STABILINE®

automatic VOLTAGE REGULATORS

TYPE

IES91005B

#78

TABLE OF CONTENTS

THE SUPERIOR ELECTRIC COMPANY

Bristol, Connecticut, U.S.A.

SECTION 1

RATING

STABILINE Automatic Voltage Regulator type IES91005B is a fast, extremely accurate solid-state regulator. It will maintain an output voltage of 115 volts rms within a maximum bandwidth of 100 millivolts rms, for any combination of rated line and/or load from 1.0 PF to 0 PF lagging. The rated output is 4.4 amperes at 115 volts. The output voltage may be set by means of a screwdriver adjustment within the range of 110-120 volts with a shift in the input range, in the direction of the deviation from nominal output voltage. The operable frequency range of the IES91005B is 50 or 60 hertz $\pm$10%. The output distortion will not exceed 3% rms under all rated input line and load conditions, when the input line voltage is sinusoidal and of the nominal frequency.

SECTION 2

DESCRIPTION

STABILINE Automatic Voltage Regulator type IES91005B is mounted in a cabinet designed for bench or rack use and painted a very durable textured gray finish. The unit is approximately 19" wide, 5 1/4" high, 11 1/4" deep behind the front panel and weighs approximately 53 lbs. Located on the front panel are a red pilot lamp which indicates whether the unit is energized, an output voltage control, an input line switch, a control unit fuse, an output fuse and two handles for use when moving the unit.

The input-output terminal board is located behind an access plate at the left rear side of the cabinet. Conduit knockouts are provided at the back and top left side of the cabinet. The printed circuit board control section is located behind a removable panel at the rear of the cabinet.

All active semiconductor components used in the STABILINE Automatic Voltage Regulator are silicon, insuring stability and reliability at elevated temperatures.

Each IES type regulator is provided with an overcurrent protection circuit designed 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 when using loads requiring high initial inrush currents such as lamp loads, motor starting, etc.

SECTION 3

THEORY OF OPERATION

The solid-state IES regulator maintains a regulated output voltage within a maximum bandwidth of 100 millivolts rms for any combination of rated line and/or load changes.

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 (L4) and tuned harmonic filters (L2 – C1; L3 – C2).

When the SCR's are fired, current will flow through autotransformer winding 1–2 through the SCR leg (L1, T2 and SCR), producing a corrective voltage across autotransformer winding 2–3 which will add or subtract vectorily from the input voltage to provide a regulated output. The corrective voltage will add or subtract from the input depending on the phase angle at which the SCR's are fired as determined by the control unit. The purposes of the SCR choke (L1) are 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 are connected across the autotransformer to minimize the harmonic content in the output of the regulator. Capacitor C1 and reactor L2 are tuned to approximately the third harmonic of the nominal frequency and capacitor C2 and reactor L3 are tuned to approximately the fifth harmonic of the nominal frequency.

B. Control Circuit

The control circuit consists of an rms voltage detector, integrating amplifier, run-up circuit, zero crossing detector, phase discriminator and an electronic switch.

The rms voltage detector monitors the output of the STABILINE Automatic Voltage Regulator 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 provides phase control for firing the SCR's. The run-up circuit is reset by the zero crossing network every half cycle of the input voltage, at the zero crossing. A turn on signal is directed to the proper SCR when coincidence occurs between the phase discriminator and the electronic switch.

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 is produced at the output of current transformer T2, that 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, 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. If the overload condition persists the input fuse will open.

SECTION 4

INSTALLATION

After unpacking the STABILINE Automatic Voltage Regulator check carefully to make certain that the unit has not been damaged in transit.

Place the unit in the desired location. Make the necessary connections at the input-output terminal board located behind the access plate. If the voltage is to be regulated at a remote point, remove the terminal jumpers from TB1–2 to TB–3 and TB1–4 to TB1–5 and connect shielded sensing leads to TB1–3 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 PF, low input line) is approximately 9.5 amperes at 60 hertz and 10.5 amperes at 50 hertz.

