OPERATIONS AND APPLICATIONS MANUAL

MODEL NUMBER PM15-2

15 kV DC HIGH POTENTIAL TESTER
WITH MEGOHMMETER
Version 1.1

Rev 7/30/2019 nab

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DANGER / WARNINGS

DANGER

Complete Grounding of this unit is necessary for the safe operation of this equipment. Disconnect inputs before ungrounding this equipment

GENERAL SAFETY PRECAUTIONS

This equipment is capable of producing POTENTIALLY LETHAL VOLTAGES! Improper operation or test practices may result in injury or death to the operator or surrounding personnel.

The operation of High Voltage test equipment should only be performed by personnel familiar with HIGH VOLTAGE testing and safety procedures. The operator of this equipment must be aware of all hazards associated with High Voltage testing. The operator is responsible for himself and others in close proximity of the testing area.

Some General Safety Practices for working with High Voltage Test Equipment have been listed below for your reference.

- Become familiar with your instrument before performing an actual test
- Know your work area, check that all circuits are de-energized and locked out.
- Never work alone; always work with another qualified worker.
- Mark off entire work area with barriers and warning tape.
- Make all personnel aware of your testing activities.
- Be aware of dangerous conditions that may arise from energizing a test specimen.
- Never modify test equipment, modifications to equipment could introduce an unknown hazard or hinder a designed-in safety feature.
- DO NOT operate damaged equipment. Remove power, and do not use the equipment until safe operation can be verified by service-trained personnel.

Phenix Technologies, Inc. assumes no liability for unsafe or improper use of test equipment.

SECTION 1: PRODUCT INFORMATION

WARNING: Contact with the test leads on this equipment can cause harmful or fatal electrical shock. Do not touch test leads while a test is in process.

SAFETY AND CAUTION NOTES

1. Contact with the test leads on this equipment can cause harmful or fatal electrical shock. Do not touch test leads while a test is in process.

2. Ensure that the unit is properly grounded before proceeding with a test.

3. Turn the unit off before reaching inside. Damage to the unit and hazardous shock to personnel will result if this procedure is not followed.

4. Ensure that the equipment to be tested is de-energized and properly isolated.

5. Ensure that the equipment to be tested has been properly grounded using a high voltage grounding stick and rubber gloves.

6. Ensure that barriers and warning signs are erected in order that personnel in the test area are protected. Use an assistant operator where appropriate to keep non-essential personnel away from the test site.

7. When testing cables, the conductors at the distant end should be isolated from each other and taped.

8. When testing a faulted cable, it is advisable to first make an insulation resistance measurement before proceeding with the high voltage test.

9. Use care to avoid damaging the unit during disassembly and re-assembly procedures.

10. This unit should only be operated by someone familiar with high voltage testing and safety procedures.

DESCRIPTION

The PM15-2 unit is capable of producing regulated voltages as high as 15 kV DC into a variety of insulated electrical apparatus. The unit will measure leakage current flow through (or insulation resistance levels of) the ground insulation of the test sample. Leakage current as low as .01 microamperes DC and as high as 2,000 microamperes DC can be read directly from the unit's front panel meter. Insulation resistance values up to 3,000,000 megohms may also be read directly at test voltages of 5, 10 or 15 kV DC.

PRODUCT INFORMATION

The unit incorporates an overcurrent trip circuit which will instantly de-energize the high voltage power supply if such a condition is encountered. The level of sensitivity at which trip-out will occur is controlled by the front panel adjustment labeled "Min-Max." The trip setting can be as low as 10% or as high as approximately 110% of full-scale reading. Overcurrent trip is indicated by an audible alarm. Unit will go into current limiting state at approximately 110% of full current output rating. If range switch is in highest setting and current trip is not set low enough, no current trip will occur even if output is shorted.

SPECIFICATIONS

Description:
DC High Potential Tester with Megohmmeter

Primary Application:
Dielectric withstand testing and insulation resistance measurement of motors, cables, and transformers.

