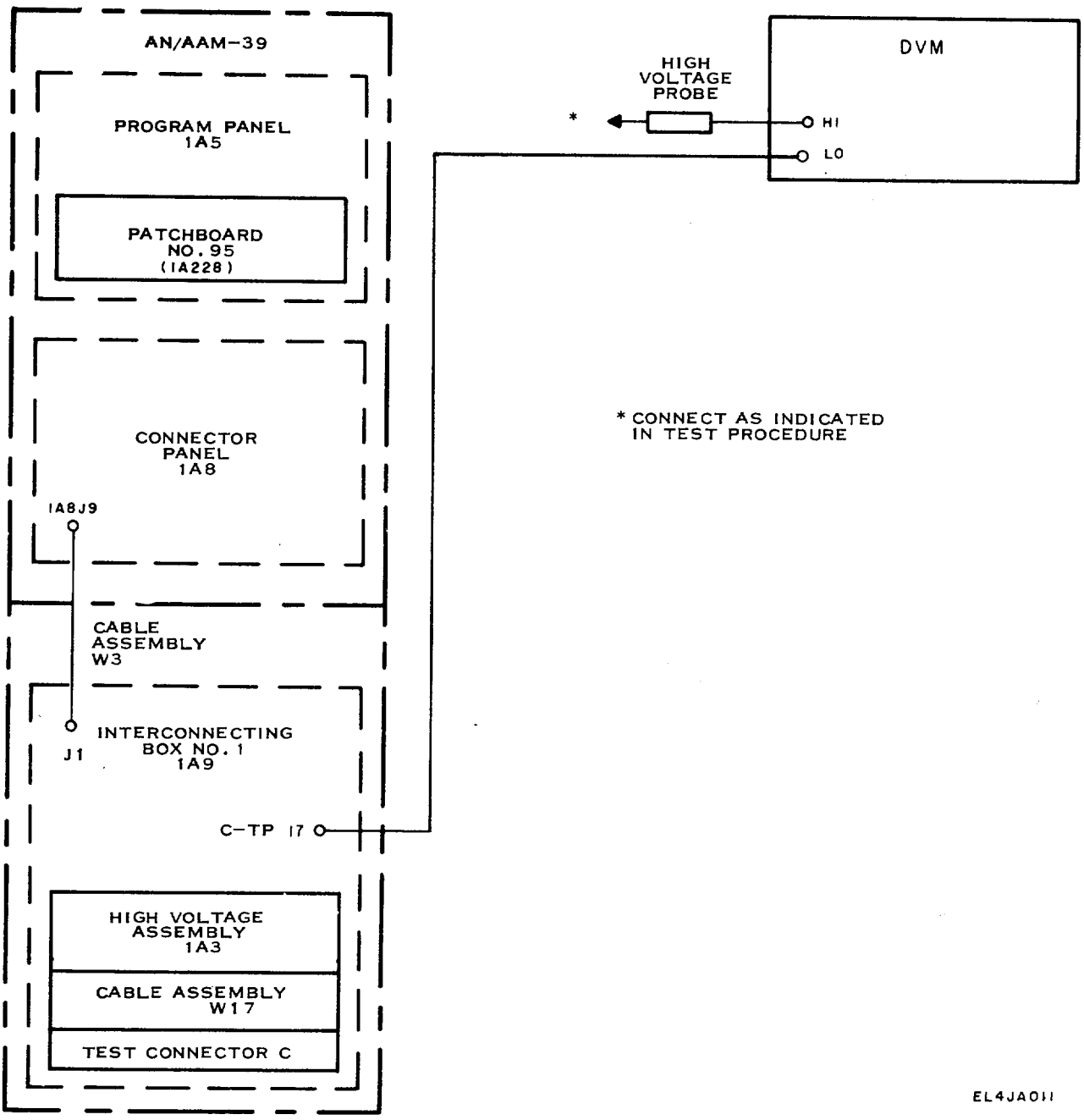


Figure 4-11. High voltage power supply 1A3, initial test setup.

j. Troubleshooting. Troubleshooting data for high voltage assembly 1A3 is given in chart 4-7.

k. Voltage, Resistance, and Waveform Data. The voltage and resistance data for all transistors and diodes on 1A3 is given in table 4-6. All voltages are taken with respect to dc return. A dash indicates a nonexistant or insignificant reading. Figure 4-4 shows component location and base diagrams.

Chart 4-6. High Voltage Power Supply 1A3, Test Procedure

Step No.	Control settings: Test equipment	Control settings: Unit under test	Test procedure	Performance standard
1	AN/AAM-9: POWER SUPPLY power mode switch: STBY.	.....	Place tip of high voltage probe against conductor of connector J2 on inside of 1A3. Place power mode switch on POWER SUPPLY of AN/AAM-39 to OPR. Observe dvm. Place SS on CONTROL NO. 2 to OFF. Observe dvm.	DVM indicates a less than 1 vdc level with S3 on CONTROL NO. 2 ON and 3250 +250 vdc with S3 on CONTROL NO. 2 OFF.
2	AN/AAM-89: POWER SUPPLY power mode switch: STBY.	.....	Place tip of high voltage probe against conductor of connector J3 on inside of connector J3 on 'inside of 1A1A3. Place power mode switch on POWER SUPPLY of AN/AAM39 to OPR. Observe dvm, place S4 on CONTROL No. 2 to OFF. Observe dvm.	DVM indicates a leas than 1 vdc level with S4 on CONTROL NO. 2 ON and 3250 +250 vdc with S4 on CONTROL NO. 2 OFF.
3	.....	.....	Perform AN/AAM-39 stopping procedure (TM 11-625-1822-12).	

Chart 4-7. High Voltage Power Supply 1A3, Troubleshooting

Malfunction	Probable cause	Corrective action
1 In test procedure, step No. 1, dvn indication incorrect.	a. Diode CR1 associated aircuitry defective.	a. Check CR1 and associated circuitry. Replace defective part.
2 In test procedure, , tep No. 2, dvm indication incorrect	b. Relay K1 defective. Relay K2 defective.	b. Replace K1. Replace K2.

l. Adjustment Procedure.

(1) Set up the test equipment, as indicated in the test procedure (a above), for step No. 1 chart 4-6 of the procedure.

(1.1) Connect DYHM Hi to C-TP 7 and Lo to C-TP 6.

(2) Place power mode switch of POWER SUPPLY on AN/A39 to OPR.

(3) Adjust R3 1A3 for a DVM indication of 0.333 + 0.003 vdc.

(4) Refer to TM 11-6625-1822-12 and perform AN/AAM-39 stopping procedure.

Table 4-6. Transistor and Diode Voltage Measurement for 1A3.