Units are connected at the factory for 60 hertz operation. For operation at 50 hertz, the filter chokes must be reconnected as indicated on the schematic diagram.

SECTION 5

OPERATION

After the STABILINE Automatic Voltage Regulator has been installed and the installation wiring has been checked, proceed as follows:

1. Check to see that the unit and the equipment connected to it are turned off.
2. Apply power to the STABILINE Automatic Voltage Regulator.
3. Place the line switch to the "on" position. The red pilot lamp should light.
4. Remove the protective cap which is screwed on over 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 STABILINE Automatic Voltage Regulator output voltage remains within its rated accuracy.

SECTION 6

MAINTENANCE AND TROUBLE SHOOTING

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

The following trouble shooting guides should be used in the event that 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 unit and that the load is not drawing leading current.
2. No Output Voltage
   a. Check to see that the line switch is in the "on" position.
   b. Check input fuse, output fuse and for an open in the power switch.
3. High Output Voltage – If the output voltage is high and the output voltage control will not adjust for it:
   a. Check to see that the conditions imposed on the STABILINE Automatic Voltage Regulator are within its rated capabilities.
   b. Check for a shorted SCR by removing the .25 amp control fuse on the front panel. If the output voltage drops, the SCR's are good. If the output remains high, replace the 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 between these two points differs by more than 40%, replace this assembly.
   d. Replace the control unit printed circuit board.

4. Low Output Voltage – If the output voltage is low and the output voltage control will not adjust for it:

   a. Check to see that the conditions imposed on the unit are within its rated capabilities.

   b. Check the control unit fuse.

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

   d. With an ohmmeter, check the resistance of the A1Z1 assembly (BU-5) between terminals 1–5 and 2–3. If the resistance between these two points differs by more than 40%, replace this assembly.

   e. If no trouble is found during the above checks, replace the control unit printed circuit board.

5. No Regulation

   a. Check to see that the conditions imposed on the STABILINE Automatic Voltage Regulator are within its rated capabilities.

   b. Replace the control unit printed circuit board.

6. Input Fuse "Blows"

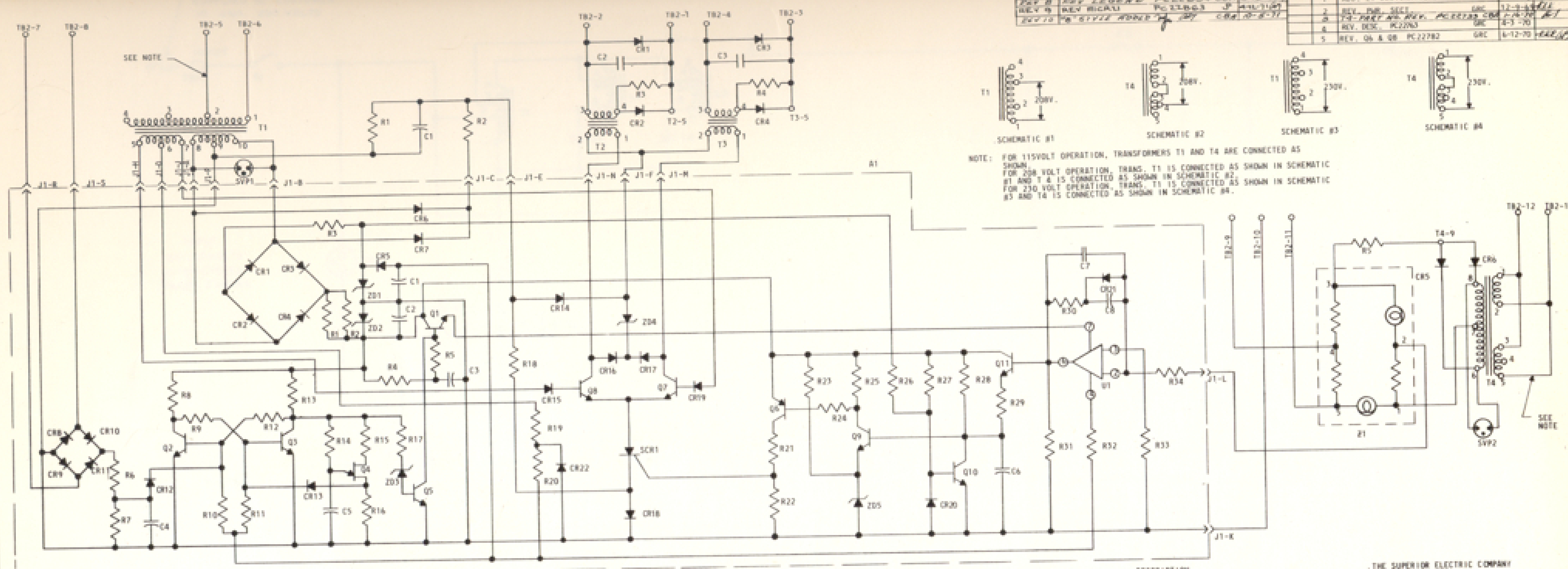
   a. Check to see that the input fuse is the value recommended on the schematic diagram.

