STABILINE®

automatic VOLTAGE REGULATORS

TYPES ESPEG

IES9215

S/N #63 GQN

109

TABLE OF CONTENTS

THE SUPERIOR ELECTRIC COMPANY

Bristol, Connecticut, U.S.A.

SECTION 1

RATING

STABILINE Automatic Voltage Regulator type IES9215 is a fast, extremely accurate solid-state regulator. It will maintain an output voltage of 230V r.m.s. within a maximum bandwidth of 100 millivolts r.m.s., for any combination of rated line and/or load from 1.0 to 0 power factor lagging. The rated output is 65.0 amperes at 230 volts. The output voltage may be set by means of a screwdriver adjustment within the range of 220-240 volts with a shift in the input range in the direction of the deviation from nominal output voltage. The operable frequency range of the IES9215 is 50 or 60 cycle $\pm$10%. When the input line voltage is sinusoidal and of the nominal 50 or 60 cycle frequency, the output distortion will not exceed 3% RMS under all rated input line and load conditions. The efficiency can be as high as 97% depending on line and load conditions.

SECTION 2

DESCRIPTION

The IES9215 is mounted in a cabinet and painted a very durable textured gray finish. The assembly is approximately 26 1/8" wide over the handles, 20 1/8" deep over the handles, 19 3/4" high and weighs approximately 340 lbs. Located on the front panel are a red pilot light which indicates whether the unit is energized, an output voltage control, a control unit fuse and two handles for use when removing the control panel. The input-output terminal board is located behind a door at the rear of the cabinet. Conduit knockouts are provided at the back of the cabinet. Access to the printed circuit board control section is obtained by removing the control panel at the front of the cabinet.

All active semiconductor components are silicon, insuring stability and reliability at elevated temperatures. Each IES Series regulator has an overcurrent protection circuit to protect the SCR's from harmful overcurrents, while continuing to allow short time overloads within the SCR current carrying capabilities. This is an important feature with loads requiring high initial inrush currents such as incandescent lamps, motor starters, etc.

SECTION 3

THEORY OF OPERATION

A solid-state IES Series regulator maintains output voltage within a maximum bandwidth of 100 millivolts r.m.s. for any combination of rated line and/or load.

A. Power Circuit

The power circuit consists of an inverse parallel pair of SCR's, an SCR choke (L1), an autotransformer (T1), a load reactor (L5) and tuned harmonic filters. When the SCR's are fired, current will flow through autotransformer winding 1-2 and the SCR leg (L1, SCR and T2) producing a corrective voltage across autotransformer winding 2-3 which will add or subtract vectorially from the input voltage, depending on the phase angle at which the SCR's are fired as determined by the control unit. The purpose of the SCR choke (L1) is to provide an optimum impedance value for the SCR leg, to limit the rate of current rise in the SCR's and to minimize distortion. Harmonic filters, connected across the autotransformer to minimize the harmonic content in the output of the regulator, are tuned to approximately the third, fifth and seventh harmonics of the nominal frequency.

B. Control Circuit

The control circuit consists of an RMS discriminating voltage detector, integrating amplifier, run-up circuit, zero crossing detector, a phase discriminator, electronic switches and Schmitt triggers.

The RMS voltage detector monitors the output and produces a positive or negative error signal, depending on the direction in which the output voltage deviates from the preset value. The error signal is fed into an integrating amplifier, the output of which is fed into the run-up circuit where D.C. information obtained from the output of the amplifier is converted to pulse-width control. The run-up circuit is reset by the zero crossing network every half cycle of the input voltage, at the zero crossings. A turn-on signal is directed to a Schmitt trigger when coincidence occurs between the phase discriminator and the electronic switches which are triggered by the pulse controlled signal from the run-up circuit. When this happens the selected Schmitt trigger is fired applying gate drive to the SCR it controls.

C. Overcurrent Protection Circuit

The overcurrent protection circuit consists of an integrating network, bi-stable flip-flop, clamping transistor, and a unijunction timing circuit.