Ref des	Volts		
	E/D/Ca	B/B1/G	Co/B2/S/A
CR2	28	-	0.0
CR3	28	-	0.0

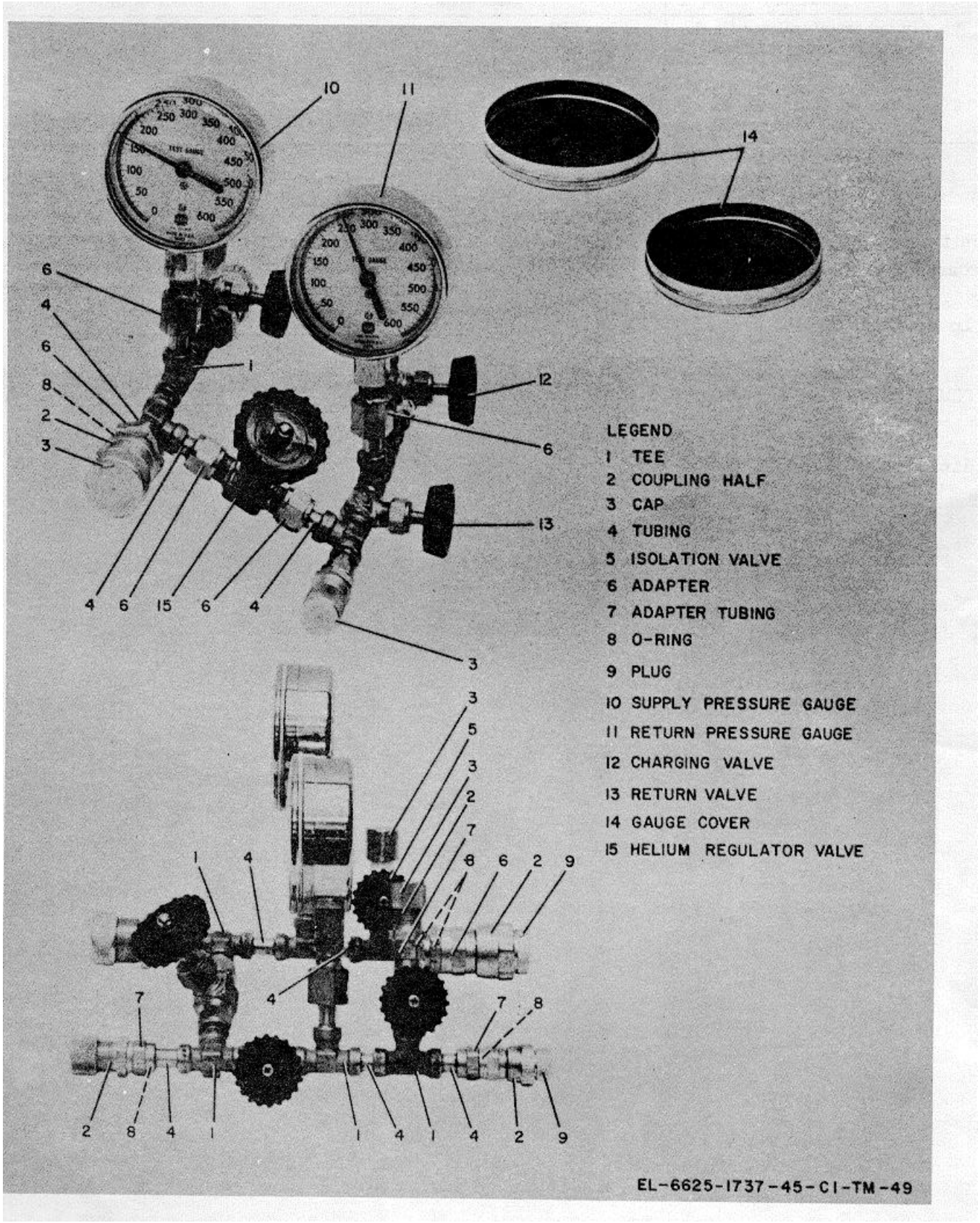


Figure 4-12 Manifold parts location diagram.

CHAPTER 5

DEPOT OVERHAUL STANDARDS

5-1. Applicability of Depot Overhaul Standards

The tests outlined in this chapter are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these -tests.

5-2. Applicable References

a. Repair Standards. Applicable procedures of the depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355-1, TB SIG 355-2, and TB SIG 355-3 form a part of the requirements for testing this equipment.

b. Technical Publication. TM 11-6625-244612 is applicable when testing this equipment.

c. Modification Work Orders. Perform all applicable modification work orders (MWO's) pertaining to this equipment before making the tests specified. DA Pam 310-7 lists all available MWO's.

5-3. Test Requirements

Perform the tests outlined for general support testing procedures contained in chapter 3. Use the applicable test equipment and materials indicated for the tests performed.

APPENDIX A

REFERENCES

The following publications contain information applicable to the operation and maintenance of Test Set, Cryogenic Refrigerator AN/AAM-40 and Service Kit, Refrigerant MK-1171/AAS-24.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders.
SB 11-573	Painting and Preservation Supplies Available for Field Use for Electronics Command Equipments.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
TB SIG 355-3	Depot Inspection Standard for Moisture and Fungus Resistant Treatment.
(C) TM 11-5850-241-12	Operator and Organizational Maintenance Manual Including Repair Parts and Special Tools List for Detecting Set, Infrared AN/AAS-24(U).
TM 11-5850-24134/1	DS and GS Maintenance Manual for Detecting Set, Infrared AN/AAS-24(U) (Volume 1 of 2).
(C) TM 11-5850-241-34/2	DS and GS Maintenance Manual for Detecting Set, Infrared AN/AAS-24(U) (Volume 2 of 2).
TM 11-6130-245-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual, Including Repair Parts and Special Tool Lists: Power Supply PP-2309A/U.
TM 11-6625-366-15	Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS-352B/U.
TM 11-6625-1703-15	Operator, Organizational, DS, GS, and Depot Maintenance Manual, Including Repair Parts and Special Tool Lists: Oscilloscope AN/USM-281A.
TM 11-6625-1822-12	Operator and Organizational Maintenance Manual, Including Repair Parts and Special Tool Lists: Test Set, Electronic Circuit Plug-In Unit AN/AAM-39.
TM 11-6625-2446-12	Operator and Organizational Maintenance Manual, Including Repair Parts and Special Tool Lists: Test Set, Cryogenic Refrigerator AN/AAM-40 and Service Kit, Refrigerant MK-1171/AAS-24.
TM 38-750	The Army Maintenance Management System (TAMMS).

INDEX

	Paragraph	Page
Adjustments	3-9, 4-13	3-14, 4-18
Alignment	3-10, 4-14	3-14, 4-19
CO, bottle:		
Description	2-1	2-1
Test	3-15	3-15
Compressor:		
Block diagram discussion	2-2	2-1
Circuit description	2-4	2-5
Test	3-15	3-15
Troubleshooting-	3-5, 4-5	3-2, 4-1
Parts location diagram, figs. 4-8(1) and 4-8(2)		4-17, 4-18
Continuity	3-5	3-2
Control group:		
Block diagram discussion (fig. 2-2)	2-2	2-4
Circuit description	2-4	2-5
Schematic, fig. FO-4		FO-4
Test	3-15	8-15
Troubleshooting	3-5	3-2
Parts location diagram, figs. 4-6(1) and 4-6(2)		4-14, 4-15
Cryogenic high vacuum unit, 1A1A2:		
Circuit description	2-6	2-11
Schematic, fig. 2-7		2-12
Parts location diagram, fig. 4-3	4-9	
Troubleshooting	4-22	4-20
Detector tester, 3A1:		
Block diagram, fig. 2-3		2-5
Circuit description	2-4	2-5
Schematic, fig. 2-6		2-10
Parts location diagram, fig., 4-7		4-16
Troubleshooting	3-5	3-2
Equipment interconnection (fig. 2-4)	2-3	2-5
Helium bottle:		
Description	2-1	2-1
Test	3-15	3-15
Indexes of publications	1-2	1-1
Introduction:		
Scope	1-1	1-1
Ion pump:		
Description	2-10	2-14
Test	3-15	3-15
Troubleshooting	3-5, 4-5	3-2, 4-1
Leak detector, 1A1A1:		
Circuit description	2-6	2-11
Schematic, fig. FO6		FO-5
Parts location diagram, fig. 4-2		4-8
Troubleshooting	4-22	4-20
Manifold:		
Parts replacement	4-6	4-2
Mechanical pump:		
Description	2-10	2-14
Test	3-15	3-15
Troubleshooting	3-5, 4-5	3-2, 4-1

