Instruction Manual AVTM681100Ja
for
50/100kV ac Test Set
Catalog No. 681100 Series

High-Voltage Equipment
Read the entire manual before operating.

Aparato de Alto Voltaje
Antes de operar este producto lea este manual enteramente.

Megger.

P.O. Box 9007
Valley Forge, PA 19485-1007 U.S.A
Tel.: 610-676-8500
Fax: 610-676-8610

Shipping Address:
Valley Forge Corporate Center
2621 Van Buren Avenue
Norristown, PA 19403 U.S.A.
www.megger.com

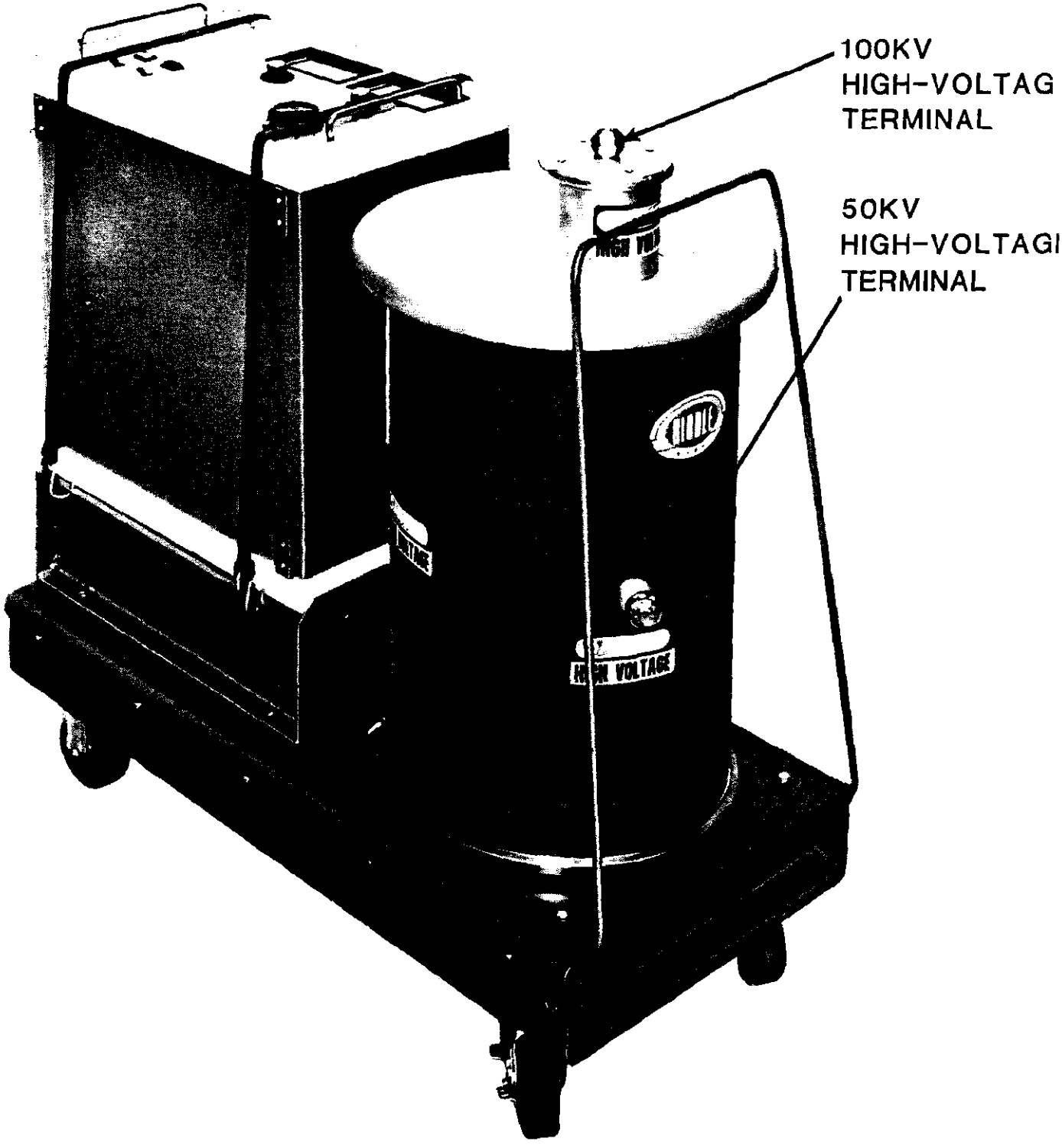

Figure 1: Typical 50/100 kV AC Test Set Showing the 50 kV and 100 kV High-Voltage Terminals.

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SECTION A

INTRODUCTION

The Biddle Catalog No. 681100 Series AC Test Set provides the high voltage high power AC output for "withstand" or "hipot" testing of capacitive test samples.

The Test Set consists of two pieces of equipment; the High Voltage Power Supply Assembly (HV ASSEMBLY) and the control console, connected together by two interconnecting cables.

The control console contains the instruments and controls required to operate the Test Set.

The high voltage transformer is specially designed to "resonate" with a test sample of capacitance equal to 50% of rated maximum capacitance. Therefore at the 50% load point of either the 50 kV or 100 kV high voltage transformer windings, the high voltage transformer will draw minimum input current, and at full load and no load the high voltage transformer will draw maximum input current. (Refer to Figure 2 for input current vs percent load for both high voltage transformer windings (50 kV and 100 kV)).

The 50% resonant-type transformer has advantages over a conventional-type transformer. For example, a considerably greater kVA output can be achieved for an equal physical size, and for an equal kVA output, the input power requirement is approximately one half. The disadvantage is that it can only do limited testing of non-capacitive type test samples, however since the majority of test samples are capacitive, this is not a problem in most cases. Should it be necessary to test non-capacitive samples, it is recommended that a conventional-type transformer, such as the Biddle Catalog No. 686100 Series AC Test Set be used.

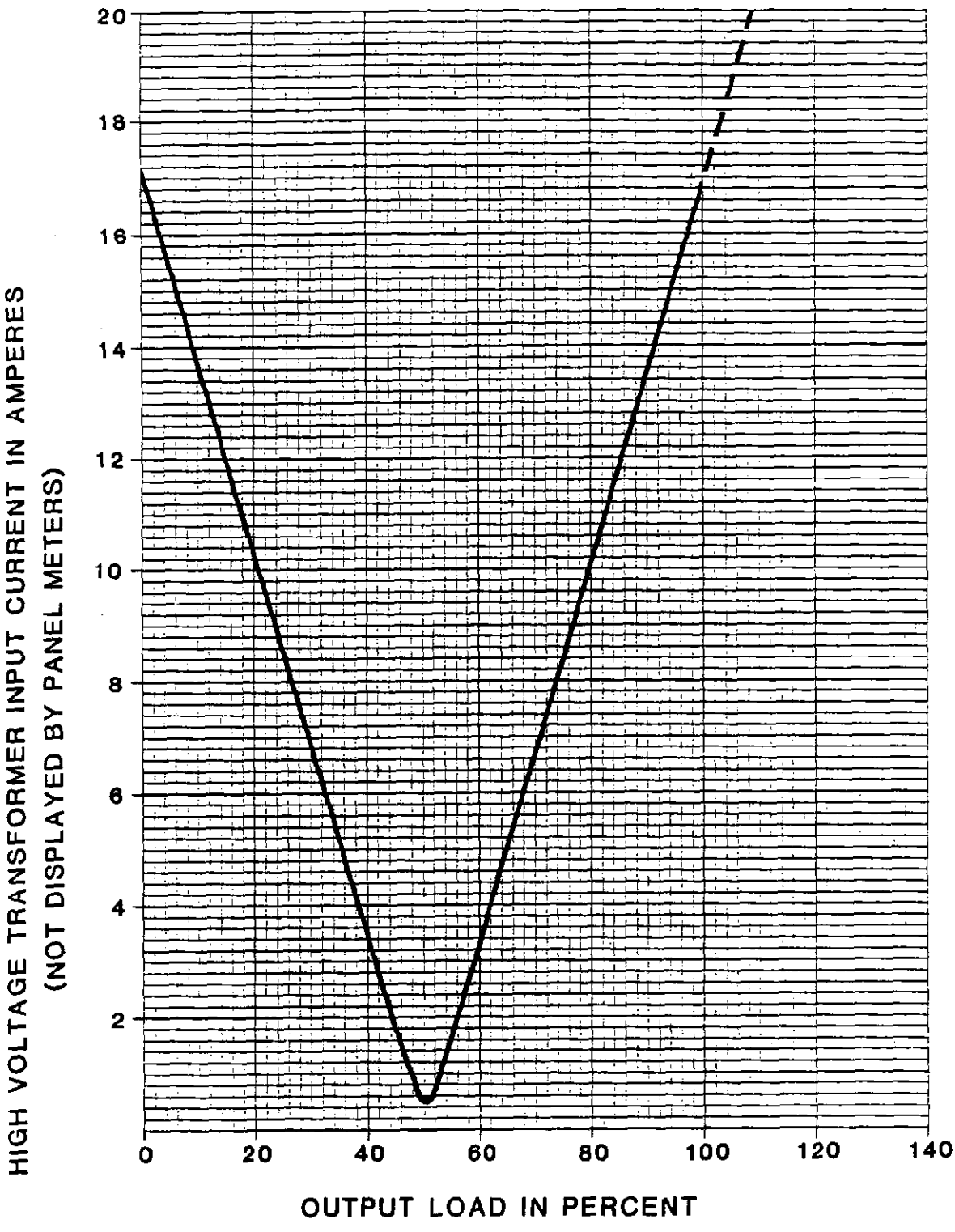


Figure 2: Typical Input Amperes vs. Percent Load for the 50 kV or 100 kV High Voltage Transformer Winding.

SECTION B

SAFETY PRECAUTIONS

SAFETY IS THE RESPONSIBILITY OF THE USER

GENERAL

This Test Set and the test sample to which it is connected are a source of high-voltage electrical energy. All persons performing or assisting in a test must use all practical safety precautions to prevent contact with energized parts of the test equipment and related circuits. Persons actually engaged in the test must stand clear of all parts of the complete high-voltage circuit unless the test set is deenergized and all parts of the test circuit are grounded. Any persons not directly involved with the work must be kept away from test activities by suitable barriers, barricades, or warnings.

High-voltage test equipment, as well as the equipment to be tested, should be enclosed in a safety interlocked area. Terminals to connect to external safety Interlock facilities are provided on all Biddle test sets supplied with a source of high voltage.

If the Test Set is operated properly and all grounds are correctly made, test personnel need not wear rubber gloves. As a routine safety procedure, however, some users require that rubber gloves be worn, not only in making connections to the high-voltage terminals, but in manipulating the controls. Biddle Instruments considers this an excellent safety practice.

Caution Concerning Heart Pacemakers

Users of high-voltage equipment should note that high-voltage discharges and other sources of strong electric or magnetic fields may interfere with the proper operation of heart pacemakers or similar devices. Personnel having heart pacemakers or similar devices should obtain expert advice on possible risks before using this equipment or being close to the equipment while it is in operation.

GENERAL SAFETY PRACTICES - LABORATORY WORK

Test Areas

1. Permanent Test Areas. Permanent test areas should be completely enclosed by walls or some type of physical barrier. Entrances to such areas should be interlocked with the Test Set so that test voltage cannot be applied while the gates are open. (Refer to SECTION E DESCRIPTION for details of the interlock circuit and connection to it).

   Appropriate warning signs, for example, **DANGER - HIGH VOLTAGE**, should be posted on or near the entrance gates. (Refer, for example, to OSHA 1910.145 *for colors, proportions and composition.*)

2. Temporary Test Areas. Temporary test areas should be completely enclosed by some type of barrier. Some examples are:

   A. Portable fencing which is grounded and equipped with interlocked entrances. (Refer to SECTION E DESCRIPTION for details of the interlock circuit and connection to it).

   B. Distinctively colored safety tape supported approximately waist high to which suitable safety signs are attached. No one may cross this barrier. When the test is completed and the test voltage has been removed, the tape must be removed before anyone may enter the area. Alternatively, a gate carrying a suitable warning sign can be made in the tape barrier with the tape or tennis netting. This gate can be opened only after test power has been removed. If possible, this gate should be interlocked or an operator-activated foot switch interlock should be used.

      If the taped-off area cannot be viewed completely by the operator, one or more observers should be stationed so that the entire area can be monitored. A taped-off area should never by left unattended while the test power is on.

   C. A loudspeaker system is sometimes desirable for the purpose of communicating with all personnel in the area.

Access to Test Areas.

A systematic procedure should be developed and implemented to control access to the test areas so that an area will not be energized with a person in it. A key switch system is one of many possible methods. In special cases it may be necessary to place an observer within a test area. This should be done only after special permission has been granted and a safe working procedure has been established. Alternatively, it involves placing the person within or behind a grounded barrier or having the person sit or stand on a special switch which removes the high voltage should the person move off the switch. Refer to OPTIONS/ACCESSORIES in SECTION D SPECIFICATIONS for details of safety switches.

Safety Within Test Areas

1. Grounding Practices. All test samples should be properly grounded so that personnel hazards do not exist. It is necessary to ground the high-voltage circuit before working on it or on the test sample.

   Insofar as practical, automatic grounding devices should be provided to apply a visible ground on the high-voltage cirucits after they are de-energized. In some high-voltage circuits, particularly those in which elements are changed from one setup to the next, this may not be feasible. In these cases the operator should attach a ground to the high-voltage terminal using a suitably insulated handle. In the case of several capacitors connected in series, it is not always sufficient to ground only the high-voltage terminal. The exposed intermediate terminals should also be grounded.

2. Safety Rules. A set of safety rules should be established and enforced for the laboratory or testing facilities. A copy of these should be given to, and discussed with, each person assigned to work in a test area. A procedure for periodic review of these rules with the operators should be established and carried out.

3. Safety Inspection. A procedure for periodic inspection of the test area should be established and carried out. These inspections should be followed by corrective actions for unsafe equipment or practices that are unsound.

GENERAL SAFETY PRACTICES - FIELD WORK

This section provides guidance in recognizing and avoiding hazards that may arise from the performance of high-voltage tests and measurements outside the controlled environment of a laboratory. It is not intended to constitute rules such as may exist in established codes of work practices nor to delineate mandatory requirements such as may be specified in national or regional codes for electrical safety. (Refer, for example, to ANSI C2-1981, Part 4, Rules for the Operation of Electric-Supply and Communications Lines and Equipment). Personnel engaged in field testing should be thoroughly conversant with the appropriate work rules and safety codes, and with the equipment to be used.

The scope excludes measurements made with permanently installed instrumentation. Also excluded are specific procedures (for example, phasing out, and testing for no voltage) which are routinely made by qualified operators under appropriate rules of work practice.

Field Tests - General

1. Since the environment in which field tests are conducted differs in important respects from that of the laboratory tests, extra care should be taken to ensure appropriate levels of safety.

   Permanent fences and gates for isolating the test area are not usually provided, nor is there permanent conduit for the instrumentation and control wiring. Further, there may be sources of high-voltage electrical energy in the vicinity in addition to the source of testing voltage.

   A. In all cases there should be a single person responsible for the performance of the tests and for the dissemination of necessary safety instructions to the personnel involved. This should be a minimum requirement.

   B. The considerations given in this section provide guidance in achieving a level of safety in field testing comparable to that achieved in the laboratory. It is to be emphasized that assurance of safe conditions must be rooted in the safety-oriented attitude of all personnel involved in the testing.

Field Tests - General (cont'd)

2. It is usual that when an energized power system is involved in or is close to the testing operation, a formal procedure for granting permission to work will exist for the purpose of ensuring safe disconnection of sources of system power at the test location. Such procedures may, in any particular case, be considerably more elaborate than those mandated by the applicable national consensus standard. (Refer to ANSI C2-1981, Part 4, Rules for the Operation of Electric-Supply and Communications Lines and Equipment). The requirements of the consensus standard represent minimum precautions to be observed with respect to the sources of system power.

   A. It should be realized that a permit to work, in accordance with the relevant standard, does not relieve any individual involved from personally ensuring the safety of himself or the other personnel involved in the test, and of any persons who, for other reasons, may be in the proximity of the test site.

   B. When working in the vicinity of energized conductors, the clearance mandated by the appropriate national or regional code for electrical safety must be maintained. (Refer to ANSI C2-1981, Part 4, Rules for the Operation of Electric-Supply and Communications Lines and Equipment.)

3. The precautions necessary for protection of personnel and equipment from the hazards of the high-voltage or high-power testing must be observed for every test.

   A. The required testing should be accomplished in accordance with the appropriate test codes or guides.

   B. In addition to the person controlling the application of voltage or current, at least one other person should be capable, either by communication, direct action, or remote control, of interrupting the testing in the case of unexpected events.

Field Test - General (cont'd)

C. Definite procedures should be formulated for dealing with the consequences of possible failure of the apparatus under test.

4. In the more elaborate or complex instances of field testing, a test coordinator should be designated to manage the coordination of test procedures with the relevant system safeguards. The test coordinator should have a complete familiarity with the test equipment, and should be guided at all times by the necessity of ensuring safety to the personnel and to the test equipment, and of maintaining the integrity of the power system.

   The test coordinator should be responsible for formulating a set of rules and a system of compliance which will provide safeguards to personnel comparable to that provided by permanent permission-to-work regulations.

5. When complex staged tests are contemplated, consultation and coordination with the appropriate persons responsible for engineering, operating, and maintaining or constructing the system should be initiated well in advance of the proposed testing, and should be carried out in sufficient detail so that a possibility of unsafe conditions or of impossible-to-execute procedures will not be encountered during the testing.

   A. Special settings of protective relays and re-examination of backup schemes may be necessary to ensure an adequate level of safety during the tests, or to minimize the effects of the testing on other parts of the power system.

   B. The test coordinator should personally ensure that all special devices or settings are applied before initiating the test procedure.

   C. The possible occurrence of unusual phenomena such as ferroresonance, neutral inversion, and self-excitation of rotating machinery should be carefully considered, and specific plans for dealing with the hazardous voltages that could develop in such cases should be formulated in advance.

Isolation (Roping-Off) of the Equipment Under Test - Field Conditions

1. The purpose of isolating areas is to avoid the presence of persons in a region where high-voltage hazards exist. It is not always possible in the field to physically prevent ingress of persons into a test area, as is accomplished by the fences and interlocked gates of the laboratory environment. Instead, readily recognizable means are employed so as to actively discourage such ingress.

   The effectiveness of such means depends upon respect for their significance, a respect which is largely a matter of discipline. Such discipline should be rigorously enforced.

   The effectivenss of the means employed can be severley compromised by inattention to the necessity for removing them when they are not required. For example, to leave barriers in place for a week at a time, when testing is performed only an hour or two per day, is likely to result in disrepect.

   Typical devices and schemes are discussed below for expository purposes. In any given organization, those barriers which are traditional are most likely to be respected. In all cases, enough warning signs to be visible from all approaches should be part of the barrier system.

2. Roping-off the area with a distinctive flexible safety line (for example, yellow-and-black polypropylene rope or orange fabric tape) is probably the most widely used means of isolation employed for hazardous areas in a power system. This method may be combined with the use of traffic cones and flags.

3. Portable electrically-interlocked stanchions or pylons, usually with warning lamps appropriately illuminated, and sometimes with audible warning devices, are a more elaborate means of isolating a test area under field conditions. A flexible cord with plugs and receptacles is used to interconnect the devices around the perimeter of the test area. Considerations appropriate to the design of a safety interlock system are discussed in SECTION E DESCRIPTION.

Isolation (Roping-Off) of the Equipment Under Test - Field Conditions (cont'd)

4. Both the person responsible for the testing and the person operating the test equipment should make sure that all necessary barriers are in place before test potential or current is applied. It should be determined that all persons likely to be in the vicinity are familiar with the significance of the barriers. In many circumstances, a guard or safety supervisor may be necessary.

Grounding in the Field

1. Test equipment and test samples should, in most cases, be properly grounded prior to making or breaking any test connections. Careful consideration should be given to possible induction from nearby conductors.