Input:
120 Volts AC, 50/60 Hz, single phase, 1 Amp
or
220 Volts AC, 50/60 Hz, single phase, .5 Amps

Output:
Regulated 0-15 kV DC, continuously adjustable with manual control.
0-2mA (PM15-2) Negative Output, Positive Ground

Voltmeter:
2%, 3.5", analog meter, 0-7.5/15 kV

Currentmeter/Megohmmeter:
2%, 3.5", analog meter, 0-.5/5/50/500/5,000 microamperes DC

Megohms at 5kV DC
2.5-100/1,000/10,000/100,000/1,000,000

Megohms at 10kV DC
5-200/2,000/20,000/200,000/2,000,000

Megohms at 15kV DC
7.5- 300/3,000,30,000/300,000/3,000,000

Termination:
Input: Standard modular 3-wire cord mating to fused input module
High Voltage: 10' attached cable with clip and insulator
Return: 10' separate cable with insulated clip
Ground: 10' separate cable with clip

Dimensions:
18" W x 11" D x 11.5" H (457 mm W x 279 mm D x 292 mm H)

Weight:

	120 VAC	220 VAC
PM15-2	15 lbs. (6.8 kg)	16 lbs. (7.3 kg)

SECTION 2: CONTROLS AND CONNECTIONS

FRONT PANEL CONTROLS AND METERS

Power On:

When pressed and locked, this illuminated pushbutton switch (green lens) supplies power to all unit components with the exception of the high voltage power supply.

Voltage Control:

Clockwise rotation of this control increases the unit's output voltage. The unit's output range is 0-15,000 volts DC. This control must be returned to the "0" (full counterclockwise position) before a test can be initiated if either the "Power" or "High Voltage" switches have been previously disengaged, or if an overcurrent condition has been encountered.

High Voltage:

When pressed and locked, this illuminated pushbutton switch (red lens) supplies power to the unit's high voltage power supply, if voltage control is set at "0." If voltage control is not set at zero, high voltage will not activate, and buzzer will sound until voltage control is returned to zero.

Currentmeter-Megohmmeter:

The currentmeter range is selected by the five-position rotary switch. The switch setting indicates the full-scale current of the currentmeter and the megohmmeter multiplier. The table below shows the full scale currentmeter range with each switch setting.

Switch Setting	Currentmeter Ranges
.5 microamps	0-.5 microamps
5 microamps	0-5 microamps
50 microamps	0-50 microamps
500 microamps	0-500 microamps
5,000 microamps	0-2,000 microamps

The megohm multiplier is selected by the same five position switch as the currentmeter range. This allows direct megohm readings at 5 and 10 kV. In order to read megohms directly, the kilovolt meter must be set to either 5 or 10 kV. The megohms are then read from the right-hand meter, megohms at 10 kV on the top scale and megohms at 5 kV on the middle scale. The table below shows the megohm range for each switch setting and kilovolt range.

CONTROLS AND CONNECTIONS

FRONT PANEL CONTROLS AND METERS (continued)

Switch Setting	Megohmmeter Ranges 5 kV	10 kV	15 kV
x10K	10,000 – 1,000,000 M	20,000 – 2,000,000 M	30,000-3,000,000 M
x1K	1,000 - 100,000 M	2,000 – 200,000 M	3,000-300,000 M
x100	100 – 10,000 M	200 – 20,000 M	300-30,000 M
x10	10 – 1,000 M	20 – 2,000 M	30 - 3,000 M
x1	2.5 – 100 M	5 – 200 M	7.5 – 300 M
			3.75 – 300 M

Voltmeter Range:

This two-position rotary switch scales the DC kilovolt meter. When the switch is rotated to "7.5", the kilovolt meter range is 0-7.5 kV and the lower black scale is read in order to determine output voltage. When the switch is rotated to "15," the kilovolt meter range is 0-15 kV and the upper scale is read in order to determine output voltage.

Current Trip:

This control, located below the currentmeter range select switch, allows the operator to set the level of leakage current measured by the instrument before high voltage shutdown occurs. At its highest level (full clockwise), approximately 110% of full-scale current will be allowed. At its lowest level (full counterclockwise), approximately 10% of full-scale current will be allowed before shutdown.

Guard:

The guard function is selected by a push button switch. When the guard switch is unlatched (non-illuminated), leakage current or insulation resistance values associated with the "Ground" terminal will be measured. When the switch is pressed to "Guard" (illuminated), leakage current or insulation resistance associated with the "Ground" terminal will not be measured. ***The low potential or return side of the test specimen must be isolated from ground to use the guard function.***

Fuses:

The protective fuses are contained in the AC power module.