	Paragraph	Page
Oil tank:		
Maintenance	4-6	4-2
Panel removal:		
Power supply, 1A1	4-9	4-4
Control group, unit 2	4-10	4-7
Pinch-off tool	4-6	4-2
Power supply, 1A1:		
Block diagram, fig. FO-2	2-2	2-1
Circuit description	2-4	2--5
Schematic, fig. FO-3.		FO-3
Test	3-15	8-4
Troubleshooting	3-5	3-2
Parts location diagrams, fig. 4-1 (1), 4-1 (2), and 4, 1 (8)		4-5, 4-6, 4-7
Receiver optics plate	4-6	4-2
Reference designation	1-4	1-1
Refrigerant service kit:		
Description	2-1	2-1
Test	3-15	3-15
Reporting of equipment manual improvement	1-3	1-1
Resistance measurements	3-5	3-2
Scope of manual	1-1	1-1
Table of contents		i
Test procedures:		
General support	3-15	3-15
Depot test	4-19	4-20
Printed circuit boards	4-22	4-20
Toolkit	4-6	4-2
Troubleshooting:		
General support	3-4,	3-2
	3-5	3-2
Depot	4-4, 4-5,	4-1
	4-6	4-2
Vacuum pump group:		
Block diagram, fig. 2-1	2-2	2-1
Vacuum system, fig. 2-11	2-10	2-44
Test	3-15	3-15
Parts location diagram, figs. 4-5 (1), 44 (2), and 46 (8		4-1, 1, 4-12, 4-18
Voltages	3-5	3-2
Wiring diagrams:		
Vacuum pump group, unit 1, figs. FO-8 (1) and FO-8 (2)		FO-8, FO-9
Control group, unit 2, fig. FO-9		FO-10

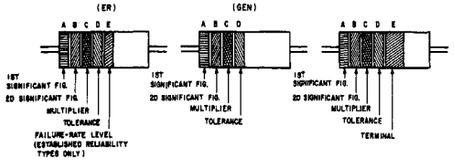
By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:
To be distributed in accordance with DA Form 12-31 (qty rqr block #225) direct and general support maintenance requirements for the OV-1D aircraft.



COLOR CODE MARKING FOR COMPOSITION TYPE RESISTORS.

COLOR-CODE MARKING FOR FILM-TYPE RESISTORS.

TABLE I
COLOR CODE FOR COMPOSITION TYPE AND FILM TYPE RESISTORS.

BAND A		BAND B		BAND C		BAND D		BAND E		
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)	COLOR	FAILURE RATE LEVEL	TERM.
BLACK	0	BLACK	0	BLACK	1			BROWN	M	
BROWN	1	BROWN	1	BROWN	10			RED	P	
RED	2	RED	2	RED	100			ORANGE	R	
ORANGE	3	ORANGE	3	ORANGE	1,000			YELLOW	S	
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	±10 (COMP. TYPE ONLY)	WHITE		SOLDERABLE
GREEN	5	GREEN	5	GREEN	100,000	GOLD	±5			
BLUE	6	BLUE	6	BLUE	1,000,000	RED	±2 (NOT APPLICABLE TO ESTABLISHED RELIABILITY)			
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7							
GRAY	8	GRAY	8	SILVER	0.01					
WHITE	9	WHITE	9	GOLD	0.1					

BAND A — THE FIRST SIGNIFICANT FIGURE OF THE RESISTANCE VALUE (BANDS A THRU D SHALL BE OF EQUAL WIDTH.)

BAND B — THE SECOND SIGNIFICANT FIGURE OF THE RESISTANCE VALUE.

BAND C — THE MULTIPLIER (THE MULTIPLIER IS THE FACTOR BY WHICH THE TWO SIGNIFICANT FIGURES ARE MULTIPLIED TO YIELD THE NOMINAL RESISTANCE VALUE.)

BAND D — THE RESISTANCE TOLERANCE.

BAND E — WHEN USED ON COMPOSITION RESISTORS, BAND E INDICATES ESTABLISHED RELIABILITY FAILURE-RATE LEVEL. ON FILM RESISTORS, THIS BAND SHALL BE APPROXIMATELY (-)1/2 TIMES THE WIDTH OF OTHER BANDS, AND INDICATES TYPE OF TERMINAL.

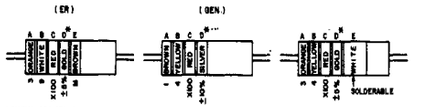
RESISTANCES IDENTIFIED BY NUMBERS AND LETTERS (THESE ARE NOT COLOR CODED)

SOME RESISTORS ARE IDENTIFIED BY THREE OR FOUR DIGIT ALPHA NUMERIC DESIGNATORS. THE LETTER R IS USED IN PLACE OF A DECIMAL POINT WHEN FRACTIONAL VALUES OF AN OHM ARE EXPRESSED. FOR EXAMPLE:

2R7 = 2.7 OHMS 10R0 = 10.0 OHMS

FOR WIRE-WOUND-TYPE RESISTORS COLOR CODING IS NOT USED, IDENTIFICATION MARKING IS SPECIFIED IN EACH OF THE APPLICABLE SPECIFICATIONS.

EXAMPLES OF COLOR CODING



NOMINAL RESISTANCE 3,900 OHMS
RESISTANCE TOLERANCE ±5%
FAILURE RATE LEVEL M

NOMINAL RESISTANCE 1,400 OHMS
RESISTANCE TOLERANCE ±10%

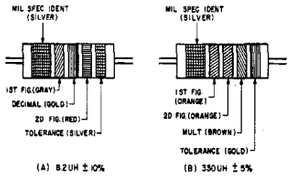
NOMINAL RESISTANCE 3400 OHMS
RESISTANCE TOLERANCE ±5%
TERMINAL SOLDERABLE

COMPOSITION-TYPE RESISTORS

FILM-TYPE RESISTORS

IF BAND D IS OMITTED, THE RESISTOR TOLERANCE IS ±20% AND THE RESISTOR IS NOT MIL-STD.

A. COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS.



COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES. AT A, AN EXAMPLE OF THE CODING FOR AN 82UH CHOKE IS GIVEN. AT B, THE COLOR BANDS FOR A 330UH INDUCTOR ARE ILLUSTRATED.

TABLE 2
COLOR CODING FOR TUBULAR ENCAPSULATED R.F. CHOKES.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	INDUCTANCE TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	1
RED	2	100	2
ORANGE	3	1,000	3
YELLOW	4		
GREEN	5		
BLUE	6		
VIOLET	7		
GRAY	8		
WHITE	9		
NONE			20
SILVER			10
GOLD	DECIMAL POINT		5

MULTIPLIER IS THE FACTOR BY WHICH THE TWO COLOR FIGURES ARE MULTIPLIED TO OBTAIN THE INDUCTANCE VALUE OF THE CHOKE COIL.

B. COLOR CODE MARKING FOR MILITARY STANDARD INDUCTORS.

CAPACITORS, FIXED, VARIOUS-DIELECTRICS, STYLES CM, CN, CY, AND CB.

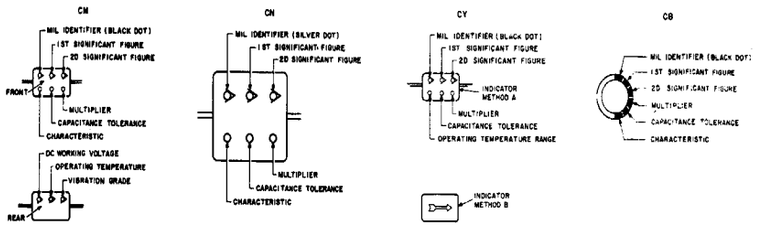


TABLE 3 — FOR USE WITH STYLES CM, CN, CY AND CB.