   A. Grounding or short-circuiting jumpers under the control of the test coordinator should be applied to the appropriate terminals or conductors. Such jumpers as are necessary to maintain a safe ground should be in place before permanent connections are disconnected. The jumper connections should be reliable for the service involved. Clamp-type connections are recommended, and use of devices such as alligator clips discouraged.

   B. When the testing results in the accumulation of electrostatic charge on the apparatus, short-circuiting or grounding jumpers, as appropriate, should remain in place for a time sufficient to reduce the charge to a non-hazardous level.

GENERAL SAFETY PRECAUTIONS FOR AC TESTING

1. Devices which rely on solid or solid/liquid dielectric for insulation preferably should be grounded and short circuited with bonding jumpers when not in use.

2. Good safety practice requires that capacitive objects be short-circuited in the following situations:

   A. Any capacitive object not in use which might be within the influence of an electric field should have its exposed high voltage terminal grounded. Failure to observe this precaution could result in a voltage induced in the capacitive object by the field.

   B. Any open-circuited capacitive device should be short-circuited and grounded before being contacted by personnel.

      NOTE: It is good practice for all capacitive devices to remain short-circuited when not in use.

For further details on safety practices and precautions in high voltage and high power testing, refer to IEEE Standard 510-1983 "IEEE RECOMMENDED PRACTICES FOR SAFETY IN HIGH-VOLTAGE AND HIGH POWER TESTING".

SUMMARY

The Biddle AC Test Set and the recommended operating procedures have been designed with careful attention to safety. Biddle has made formal safety reviews of the initial design and any subsequent changes. Every effort has been made to point out in the instruction manual the proper procedures and precautions to be followed by the user in operating the equipment and to mark the equipment itself with precautionary warnings where appropriate. However, it is not possible to foresee every possible hazard which may occur in the great variety of applications of this test set. It is therefore essential that the user also carefully consider all safety aspects of the test before proceeding, in addition to following the safety rules in this manual.

SECTION C

RECEIVING INSTRUCTIONS

When your Biddle AC Test Set arrives, check the equipment received against the packing list to ensure that all materials are included. Notify Biddle Instruments, Blue Bell, PA, of any shortage of materials.

Examine the equipment for damage received in transit. If any damage is discovered, file a claim with the carrier at once and notify Biddle Instruments or its nearest authorized sales representative. Be sure to provide a detailed description of the damages observed.

This equipment has been thoroughly tested and inspected to meet rigid inspection specifications before being shipped. It is ready for use when set up as indicated in Section F.

SECTION D

SPECIFICATIONS

RATING

Maximum Output:	50kV/100kV, 7.5 kVA/7.5 kVA
Duty Cycle:	15 minutes ON/45 minutes OFF
Test Sample:	Capacitive test objects, for capacitive load range, see Figure 3.

INPUT

The standard unit allows powering from a 240V ac, 30 A, 60 Hz line. Connection to the control console is made via a 10 ft. power cord, utilizing a NEMA L6-30P cap on the outboard end. Refer to APPENDIX I - 50/100 kV AC TEST SET SCHEMATIC FOR 681100 OR 686100 SERIES at the end of this manual for connection details.

Recommended Source:	National Electric Code (N.E.C.) 30 A, 240V ac, 60 Hz single phase.
Voltage (rms):	216-264 volts for 240 volt operation. (Note: Maximum output voltage of the system may be reduced between 216-230 V.)
Current (rms):	17 amps nominal at 240 V ac per duty cycle.

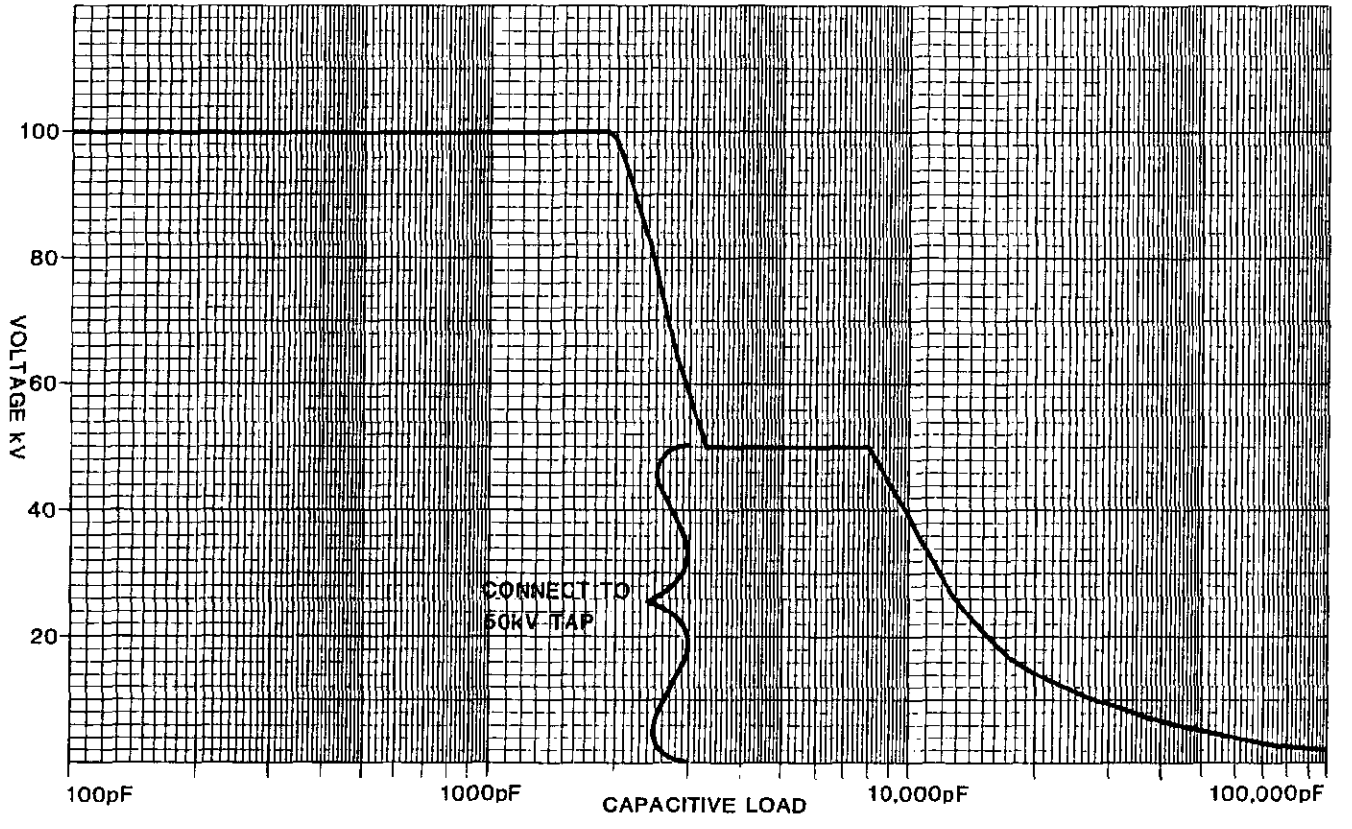


Figure 3: Loading Capability of the Catalog No. 681100 Series for 60 Hz Operation.

SYSTEM DESCRIPTION

Control Console: The control console contains the instruments and controls required to operate the test set. Dimensions approximately 22" D x 20" W x 15" H. (559 mm D x 508 mm W x 381 mm H). Weight approximately 60 lbs. (28 Kg) (no options).

High Voltage Assembly: The high voltage transformer is contained in an oil filled fiberglass enclosure. Voltage is introduced into and obtained from the tank by means of connectors and suitable connections. High voltage transformer and base assembly dimensions approximately 38" D x 19" W x 40" H. (965 mm D x 483 mm W x 1016 mm H). Weight approximately 440 lbs. (200 Kg).

All system interconnecting cables are provided with plugs to mate with connectors on the control console and HV assembly. The power input cable is provided with a plug on one end to mate with the proper connector on the control console, and the proper cord cap on the other end to allow connection to the recommended source. The ground cable is provided with a lug on one end for connection to the HV assembly ground terminal, and a "C" type ground clamp on the other end for connection to a ground rod or other suitable grounding system. Combined weight of standard cables approximately 17 lbs. (7.7 Kg).

Temperature:

Operating: -4°F (-20°C) to 104°F (40°C)

Storage: -22°F (-30°C) to 131°F (55°C)

Humidity: Operating and storage limits, 5 to 95 R.H. non-condensing.

Climate: Operation prohibited in direct rain or snow for safety reasons.

RECOMMENDED GROUND (FOR HIGH VOLTAGE ASSEMBLY)

Solid metallic rod or counterpoise with a resistance of less than 5 ohms to earth.

INSTRUMENTATION

Two 4 1/2" 1 mA dc, zero left analog meters with high torque ruggedized movements are provided to display output voltage and current.

Output Voltage

Output voltage of the system is measured using a peak responding circuit, rms calibrated. Output voltage is manually controlled.

RANGES AND ACCURACY:

0-10/20/50/100 kV.
±2.0% full scale 100 kV range.
±3.0% full scale on other ranges.

Output Current

Output current is measured using an average responding circuit, rms calibrated.

RANGES AND ACCURACY:

0-1.5/15/75/150 mA.
±2.0% full scale on 150 mA range.
±3.0% full scale on other ranges.

SAFETY FEATURES

1. A connection is supplied for a test area interlock system which, when opened, causes the high voltage output of the system to be switched off. This connector is shipped from the factory with a shorting plug installed.

2. A connection is provided to operate a safety warning beacon; 120V ac, 1 A is available at this connector when the high voltage is switched on.

3. Zero start interlock is provided so that high voltage cannot be activated unless the output voltage control is on zero.

SPECIAL FEATURES

1. The two interconnecting cables, (each 15 feet (4.6 M) in length) and power input cable (10 feet (3 M) in length) required for operating the system are supplied. Extensions for these cables are available. The necessary ground cable (25 feet (7.6 M) in length) for the system is also supplied.

2. Electronic overvoltage and overcurrent protection is provided to switch off the system high voltage output in the event of any overvoltage or overcurrent condition greater than approximately 110% of any meter range. The overvoltage and overcurrent monitoring system will automatically reset itself once the trip condition is removed. The test set cannot be re-energized until the voltage control is returned to zero. Should the sample break down during the test, indication of the output voltage will be retained.

3. BNC type connectors are supplied to provide 0-5 V dc outputs proportional to output voltage and current on any meter range.

OPTIONS/ACCESSORIES (Available separately)

1. External Safety Interlock Switch and Cable Assembly:

   A footswitch with either a 10 ft or 50 ft length of cable connects to the interlock receptacle on the control console. It permits "lock out" of the high voltage by a second person separated from the operator. Any time the switch is opened, the high voltage is immediately de-energized. High voltage cannot be established again until all external interlocks plus the zero-start interlock are closed.

   10 ft Length Assembly BIDDLE Instruments P/N 10229
   50 ft Length Assembly BIDDLE Instruments P/N 10229-1.

2. Extensions for control cables:

Transformer Primary	BIDDLE Instruments	P/N 22483-L
Instrumentation	BIDDLE Instruments	P/N 22481-L
Power Input	BIDDLE Instruments	P/N 22556-L

   -L = length tip to tip in feet.

3. Rotating Red Warning Beacon BIDDLE Instruments P/N 13470:

   Connects to the beacon receptacle on the control console and is illuminated whenever high voltage is switched on. Supplied on a 3-legged tripod with a 50-foot connecting cable.

OPTIONS/ACCESSORIES (must be ordered as part of the system)

1. Test Timer:
   The Test Timer allows the timing of a high voltage test for a specified period of time (variable from 0.01 minutes to 99.99 minutes). At the end of the test period a buzzer is sounded to signal the completion of the test. Should the sample break down during the test, indication of the time will be retained.

2. Variable Red Line Display of Overvoltage and Overcurrent Trip Levels:
   Electronic overvoltage and overcurrent trips with continuously variable limits displayed through the meter scales are provided. Trips work on any meter range and are totally electronic and therefore do not depend on the meter movement response time for their operation. This option is not available with the digital meter option.

3. Motorized Voltage Control:
   The manual voltage control is replaced with a motorized voltage control to achieve a constant rate-of-rise (approximately 1.5 kV/sec. when connected to the 50 kV high-voltage terminal, and approximately 3 kV/sec. when connected to the 100 kv high-voltage terminal.) This option is not available with the 120 or 200/208 voltage options.

4. Digital Meters:
   The 4 1/2" analog meters are replaced with digital meters with the following ranges and accuracy:

   Output Voltage
   0-10.0/20.0/50.0/100 kV
   ±1.0% of full scale on all ranges.

   Output Current
   0-15.00/30.0/75.0/150 mA
   ±1.0% of full scale on all ranges.

   This option is not available with the variable red line display of overvoltage and overcurrent trip levels option.

5. *200/208 V ac, 30 A, 60 Hz operation:

   System can be operated from a 200 or 208 V ac 50 A, 60 Hz service.

6. *120 V ac, 50 A, 60 Hz operation:

   System can be operated from a 120 V ac 50 A, 60 Hz service.

7. *240 V ac, 30 A, 50 Hz operation:

   System can be operated from a 240 V ac, 30 A, 50 Hz service.

8. *200 or 208 V ac, 30 A, 50 Hz operation:

   System can be operated from a 200 or 208 V ac, 30 A, 50 Hz service.

9. *120 V ac, 50 A, 50 Hz operation:

   System can be operated from a 120 V ac, 50 A, 50 Hz service.

   *Only one voltage option can be ordered, no combinations.

SECTION E

DESCRIPTION

CONTROL AND CONNECTION IDENTIFICATION

CONTROL CONSOLE

Control Panel

The panel at the front of the control console includes the meters, controls, and indicators that are required to operate the test system. This panel together with the schematic reference numbers of the various components is illustrated in Figure 4.

CB101: Control Power Circuit Breaker

This breaker controls the power to all of the control and panel indicators. When closed the CONTROL POWER ON indicator (DS101) will be lit.

CB102: High Voltage Circuit Breaker

This breaker controls the power to the primary of the high voltage transformer (T201) which is part of the HV ASSEMBLY.

DS101: Control Power On

This indicator is lit when the CONTROL POWER circuit breaker (CB101) is closed and 120 V ac is available to operate the control system.

DS102: HV On

This indicator is lit when the high voltage contactor (K102) is closed. High voltage may be present at the output of the HV ASSEMBLY.

M101: Output Current

This meter indicates the current being drawn by the test sample.

Range Switch

Output current meter ranges are available for 1.5, 15, 75 and 150 mA.

M102: Output Voltage

This meter indicates the voltage which is being applied to the test sample.

Range Switch

Output voltmeter ranges are available for 10, 20, 50 and 100 kV.

T102: Output Voltage Control

This variable autotransformer provides input power to the primary of the high voltage transformer (T201) part of the HV ASSEMBLY. NOTE: The OUTPUT VOLTAGE CONTROL (T102) is part of an interlock system so the high voltage contactor (K102) cannot be energized unless the OUTPUT VOLTAGE CONTROL (T102) is in the ZERO START position.

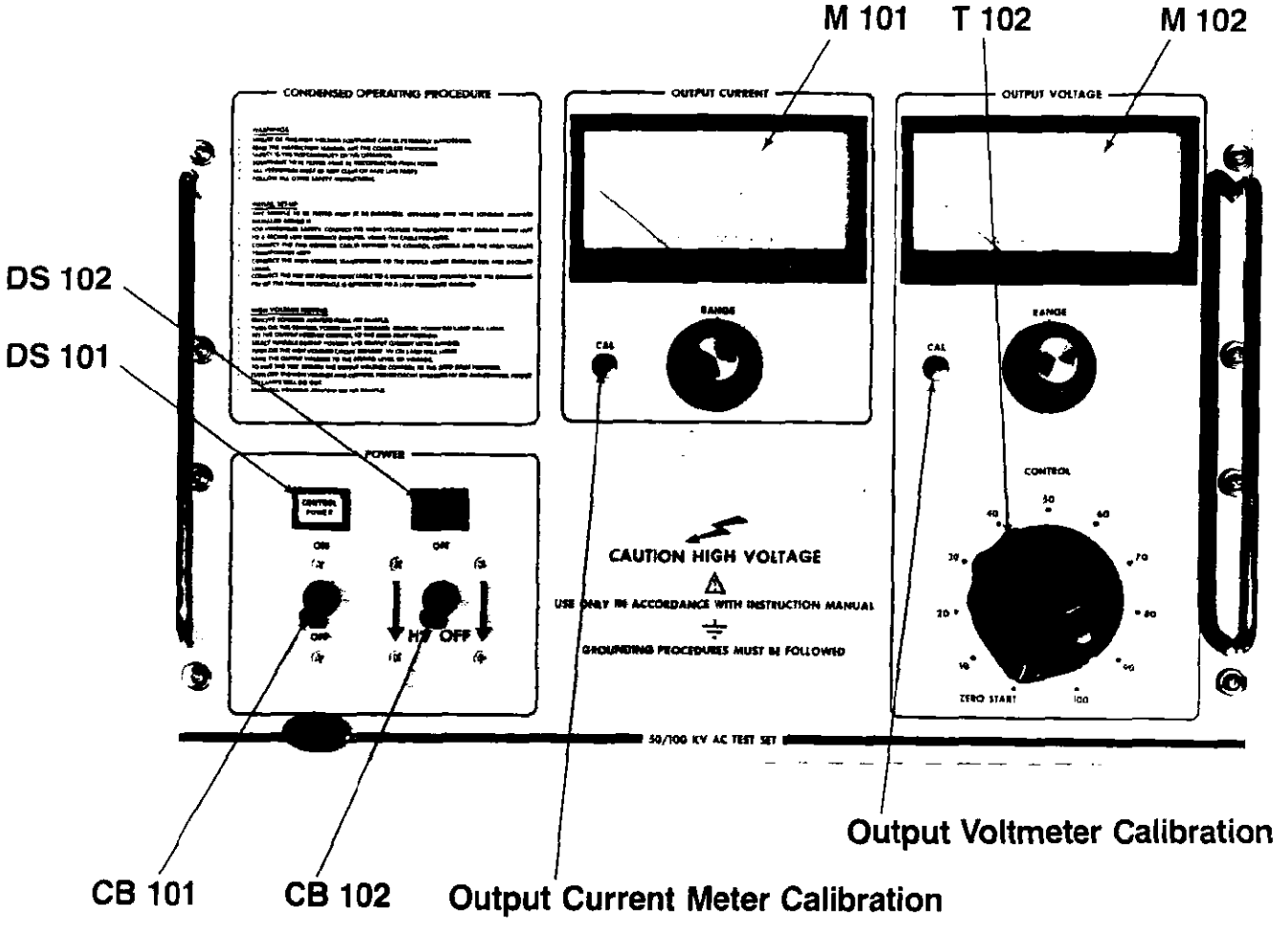


Figure 4: Typical Control Panel.

Rear Panel

The panel at the rear of the control console includes the connections for the HV ASSEMBLY, safety equipment and other equipment. The panel together with the schematic reference numbers of the various components is illustrated in Figure 5.

CB103: AC Power Input Control Circuit Breaker

This breaker controls the power to the 240-120 volt step-down transformer (T101) for the controls and indicators of the console.
NOTE: The AC POWER INPUT CONTROL circuit breaker (CB103) is provided for the protection of step-down transformer (T101) and should normally be left in the ON position.

CB107: Beacon Circuit Breaker

This breaker feeds the BEACON receptacle (J107).

J104: Xfmr Primary

This receptacle accepts the control cable which connects to the XFMR PRIMARY receptacle (P204) on the HV ASSEMBLY Connection Panel.

J105: Instrumentation

This receptacle accepts the control cable which connects to the INSTRUMENTATION receptacle (P205) on the HV ASSEMBLY Connection Panel.