A signal produced at the output of current transformer T2, is proportional to the magnitude of the current flowing in the SCR leg. This signal is integrated by an RC network and triggers a bi-stable flip-flop when a predetermined level is exceeded. The flip-flop turns on a transistor that clamps the output of the integrating amplifier to zero potential thereby preventing the control unit from delivering gate signals to the SCR's. The flip-flop also starts a unijunction timing circuit that will automatically reset the flip-flop within 1-2 seconds. If the overcurrent condition has not cleared by this time, the overcurrent circuit will again be actuated and the cycle will be repeated.

SECTION 4

INSTALLATION

After unpacking the regulator check carefully to make certain that it has not been damaged in transit.

Place the unit in the desired location and make the necessary connections at the input-output terminal board located in back of the cabinet. If the voltage is to be regulated at a remote point, remove the terminal jumpers from TB1-1 to TB1-2 and TB1-3 to TB1-4 and connect shielded sensing leads to TB1-2 and TB1-4. Regulation accuracy is affected by the size and length of the remote sensing leads. To minimize reductions in accuracy, keep sensing leads as short as possible. Wire smaller than AWG #16 is not recommended for sensing leads.

The maximum input current (0 power factor, low input line) is approximately 115 amperes at 60 cycles and 125 amperes at 50 cycles.

Standard units are connected for 60 cycle operation. For operation at 50 cycles the filter chokes must be reconnected as indicated on the schematic diagram.

For 208V operation at rated output current, reconnect the lead on terminal 5 to terminal 4 on transformers A1T3 (T6085) and A1T4 (T6083).

SECTION 5

OPERATION

After the unit has been installed and the installation wiring has been checked, proceed as follows:

1. Check to see that the regulator and the equipment connected to it are turned off.
2. Apply power to the regulator. The red pilot lamp should light.
3. Connect an a-c r.m.s. voltmeter across the output. (Note: many analyzers use a rectifier type meter and will not give a true indication of the r.m.s. output voltage).
4. Remove the protective cap on the output voltage control and turn the control for the desired output voltage. If a very exact setting is necessary, allow ten to thirty minutes operation before adjusting.
5. Energize the connected equipment and note that the output voltage remains within the rated accuracy.

SECTION 6

MAINTENANCE

Under normal operating conditions, the STABILINE Automatic Voltage Regulator should require little maintenance for years of continuous, reliable operation.

The following troubleshooting guides should be used if a malfunction develops.

1. Improper Operation - Should an apparent malfunction develop, check to see that the input voltage, input frequency, output voltage setting and output current are within the rated values for the regulator and that the load power factor is not leading.
2. No Output Voltage -
   a) Check the input and output fuses.
3. High Output Voltage - If the output voltage is high and the output voltage control will not correct it:
   a) Check to see that the conditions imposed on the regulator are within its rated capabilities (see 1 above).
   b) Check for a shorted SCR.
   c) With an ohmmeter, check the resistance of the A1Z1 assembly (BU-5) between terminals 1-5 and 2-3. If the resistance is greater than 5 ohms, replace the assembly.
   d) Check A1C1 (5000 μf, 25V capacitor) for an open.
   e) Replace the control unit printed circuit board (EHR93190G1).

4. Low Output Voltage - If the output voltage is low and the output voltage control will not correct it:

   a) Check to see that the conditions imposed on the regulator are within its rated capabilities (see 1 above).

   b) Check the control unit fuse (F1).

   c) Check to see that the printed circuit board is inserted tightly in its female connector.

   d) Check the following components in the power section of the control unit:

      1. A1R21, A1R22 (47 ohm, 1/2W) resistors for an open
      2. A1C1 (5000 μf, 25V) capacitor for a short
      3. A1R63 (80.6 ohm, 50W) resistor for a short
      4. A1R3 (7.5 ohm, 25W) resistor for an open
      5. R1 (39 ohm, 1/2W) resistor for an open
      6. Check the voltages across the secondary windings of transformer A1T3. Approximate RMS voltages with nominal input voltage should be:

         A1T3, Terminals, 6-7, 7-8 28 volts
         9-10, 10-11 24 volts
         12-13, 13-14 26 volts

   e) With an ohmmeter, check the resistance of the A1Z1 assembly (BU-5) between terminals 1-5 and 2-3. If the resistance is greater than 5 ohms, replace this assembly.

   f) If no trouble is found during the above checks, replace the control unit printed circuit board (EHR93190G1).