CONTROLS AND CONNECTIONS

INPUT/OUTPUT CONNECTIONS

Return:

Leakage current or insulation resistance values associated with this terminal are measured by the "DC Microammeter." The low potential side of the test specimen should be connected to this terminal (red cable provided). When guard is not activated (switch not depressed), the return terminal is connected internally to ground. All currents associated with return and ground will pass through the current meter. When guard is activated (switch depressed), return is isolated from ground and only currents associated with return will be measured. ***The test specimen low potential side must be isolated from ground in order to measure currents to return in guard mode.***

Ground:

This terminal is to be connected to the facility ground (black cable provided). Leakage current or insulation resistance values associated with this binding post terminal may be either measured by the "DC Microammeter" (guard switch not depressed) or bypassed around the "DC Microammeter" (guard switch depressed) depending on the state of the guard switch.

If the low potential side of the test specimen connected to Return can not or will not be isolated from ground, guard mode cannot be used, or the current meter will not function properly.

Output:

This test lead with clip and insulation boot supplies the unit's high voltage output to the apparatus under test.

AC Power Module:

The provided AC input cable plugs in here to provide AC power to the unit. The module also contains the protective fuses for the unit.

SECTION 3: SET UP AND OPERATION INSTRUCTIONS

SET UP

Set up the unit as follows:

1. Turn the main “Power” switch off (push button out position, non-illuminated).

2. Turn the “High Voltage” power switch off (push button out position, non-illuminated).

3. Make necessary grounding connections.

4. Set all switches and controls present on your unit as listed below for initial start-up:

“Voltage Control”	0 (zero)
“Ammeter/Megohm” Range	× 1/5000
“KV Meter”	15 kV (or desired range)
“Current Trip”	Mid-range

5. ***CAUTION: Ensure that test specimen is non-energized, discharged, and properly isolated before proceeding.***

   Connect the test leads to the specimen to be tested. See Test Lead Connections section for information on how to connect the test leads.

6. Connect the “AC Line” cord to the power module and to the appropriate “AC Power Source” (see unit specification tag; either 120V or 220V).

TEST LEAD CONNECTIONS

An understanding of the function of the two current return terminals (“Return” and “Ground”) on the unit will allow the operator to properly connect the test leads for a variety of configurations.

The following points should be kept in mind when determining the proper connections for a given test requirement:

CAUTION: Ensure that test specimen is non-energized, discharged and properly isolated before connecting test leads.

1. Always attach the “High Voltage Test Lead” to the “High Potential Side” of the test specimen.

2. Any current flowing through the test lead attached to the “Return” terminal on the unit will always be measured by the “DC Microammeter” if the “Guard” switch is in its out position (non-illuminated).

SET UP AND OPERATION INSTRUCTION

TEST LEAD CONNECTIONS (continued)

3. Any current flowing through the test lead attached to the “Return” terminal on the unit will always be measured by the “DC Microammeter” if the “Guard” switch is activated (illuminated), unless the specimen return is not isolated from ground in which case the currentmeter will be inoperative. .

4. Current flowing through the test lead attached to the “Ground” terminal on the unit will be measured by the “DC Microammeter” only when the “Guard” switch is not activated (non-illuminated). Ground current associated with the “Ground” terminal will not be measured when the “Guard” switch is activated (illuminated).

5. To use the “Guard” mode (switch depressed, illuminated), the specimen must be isolated from ground. If the low potential side of the specimen will not or can not be isolated from ground, the “Guard” mode cannot be used.

OPERATION

1. Turn the unit on by pressing the “Power” switch. The switch will illuminate and remain recessed. There will be a normal short delay in illumination of the switch after it is pressed.

2. Set “Voltage Control” to zero. Energize the high voltage power supply by pressing the “High Voltage” power switch. The switch will illuminate and remain recessed.

   NOTE: If the “Voltage Control” has not been set to “Zero,” the overcurrent alarm will sound. To silence this alarm, ensure that the voltage control is in its full counter-clockwise position. When fully set to “Zero” it will click into place.

3. Rotate the “Voltage Control clockwise until the desired test voltage is observed on the “Kilovolt” meter. Maintain output voltage at the desired level for the required amount of time. If the test was initiated on the “15” scale and a more accurate voltage reading is required (7.5 kV or below), select “7.5” on the “KV Meter” range switch.

   NOTE: If an overcurrent condition is encountered before required test voltage is reached and it is desirable to achieve a higher test voltage, adjust the “Min-Max” to a more clockwise position. Restart “Voltage Control” at “Zero.”