J106 and P106 (Mate): Interlock

This receptacle and plug have been provided to allow the use of a test area interlock system. P106 is provided with a shorting wire in the event that a test area interlock system is not used. It is suggested that the customer remove the short-circuit from the plug and that the plug be connected to a suitable test area interlock system. The system must be constructed so that the interlock switch or switches are closed when the test area gate or gates are closed. The interlock wiring MUST be run as a twisted pair to minimize electromagnetic coupling from the output of the system to the control console. This interlock system should be connected to Pins A and B on P106.

It is not necessary or recommended that shielded wire be used for the interlock wiring, but if shielded wire is used, the shield should be connected to Pin C of P106. The shield should not be connected to any other point. When the interlock system is opened the high-voltage contactor (K102) is deenergized.

CAUTION!

The interlock circuit is powered from the 240-120 volt step-down transformer (T101) in the control console, consequently all interlock switches in the external test area interlock system are energized at 120 V ac whenever the High Voltage Contactor (K102) is energized.

J107 and P107 (Mate): Beacon

This receptacle and plug have been provided for use with an external warning light system (for example, Biddle P/N 13470 Rotating Red Warning Beacon available as an option). This receptacle will provide a power source of 120 V, 1 A at Pins B (hot wire), C (neutral wire), and A (ground wire) whenever the high-voltage contactor (K102) is energized.

J108: VM Record Out

This receptacle provides a zero to +5 volt dc signal proportional to full scale of any of the four voltmeter ranges.

J109: AM Record Out

This receptacle provides a zero to +5 volt dc signal proportional to full scale of any of the four current meter ranges.

P103: AC Power Input

This receptacle accepts the input power cable which should be connected to a suitable service.

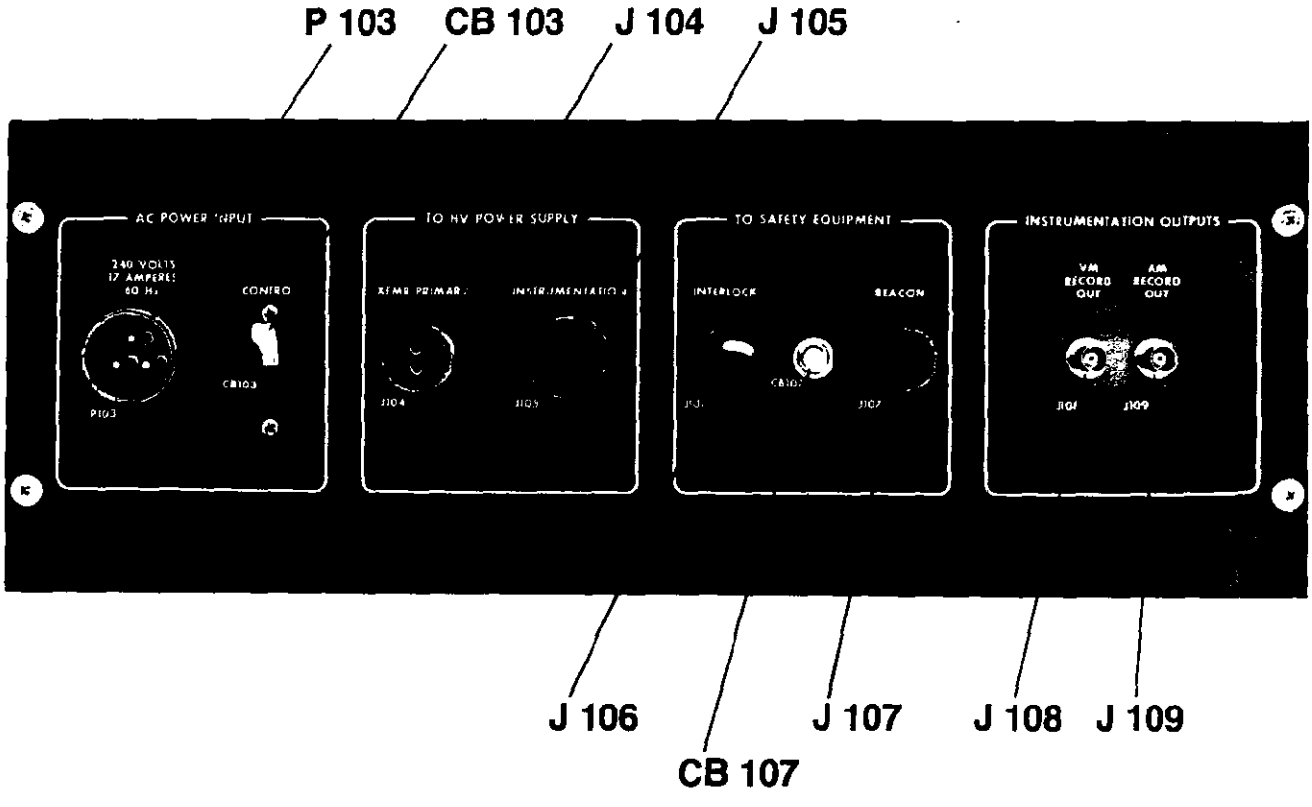


Figure 5: Typical Rear Panel.

HV ASSEMBLY

Connection Panel

The panel at the end of the HV ASSEMBLY includes the connections to the CONTROL CONSOLE and ground terminals. The panel together with the schematic reference numbers of the various components is illustrated in Figure 6.

E207: Ground

This terminal accepts the HV ASSEMBLY ground cable which must be connected to a ground system with a resistance of less than 5 ohms to earth.

E208: Guard

This terminal is provided so that guarded tests can be performed. Any sample ground connection that is made to the guard terminal will not contribute to the current indicated on the OUTPUT CURRENT meter (M101).

P204: Xfmr Primary

This receptacle connects to the primary of the high voltage transformer (T201) inside the HV ASSEMBLY tank and accepts the control cable which connects to the XFMR PRIMARY receptacle (J104) on the CONTROL CONSOLE Rear Panel.

P205: Instrumentation

This receptacle connects to the MEASURING CIRCUITS PC board (A201) mounted on the HV ASSEMBLY base to provide metering signals to the control console. This receptacle accepts the control cable which connects to the INTRUMENTATION receptacle (J105) on the CONTROL CONSOLE rear panel.

Cable Storage

A cable storage compartment is provided as part of the HV ASSEMBLY. Refer to Figure 7.

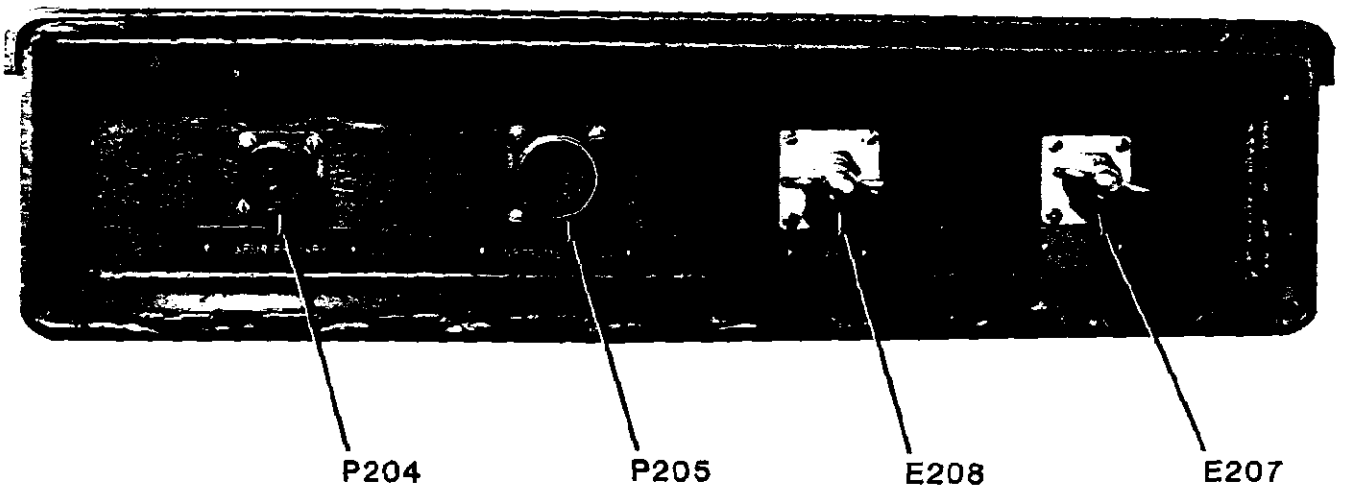


Figure 6: Typical High Voltage Assembly Connection Panel.

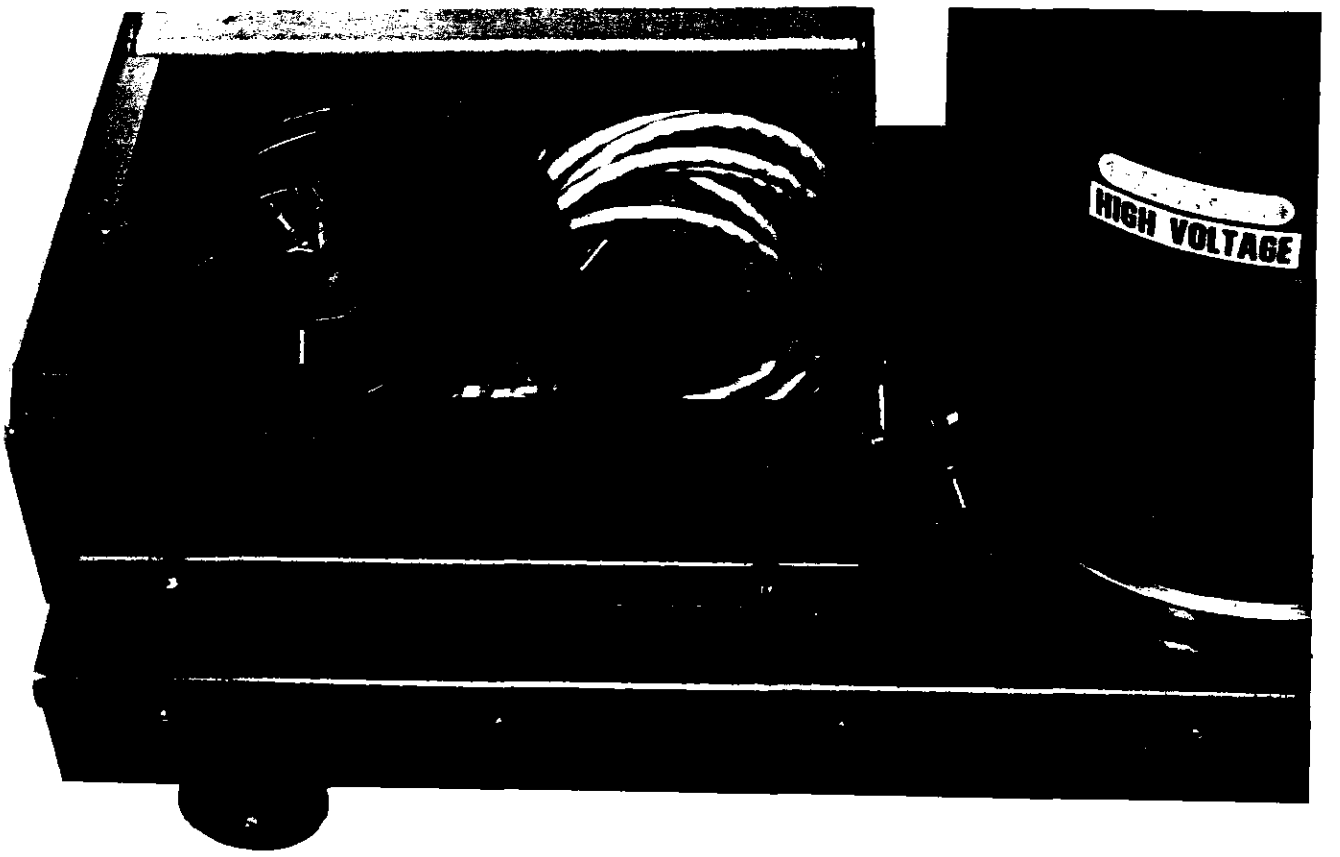


Figure 7: Typical Cable Storage Compartment, Control Console Removed.

SECTION F

OPERATION

INSTALLATION

1. Safety Precautions

The output of this Test Set can be lethal. As with any high voltage equipment, caution must be exercised at all times and all safety procedures followed. Refer to Section B Safety Precautions. Ensure sample is deenergized and safe before making connections. Make certain no person can come into contact with the HV output terminal or any material energized by the output. The use of protective barriers is recommended. Locate the control console in an area which is as dry as possible.

Be sure that adequate clearances are maintained between energized conductors and ground to prevent arc-over. Such accidental arc-overs may create a safety hazard or damage the equipment being tested. To limit the dangers of static induced voltages which can develop on nearby insulated objects, including personnel, Biddle standard practice is as follows: "All personnel must maintain a distance from all energized high voltage parts so that the average field strength does not exceed one volt per mil in air. This is to be calculated using the crest value of voltage and assuming the field is uniform".

For example, for 100 kV ac the distance would be 100 x 1.41 inches = approximately 12 ft.

As an additional precaution, adequate barriers should be used to maintain the required distance between personnel and energized high voltage equipment.

BIDDLE Instruments does not know of any accepted industry standard for clearances between high voltage and personnel, but has found the above precautions an excellent safety practice.

2. Connections

A. Ground Connections

1. Normal

Connect the GROUND wing nut of the HV ASSEMBLY to a secure, low resistance ground (less than 5 ohms) using the 25-foot ground cable supplied with the Test Set. A safety grounding stick (strongly recommended but not supplied) should also be connected to this same low resistance ground.

Connect the GROUND wing nut of the HV ASSEMBLY to the ground terminal of the test sample. Refer to Figure 8.

2. Use of the Guard Circuit For Output Current Measurements Below 3 mA)

Output current measurements become difficult below 3 mA due mainly to the stray capacitive current of the HV ASSEMBLY. To effectively eliminate this stray capacitive current from being measured, the HV ASSEMBLY is guarded as follows:

a. Connect the GUARD wing nut of the HV ASSEMBLY to a secure, low resistance ground (less than 5 ohms) using the 25 foot ground cable supplied with the Test Set. A safety grounding stick (strongly recommended but not supplied) should also be connected to this same low resistance ground.

b. Connect the GROUND wing nut of the HV ASSEMBLY to the ground terminal of the test sample.
NOTE: To obtain accurate output current measurements, the test sample must be insulated from ground. Phenolic or glass epoxy (a minimum of 1/16" thickness) are two possible materials to insulate the test sample from ground. Refer to Figure 9.

DANGER!

Improper grounding may present a shock hazard to the operator or cause damage to the test set.

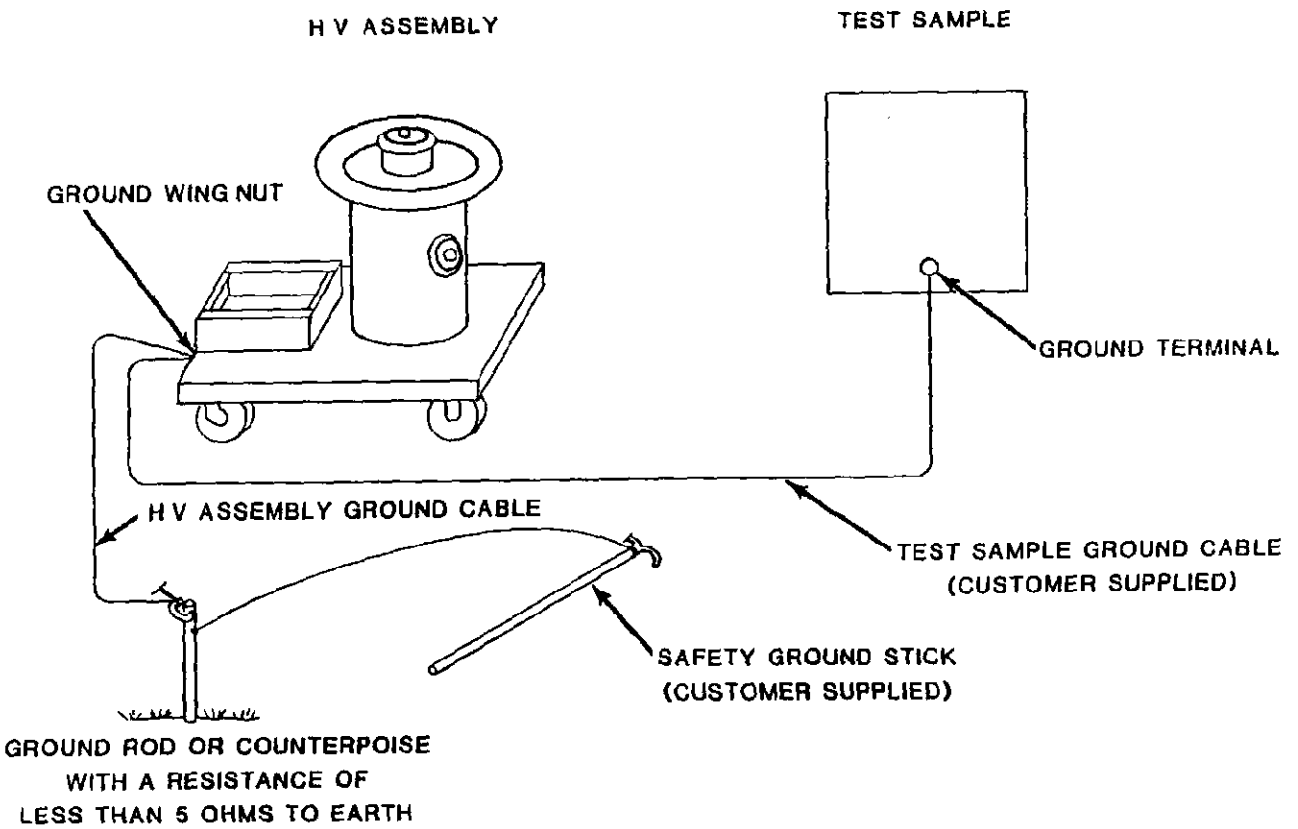


Figure 8: Ground Connections for Normal Testing.

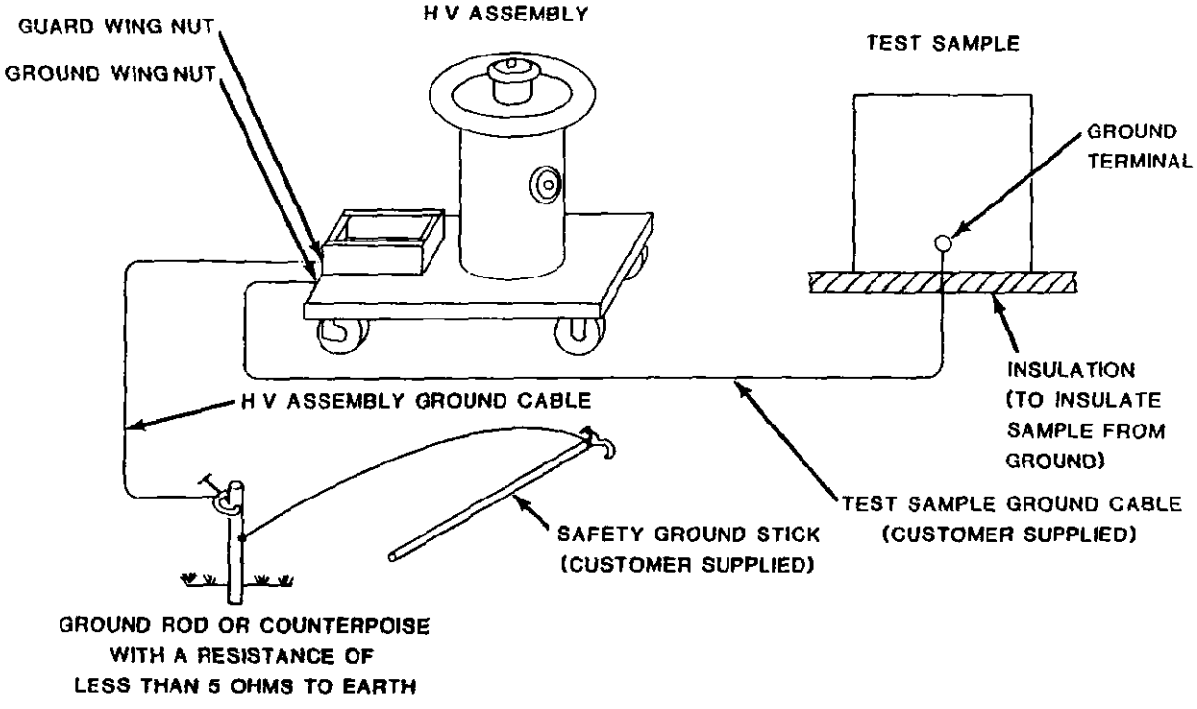


Figure 9: Ground Connections for Output Current Measurements Below 3 mA.