5. No Regulation

   a) Check to see that the conditions imposed on the regulator are within its rated capabilities (see 1 above).

   b) Check A1R63 (80.6 ohm, 50W) resistor for an open.

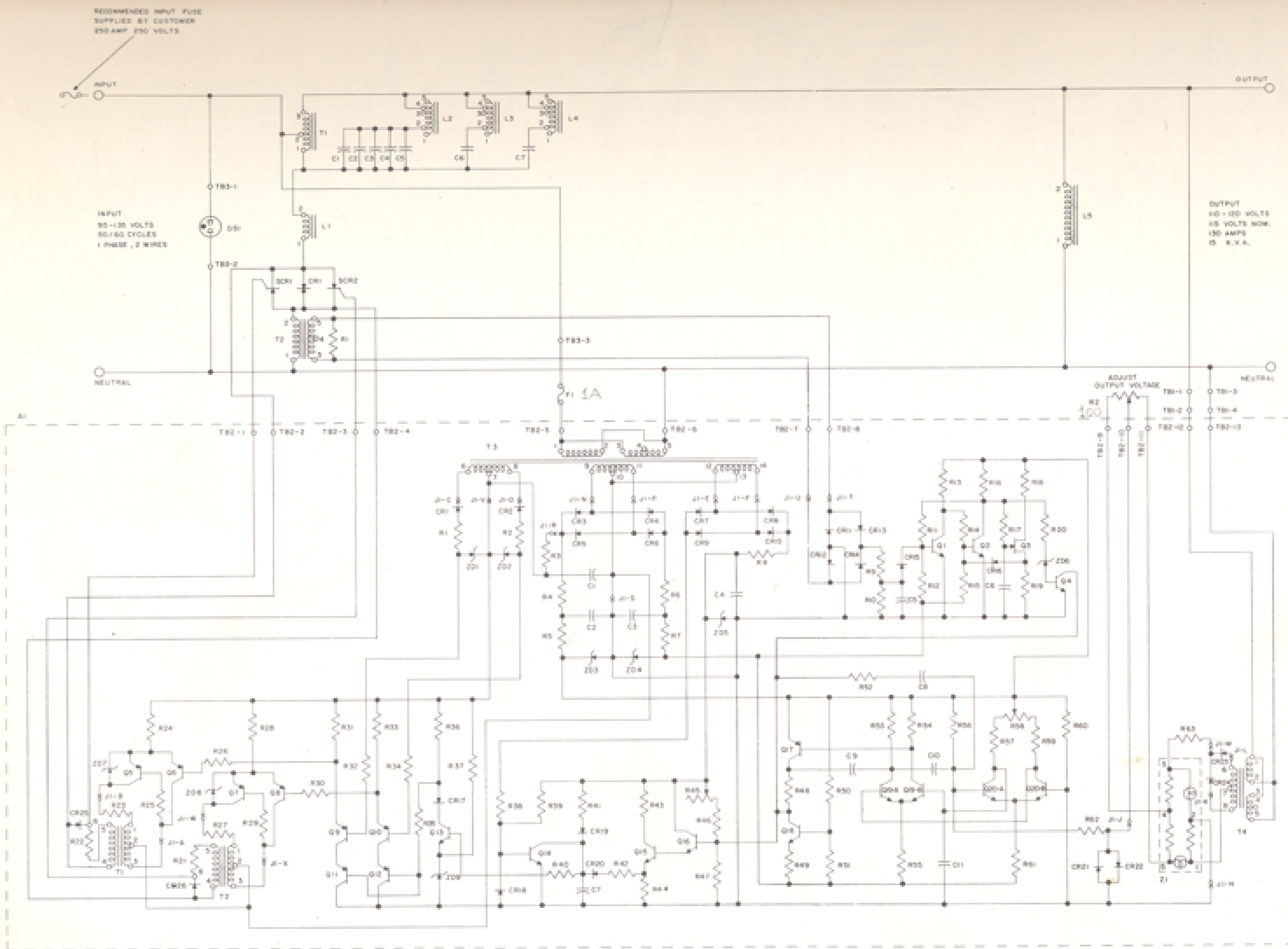
   c) Replace the control unit printed circuit board (EHR93190G1).