   b. Check to see that rated output current is not being exceeded.

   c. Check filter capacitors C1 and C2 for shorts.

ZONE	SYM	DESCRIPTION		DATE	APPROVAL
	1	ADD. Z1 DESIGNATIONS	GRC	9-26-69	
	2	REV. PWR. SECT.	GRC	12-9-69	
	3	T4-PART NO. REV. PC22238	CBB	1-14-70	
	4	REV. DESC. PC22263	GRC	4-3-70	
	5	REV. Q6 & Q8 PC22782	GRC	6-12-70	

REV 7	REV LEGEND PC23818		10-23-70
REV 8	REV LEGEND PC22854	CBA	3-16-71
REV 9	REV MICAU PC23863		
REV 10	"B" STYLE ADDED	CBA	



SYMBOL	DESCRIPTION	THE SUPERIOR ELECTRIC COMPANY PART NO.
A1	PRINTED WIRING BOARD ASSEMBLY	EHR9522561
C1	CAPACITOR, 1300 MFD, +75%, 50V DC -10%	DM14498563
C2	CAPACITOR, .1 MFD, ±10%, 200V DC	BD36420634
C3	SAME AS C2	
CR1	RECTIFIER, SILICON AVALANCHE	BR10433562
CR2	SAME AS CR1	
CR3	SAME AS CR1	
CR4	SAME AS CR1	
CR5	SAME AS CR1	
CR6	SAME AS CR1	
J1	CONNECTOR, RECEPTACLE, PRINTED CIRCUIT	DM14465403
R1	RESISTOR, W.W., 100 OHM, 25 W ±5%	BP262031
R2	RESISTOR, W.W., 25 OHM, 25 W ±5%	BP26208
R3	RESISTOR, 100 OHM, 1/2 W, ±10%	BR27879G166
R4	SAME AS R3	
R5	RESISTOR, W.W., 80.6 OHM, 50 W., ±1%	DR10430062
SVP1	SURGE VOLTAGE PROTECTOR	BR10449561
SVP2	SAME AS SVP1	
T1	TRANSFORMER, POWER	T6332
T2	TRANSFORMER, SCR GATE	T6335
T3	SAME AS T2	
T4	TRANSFORMER, DETECTOR	T6083
TB2	TERMINAL STRIP, 13 TERMINAL	BP8552G16
Z1	RESISTOR ASSEMBLY	BU-5
A1C1	CAPACITOR, 100 MFD, +150% 50V DC -10%	BR10387205
A1C2	SAME AS A1C1	
A1C3	SAME AS A1C1	
A1C4	CAPACITOR, 22 MFD, ±10%, 15V DC	AB405066146
A1C5	SAME AS A1C4	
A1C6	CAPACITOR, .68 MFD, ±10%, 35V DC	AB405066287
A1C7	CAPACITOR, .022 MFD, ±10%, 200V DC	BD36420618
A1C8	CAPACITOR, 2.2 MFD, ±10%, 35V DC	AB405066293
A1CR1	RECTIFIER, SILICON AVALANCHE, 1 AMP	BR10433562