B. Connect the two control cables (Xfmr Primary, Instrumentation) between the HV ASSEMBLY and the control console.

C. Connect the desired high-voltage terminal (50 kV or 100 kV) of the HV ASSEMBLY to the high-voltage terminal of the test sample using suitable bus connections. It is recommended that a minimum size of 1 1/2" diameter tubing be used to avoid producing high electrical stresses that could ionize adjacent air. This is important when accurate current measurements are required, since ionized air can produce excessive leakage currents that could mask the true sample current.

D. Connect the control console input power cable between the control console and a suitable service. The ground contact of the power receptacle must be connected to a low resistance ground.

E. It is recommended that any high voltage testing be conducted within a grounded, interlocked, safety enclosure. An INTERLOCK receptacle (J106) and plug (P106) have been provided for use with a test area interlock system.

P106 is provided with a shorting wire in the event that a test area interlock system is not used. It is suggested that the customer remove the short circuit from the plug and that the plug be connected to a suitable test area interlock system. The system must be constructed so that the interlock switch or switches are closed when the test area gate or gates are closed. The interlock wiring MUST be run as a twisted pair to minimize electromagnetic coupling from the output of the system to the control console. This interlock system should be connected to Pins A and B on P106. It is not necessary or recommended that shielded wire be used for the interlock wiring, but if shielded wire is used, the shield should be connected to Pin C of P106. The shield should not be connected to any other point. When the interlock system is opened the high-voltage contactor (K102) is deenergized.

CAUTION!

The interlock circuit is powered from the 240-120 volt step-down transformer (T101) in the control console, consequently all interlock switches in the external test area interlock system are energized at 120 V ac whenever the High Voltage Contactor (K102) is energized.

F. A warning beacon receptacle (J107) and plug (P107) have been provided for use with an external warning light system. This receptacle will provide a power source of 120 V, 1 A at Pins B (hot wire), C (neutral wire), and A (grounded wire) whenever the high-voltage contactor (K102) is energized.

OPERATION PROCEDURE

Proceed only after fully understanding SECTION B SAFETY PRECAUTIONS, and the set-up and connection procedures detailed previously in this section have been observed.

3. High-Voltage Testing

A. Remove all safety grounds and bonding jumpers from the sample to be tested and HV ASSEMBLY.

B. Verify that the AC POWER INPUT CONTROL circuit breaker (CB103) located on the rear panel of the console is closed.

C. Close the CONTROL POWER circuit breaker (CB101). The CONTROL POWER ON lamp (DS101) will now light.

D. MANUAL VOLTAGE CONTROL (STANDARD):
Turn the OUTPUT VOLTAGE CONTROL (T102) fully counterclockwise to the ZERO START position.

MOTORIZED VOLTAGE CONTROL (OPTION):
Actuate and hold the OUTPUT VOLTAGE CONTROL (S105) to the LOWER position until the voltage control autotransformer (T102) reaches the zero voltage position. The ON ZERO lamp (DS103) will now light. Refer to APPENDIX C-MOTORIZED VOLTAGE CONTROL OPTION at the end of this manual for further details.

E. Select suitable OUTPUT CURENT (M101) and OUTPUT VOLTAGE (M102) meter ranges.

F. If the test set is equipped with the TEST TIMER OPTION and it is desired to be used, enter the desired test time into the ELECTRONIC TIMER (A104) by using the white toggle set levers. The display appears immediately above the toggle levers. Pay particular attention to the units of this timer. It functions in minutes and hundredths of minutes not minutes and seconds. Refer to APPENDIX A-TEST TIMER OPTION at the end of this manual for further details.

G. Close the HIGH VOLTAGE circuit breaker (CB102). The HV ON lamp (DS102) will now light.

WARNING!

The test set is now capable of producing high voltage at the output.

H. Raise the output voltage slowly to the desired level by the following method:
MANUAL VOLTAGE CONTROL (STANDARD): turn the OUTPUT VOLTAGE CONTROL (T102) clockwise.

MOTORIZED VOLTAGE CONTROL (OPTION): actuate the OUTPUT VOLTAGE CONTROL (S105) to the RAISE position.

I. If the VARIABLE RED LINE DISPLAY OF OVERVOLTAGE AND OVERCURRENT TRIP LEVELS OPTION is supplied, set the desired output current and output voltage trip levels by adjusting of the red pointer located in each control meter. The adjustment is made using the small black knob on the front of the control meters. When the system output voltage or current reaches the level indicated by the red pointer, the OVERVOLTAGE/OVERCURRENT TRIP PC BOARD (A103) will operate and open the high voltage contactor (K102). Refer to APPENDIX B, VARIABLE RED LINE DISPLAY OF OVERVOLTAGE AND OVERCURRENT TRIP LEVELS OPTION at the end of this manual for further details.

J. If the TEST TIMER OPTION is supplied and intended to be used, press the START TIMER pushbutton (S103). The blue display above the toggle levers on the ELECTRONIC TIMER (A104) will light and begin to count from zero up to the selected time indicating the elapsed time of the test. When the display reaches the selected time a buzzer (LS101) will sound to signal the completion of the test.

Should an over-limit trip occur or the high voltage contactor (K102) open for any other reason during the test, indication of the time and output voltage will be retained.

The ELECTRONIC TIMER (A104) can be reset and the buzzer (LS101) silenced by pressing the RESET TIMER pushbutton (S104).

K. To end the test, complete the following:

1. MANUAL VOLTAGE CONTROL (STANDARD): Turn the OUTPUT VOLTAGE CONTROL (T102) fully counterclockwise to the ZERO START position.

   MOTORIZED VOLTAGE CONTROL (OPTION): Actuate and hold the OUTPUT VOLTAGE CONTROL (S105) to the LOWER position until the voltage control autotransformer (T102) reaches the zero voltage position. The ON ZERO lamp (DS103) will now light.

2. Open the HIGH VOLTAGE circuit breaker (CB102) and CONTROL POWER circuit breaker (CB101).

L. Ground the high-voltage terminals (50 kV and 100 kV) of the HV ASSEMBLY and sample using the safety ground stick. Reinstall bonding jumpers on both the sample and HV ASSEMBLY. A corona ball is provided on the high-voltage terminals (50 kV and 100 kV) of the HV ASSEMBLY to facilitate the connection of a shorting wire between the high-voltage terminals and ground.

DANGER!

The sample under test may retain a lethal electrical charge even after switching off the test supply. Discharge the test sample with a safety-ground stick to ground all live parts, then, while the safety-ground stick is still in place, solidly ground and bond these parts. Keep the HV ASSEMBLY and sample shorted with bonding jumpers at all times except when actually performing tests.

OPERATING NOTES

1. In the event of a sample breakdown, excessive current, or excessive voltage, either the HIGH VOLTAGE circuit breaker (CB102) or HIGH VOLTAGE contactor (K102) will disconnect the main power to the HV ASSEMBLY. This in turn will remove the high voltage available at the high voltage terminals (50 kV or 100 kV) of the HV ASSEMBLY.

2. Overloading the Test Set, when connected to either the 50 kV or 100 kV high voltage terminals, will cause the HIGH VOLTAGE circuit breaker (CB102) to open. Referring to Figure 2 in SECTION A INTRODUCTION, it should be noted that the high voltage transformer input current will increase if the load applied to the high voltage transformer is increased. Therefore the HIGH VOLTAGE circuit breaker will open if the load applied draws from the OUTPUT VOLTAGE CONTROL autotransformer (T102) a current greater than 20 amperes, the rating of the HIGH VOLTAGE circuit breaker (CB102). Under overloading conditions it is normal to experience a HIGH VOLTAGE circuit breaker (CB102) opening while observing a OUTPUT CURRENT meter (M102) below 150 mA.

3. After a trip-out, the following must be completed before the HV ASSEMBLY can be reenergized.

   MANUAL VOLTAGE CONTROL (STANDARD):
   Turn the OUTPUT VOLTAGE CONTROL (T102) fully counterclockwise to the ZERO START position.

   MOTORIZED VOLTAGE CONTROL (OPTION):
   Actuate and hold the OUTPUT VOLTAGE CONTROL (S105) to the LOWER position until the voltage control autotransformer (T102) reaches the zero voltage position. The ON ZERO lamp (DS103) will now light.

4. If excessive leakage current is observed, it may be due to a high corona, high-voltage termination. It should also be noted that the OUTPUT CURRENT METER (M101) indicates the total sample current including surface leakage. A GUARD terminal is provided adjacent to the GROUND terminal on the HV ASSEMBLY connection panel so that guarded tests can be performed. Any sample ground connection that is made to the guard terminal of the HV ASSEMBLY instead of the ground terminal will not contribute to the current indicated on the OUTPUT CURRENT METER (M101). In this way surface leakage currents can be eliminated from the measurement.

   For current measurements below 3 mA special guarding of the HV ASSEMBLY must be done; refer to GROUND CONNECTIONS in this section for details.

5. The HIGH VOLTAGE CONTACTOR (K102) cannot be energized unless several interlock conditions are met as detailed below:

   A. Control cables (xfmr primary and instrumentation) connected between the HV ASSEMBLY and control console.

   B. Test area interlock system closed, pins A and B on the INTERLOCK receptacle (J106) electrically connected together.

   C. AC POWER INPUT CONTROL circuit breaker (CB103) located on the rear panel of the console closed.

   D. CONTROL POWER circuit breaker (CB101) closed. (CONTROL POWER ON indicator (DS101) lit).

   E. MANUAL VOLTAGE CONTROL (STANDARD): OUTPUT VOLTAGE CONTROL (T102) in the ZERO START position.

      MOTORIZED VOLTAGE CONTROL (OPTION): Voltage control autotransformer (T102) in the zero voltage position. The ON ZERO lamp (DS103) lit.

   F. The Overvoltage/Overcurrent Trip PC Board (A102) reset, (no overvoltage or overcurrent trip condition).

   G. HIGH VOLTAGE circuit breaker (CB102) closed.

Once the above conditions are met, the high voltage contactor (K102) will pull in, lighting the HV ON indicator (DS102).

WARNING!

The Test Set is now capable of producing high voltage at the output.

SECTION G

APPLICATION NOTES

TESTING OF VEHICLE-MOUNTED ELEVATING AND ROTATING WORK PLATFORMS

This Test Set can be utilized for complete electrical testing of vehicle-mounted elevating and rotating work platforms which are to be used on power lines rated at less than 69 kV in accordance with ANSI STANDARD A92.2. The test methods detailed in ANSI STANDARD A92.2 require a leakage current measurement below 1 mA. The Test Set should be set up following the procedure under INSTALLATION part of SECTION F OPERATION in this manual. Due to the 1 mA leakage requirement pay particular attention to the guard and ground connection details under INSTALLATION in SECTION F OPERATION. Refer to Figure 10 for details of a typical test set up.

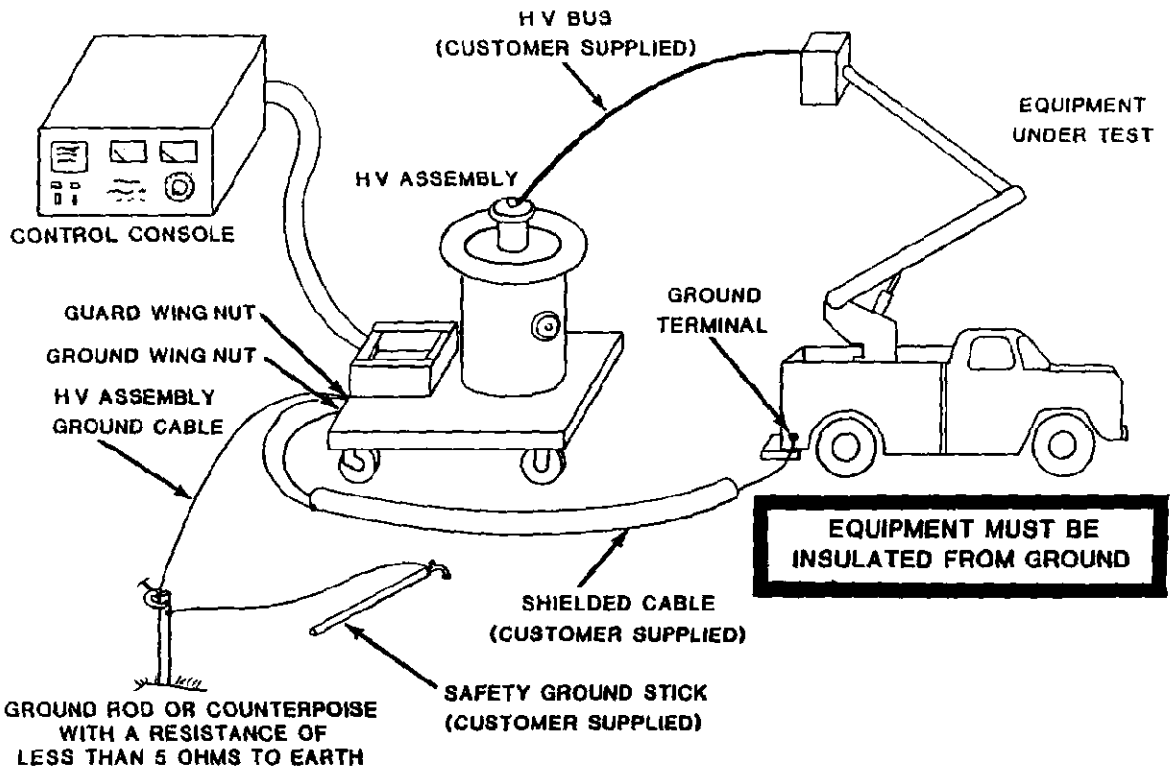


Figure 10: Typical Test Setup for Testing Vehicle-Mounted Elevating and Rotating Work Platforms which are to be used on Power Lines Rated Less than 69 kV (without Collector Bands).

SECTION H

MAINTENANCE

ROUTINE MAINTENANCE

The Test Set has been designed to be virtually maintenance free. However it will be necessary to keep the HV ASSEMBLY tank clean and dust free. Clean as often as required using a clean lint-free cloth and isopropyl alcohol. Always keep the HV ASSEMBLY shorted with bonding jumpers and grounded while cleaning the tank. Allow the alcohol to evaporate before energizing the Test Set.

At six-month intervals, a sample of insulating oil should be tested in accordance with ASTM-D877. The sample can be obtained by removing the 100 kV HIGH VOLTAGE TERMINAL cover (refer to Figure 1) and syphoning out the required amount of oil from the oil reservoir. If the breakdown voltage of the oil sample falls below 25 kV the oil should be filtered and retested. If the breakdown voltage falls below 22 kV, do not operate the Test Set until the oil is replaced.

Before the insulating oil can be replaced the interior of the tank must be cleaned. Removal of the top ring and lid is required to clean the tank. Replace the ring and lid once the interior of the tank has been cleaned.

To filter or replace the insulating oil, a special plate must be fabricated to bolt onto the oil reservoir. This plate must have provisions for oil and vacuum hoses. Insulating oil must be inserted under vacuum per Biddle Spec Fk-37. The tank holds approximately 16 gallons or 61 liters. The oil level at room temperature must be approximately 1/4" or 6 MM into the oil reservoir.

The transformer oil used must meet ASTM Standard D3487-82 or CSA Standard C50.

CALIBRATION

Refer to the following figures:

Figure 11: VOLTMETER DRIVER (A102) Schematic.

Figure 12: CURRENT METER DRIVER (A101) Schematic.

Figure 13: OVERVOLTAGE/OVERCURRENT TRIP BOARD (A103) Schematic.

Mechanical Zero

With power to the control console off, adjust the mechanical zero, if required, of both panel meters before proceeding.

Output Voltage Meter Calibration

The accuracy of this meter is ±2% of full scale on the calibrated range (100 kV) and ±3% of full scale on the other three ranges. Set up the test set following the details where applicable under INSTALLATION which is part of SECTION F OPERATION in this manual. Connect a suitable standard kilovoltmeter with an overall accuracy of 0.5% or better between the 100 kV high-voltage terminal and GROUND connection of the HV ASSEMBLY. Place the standard kilovoltmeter so that it may be safely and precisely read. Set the panel OUTPUT VOLTAGE meter range switch to the 100 kV range. Remove the hole plug covering the hole marked CAL below the OUTPUT VOLTAGE meter (M102) (Refer to Figure 4 in SECTION E DESCRIPTION) to gain access to the OUTPUT VOLTAGE calibration pot.

Raise the output voltage to 2/3 of full scale of the panel OUTPUT VOLTAGE meter (M102). Adjust the OUTPUT VOLTAGE calibration pot to compensate for any discrepancy between the standard kilovoltmeter and the OUTPUT VOLTAGE meter (M102) readings. Once the OUTPUT VOLTAGE meter (M102) is calibrated resinstall the hole plug in the hole marked CAL below the OUTPUT VOLTAGE meter (M102).