6. Input Fuse "Blows"

a) Check to see that the input fuse is 125 amperes.

b) Check to see that rated output current is no greater than 65.0 amperes.

c) Check filter capacitors C1 (60 μf, 440V), C2 (20 μf - 440V) and C3 (10 μf, 440V) for shorts



NOTES:

1. CONNECTIONS SHOWN ARE FOR 60 CYCLE OPERATION FOR 50 CYCLE OPERATION REMOVE (WHT/YEL) LEAD FROM L2-2 AND CONNECT TO L2-1, REMOVE (WHT/GRN) LEAD FROM L3-2 AND CONNECT TO L3-1, REMOVE (WHT/BLK/YEL) LEAD FROM L4-2 AND CONNECT TO L4-1.

2. FOR REMOTE SENSING REMOVE TERMINAL JUMPERS FROM TB1-1 TO TB1-3, AND TB1-2 TO TB1-4. THEN CONNECT SENSING LEADS TO TB1-2 AND TB1-4.

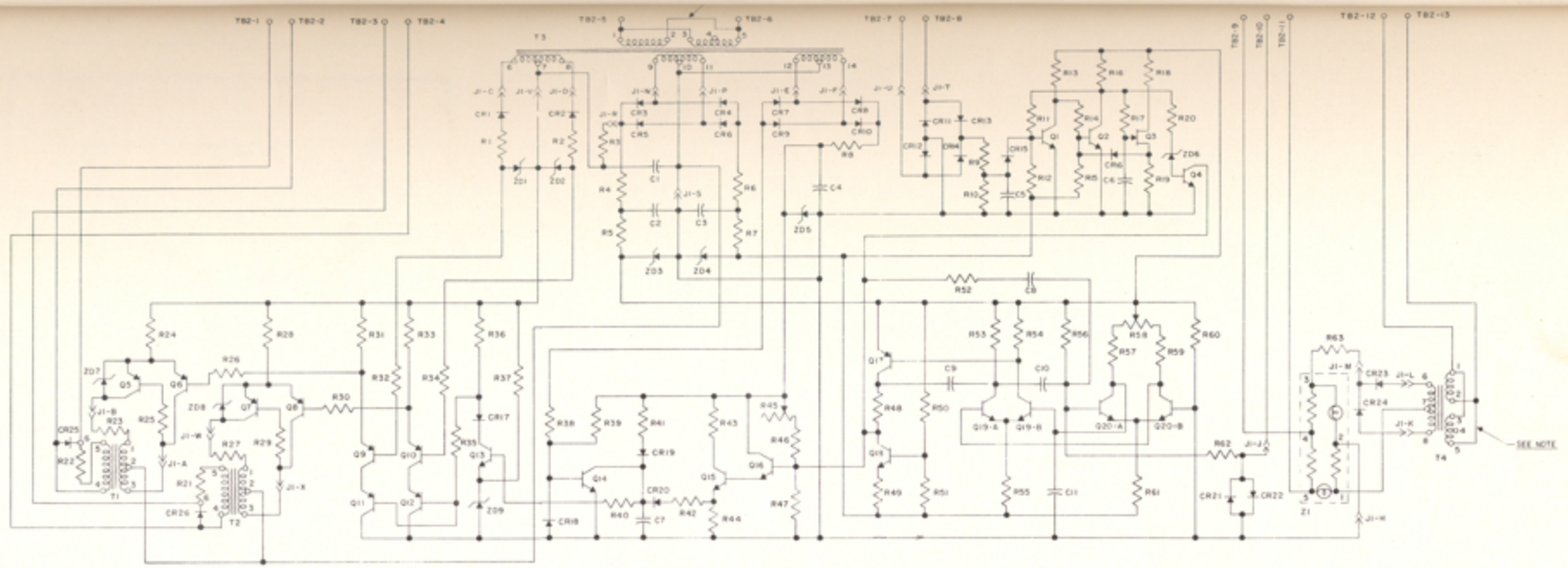
Schematic Diagram for IES9115 Regulator

Size E, Drawing Number RR19997 — Revision 2

THE SUPERIOR ELECTRIC COMPANY

BRISTOL, CONNECTICUT

SE-E12669



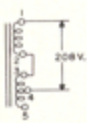
SYMBOL	DESCRIPTION	THE SUPERIOR ELECTRIC COMPANY PART NO.
C1	CAPACITOR, 5000 MFD., -10%, +75% -10%, 25V. DC	EM1446180A
C2	CAPACITOR, 100 MFD., +150%, -10%, 50V. DC	BR103872105
C3	SAME AS C2	
C4	CAPACITOR, 250 MFD., +150%, -10%, 50V. DC	BR103872106
C5	CAPACITOR, 22 MFD., ±10%, 15V DC	AB405060146
C6	CAPACITOR, 10 MFD., ±10%, 20V. DC	AB405060222
C7	CAPACITOR, .68 MFD. ±10%, 35V. DC	AB405060287
C8	CAPACITOR, 2.2 MFD., ±10%, 35V. DC	AB405060293
C9	CAPACITOR, 100 PFD., ±5%, 500V. DC	BR103013G3
C10	CAPACITOR, 24 PFD., ±5%, 500V. DC	BR103013G2
C11	CAPACITOR, 200 PFD. ±5%, 500V. DC	BR103013G4
CR1	RECTIFIER, SILICON AVALANCHE, 1 AMP.	BR103335G1