COLOR	MIL ID	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER	CAPACITANCE TOLERANCE				CHARACTERISTIC			2 DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CB	CM	CY, CN	CM
BLACK	CM, CY, CB	0	0	1			±20%	±20%		A			-55°TO +70°C	10-55HZ
BROWN		1	1	10					B	E	B			
RED		2	2	100	±2%		±2%	±2%	C				-55°TO +85°C	
ORANGE		3	3	1,000		±30%			D		D	300		
YELLOW		4	4	10,000					E				-55°TO +25°C	10-2,000HZ
GREEN		5	5		±5%				F			500		
BLUE		6	6										-55°TO +150°C	
PURPLE (VIOLET)		7	7											
GREY		8	8											
WHITE		9	9											
GOLD				0.1			±5%	±5%						
SILVER	CN				±10%	±10%	±10%	±10%						

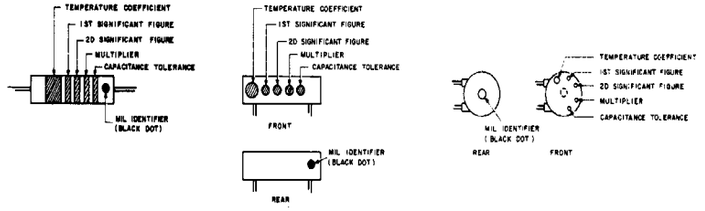


TABLE 4 — TEMPERATURE COMPENSATING, STYLE CC.

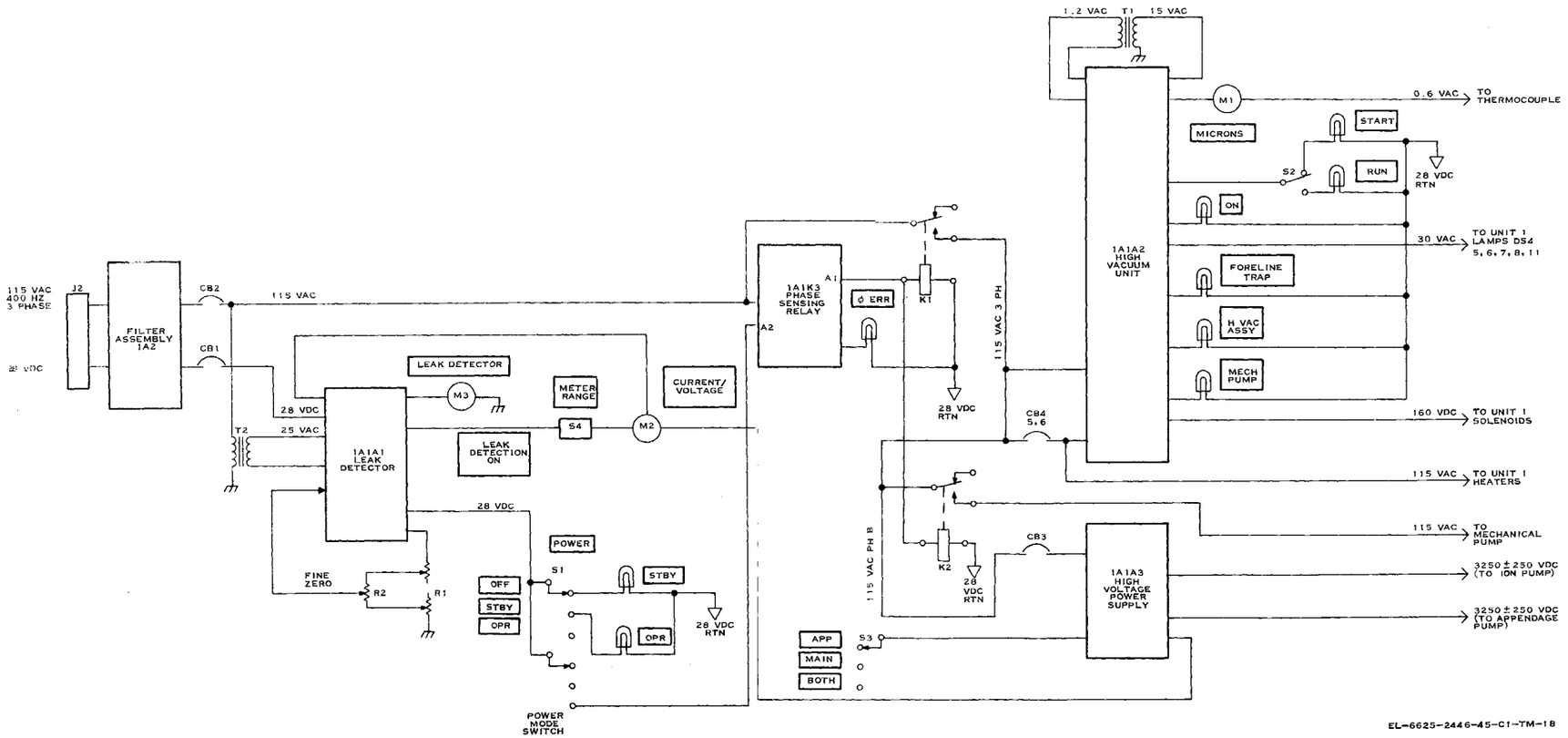
COLOR	TEMPERATURE COEFFICIENT[4]	1ST SIG FIG.	2D SIG FIG.	MULTIPLIER[1]	CAPACITANCE TOLERANCE		MIL ID
					CAPACITANCES OVER 10 UUF	CAPACITANCES 10 UUF OR LESS	
BLACK	0	0	0	1		±2.0 UUF	CC
BROWN	-30	1	1	10	±1%		
RED	-80	2	2	100	±2%	±0.25 UUF	
ORANGE	-150	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-330	5	5		±5%	±0.5 UUF	
BLUE	-470	6	6				
PURPLE (VIOLET)	-750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	±10%		
GOLD	+100					±1.0 UUF	
SILVER							

1. THE MULTIPLIER IS THE NUMBER BY WHICH THE TWO SIGNIFICANT (SIG) FIGURES ARE MULTIPLIED TO OBTAIN THE CAPACITANCE IN UUF.
2. LETTERS INDICATE THE CHARACTERISTICS DESIGNATED IN APPLICABLE SPECIFICATIONS: MIL-C-5, MIL-C-250, MIL-C-11272B, AND MIL-C-10950C RESPECTIVELY.
3. LETTERS INDICATE THE TEMPERATURE RANGE AND VOLTAGE-TEMPERATURE LIMITS DESIGNATED IN MIL-C-11015D.
4. TEMPERATURE COEFFICIENT IN PARTS PER MILLION PER DEGREE CENTIGRADE.

C. COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS.

ESC-FM 4(13-69

FO-1. Color code for military standard resistors, inductors, and capacitors.



FO-2. Vacuum pump group unit 1, block diagram.