4. Observe and record the resultant leakage current or insulation resistance value on the “Microamperes/Megohms” meter. If no current reading is indicated, select a lower sensitivity range until an observable reading is obtained at less than full scale on the “DC Micro-amperes/Megohms” meter.

   NOTE: The megohmmeter is scaled to read megohms directly at three test voltages; 5 kV (lower megohm scale), 10kV (mid scale), and 15 kV (upper megohm scale). If any other test voltage is used, the megohm reading must be taken by dividing the voltage read on the kilovolt meter by the current on the DC microamperes meter.

SET UP AND OPERATION INSTRUCTIONS

OPERATION (continued)

Example: If 2kV is read on the voltmeter and you are drawing 50 μA, the resistance would be 40 megohms.

Formula: $\frac{V}{I} = R \qquad \frac{2000V}{.00005A} = 40{,}000{,}000\Omega$

NOTE: Be sure that the "Guard" switch is in the desired position. Certain test conditions may require that leakage currents associated with the "Ground" post be measured by the microammeter.

5. When testing is completed, return the "Voltage Control" to its zero (0) or fully counter-clockwise position, the control knob will click into position.

6. Observe that the Kilovolt meter indicates zero (0) output.

7. Turn off the high voltage power supply by pressing the "High Voltage" power switch. Observe that this switch is no longer illuminated and is in its out position.

8. Turn the unit off by pressing the "Power" switch. Observe that this switch is no longer illuminated and that it is in its out position.

   CAUTION: Use discharge or shorting stick on test specimen before disconnecting cables.

9. If continued testing is required, return to step 1 above.

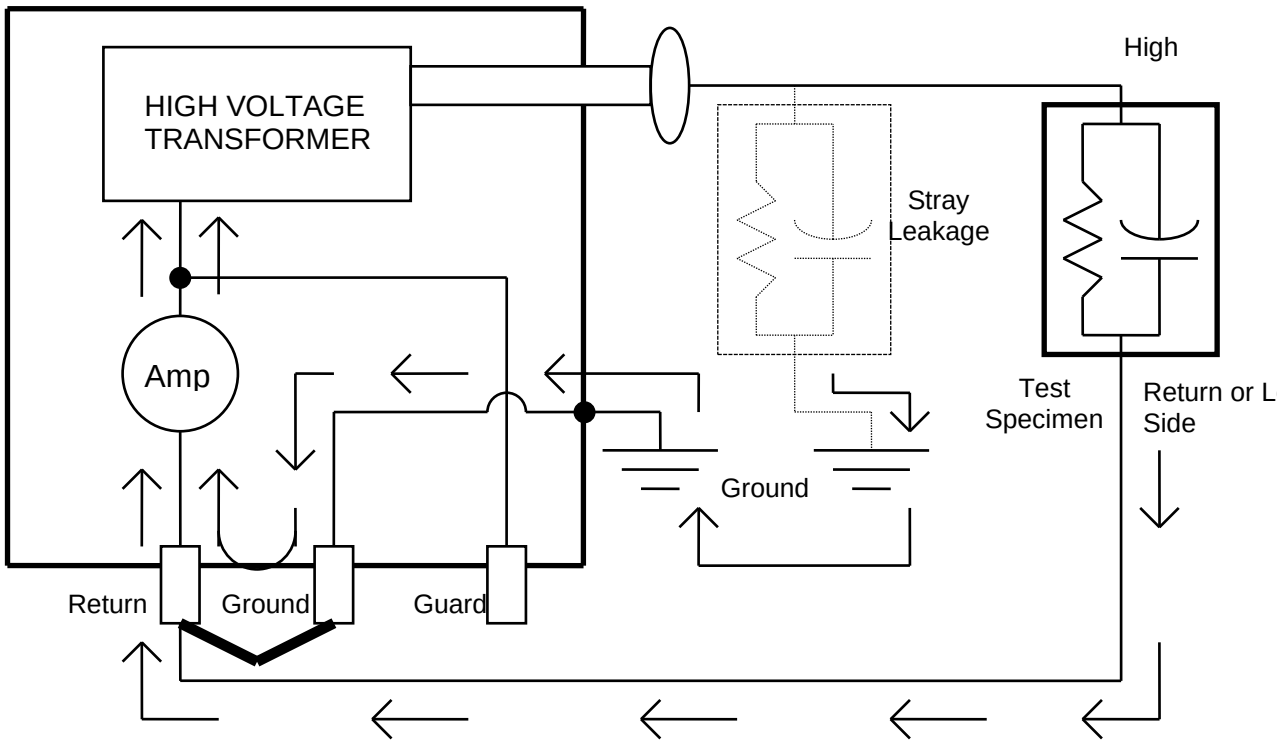
   NOTE: Further testing cannot be accomplished once either or both of the power switches have been disengaged unless the "Voltage Control" has been reset to its zero or full counter-clockwise position.