CR2	SAME AS CR1	
CR3	SAME AS CR1	
CR4	SAME AS CR1	
CR5	SAME AS CR1	
CR6	SAME AS CR1	
CR7	SAME AS CR1	
CR8	SAME AS CR1	
CR9	SAME AS CR1	
CR10	SAME AS CR1	
CR11	SAME AS CR1	
CR12	SAME AS CR1	
CR13	SAME AS CR1	
CR15	SAME AS CR1	
CR16	SAME AS CR1	
CR17	SAME AS CR1	
CR18	SAME AS CR1	
CR19	SAME AS CR1	
CR20	SAME AS CR1	
CR21	DIODE, GERMANIUM	BM1446170J
CR22	SAME AS CR21	
CR23	SAME AS CR1	
CR24	SAME AS CR1	
CR25	DIODE, SILICON, HIGH CURRENT	BM1447305G1
CR26	SAME AS CR25	
J1	CONNECTOR, RECEPTACLE, PRINTED CIRCUIT	BM1446540A
Q1	TRANSISTOR, SILICON, NPN	BM1447425G1
Q2	SAME AS Q1	
Q3	TRANSISTOR, UNIJUNCTION, TYPE 2N2646	BD363706A
Q4	SAME AS Q1	
Q5	TRANSISTOR, TYPE 2N3740	BM1448023G1
Q6	SAME AS Q5	
Q7	SAME AS Q5	
Q8	SAME AS Q5	
Q9	TRANSISTOR, TYPE 2N3638	BM1447378G1
Q10	SAME AS Q9	
Q11	SAME AS Q9	
Q12	SAME AS Q9	
Q13	SAME AS Q1	
Q14	TRANSISTOR, SILICON, NPN	BM1447425G2
Q15	SAME AS Q1	
Q16	SAME AS Q1	
Q17	SAME AS Q9	
Q18	SAME AS Q1	
Q19-A	TRANSISTOR, DIFFERENTIAL AMPLIFIER	BM1447676G1
Q19-B	PART OF Q19-A	
Q20-A	TRANSISTOR, DIFFERENTIAL AMPLIFIER	BM1447676G1
Q20-B	PART OF Q20-A	
R1	RESISTOR, COMP., 1K., OHM, 1/2 WATT, ±10%	BR2378796178
R2	SAME AS R1	
R3	RESISTOR, W.W., 7.5 OHM, 25 WATT, ±5%	BP262G14
R4	RESISTOR, W.W., 300 OHM, 3 WATT, ±5%	BR103532621
R5	RESISTOR, W.W., 50 OHM, 3 WATT, ±5%	BR103530G16
R6	SAME AS R4	
R7	SAME AS R5	
R8	RESISTOR, W.W., 300 OHM, 3 WATT, ±5%	BR103532G24
R9	RESISTOR, COMP., 4.7K., OHM, 1/2 WATT, ±10%	BR2378796186
R10	SAME AS R9	