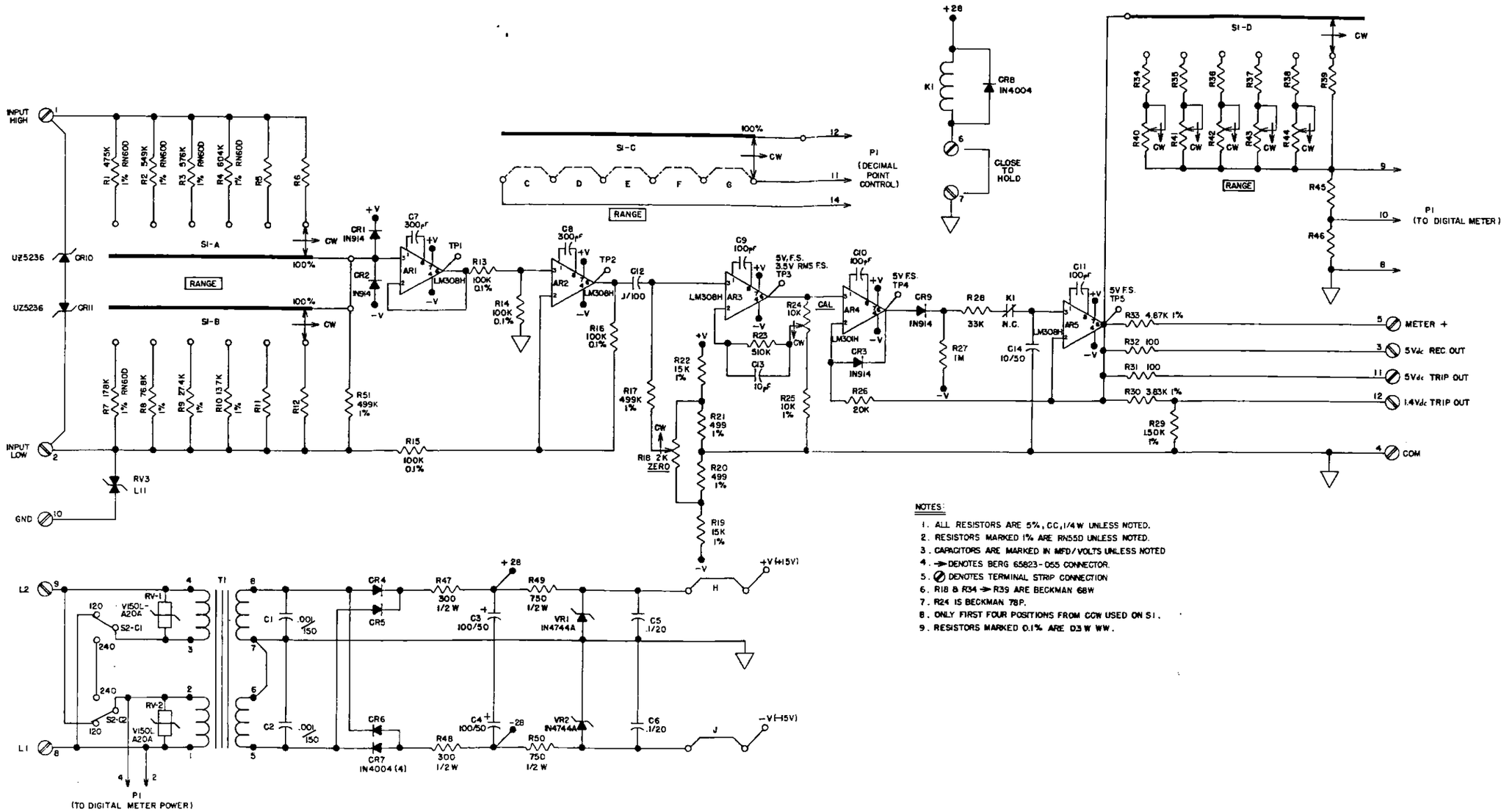
Output Current Meter Calibration

The accuracy of this meter is ±2% of full scale on the calibrated range (150 mA) and ±3% of full scale on the other three ranges. Set up the Test Set following the details where applicable under INSTALLATION which is part of SECTION F OPERATION in this manual. This calibration procedure will use a current source in series with the Output Current meter Current Transformer (T202) therefore it will not be necessary to connect a test sample or energize the HV ASSEMBLY. Connect a suitable current source and a suitable standard ammeter with an overall accuracy of 0.5% or better between the GROUND wing nut and GUARD wing nut on the HV ASSEMBLY. Close the CONTROL POWER circuit breaker (CB101). The CONTROL POWER ON lamp (DS101)

will now light. Set the panel OUTPUT CURRENT meter range switch to the 150 mA range. Remove the hole plug covering the hole marked CAL below the OUTPUT CURRENT meter (M101) (Refer to Figure 4 in SECTION E DESCRIPTION) to gain access to the OUTPUT CURRENT calibration pot). Energize the current source and increase the current until 2/3 of full scale of the panel OUTPUT CURRENT meter (M101) is reached. Adjust the OUTPUT CURRENT calibration pot to compensate for any discrepancy between the standard ammeter and the OUTPUT CURRENT meter (M101) reading. Once the OUTPUT CURRENT meter (M101) is calibrated reinstall the hole plug in the hole marked CAL below the OUTPUT CURRENT meter (M101).

Overvoltage/Overcurrent Trip Calibration

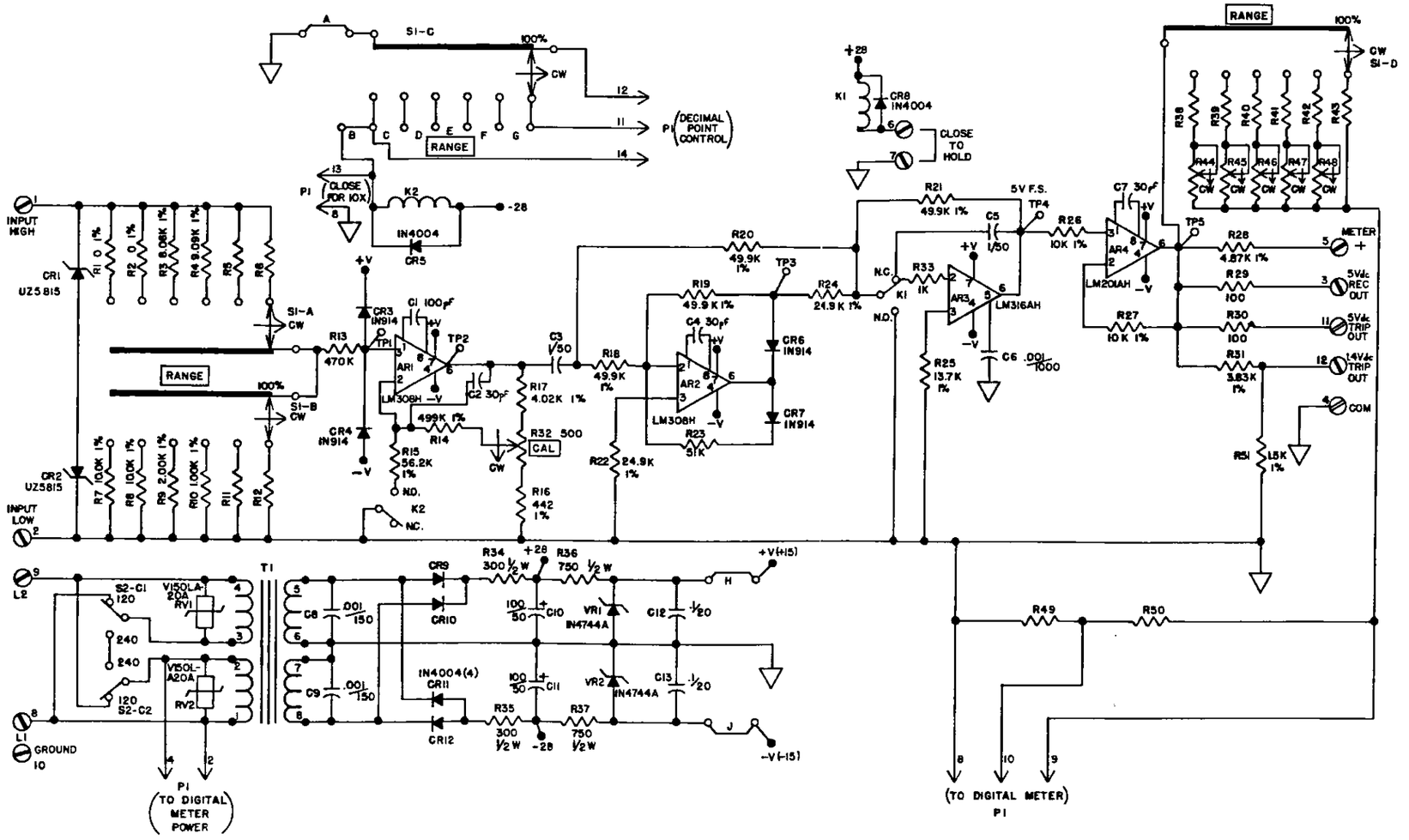
There is no calibration for this printed circuit board, it is designed to operate (open the high voltage contactor (K102)) whenever any overvoltage or overcurrent condition greater than approximately 110% of any meter range exists.



NOTES:

1. ALL RESISTORS ARE 5%, CC, 1/4W UNLESS NOTED.
2. RESISTORS MARKED 1% ARE RN55D UNLESS NOTED.
3. CAPACITORS ARE MARKED IN MFD/VOLTS UNLESS NOTED
4. ⇒ DENOTES BERG 65823-055 CONNECTOR.
5. ⊘ DENOTES TERMINAL STRIP CONNECTION
6. R18 & R34 ⇒ R39 ARE BECKMAN 68W
7. R24 IS BECKMAN 78P.
8. ONLY FIRST FOUR POSITIONS FROM CCW USED ON S1.
9. RESISTORS MARKED 0.1% ARE 0.3W WW.

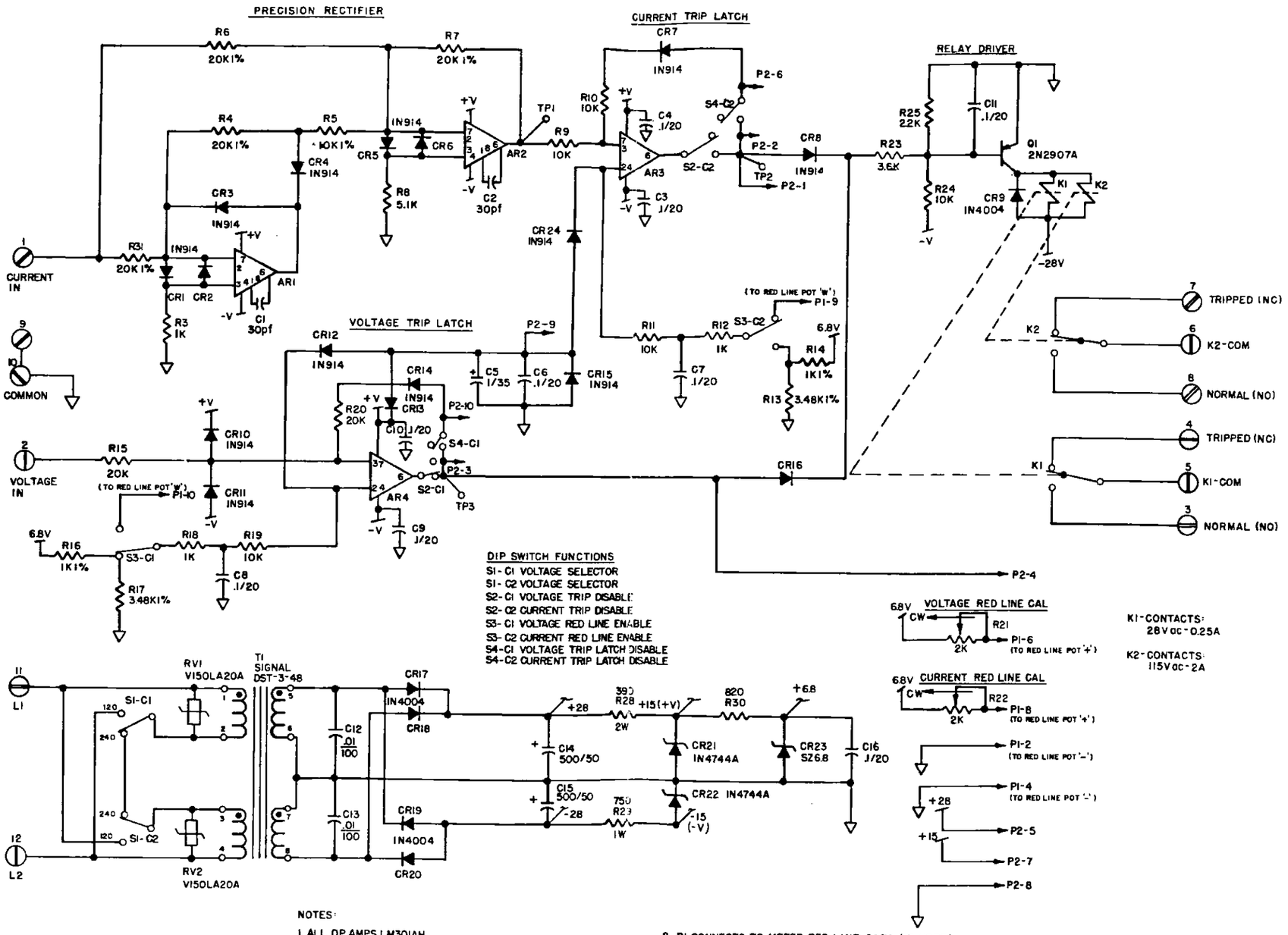
Figure 11: Voltmeter Driver Schematic.



NOTES

1. ALL RESISTORS 5% CC1/4W UNLESS NOTED.
2. RESISTORS MARKED 1% ARE RN55D UNLESS NOTED.
3. CAPACITORS ARE MARKED IN MFD/VOLTS UNLESS NOTED
4. ⊘ DENOTES TERMINAL STRIP CONNECTION.
5. → DENOTES BERG 65823-055 CONNECTOR.
6. R40 — R48 ARE BECKMAN TYPE 68W.
7. R32 IS BECKMAN TYPE 78P.
8. ONLY FIRST FOUR POSITIONS FROM CCW USED ON S1.

Figure 12: Current Meter Driver Schematic.



NOTES:

1. ALL OP AMPS LM301AH.
2. ALL CAPACITORS IN MFD/VOLTS UNLESS OTHERWISE NOTED.
3. ALL RESISTORS ARE 5%, 1/4W, C.C UNLESS OTHERWISE NOTED.
4. ALL RESISTORS MARKED 1% ARE RN55D
5. ⏚ DENOTES CIRCUIT COMMON.
6. ⊸ DENOTES BERG CONNECTOR.
7. ● DENOTES TERMINAL STRIP CONNECTION.
8. P1 CONNECTS TO METER RED LINE POTS (IF USED).
9. P2 CONNECTS TO REMOTE RESET/INDICATOR ASSY (IF USED).

Figure 13: Overvoltage/Overcurrent Trip Board Schematic.

SECTION I

REPLACEABLE PARTS LIST

SYMBOL	DESCRIPTION	QTY	BIDDLE PART NO.
A101	Current Meter Driver Printed Circuit Board Assy.	1	23107-1
A101 (Option)	Digital Current Meter Driver Printed Circuit Board Assy.	1	23107-2
A102	Voltmeter Driver Printed Circuit Board Assy.	1	23452-1
A102 (Option)	Digital Voltmeter Driver Printed Circuit Board Assy.	1	23452-2
A103	Overvoltage/Overcurrent Printed Circuit Board Assy.	1	23109
A104 (Option)	Timer, .01 to 99.99 minutes, Automatic Timing & Controls, 355A352A30PX	1	22104
A201	Measuring Circuits Printed Circuit Board Assy.	1	22536
B101 (Option)	Autotransformer Drive Motor, 120 V ac, 50/60 Hz, 500:1, 2.5 RPM, Holtzer-Cabot L07-Z0-500-S02	1	16315-2
C101 (Option)	Phase Shift Capacitor for B101, 1 μF/230 V, Eastern Air Devices	1	16316-1
CB101	Circuit Breaker, 1 Pole, 2 Amp, 250 V ac, Airpax UPG-1-2838-12	1	6807-12
CB102	Circuit Breaker, 3 Pole, 20 Amp, 250 V ac, Airpax UPG-111-1REC4-4949-3	1	17381-3
CB103	Circuit Breaker, 2 Pole, 1 Amp, 250 V ac, Airpax UPG-11-7136-1	1	10093-1
CB107	Circuit Breaker, 1 Pole, 1 Amp, 250 V ac, Potter & Brumfield W58XB1A4A-1	1	10666-1

SYMBOL	DESCRIPTION	QTY	BIDDLE PART NO.
DS101-DS103	Actuator, 5A, 125 V ac, Arrow-Hart 83501	1 ea	6847-10
	Lamp, .04A, 28 V ac, Midget Groove Base, T1-3/4	1 ea	5297
DS101	Lens - CONTROL POWER ON	1	6867-33
DS102	Lens - HV ON	1	6867-19
DS103	Lens - ON ZERO	1	6867-27
E201	Spark Gap (Part of A201) 550 V ±10%, Clare UBD-550	1	14786-1
J101	Connector, Cannon CA3101F24-10S-F80-F85	1	19485-1
J102	Connector, Beau Products S-3330-CCT-K	1	16062-6
J103	Connector, Cannon CA3106F22-2S-F80-F85	1	22366-7
J104	Connector, Cannon (and Military #) MS3102A16-11S	1	9018-50
J105	Connector, Cannon (and Military #) MS3102A20-29S	1	9018-27
J106	Connector, Cannon (and Military #) MS3102A16-10S	1	10225
J107	Connector, Cannon (and Military #) MS3102A16-9S	1	9018-26
J108	Connector, Cannon BNC-RBH-F-0, Military # UG-912/U	1	8419
J109	Connector, Cannon BNC-RBH-F-0, Military # UG-912/U	1	8419
J203	Connector, Cannon (and Military #) MS3102C 16-9S	1	9018-26
J204	Connector, Cannon CA3106F16-11S-F80-F85	1	22366-6
J205	Connector, Cannon CA3106F20-29S-F80-F85	1	22366-14

SYMBOL	DESCRIPTION	QTY	BIDDLE PART NO.
K101	Relay, 3PDT, Contacts 10A, 120V, Coil 120 V ac, 50/60 Hz Deltrol Controls 20308-84	1	17831
	Socket, Cyrtus Industries CUS-12	1	17832
K102	Relay, 4PDPT, Contacts 25A, 240V, Coil 120 V ac, 50/60 Hz Potter & Brumfield PM17AY-120	1	6806
LS101 (Option)	Timer Buzzer, 120 V ac, 50/60 Hz 4.6 VA, Potter & Brumfield BU-120	1	14860
M101	Meter Ass'y - Output Current	1	16802-4
M101 (Option)	Meter Ass'y - Output Current (with Red Line)	1	22768-8
M101 (Option)	Digital Meter Ass'y - Output Current	1	16180-1
M102	Meter Ass'y - Output Voltage	1	16198-1
M102 (Option)	Meter Ass'y - Output Voltage (with Red Line)	1	22768-9
M102 (Option)	Digital Meter Ass'y - Output Voltage	1	16180-1
P101	Connector, Cannon CA3106F24-10P-F80-F85	1	22366-1
P102	Connector, Beau Products P-3330-CCT-L	1	16061-6
P103	Connector, Cannon (and Military #) MS3102A-22-2P	1	9018-11
P104	Connector, Cannon CA3106F16-11P	1	22366-5
P105	Connector, Cannon CA3106F20-29P	1	22366-15
P106	Connector, Cannon (and Military #) with shorting wire) MS3106A16-10P (without shorting wire)	1	10226

SYMBOL	DESCRIPTION	QTY	BIDDLE PART NO.
P107	Connector, Cannon (and Military #) MS3106A-16-9P	1	9298-22
P203	Connector, Cannon CA3106F20-15S	1	22366-11
P204	Connector, Cannon (and Military #) MS3102A16-11P	1	9018-20
P205	Connector, Cannon (and Military #) MS3102A20-29P	1	9018-39
R101	Resistor, 2.5K, ±5%, 8W, WW Ohmite Brown Devil	1	4500-55
R102	Resistor, 2.5K, ±5%, 8W, WW Ohmite Brown Devil	1	4500-55
R201	Voltage Divider High Voltage Resistor 50 M ±1%, 15W, 30 kV, Caddock Electronics MG815N	1	10646-9
R202	Voltage Divider High Voltage Resistor 50 M ±1%, 15W, 30 kV, Caddock Electronics MG815N	1	10646-9
RV101	Metal Oxide Varistor (MOV) General Electric V150LA20A	1	3384-1
S101	Lower Limit Switch, 15A, 480 Vac, Microswitch BZ-2RW822-A2	1	19152
S102 (Option)	Upper Limit Switch, 15A, 480 V ac, Microswitch BZ-2RW822-A2	1	19152
S103,S104 (Option)	Switch Button, Color-White General Electric CR2940UA200F	1 ea	5824-2
	Contact Block (for S103), Single Block, 1 N.O. Contact, General Electric CR2940U310A	1	16698-1
	Contact Block (for S104), Single Block, 1 N.C. Contact, General Electric CR2940U301A	1	16698-2

SYMBOL	DESCRIPTION	QTY	BIDDLE PART NO.
S105 (Option)	Raise-Lower Switch, 15A, 125 V ac, Mom On-Off - Mom On, Arrow-Hart 82726	1	19532
T100 (Option)	Voltage Option XFMR, 120 V Input 200/208 V Input	1	22620 22610
T101	Control Transformer, 240/120 V ac, .10 kVA, Jefferson Electric 636-1131	1	16499-2
T102	Autotransformer, 240 V ac, 50/60 Hz Superior Electric 116BU-2	1	17687
W1	Input Power Cable 240 V	1	22555-240
W2	Transformer Primary Cable	1	22482-15
W3	Instrumentation Cable	1	22480-15
W4	Main Ground Cable	1	7914
W1 (120 V Option)	Input Power Cable	1	22555-120
W1 (200/208V Option)	Input Power Cable	1	22555-240
-	100 kV High Voltage Ring	1	22969
-	100 kV Connection Ball	1	9392-2
-	50 kV Connection Ball	1	9392-1
-	Clamp Ring for High Voltage Tank Covers.	1	22609
-	Square Seal Ring for High Voltage Tank Covers.	1	22970
-	Square Seal Ring for High Voltage Expansion Chamber.	1	22410-2
-	Popoff Relief Valve for High Voltage Tank Ass'y, set for 3 PSI, NUPRO B-4CPA2-3-DC	1	19159
-	Wing Nut for Ground or Guard Terminal on HV ASSEMBLY.	1	5026
-	Handle for HV ASSEMBLY	1	23443