SET UP AND OPERATION INSTRUCTIONS

NOTES CONCERNING THE USE OF GUARD AND GROUND

NORMAL MODE CONFIGURATION

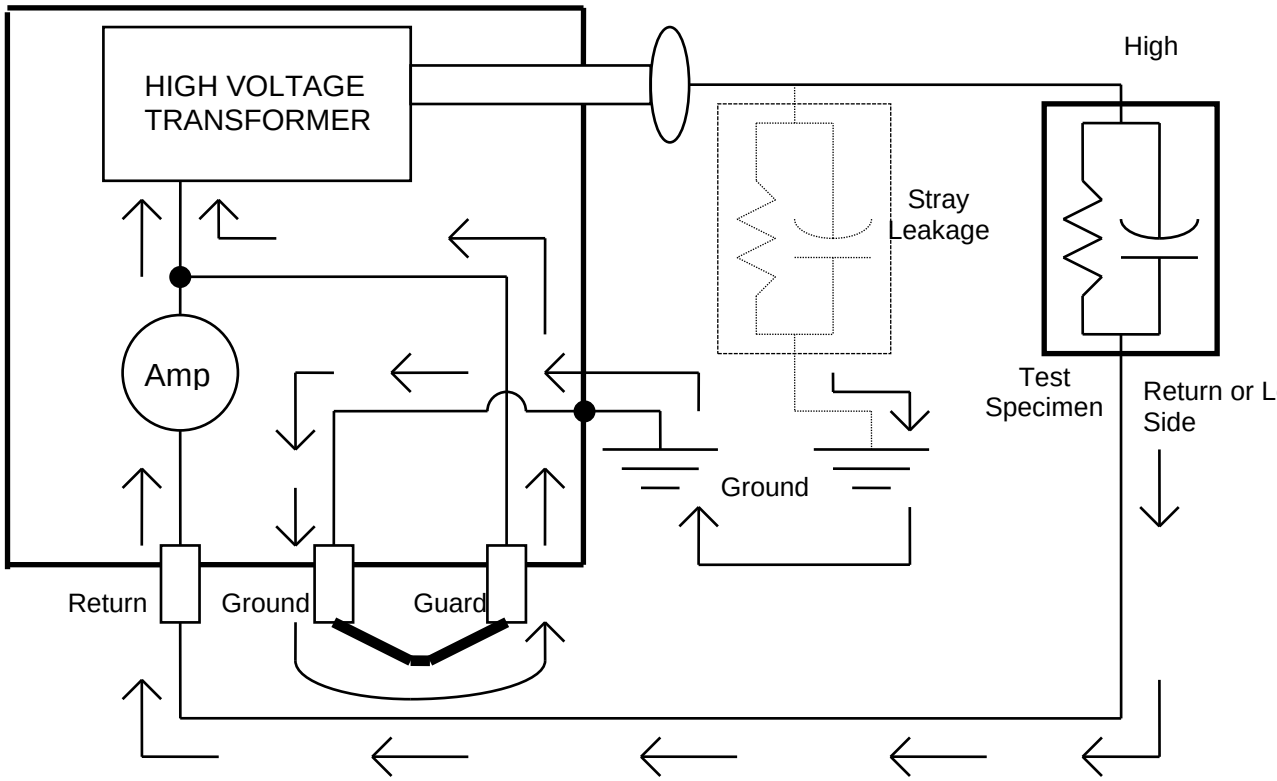
In this configuration the **Return** and **Ground** are connected together with an external jumper or a switch internal to the Test Set, depending on the design. Nothing is connected to the **Guard**. Both stray leakage to earth ground and leakage through the Test Specimen is indicated on the current meter. This configuration should be used if it is not possible to isolate the return side of the Test Specimen from earth ground.



SET UP AND OPERATION INSTRUCTIONS

GUARD MODE CONFIGURATION

In this configuration the **Guard** and **Ground** are connected together with an external jumper or a switch internal to the Test Set, depending on the design. Any current associated with the **Return** is indicated on the current meter. Any current associated with the **Guard** bypasses the current meter. Leakage current through the test specimen is indicated on the current meter. Stray leakage to earth ground is not indicated on the current meter. This configuration can not be used if it is not possible to isolate the return side of the Test Specimen from earth ground.