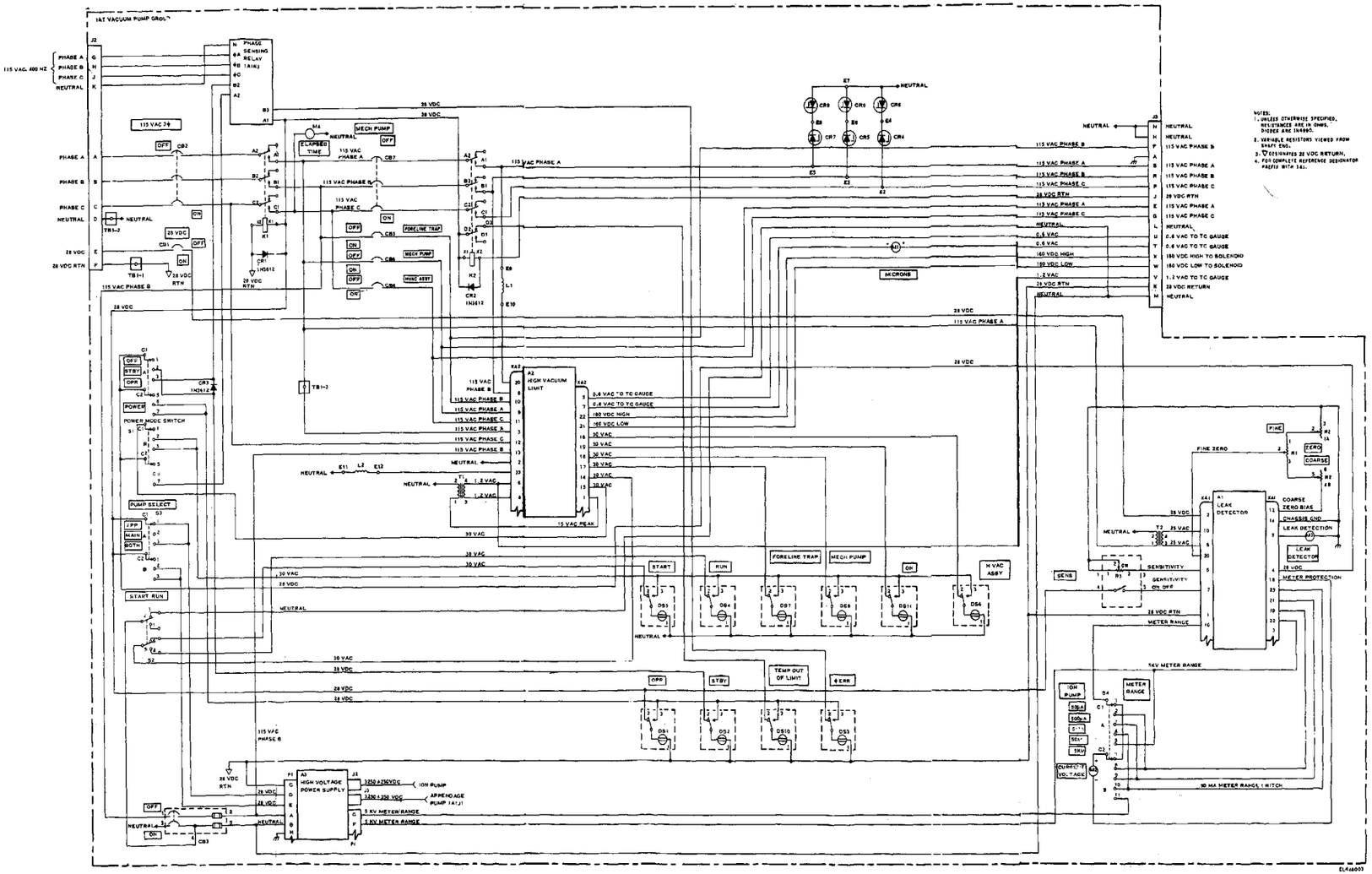


Figure FO-3. Vacuum pump group unit 1, schematic diagram.

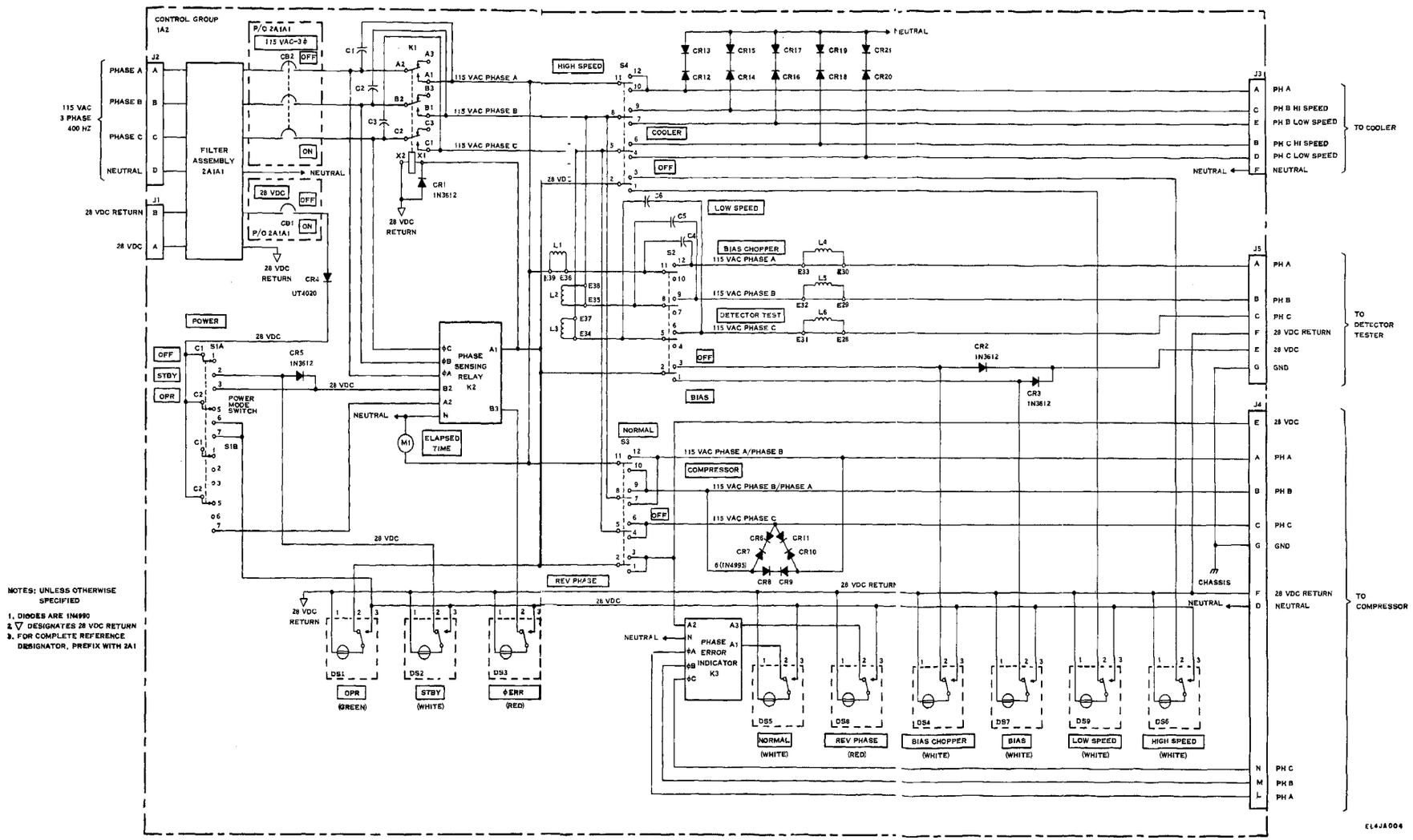


Figure FO-4. Control group unit 2, schematic diagram.