SECTION J

WARRANTY AND REPAIR

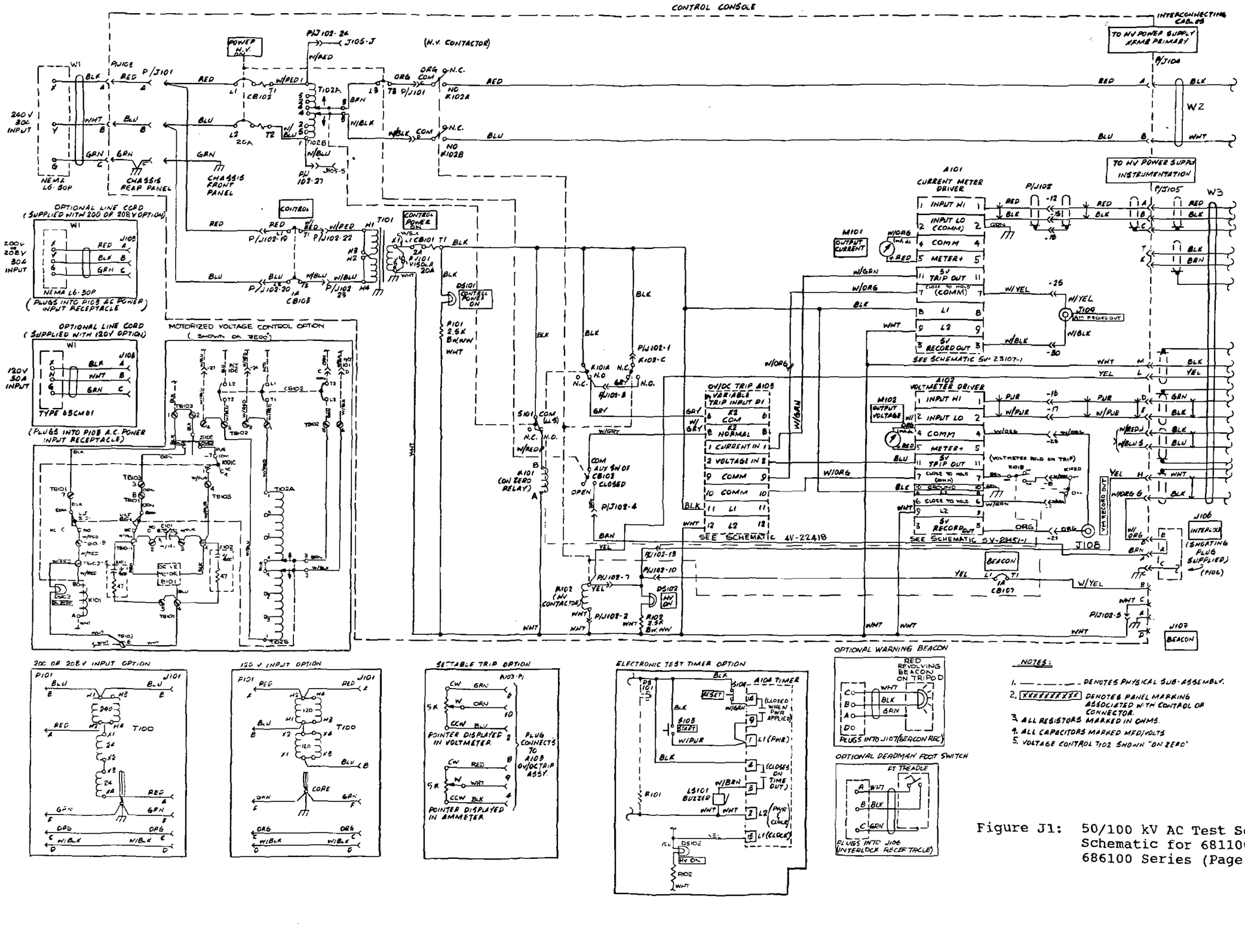
WARRANTY

All products supplied by Biddle Instruments are warranted against all defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned to the factory for repair will be shipped Prepaid and Insured. The warranty does not include batteries, lamps or tubes, where the original manufacturer's warranty shall apply. WE MAKE NO OTHER WARRANTY.

The warranty is void in the event of abuse or failure by the customer to perform specified maintenance as indicated in this manual.

REPAIR

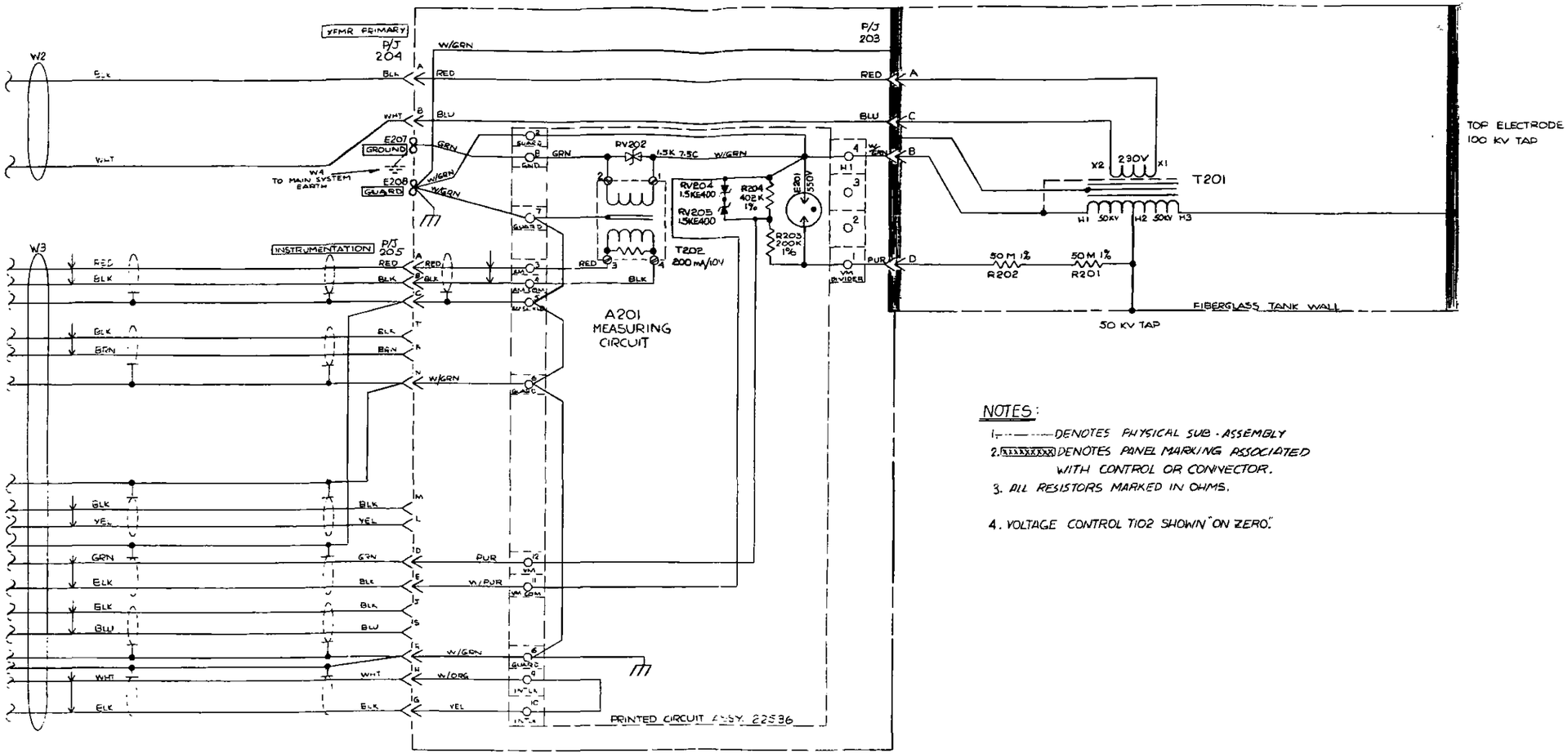
Biddle Instruments maintains a complete repair service. Before returning this equipment for repair it is recommended to contact your local sales rerpresentative or the Biddle Service Manager. Many apparent problems can be identified and corrected on-site which is often faster, more economic and more convenient than returning the equipment. Should it be necessary to return this equipment for repair at the factory be sure to get authorization and preparation for shipment instructions from the Biddle Service Manager. When returning equipment for repairs, either in or out of warranty, it should be shipped Prepaid and Insured, and marked for the attention of the Service Manager.



NOTES:

1. ——— DENOTES PHYSICAL SUB-ASSEMBLY.
2. [XXXXXXXX] DENOTES PANEL MARKING ASSOCIATED WITH CONTROL OR CONNECTOR.
3. ALL RESISTORS MARKED IN OHMS.
4. ALL CAPACITORS MARKED MFD/VOLTS
5. VOLTAGE CONTROL T102 SHOWN "ON ZERO"

Figure J1: 50/100 kV AC Test Set Schematic for 681100 or 686100 Series (Page 1)



NOTES:

1. ——— DENOTES PHYSICAL SUB-ASSEMBLY
2. [xxxxxxx] DENOTES PANEL MARKING ASSOCIATED WITH CONTROL OR CONNECTOR.
3. ALL RESISTORS MARKED IN OHMS.
4. VOLTAGE CONTROL T102 SHOWN "ON ZERO."

DIGITAL METERING OPTION

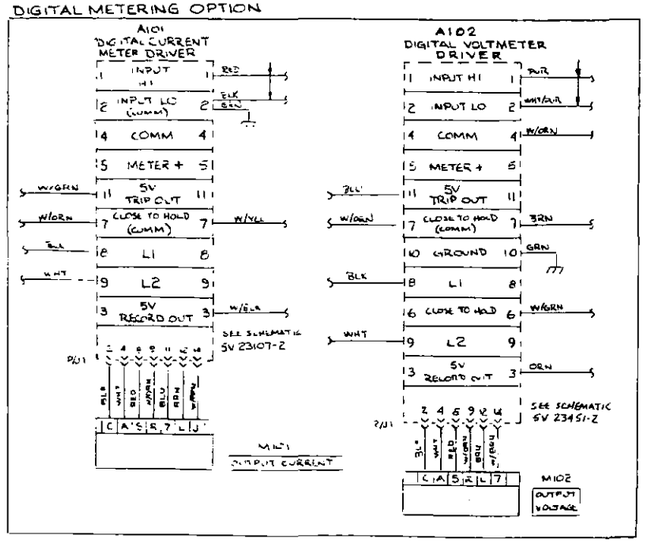


Figure J2: 50/100kV AC Test Set
Schematic for 681100 or 686100
Series (Page 2)

APPENDIX A

TEST TIMER OPTION

INTRODUCTION

This appendix is intended as a guide to the test timer option available for Biddle AC Test Sets. This option includes an electronic timer (A104), a START TIMER pushbutton (S103), a RESET TIMER pushbutton (S104) and a buzzer (LS101).

DESCRIPTION

The test timer option allows the timing of a high voltage test for a specified time length, between 0.01 minutes to 99.99* minutes. At the end of the test period a buzzer (LS101) is sounded to signal the completion of the test. Should an over-limit occur or the high voltage contactor (K102) open for any other reason during the test, indications of the time will be retained. The test timer option will not function unless the high voltage contactor (K102) is closed. (HV ON lamp (DS102) lit).

CONTROL AND CONNECTION IDENTIFICATION

Control Panel

The control panel with the test timer option together with the schematic reference numbers of the various components is illustrated in Figure A1.

A104: Electronic Timer

This timer is used to select a specified time length, from .01 minutes to 99.99* minutes. Using the white toggle set levers, the desired time may be set into the display above the levers.

S103: Start Timer Pushbutton

This pushbutton will cause the blue fluorescent display of the ELECTRONIC TIMER (A104) to light and start timing from zero up to the selected time as long as the high voltage contact (K102) is closed (HV ON lamp (DS102) lit).

S104: Reset Timer Pushbutton

This pushbutton will reset the ELECTRONIC TIMER (A104) causing the blue display above the ELECTRONIC TIMER (A104) to go out and the buzzer (LS101) to be silenced.

* Refer to SECTION D SPECIFICATIONS in this manual for DUTY CYCLE limitations.

OPERATION

The operation of the Test Timer Option is described in detail in SECTION F OPERATION in this manual.

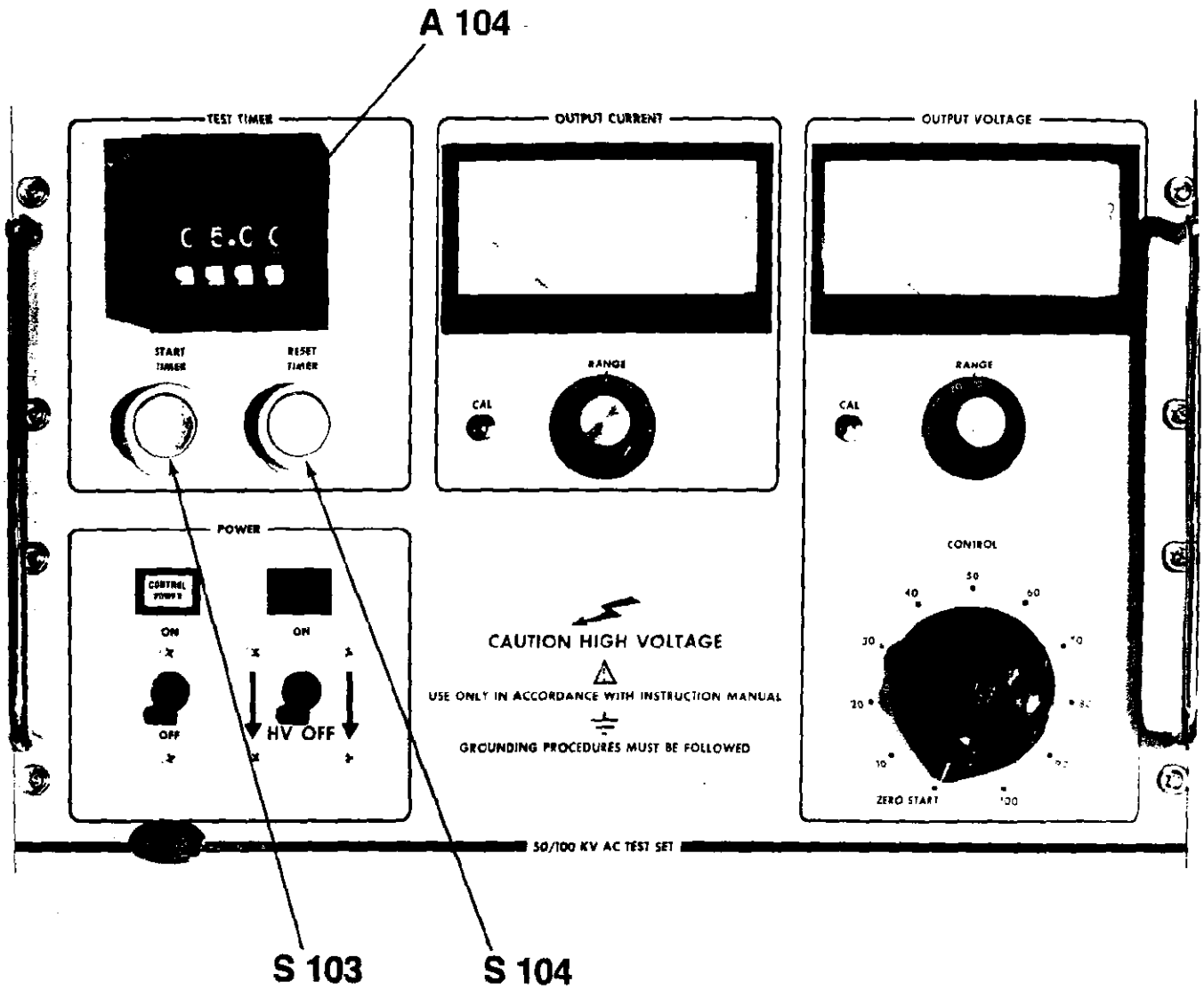


Figure A1: Typical Control Panel with the Test Timer Option.

APPENDIX B

VARIABLE RED LINE DISPLAY OF OVERVOLTAGE AND OVERCURRENT TRIP LEVELS OPTION

INTRODUCTION

This appendix is intended as a guide to the variable red line display of overvoltage and overcurrent trip levels option available for Biddle AC Test Sets (hereafter referred to as Red Line Metering Option). The red line metering option includes two control meters which replace the two standard meters and an interface harness to connect the two control meters to the OVERVOLTAGE/OVERCURRENT TRIP PC board (A103).

DESCRIPTION

The red line metering option control meters combine all of the features of the standard meters with a precision potentiometer that is coupled to a set point indicator. Both the meter movement and the potentiometer set point indicator assemblies are accurately calibrated to the same meter dial (without mechanical interaction). The set point indicator in each control meter is a red pointer arranged to pivot behind the dial, with indication visible through a slot in the dial. Each control meter potentiometer is electrically connected to the OVERVOLTAGE/OVERCURRENT TRIP PC board (A103). Moving the red pointer by use of the small black knob on the front of each control meter allows the setting of the desired trip level for any meter range. When the system output voltage or current reaches the level indicated by the red pointer, the OVERVOLTAGE/ OVERCURRENT TRIP pc board (A103) will operate and open the high voltage contactor (K102). The trip system is totally electronic and therefore does not depend on the meter movement response time for its operation. Due to the accuracy limits of the trip system, it is recommended that the red pointer be set no closer to the actual meter reading than 5% of full scale. With the red pointer set as high as possible, fully clockwise, the actual trip level is approximately 105% of full scale.

OPERATION

The operation of the red line metering option is described in detail in SECTION F OPERATION in this manual.

CALIBRATION

Mechanical Zero

With the power to the control console off, adjust the mechanical zero if required of both panel meters before proceeding.

Output Voltage Meter Red Line Calibration

With the red pointer set at full scale of the OUTPUT VOLTAGE meter (M102) obtain a 2/3 scale deflection on any range. Lower the red pointer slowly to the position of the meters black pointer. When the pointers coincide the high voltage contactor (K102) should open, the HV ON lamp (DS102) should go out. If not, use R21 (VOLTAGE REDLINE CAL) pot to compensate. See Figure B1 for the location of R21.

Output Current Meter Red Line Calibration

With the red line pointer set at full scale of the OUTPUT CURRENT meter (M101) obtain a 2/3 scale deflection on any range. Lower the red pointer slowly to the position of the meters black pointer. When the pointers coincide the high voltage contactor (K102) should open, the HV ON lamp (DS102) should go out. If not, use R22 (CURRENT REDLINE CAL) pot to compensate. See Figure B1 for the location of R22.