SYMBOL	DESCRIPTION	THE SUPERIOR ELECTRIC COMPANY PART NO.
R11	RESISTOR, COMP., 6.8K., OHM, 1/2 WATT, ±10%	BR2378796188
R12	RESISTOR, COMP., 33K., OHM, 1/2 WATT, ±10%	BR2378796196
R13	SAME AS R11	
R14	SAME AS R11	
R15	SAME AS R12	
R16	SAME AS R11	
R17	RESISTOR, COMP., 27K, OHM, 1/2 WATT, ±10%	BR2378796195
R18	RESISTOR, COMP., 680 OHM 1/2 WATT, ±10%	BR2378796176
R19	RESISTOR, COMP., 47 OHM, 1/2 WATT, ±10%	BR2378796162
R20	SAME AS R11	
R21	SAME AS R19	
R22	SAME AS R19	
R23	RESISTOR, W.W., 25 OHM, 10 WATT, ±5%	BD218H4610
R24	RESISTOR, W.W., 5 OHM, 3 WATT, ±5%	BR103533G06
R25	SAME AS R4	
R26	RESISTOR, COMP., 100 OHM, 1/2 WATT, ±10%	BR2378796166
R27	SAME AS R23	
R28	SAME AS R24	
R29	SAME AS R4	
R30	SAME AS R26	
R31	SAME AS R26	
R32	RESISTOR, COMP., 2.2K OHM, 1/2 WATT, ±10%	BR2378796182
R33	SAME AS R26	
R34	SAME AS R32	
R35	SAME AS R26	
R36	SAME AS R11	
R37	SAME AS R11	
R38	RESISTOR, W.W., 750 OHM, 3 WATT, ±5%	BR103532G31
R39	SAME AS R32	
R40	SAME AS R26	
R41	RESISTOR, COMP., 47K, OHM, 1/2 WATT, ±10%	BR2378796198
R42	RESISTOR, COMP., 150 OHM, 1/2 WATT, ±10%	BR2378796168
R43	SAME AS R26	
R44	SAME AS R1	
R45	RESISTOR COMP., VAR., 20K. OHM, 0.2 WATT, ±20%	DR104J396G1
R46	SAME AS R11	
R47	RESISTOR, COMP., 12K., OHM, 1/2 WATT, ±10%	BR2378796190
R48	RESISTOR, COMP., 470 OHM, 1/2 WATT, ±10%	BR2378796174
R49	SAME AS R11	
R50	RESISTOR, COMP., 22K., OHM, 1/2 WATT, ±10%	BR2378796194
R51	SAME AS R32	
R52	RESISTOR, COMP., 56K., OHM, 1/2 WATT, ±10%	BR2378796199
R53	SAME AS R32	
R54	SAME AS R32	
R55	RESISTOR, COMP., 10K., OHM, 1/2 WATT, ±10%	BR2378796190
R56	RESISTOR, COMP., 15 MEG., OHM, 1/2 WATT, ±10%	BR2378796228
R57	RESISTOR, COMP., 100K., OHM, 1/2 WATT, ±10%	BR2378796200
R58	RESISTOR, COMP., VAR., 100K. OHM, 0.2 WATT, ±20%	DR104J396G
R59	SAME AS R57	
R60	SAME AS R56	
R61	SAME AS R57	
R62	RESISTOR, COMP., 18K., OHM, 1/2 WATT, ±10%	BR2378796193
R63	RESISTOR, W.W., 80.6 OHM, 50 WATT, ±1%	DR104J806G
T1	TRANSFORMER, SCR GATE	16086
T2	SAME AS T1	
T3	TRANSFORMER, POWER	16085
T4	TRANSFORMER, DETECTOR	16083
TB2	TERMINAL STRIP, 13 TERM.	BP8553G16
Z1	RESISTOR ASSEMBLY	BG-1
Z01	DIODE, ZENER, 15V., 1 WATT	BD1365516620
Z02	SAME AS Z01	
Z03	SAME AS Z01	
Z04	SAME AS Z01	
Z05	SAME AS Z01	
Z06	DIODE, ZENER, 7.5V., 1 WATT	BD1365515G3
Z07	DIODE, ZENER, 22V., 1 WATT	BD1365516619
Z08	SAME AS Z07	
Z09	DIODE, ZENER, 6.8V., 1 WATT	BD1365516G21