SYMBOL	DESCRIPTION	THE SUPERIOR ELECTRIC COMPANY PART NO.
A1CR2	SAME AS A1CR1	
A1CR3	SAME AS A1CR1	
A1CR4	SAME AS A1CR1	
A1CR5	SAME AS A1CR1	
A1CR6	SAME AS A1CR1	
A1CR7	SAME AS A1CR1	
A1CR8	SAME AS A1CR1	
A1CR9	SAME AS A1CR1	
A1CR10	SAME AS A1CR1	
A1CR11	SAME AS A1CR1	
A1CR12	SAME AS A1CR1	
A1CR13	SAME AS A1CR1	
A1CR14	SAME AS A1CR1	
A1CR15	SAME AS A1CR1	
A1CR16	SAME AS A1CR1	
A1CR17	SAME AS A1CR1	
A1CR18	SAME AS A1CR1	
A1CR19	SAME AS A1CR1	
A1CR20	SAME AS A1CR1	
A1CR21	DIODE, SILICON	DM14484561
A1CR22	SAME AS A1CR1	
A1Q1	TRANSISTOR, TYPE 2N2222	EM14504361
A1Q2	SAME AS A1Q1	
A1Q3	SAME AS A1Q1	
A1Q4	TRANSISTOR, UNIJUNCTION, TYPE 2N2646	BD3637004
A1Q5	SAME AS A1Q1	
A1Q6	TRANSISTOR, TYPE 2N2907	BM14477862
A1Q7	TRANSISTOR, TYPE 2N3766	BM14482363
A1Q8	SAME AS A1Q7	
A1Q9	SAME AS A1Q1	
A1Q10	SAME AS A1Q1	
A1Q11	SAME AS A1Q1	
A1R1	RESISTOR, COMP., 390 OHM, 2 W, ±5%	BR27881G39
A1R2	SAME AS A1R1	
A1R3	SAME AS A1R1	
A1R4	RESISTOR, COMP. 10K OHM, 1/2 W, ±5%	BR27879G190
A1R5	RESISTOR, COMP. 47 OHM, 1/2 W, ±10%	BR27879G142
A1R6	RESISTOR, FIXED FILM, 4.64K OHM, 1/4 W, ±1%	AB4105466
A1R7	SAME AS A1R6	
A1R8	RESISTOR, COMP., 1K OHM, 1/2 W, ±10%	BR27879G178
A1R9	RESISTOR, COMP., 4.7K OHM, 1/2 W, ±10%	BR27879G186
A1R10	RESISTOR, COMP., 47K OHM, 1/2 W, ±10%	BR27879G198
A1R11	SAME AS A1R10	
A1R12	SAME AS A1R9	
A1R13	SAME AS A1R8	
A1R14	SAME AS A1R10	
A1R15	SAME AS A1R8	
A1R16	SAME AS A1R5	

SYMBOL	DESCRIPTION	THE SUPERIOR ELECTRIC COMPANY PART NO.
A1R17	RESISTOR, COMP., 2.2K OHM, 1/2 W, ±10%	BR27879G182
A1R18	SAME AS A1R17	
A1R19	SAME AS A1R1	
A1R20	SAME AS A1R17	
A1R21	SAME AS A1R8	
A1R22	RESISTOR, COMP., 270 OHM, 1/2 W, ±10%	BR27879G171
A1R23	SAME AS A1R8	
A1R24	SAME AS A1R17	
A1R25	SAME AS A1R8	
A1R26	SAME AS A1R17	
A1R27	SAME AS A1R9	
A1R28	RESISTOR, FIXED FILM, 46.4K OHM, 1/4 W, ±10%	AB4105409
A1R29	RESISTOR, COMP., 150 OHM, 1/2 W, ±10%	BR27879G148
A1R30	RESISTOR, FIXED FILM, 68.1K OHM, 1/4 W, ±1%	AB4105457
A1R31	SAME AS A1R10	
A1R32	RESISTOR, COMP., 1 OHM, 1/2 W, ±10%	BR27879G255
A1R33	SAME AS A1R17	
A1R34	RESISTOR, FIXED FILM, 18.7K OHM, 1/4 W, ±1%	AB4105465
A1SCR1	RECTIFIER, SILICON CONTROLLED	BD3639404
A1U1	INTEGRATED CIRCUIT, OPERATIONAL AMPLIFIER	DR10458601
A1ZD1	DIODE, ZENER, 15V, 1 W.	BD126516620
A1ZD2	SAME AS A1ZD1	
A1ZD3	DIODE, ZENER, 6.8V, 1 W.	BD126516621
A1ZD4	SAME AS A1ZD1	
A1ZD5	SAME AS A1ZD3	