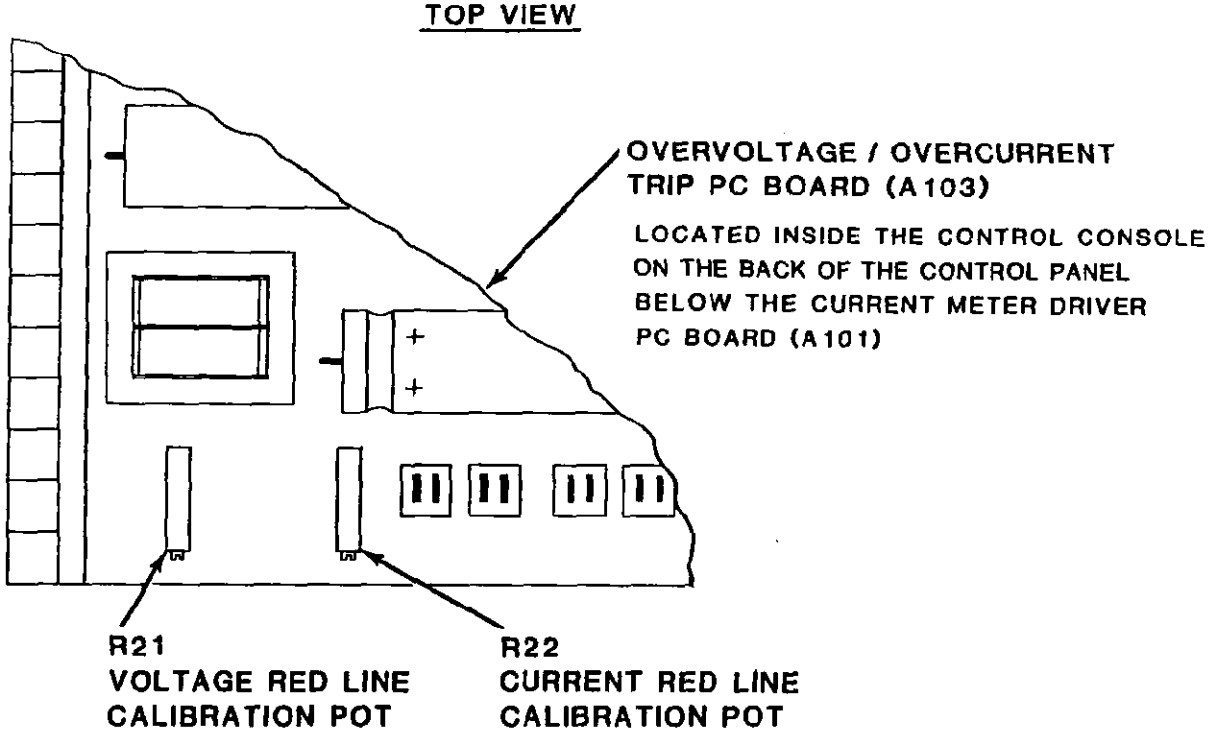


Figure B1: Location of Calibration Pots for Red Line Metering Option.

APPENDIX C

MOTORIZED VOLTAGE CONTROL OPTION

INTRODUCTION

This appendix is intended as a guide to the motorized voltage control option available for Biddle AC Test Sets. This option replaces the manual voltage control to achieve a constant rate of rise; approximately 1.5 kV/sec. when connected to the 50 kV high-voltage terminal, and approximately 3 kV/sec. when connected to the 100 kV high-voltage terminal.

DESCRIPTION

The motorized voltage control option includes a motorized autotransformer assembly, a spring return both side to center toggle switch (S105), and an ON ZERO indicator (DS103). The manual voltage control is removed and the motorized autotransformer assembly is installed inside the control console. The spring return both sides to center toggle switch (S105) is installed in the control panel for RAISE/LOWER control. The ON ZERO indicator (DS103) is installed to signal when the motorized autotransformer assembly is at its zero voltage position.

OPERATION

The operation of the motorized voltage control option is described in detail in SECTION F OPERATION in this manual.

APPENDIX D

200/208 Vac, 30 A, 60 HZ OPERATION OPTION

INTRODUCTION

This appendix is intended as a guide to the 200/208 Vac, 30A, 60 Hz operation option available for Biddle AC Test Sets. This option provides a means of operating the Test Set from a 200 or 208 Vac, 30A, 60 Hz service.

DESCRIPTION

The 200/208 Vac, 30A, 60 Hz operation option includes a "buck-boost" transformer mounted inside the control console to step up the input voltage of 200 or 208 Vac to approxiamtely 240 Vac, and a 10 ft. power cord to allow connection to the control console.

INPUT

Recommended Source:	National Electric Code (N.E.C.) 30A, 200 or 208 Vac, 60 Hz single phase.
Voltage (rms):	180-220 volts (NOTE: Maximum output voltage of the system may be reduced between 180-192V).
Current (rms):	21 amps maximum at 200 Vac per duty cycle.
Connection:	Connection to the control console is made via a 10 ft. power cord, utilizing a NEMA L6-30P cap on the outboard end. Refer to APPENDIX I - 50/100 kV AC TEST SET SCHEMATIC FOR 681100 OR 686100 SERIES at the end of this manual for connection details.

APPENDIX E

120 Vac, 50A, 60 Hz
OPERATION OPTION

INTRODUCTION

This appendix is intended as a guide to the 120 Vac, 50A, 60 Hz operation option available for Riddle AC Test Sets. This option provides a means of operating the Test Set from a 120 Vac, 50A, 60 Hz service.

DESCRIPTION

The 120 Vac, 50A, 60 Hz operation option includes a step up transformer mounted inside the control console to step up the input voltage of 120 Vac to approximately 240 Vac, and a 10 ft. power cord to allow connection to the control console.

INPUT

Recommended Source:	National Electric Code (N.E.C.) 50A, 120 Vac, 60 Hz single phase.
Voltage (rms):	108-132 volts. (NOTE: Maximum output voltage of the system may be reduced between 108-115V).
Current (rms):	34 amps maximum at 120 Vac per duty cycle.
Connection:	Connection to the control console is made via a 10 ft. power cord utilizing a 63CM61 cap on the outboard end. Refer to APPENDIX I - 50/100 kV AC TEST SET SCHEMATIC FOR 681100 OR 686100 SERIES at the end of this manual for connection details.

APPENDIX F

240 Vac, 30A, 50 Hz
OPERATION OPTION

INTRODUCTION

This appendix is intended as a guide to the 240 Vac, 30A, 50 Hz operation option available for Biddle AC Test Sets. This option provides a means of operating the Test Set from a 240 Vac, 30A, 50 Hz service.

DESCRIPTION

The 240 Vac, 30A, 50 Hz operation option takes a standard AC Test Set and replaces the HV ASSEMBLY with one fabricated for 50 Hz operation.

RATING

Maximum Output:	50 kV/100 kV, 7.5 kVA/7.5 kVA.
Duty Cycle:	15 minutes ON/45 minutes OFF.
Test Sample:	Capacitive test objects. For capacitive load range, see Figure F1.

INPUT

Recommended Source:	National Electric Code (N.E.C.) 30A, 240 Vac, 50 Hz single phase.
Voltage (rms):	216-264 volts for 240 volt operation. (NOTE: Maximum output voltage of the system may be reduced between 216-230V).
Current (rms):	17 amps maximum at 240 Vac per duty cycle.
Connection:	Connection to the control console is made via a 10 ft. power cord utilizing a NEMA L6-30P cap on the outboard end. Refer to APPENDIX I - 50/100 kV AC TEST SET SCHEMATIC FOR 681100 OR 686100 SERIES at the end of this manual for connection details.

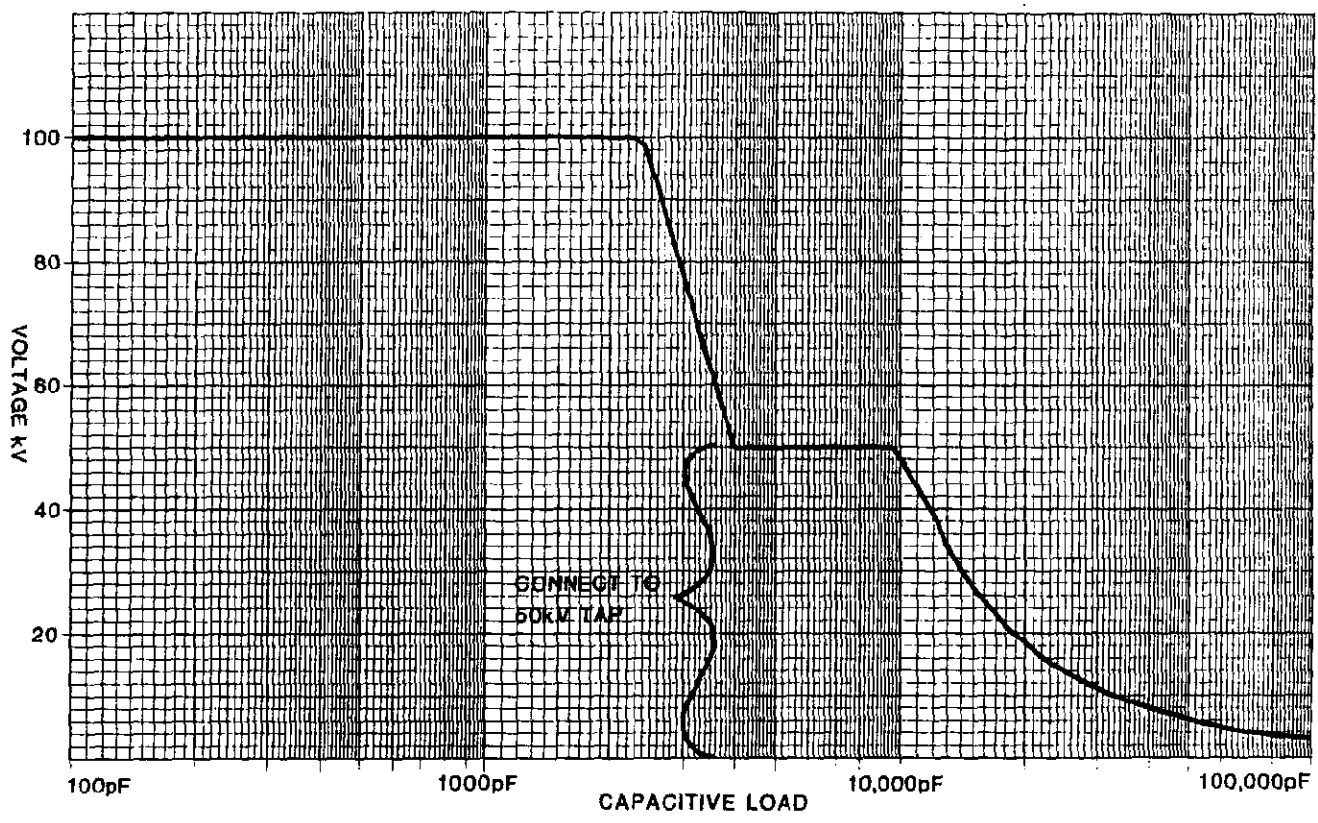


Figure F1: Loading Capability of the Cat. No. 681100 Series for 50 Hz Operation.

APPENDIX G

200/208 Vac, 30A, 50 HZ
OPERATION OPTION

INTRODUCTION

This appendix is intended as a guide to the 200/208 Vac, 30A, 50 Hz operation option available for Biddle AC Test Sets. This option provides a means of operating the Test Set from a 200 or 208 Vac, 30A, 50 Hz service.

DESCRIPTION

The 200/208 Vac, 30A, 50 Hz operation option includes a "buck-boost" transformer mounted inside the control console to step up the input voltage of 200 or 208 Vac to approximately 240 Vac, a 10 ft. power cord to allow connection to the control console and a different HV ASSEMBLY fabricated for 50 Hz operation.

RATING

Maximum Output:	50kV/100kV, 7.5kVA/7.5kVA.
Duty Cycle:	15 minutes ON/45 minutes OFF.
Test Sample:	Capacitive test objects, for capacitive load range, see Figure F1 in Appendix F.

INPUT

Recommended Source:	National Electric Code (N.E.C.) 30A, 200 or 208 Vac, 50 Hz single phase.
Voltage (rms):	180-220 volts (NOTE: Maximum output voltage of the system may be reduced between 180-192V).
Current (rms):	21 amps maximum at 200 Vac per duty cycle.
Connection:	Connection to the control console is made via a 10 ft. power cord, utilizing a NEMA L6-30P cap on the outboard end. Refer to APPENDIX I - 50/100 kV AC TEST SET SCHEMATIC FOR 681100 OR 686100 SERIES at the end of this manual for connection details.

APPENDIX H

120 Vac, 50A, 50 HZ
OPERATION OPTION

INTRODUCTION

This appendix is intended as a guide to the 120 Vac, 50A, 50 Hz operation option available for Biddle AC Test Sets. This option provides a means of operating the Test Set from a 120 Vac, 50A, 50 Hz service.

DESCRIPTION

The 120 Vac, 50A, 50 Hz operation option includes a step up transformer mounted inside the control console to step up the input voltage of 120 Vac to approximately 240 Vac, a 10 ft. power cord to allow connection to the control console, and a special HV ASSEMBLY fabricated for 50 Hz operation.

RATING

Maximum Output:	50kV/100kV, 7.5kVA/7.5kVA.
Duty Cycle:	15 minutes ON/45 minutes OFF.
Test Sample:	Capacitive test objects. For capacitive load range, see Figure F1 in APPENDIX F.

INPUT

Recommended Source:	National Electric Code (N.E.C.) 50A, 120 Vac, 50 Hz single phase.
Voltage (rms):	108-132 volts. (NOTE: Maximum output voltage of the system may be reduced between 108-115V).
Current (rms):	34 amps maximum at 120 Vac per duty cycle.
Connection:	Connection to the control console is made via a 10 ft. power cord utilizing a 63CM61 cap on the outboard end. Refer to APPENDIX I - 50/100 kV AC TEST SET SCHEMATIC FOR 681100 OR 686100 SERIES at the end of this manual for connection details.

APPENDIX I

DIGITAL METERING OPTION

INTRODUCTION

This appendix is intended as a guide to the digital metering option available for Biddle AC Test Sets. The digital metering option includes two 3 1/2 digit LED type meters which replace the two standard 4 1/2" analog meters, a digital voltmeter driver and digital current meter driver to replace the standard meter drivers, and interface harness to connect the digital meters to the digital meter drivers.

SPECIFICATIONS

OUTPUT VOLTAGE

Output voltage is measured using a peak responding circuit, rms calibrated.

Ranges and Accuracy:

0-10.0/20.0/50.0/100 kV
±1.0% of full scale on all ranges

OUTPUT CURRENT

Output current is measured using an average responding circuit, rms calibrated.

Ranges and Accuracy:

0-15.00/30.0/75.0/150 mA
±1.0% of full scale on all ranges.

CALIBRATION

Refer to the following figures:

Figure I1: Typical Digital Panel Meter with Front Lens Removed.

Figure I2: Digital Meter Schematic.

Figure I3: Digital Voltmeter Driver (A102) Schematic.

Figure I4: Location of Calibration Pots for the Output Voltage Meter.

Figure I5: Digital Current Meter Driver (A101) Schematic.

Figure I6: Location of Calibration Pots for the Output Current Meter.

Digital Panel Meter Calibration

This calibration is only necessary after a repair has been made to the meter. A calibration reference DC voltage source is required to calibrate the panel meter. This source should be accurate to ±0.01% or better. Disconnect the edge connector from the rear of the meter and remove the meter from the control panel. Remove the lens from the front of the meter to make the full scale potentiometer (R3) accessible for calibration. Refer to Figure I1

Supply 120 Vac to the meter Pin A (AC COM) and Pin C (AC H1). Connect the DC voltage source to the meter Pin S (SIG IN) and Pin R (SIG RTN). Set the DC voltage source to +1.900 volts. Adjust the panel meter full scale potentiometer (R3) for a readout on the meter of 1900. Once the meter is calibrated replace the lens onto the meter and reinstall the meter into the control panel.

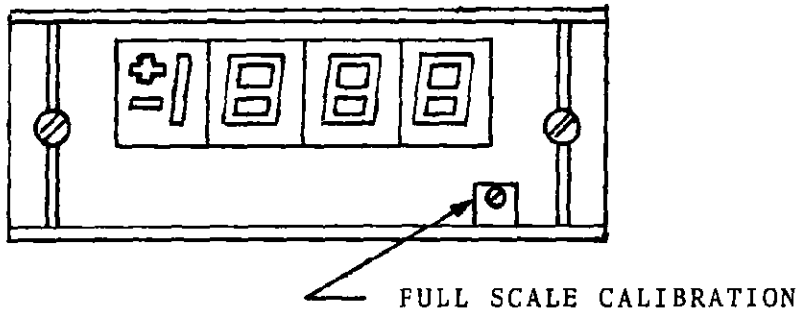


Figure I1: Typical Digital Panel Meter With Front Lens Removed.

Digital Output Voltage Meter Calibration

Set up the test set following the details where applicable under INSTALLATION which is part of SECTION F OPERATION in this manual. Connect a suitable standard kilovoltmeter, with an overall accuracy of 0.2% or better, between the 100 kV high-voltage terminal and GROUND terminal of the HV ASSEMBLY. Place the standard kilovoltmeter so that it may be safely and precisely read. Set the panel OUTPUT VOLTAGE meter range switch to the 100 kV range. Remove the hole plug covering the hole marked CAL below the OUTPUT VOLTAGE meter (M102). (Refer to Figure 4 in SECTION E DESCRIPTION) to gain access to the OUTPUT VOLTAGE 100 kV range calibration pot (R24). Raise the output voltage to 2/3 of full scale of the panel OUTPUT VOLTAGE meter (M102). Adjust the OUTPUT VOLTAGE 100 kV range calibration pot (R24) to compensate for any discrepancy between the standard kilovoltmeter and the OUTPUT VOLTAGE meter (M102) readings. Once the 100 kV range of the OUTPUT VOLTAGE meter (M102) is calibrated reinstall the hole plug in the hole marked CAL below the OUTPUT VOLTAGE meter (M102).

NOTE: Once the 100 kV range is calibrated there is no need to remove the hole plug or change the setting of the 100 kV range calibration pot (R24) for the calibration of the other three ranges (10, 20, 50 kV).

Deenergize the test set and remove all power to the control console. To calibrate the other three ranges (10, 20, 50 kV) the control console lid must be removed and the OUTPUT VOLTAGE meter (M102) must be slid out of the control panel but left connected to gain access to the other calibration pots.

WARNING!

The edge connector of the OUTPUT VOLTAGE meter has 120 Vac at its terminals. Care should be taken to keep personnel away from the edge connector. Insulate the edge connector from the control panel during calibration.

Repeat the calibration procedure for the other three ranges (10, 20, 50 kV) using the appropriate calibration pot for each range. (R40 - 10 kV range, R41 - 20 kV range, R42 - 50 kV range). (Refer to Figure I4).

Digital Output Current Meter Calibration

Set up the Test Set following the details where applicable under INSTALLATION which is part of SECTION F OPERATION in this manual. This calibration procedure will use a current source in series with the Output Current meter Current Transformer (T202) therefore it will not be necessary to connect a test sample or energize the HV ASSEMBLY. Connect a suitable current source and a suitable standard ammeter with an overall accuracy of 0.2% or better between the GROUND wing nut and GUARD wing nut on the HV ASSEMBLY. Close the CONTROL POWER circuit breaker (CB101). The CONTROL POWER ON lamp (DS101) will now light. Set the panel OUTPUT CURRENT meter range switch to the 150 mA range. Remove the hole plug covering the hole marked CAL below the OUTPUT CURRENT meter (M101). (Refer to Figure 4 in SECTION E DESCRIPTION) to gain access to the OUTPUT CURRENT 150 mA range calibration pot (R32). Energize the current source and increase the current until 2/3 of full scale of the panel OUTPUT CURRENT meter (M101) is reached. Adjust the OUTPUT CURRENT 150 mA range calibration pot (R32) to compensate for any discrepancy between the standard ammeter and the OUTPUT CURRENT meter (M101) reading. Once the 150 mA range of the OUTPUT CURRENT meter (M101) is calibrated reinstall the hole plug in the hole marked CAL below the OUTPUT CURRENT meter (M101).

NOTE: Once the 150 mA range is calibrated there is no need to remove the hole plug or change the setting of the 150 mA range calibration pot (R32) for the calibration of the other three ranges (15, 30, 75 mA).

Deenergize the control console and remove all power to the control console. To calibrate the other three ranges (15, 30, 75 mA) the control console lid must be removed and the OUTPUT CURRENT meter (M101) must be slid out of the control panel but left connected to gain access to the other calibration pots.

WARNING!

The edge connector of the OUTPUT CURRENT meter has 120 Vac at its terminals. Care should be taken to keep personnel away from the edge connector. Insulate the edge connector from the control panel during calibration.