SECTION 4: SCHEMATIC

Drawing Number	Description
9109080	PM15-2

SECTION 5: PM15-2 PARTS LIST

Qty.	Phenix Stock #	Item	Description
	9109080		**PM15-2 Complete Assembly**
MECHANICAL			
1	2100513	CASE	Case, Carrying, HD Polyethylene
1	40400030	PANEL	Panel, Divider, Chassis/Case
1	40400031	BRACKET	Bracket, Front Panel to H.V. Panel
1	N.P.N.	BRACKET	Bracket, Fiberglass Channel, Power Supply
1	N.P.N.	PANEL	Panel, Fiberglass, H.V.
1	42000014	PANEL	Panel, Front, Control/Metering
CABLES / LEADS			
1	1077170	CORD	Cord, Input Power, Right Angle
*1	30070002	CABLE	Cable, H.V. Output, w/ Insulated Clip (RG58C/U)
1	30080004	LEAD	Lead, Return Test (Red) w/ Insulated Clip
1	30080005	LEAD	Lead, Ground (Black), w/ Insulated Clip
HIGH VOLTAGE COMPONENTS			
1	1748200	R37	Resistor, 6W, 75M
1	1590171	H.V. POWER SUPPLY	Power Supply, 15kV-2mA
ELECTRICAL PARTS / COMPONENTS			
1	1152590		Module, Power Entry – Corcom 6VM1
4	1350104		Spacer/Standoff, 6-32X1/2"
1	1351100	BINDING POST	Binding Post, Ground, Black
1	1351102	BINDING POST	Binding Post, Return, Red
*2	1603702	F1, A&B	Fuse, 2A, GDC
*3	1420145	LAMP	Lamp, Guard, High Voltage, Power, 28V
1	1422150	LENS-RED	Lens, Red, High Voltage Lamp
1	1422151	LENS-GREEN	Lens, Green, Power On Lamp
1	1422152	LENS-YELLOW	Lens, Yellow, Guard Lamp
*2	1501012	M1, M2	Voltmeter, Currentmeter, 50μA, 3 ½”
1	N.P.N.	M1	Scale, Currentmeter
1	N.P.N.	M2	Scale, Voltmeter
1	1590170	POWER SUPPLY 24V	Power Supply, 24VDC, 2.5A PSA-60-124
1	1761092	R32	Linear Pot., 10K, 1 Turn - Current Trip
1	1355305	R32 KNOB	Knob for Current Trip Pot.
1	1761960	R36	100k Linear Pot w/Switch – Voltage Control

PM15-2 PARTS LIST

1	N.P.N.	R36 KNOB	Knob, Raise Voltage
1	1860260	SW1	Switch, Main Power, Lighted, Latching 1 Pole
1	1860265	SW5	Switch, Guard, Lighted, Latching 2 Pole
2	1355310	SW3, SW4 KNOBS	Knobs for Voltmeter, Currentmeter Range Switches
2	1863040	SW3, SW4	Switch, Range, Voltmeter, Currentmeter, 2 Pole, 2-6 Pos.
1	3111696	CKT. BOARD ASSY.	PCB 1169 PM15 Control Board Assembly
PARTS – PCB 1169 CIRCUIT BOARD			
1	1424015	B1	Buzzer, Intervox, 24V, 35mA, BS2316P-24C
1	1093175	C1	Capacitor, .27μf, 50 VDC
1	1095800	C2	Capacitor, 10μf, 20V
2	1092050	C3, C9	Capacitor, .01μf, 1kV
2	1098470	C4, C5	Capacitor, Electrolytic, 470uf, 35V
2	1095825	C8,10	Capacitor, Electrolytic, 10uf, 25V
1	1094438	C13	Capacitor, 2.2μf, 50V
2	1152285	CON1,4	Connector, 8 Pin, Red
2	1152286	CON1,4	Connector, Board, 8 Pin
5	1152260	CON2,3,6,7,9	Connector, 4 Pin, Red
5	1152261	CON2,3,6,7,9	Connector, Board, 4 Pin
1	1152230	CON8	Connector, 12 Pin, Red
1	1152231	CON8	Connector, Board, 12 Pin
6	1780025	DI-6	Diodes
1	1701033	K1	Relay, 2 Pole, 120 VDC
1	1701323	K2	Relay, 4 Pole, RY4S-UDC24V, IDEC
1	1157340	K2 Socket	Socket, 4 Pole, Printed Circuit
1	1700920	K3	Relay, 2 Pole, 12VDC, Omron G5A-237P
1	1111692	PCB	Printed Circuit Board, Control
1	1794005	Q1	Voltage Regulator, +12V, MC78M12CT
1	1794006	Q2	Voltage Regulator, -12V, LM320T-12
1	1803100	Q3	C106D SCR
2	1723300	R1, R26	Resistor, 68kΩ, .5W, 1%
2	1761090	R2,30	Resistor, 10 kΩ, Type 43P Pot.
3	1761502	R3,20,27	Resistor, 50 kΩ, Type 43P Pot.
1	1722615	R6	Resistor, 20 kΩ, .25W, 1%
1	1734050	R7	Resistor, 49.9 kΩ, .25W, 1%
4	1722082	R10,11,33,39	Resistor, 1 kΩ, .25W, 1%
1	1760050	R14	Resistor, 50 Ω, Type 43P Pot.
1	1720201	R15	Resistor, 180 Ω, .5W, 1%
1	1760900	R16	Resistor, 1 kΩ, Type 43P
1	1722075	R17	Resistor, 1.5 kΩ, .5W, 1%
1	1761052	R18	Resistor, 5 kΩ, Type 43P