NEXT ASSY.	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS DECIMALS ANGLES
MATERIAL
GOVT. OR COML.

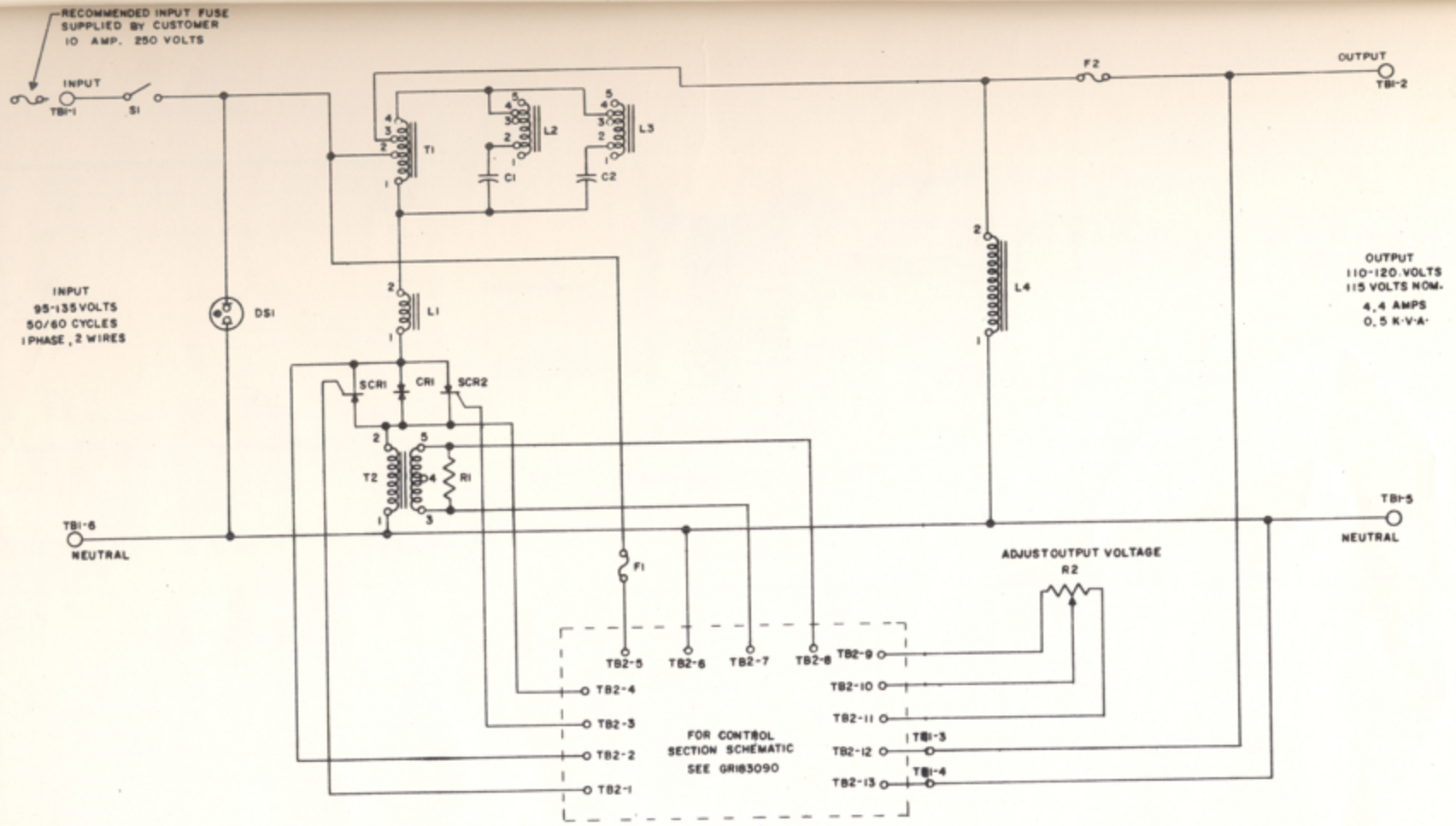
DRAWN G.R. CARLSON/bw
DATE 9-10-69
APPROVED
DATE