Repeat the calibration procedure for the other three ranges (15, 30, 75 mA) using the appropriate calibration pot for each range (R44 - 15 mA range, R45 - 30 mA range, R46 - 75 mA range). Refer to Figure I6.)

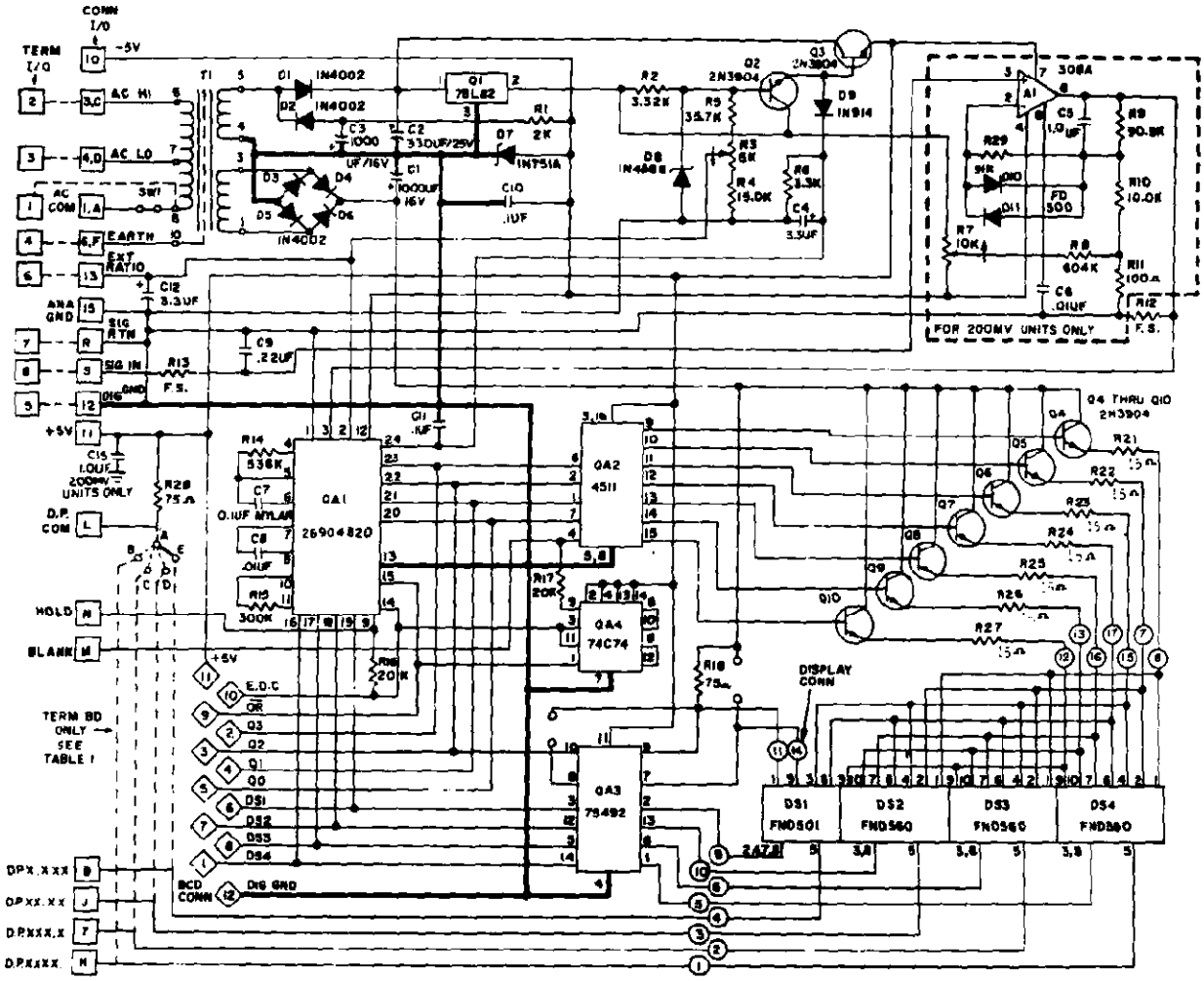
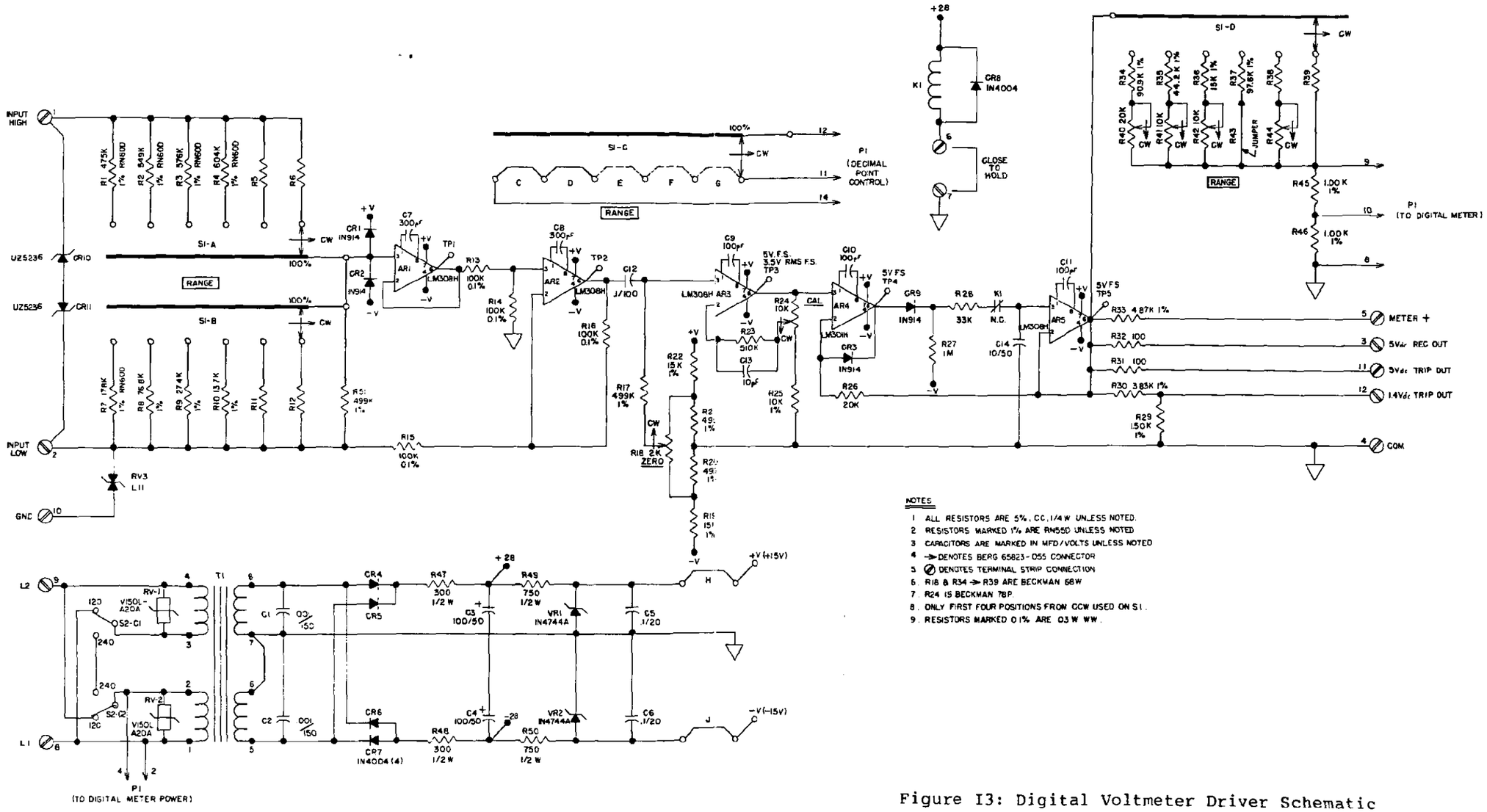


Figure I2: Digital Meter Schematic



NOTES

1. ALL RESISTORS ARE 5%, CC, 1/4 W UNLESS NOTED.
2. RESISTORS MARKED 1% ARE RN55D UNLESS NOTED
3. CAPACITORS ARE MARKED IN MFD/VOLTS UNLESS NOTED
4. → DENOTES BERG 65823-055 CONNECTOR
5. ⊘ DENOTES TERMINAL STRIP CONNECTION
6. R18 & R34 → R39 ARE BECKMAN 68W
7. R24 IS BECKMAN 78P.
8. ONLY FIRST FOUR POSITIONS FROM CCW USED ON S1.
9. RESISTORS MARKED 0.1% ARE .03 W WW.

Figure I3: Digital Voltmeter Driver Schematic

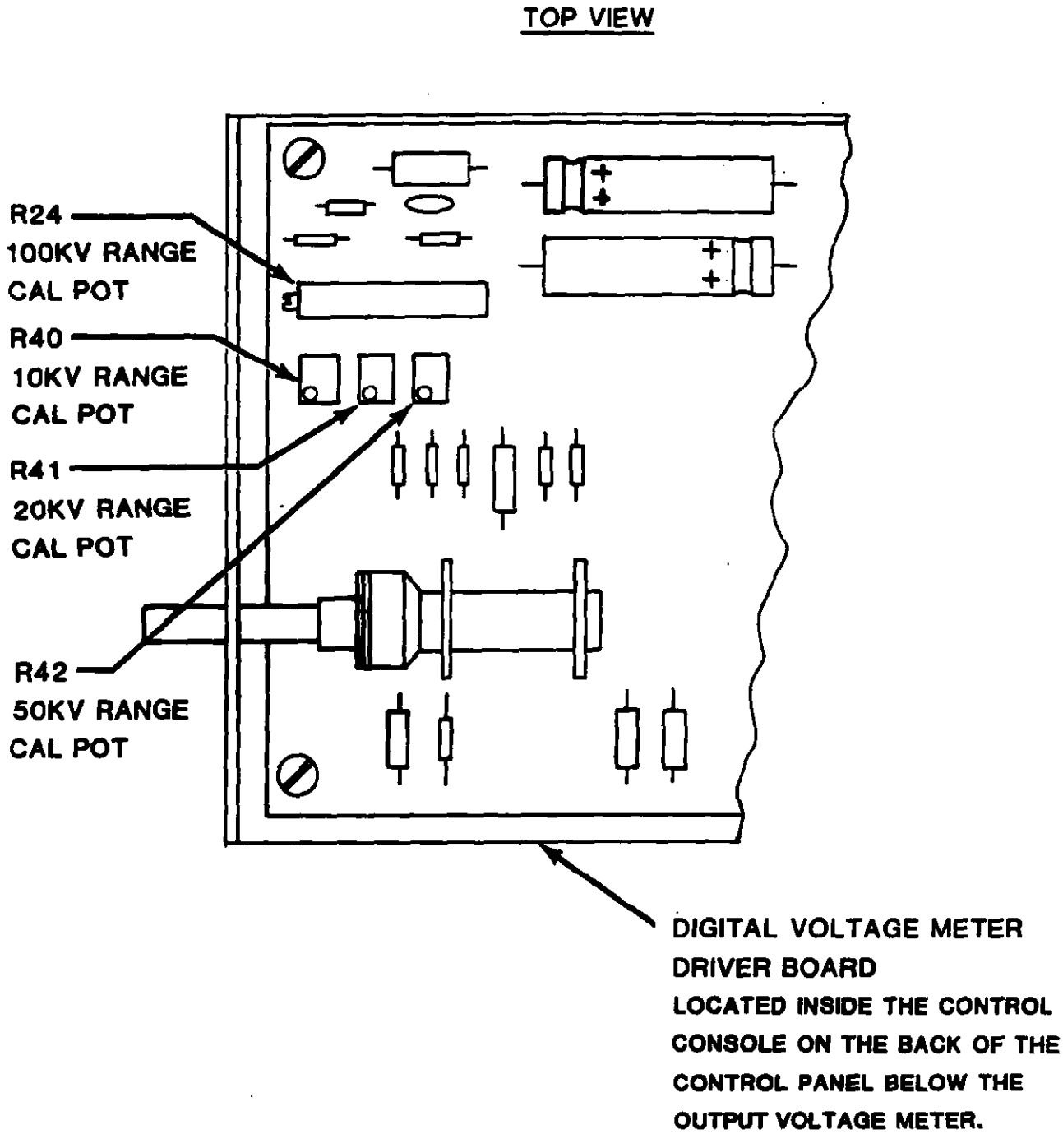


Figure I4: Location of Calibration
Pots for the Output
Voltage Meter

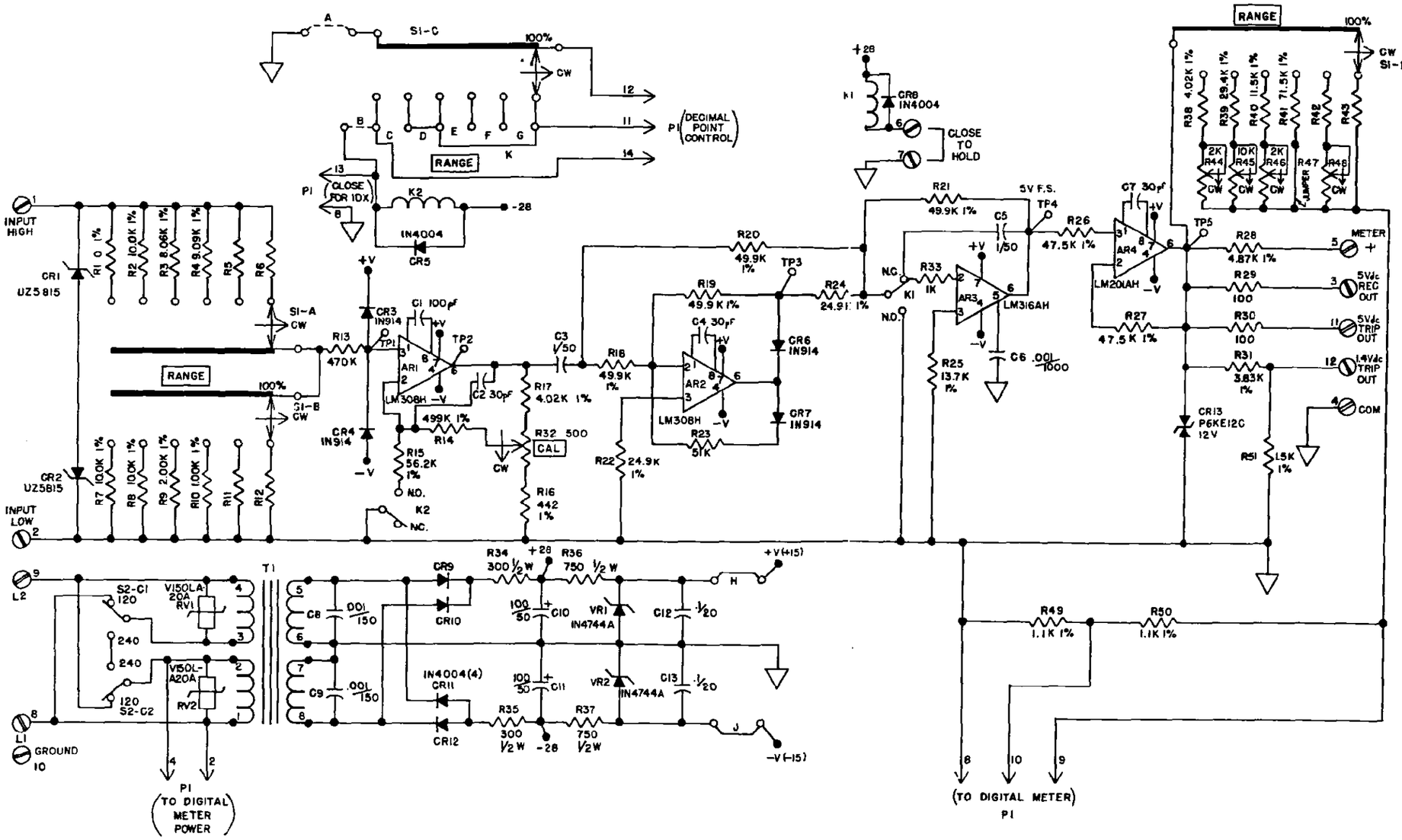


Figure I5: Digital Current Meter Driver Schematic

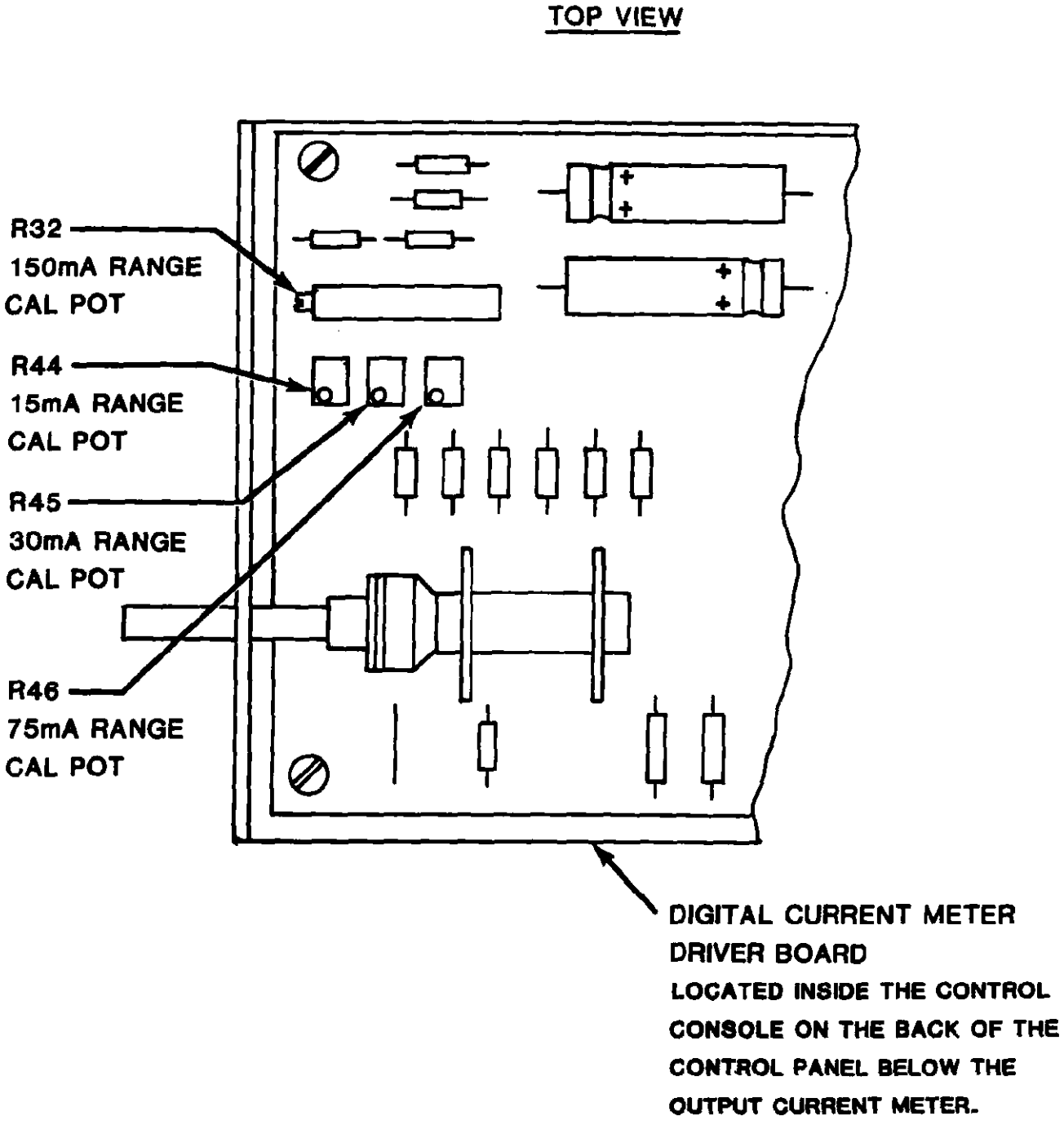


Figure I6: Location of Calibration Pots
for the Output Current Meter