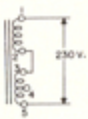
NOTE: FOR 115 VOLT OPERATION, TERMINALS ON TRANSFORMERS T3 AND T4 ARE JUMPERED AS FULLOWS:
TERMINALS #1 TO #3, AND TERMINALS #2 TO #5 (AS SHOWN).

FOR 208 VOLT OPERATION, TRANS. T3 & T4 ARE CONNECTED AS SHOWN IN SCHEMATIC #1

FOR 230 VOLT OPERATION, TRANS. T3 & T4 ARE CONNECTED AS SHOWN IN SCHEMATIC #2



SCHEMATIC #1



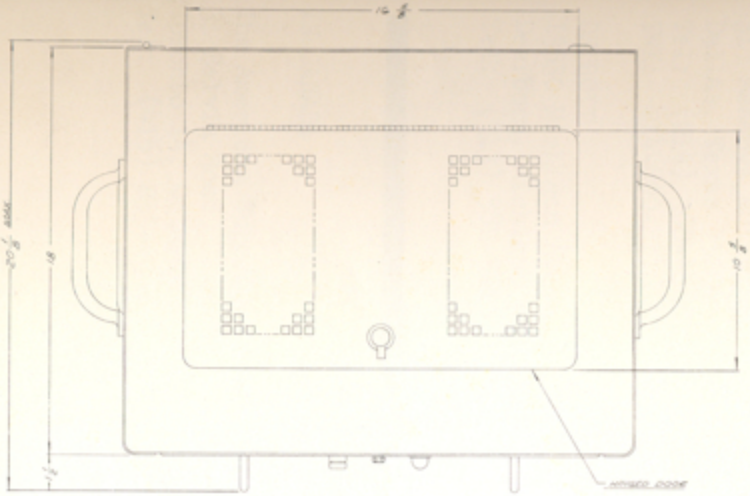
SCHEMATIC #2

Schematic Diagram
IES Control Unit 115 & 230 Volt

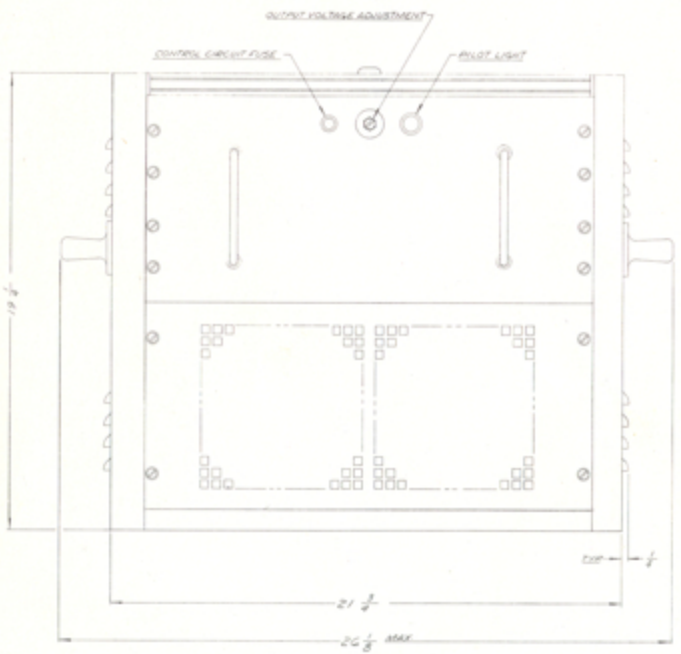
Size E, Drawing No. RR183013 — Revision 0