SCHEMATIC DIAGRAM,
"B" STYLE
IES REG. CONTROL UNIT,
50/60 HZ.

THE SUPERIOR ELECTRIC COMPANY
BRISTOL, CONNECTICUT

SIZE D GR183090
CODE 58474 SHEET 1 OF 1
SCALE WT. CALC. ACT.

SE-F4 7819



SYMBOL	DESCRIPTION	THE SUPERIOR ELECTRIC COMPANY PART NO.
C1	CAPACITOR, 7.5 MFD., ±6%, 440V. A.C.	BR10A341G7
C2	CAPACITOR, 2 MFD., ±6%, 440V. A.C.	BR10A341G1
CR1	DIODE THYRECTOR	AB506035G1
DS1	LAMP., NEON, NE-51	AR27252
F1	FUSE CARTRIDGE, 1/4 AMP., 250V.	AR704711
F2	FUSE, CARTRIDGE, 6 AMP., 250V.	AR704767
L1	REACTOR	T6104G2
L2	REACTOR	T6101
L3	REACTOR	T6100
L4	REACTOR	T6103
R1	RESISTOR, COMP., 390 OHM, 1/2 WATT, ±5%	BR2787G39
R2	RESISTOR, COMP., VAR., 100 OHM, 2 WATT	AB415006G2
S1	SWITCH, TOGGLE, DPST	AR7036
SCR1	RECTIFIER, SILICON CONTROL, 35 AMPS, 500V.	DR104G5BG4
SCR2	SAME AS SCR1	
T1	TRANSFORMER, AUTO	T6102
T2	TRANSFORMER, CURRENT	T6095
TBI	TERMINAL STRIP, 6 TERM.	AR7120G1

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.
2. FOR REMOTE SENSING REMOVE TERMINAL JUMPER FROM TBI-2 TO TBI-3 AND TBI-4 TO TBI-5. THEN CONNECT SENSING LEADS TO TBI-3 AND TBI-4.