PM15-2 PARTS LIST

1	1722300	R19	Resistor, 18 kΩ, .5W, 1%
1	1722635	R21	Resistor, 180 kΩ, .25W, 1%
1	1762950	R22	Resistor, 1 mΩ, Type 43P
1	1735140	R23	Resistor, 1.5 mΩ, .25W, 1%
1	1722587	R24	Resistor, 22 kΩ, .25W, 1%
1	1734110	R25	Resistor, 110 kΩ, .25W, 1%
1	1722080	R29	Resistor, 2.2 k Ω.5w, 12
2	1722600	R31,38	Resistor, 10 kΩ, .25W, 1%
1	1720180	R34	Resistor, 100 Ω, .25W, 1%
1	1894335	T1	Transformer, ST4-24
5	1356300	TP1-5	Test Points, Minwrap, T68A
3	1158008	U1-3 Sockets	Socket, 8 Pin, IC
2	1790100	U1,3	Operational Amplifier
1	1794493	U2	Voltage Comparator
2	1606130	Z1,3	Movistor
2	1780063	Z2	Transorb, 10V

SECTION 6: PARTS ORDERING INFORMATION

Replacement parts are available from Phenix Technologies, Inc.

Changes to Phenix Technologies' products are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest technical improvements developed in our Engineering Department. It is, therefore, important when ordering parts to include the serial number of the unit as well as the part number of the replacement part.

When your purchase order is received at our office, a representative of Phenix Technologies will contact you to confirm the current price of the part being ordered. If a part you order has been replaced with a new or improved part, an applications engineer will contact you concerning any change in part number.

Send orders for replacement parts to:

Service Department
Phenix Technologies, Inc.
75 Speicher Drive
Accident, Maryland 21520

Ph: 1 (301) 746-8118
Fax: 1 (301) 895-5570
E-Mail: info@phenixtech.com

SECTION 7: RETURNED MATERIAL

If for any reason it should become necessary to return this equipment to the factory, the Service Department of Phenix Technologies, Inc. must be given the following information:

Name Plate Information
Model Number
Serial Number
Reason for Return
Cause of Defect

If Phenix Technologies, Inc. deems return of the part appropriate, it will then issue an "Authorization for Return."

If return is not deemed advisable, other inspection arrangements will be made.

NOTE: Material received at this plant without the proper authorization shall be held as "Customer's Property" with no service until such time as the proper steps have been taken.

Your cooperation is requested in order to ensure prompt service.

SECTION 8: CUSTOMER COMMENTS / SUGGESTIONS

Phenix Technologies made significant efforts to ensure that the materials in this Operator's Manual are correct. If there are concerns or comments as you have used this information, Phenix Technologies appreciates any feedback.

Unit Serial Number:

Sect	Page(s)	Comment

Please return to Phenix Technologies, Engineering Department, 75 Speicher Drive, Accident, MD 21520 USA.

Phone: 1 (301) 746-8118, Fax 1 (301) 895-5570, or info@phenixtech.com