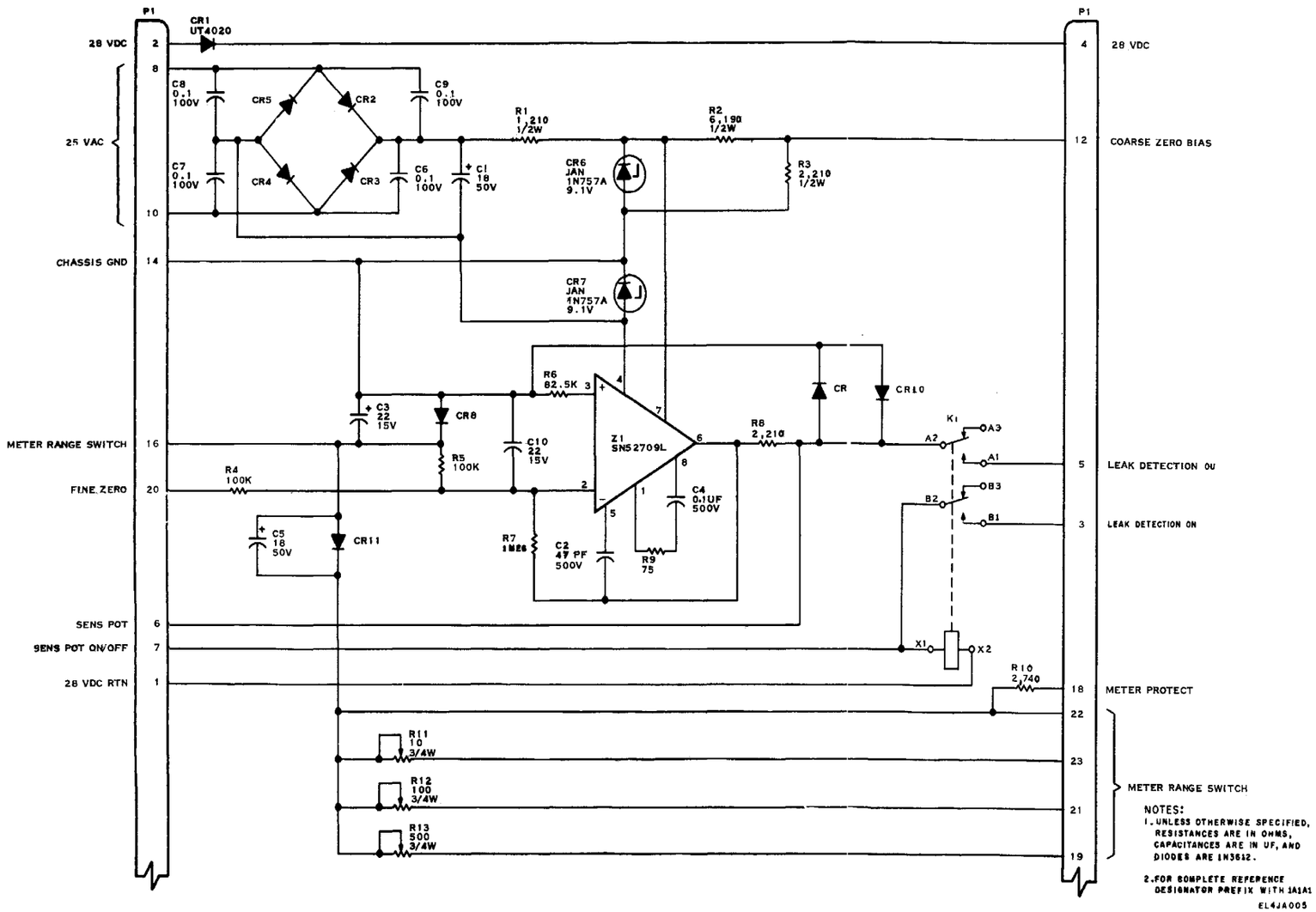
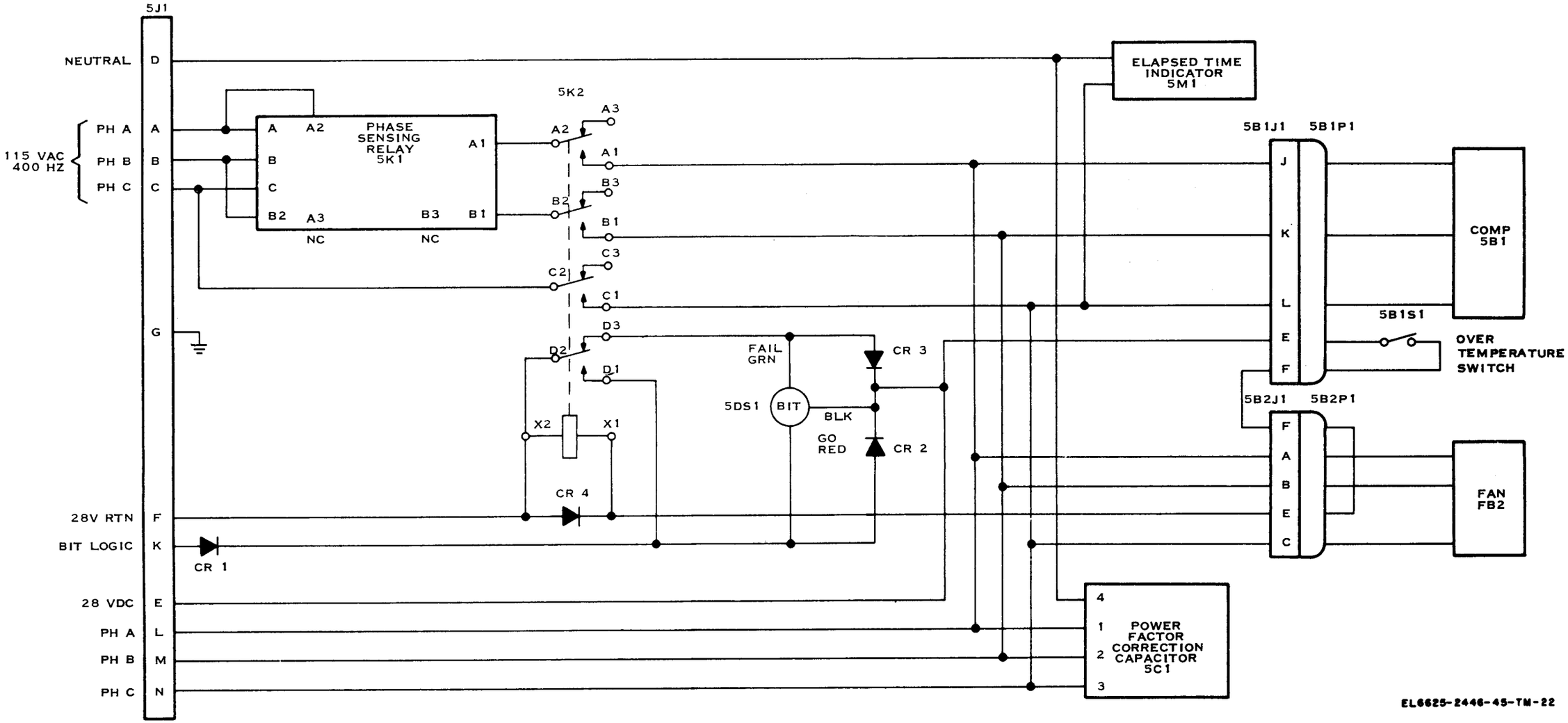
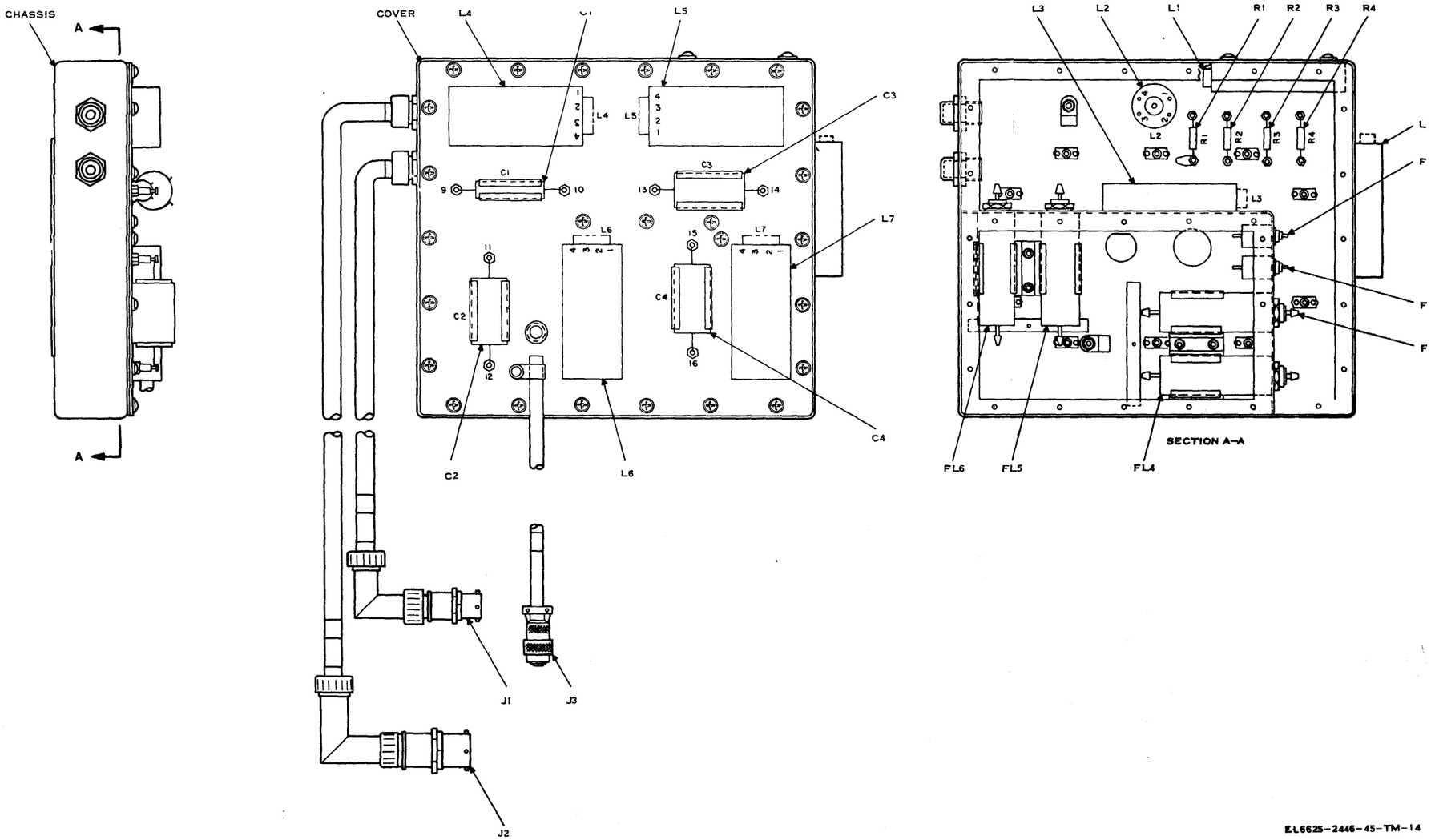