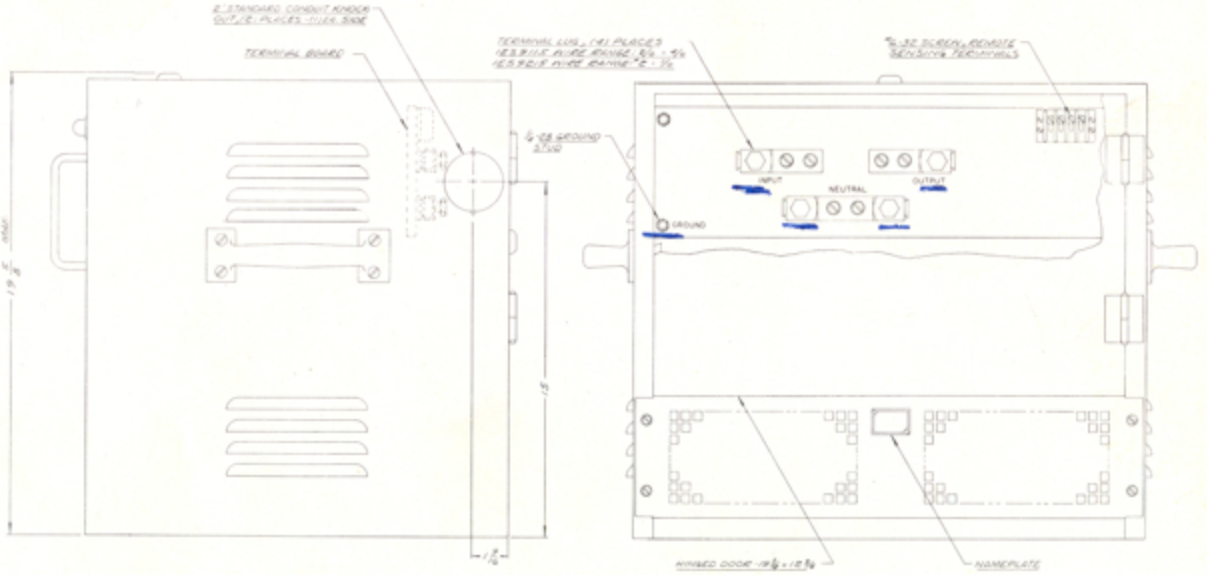
THE SUPERIOR ELECTRIC COMPANY
BRISTOL, CONNECTICUT

SE-E76722



REGULATOR TYPE	INPUT VOLTAGE RANGE	FREQUENCY (CYCLES)	OUTPUT VOLTAGE RANGE (ADJUST)	NOMINAL OUTPUT VOLT	OUTPUT KVA	OUTPUT AMPS
IES9115	95-135	50/60	110-120	115	15	130
IES9215	195-255	50/60	220-240	230	15	65.0





Outline for IES9115 & IES9215 Regulator

Drawing Number RR147039 — Revision 0

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BRISTOL, CONNECTICUT

SE-E46735

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WARRANTY

THE SUPERIOR ELECTRIC COMPANY
Bristol, Connecticut, U.S.A.

The Superior Electric Company, Bristol, Connecticut guarantees the IES9215
Serial # 63 to be free from defects in material and workmanship under normal use and service for a period of one year from date of sale to original owner. The obligation under this guarantee is limited to repairing or replacing the instrument provided it is returned prepaid to the Repair Service Dept. of The Superior Electric Company, Bristol, Connecticut. This guarantee is in lieu of all other guarantees, expressed or implied and no other representative or person is authorized to assume for us any other liability. This guarantee does not apply to any product which has been tampered with or altered in any way or which has been subjected to misuse, neglect or accident.

Before returning any equipment under the terms of this guarantee, return authorization must be obtained otherwise the shipment cannot be accepted.

TEAR OUT AND MAIL

SERVICE RECORD CARD

Please supply the information requested below and return the card promptly. Receipt of this information will materially assist us in rendering proper service on this equipment.

TYPE # IES9215 SERIAL # 63

DATE PURCHASED ..... CONDITION: ☐ GOOD ☐ DAMAGED

WHERE INSTALLED: ..... WHEN INSTALLED .....

COMPANY ..... BUILDING # ..... ROOM # .....

..... Street City State

Person Using Equipment

.....

Do you desire more information concerning the equipment or its application? ☐ Yes ☐ No

REMARKS: .....

.....