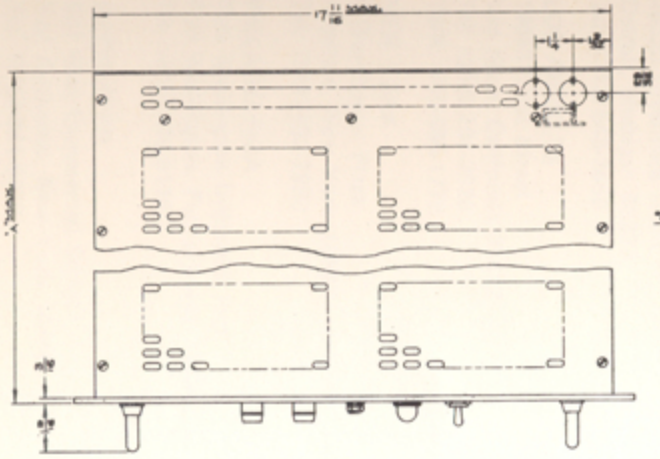
SCHEMATIC DIAGRAM FOR IES91005B

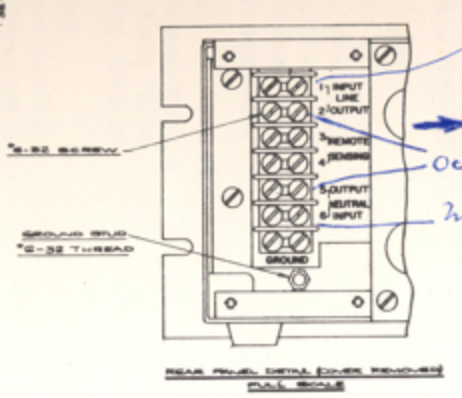
Size D, Drawing No. GR183104 Rev. 1

The Superior Electric Company

Bristol, Connecticut 06010

SE-E47138

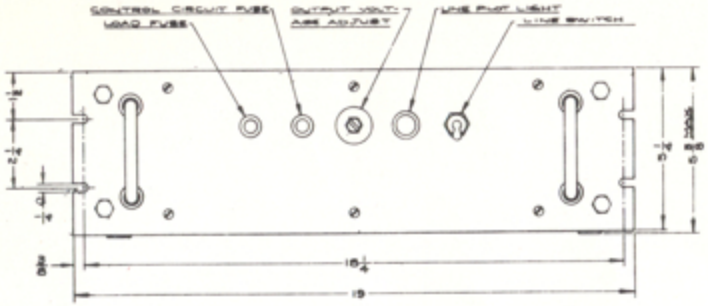


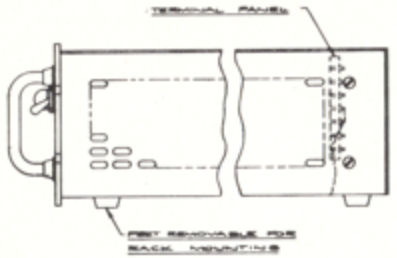


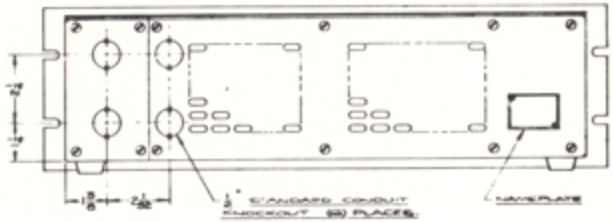
REGULATOR TYPE	INPUT VOLTAGE RANGE	FREQUENCY (CYCLES)	OUTPUT VOLTAGE RANGE (ADJUST.)	NOMINAL OUTPUT VOLT.	OUTPUT KVA	OUTPUT AMPS
IES 91005B	95-135	60 / 50	110 - 120	115	0.5	4.4
IES 9101B	95-135	50 / 60	110 - 120	115	1.0	8.7

NOTE:
TOP & REAR COVERS MAY BE REMOVED FOR ACCESS.

REGULATOR TYPE	"A" DIM.
IES91005B	11-1/4
IES 9101B	13-1/4







OUTLINE FOR IES91005B and IES9101B
Size D, Drawing GR147078 Rev. 0
The Superior Electric Company
Bristol, Connecticut 06010

SE-E47144

THE SUPERIOR ELECTRIC COMPANY

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TELEX: 06-967806

A10735

PRINTED IN USA

WARRANTY

THE SUPERIOR ELECTRIC COMPANY
Bristol, Connecticut 06010

The Superior Electric Company, Bristol, Connecticut warrants the IES 91005B, Serial # 78 to be free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from the factory or a Superior Electric Company warehouse. The obligation under this warranty is limited to repair or replacement of the apparatus or parts thereof at the factory of The Superior Electric Company.

This warranty is in lieu of all other warranties, expressed or implied, and no other representative or person is authorized to assume for us any other liability. This warranty does not apply to any apparatus which has been tampered with or altered in any way or which has been subjected to misuse, neglect or accident.

Before returning any apparatus or parts thereof under the terms of this warranty, written authorization must be obtained from The Superior Electric Company otherwise the shipment cannot be accepted.

The sender is responsible for all transportation charges to and from the factory at Bristol, Connecticut.

SE-167116

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 # IES91005B SERIAL # 78

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: .....