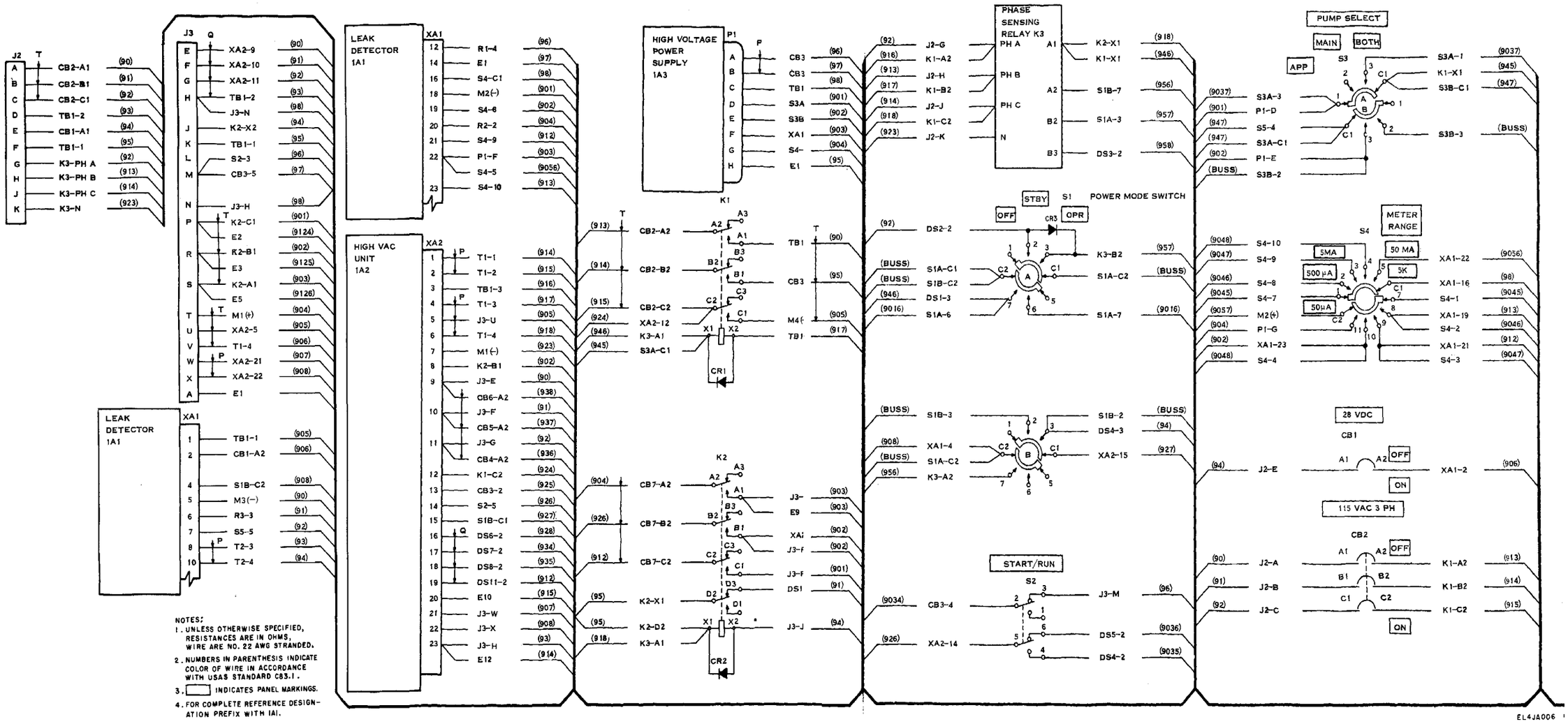
Figure FO-5. Leak detector 1A1A1, schematic diagram.



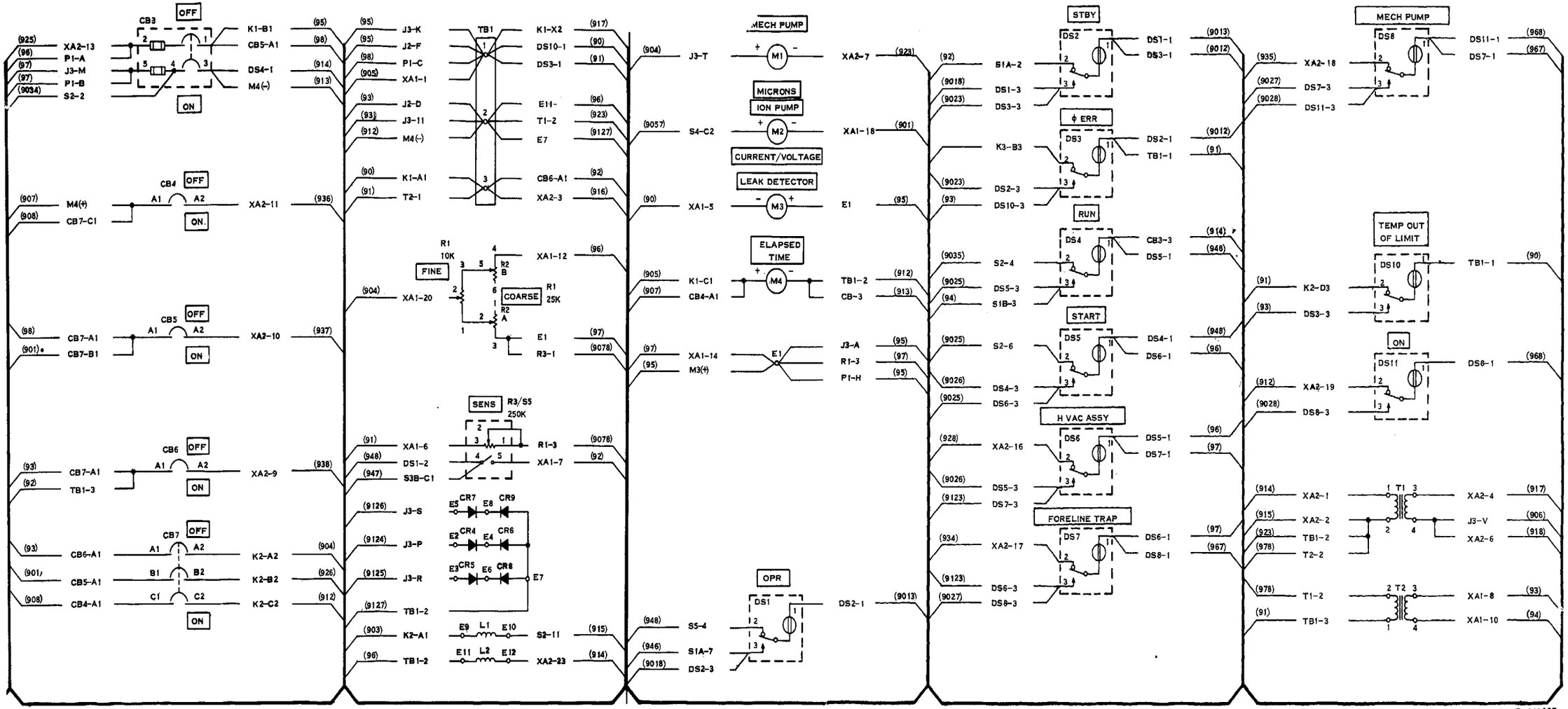
FO-6. Compressor unit 5, schematic diagram.



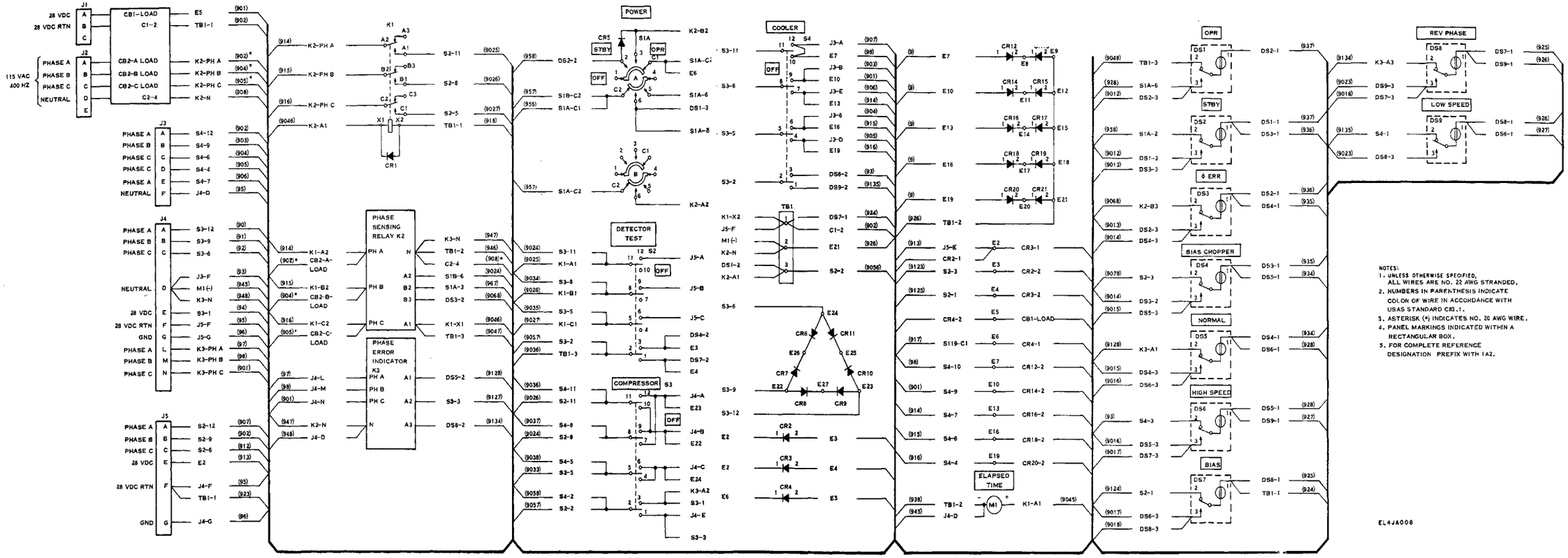
FO-7. Filter assembly 1A2, parts location.



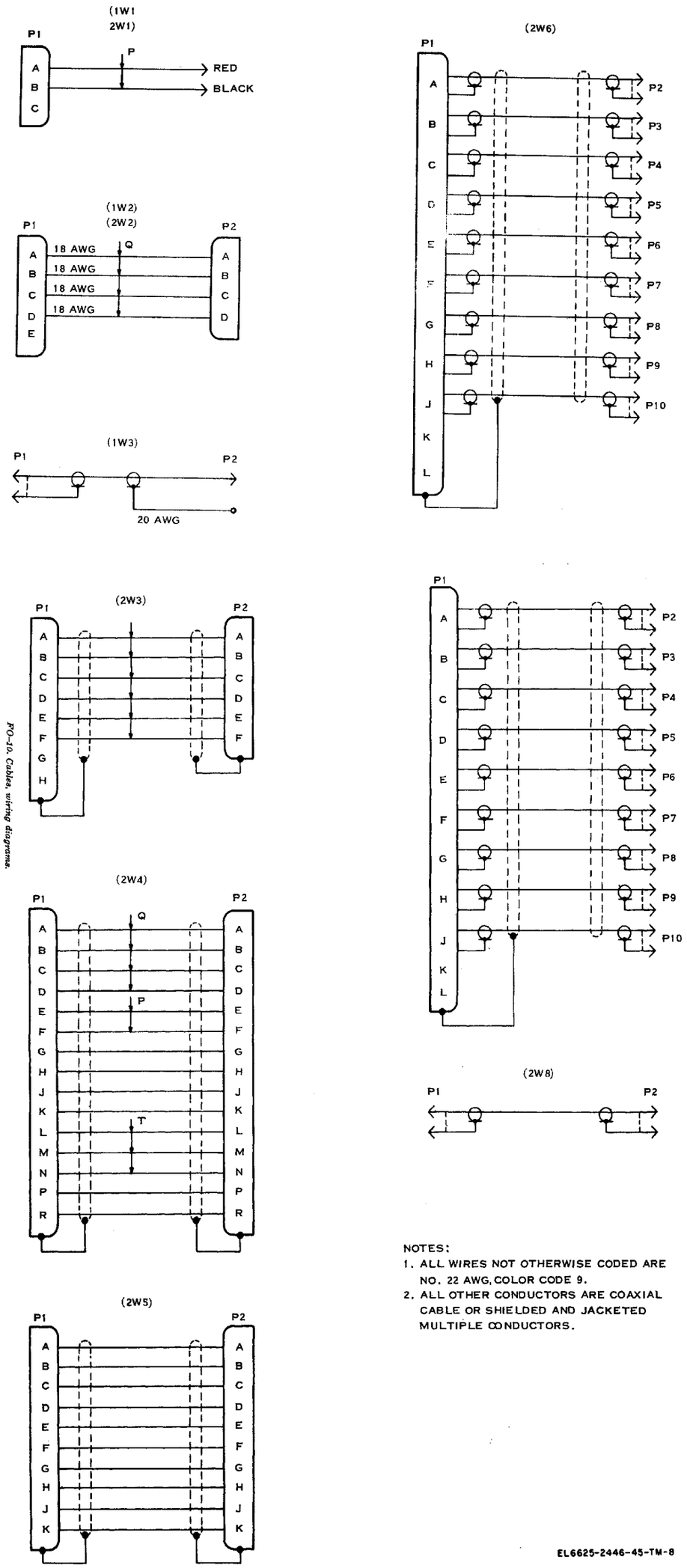
FO-8(1). Vacuum pump group unit 1 wiring diagram (part 1 of 2).



FO-8(2). Vacuum pump group unit 1 wiring diagram (part 2 of 2).



FO-9. Control group unit 2, wiring diagram



FO-10. Cables, wiring diagrams.

FO-10. Cables, wiring diagrams.

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ▸ ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

PIN : 016376-000