INSTRUCTIONS

SIGNAL CONVERTER 3S7513TC108

INTRODUCTION

Signal Converter 3S7513TC108 is used with steam turbines to position the speed/load changer mechanism by means of the speed/load changer motor. The reference for position is an electrical signal obtained from external equipment.

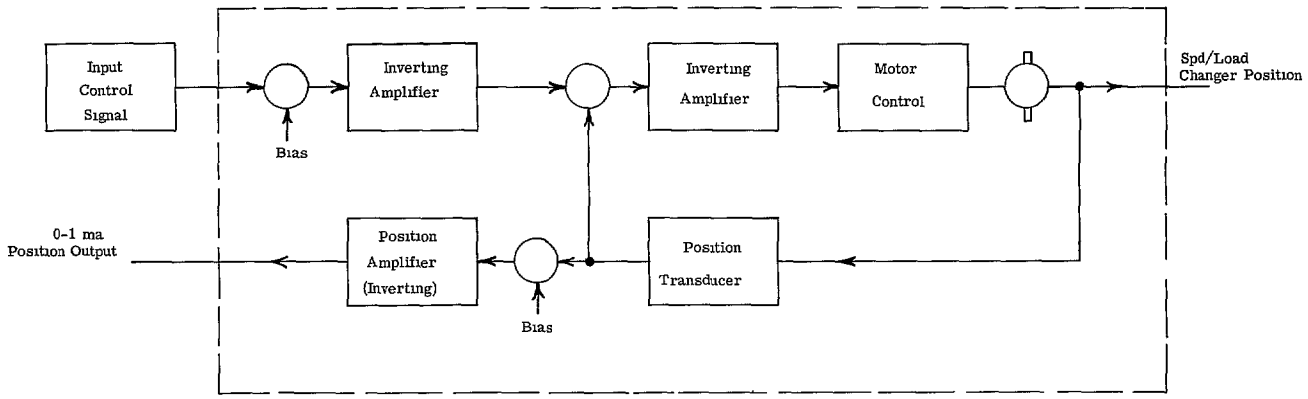
RECEIVING, HANDLING AND STORAGE

As soon as the equipment is received, it should be examined for any damage sustained in transit. If injury or rough handling is evident, a damage claim should be filed immediately with the transportation company, and the nearest General Electric Sales Office should be notified promptly. If the equipment is not to be used as soon as it is unpacked, it should be stored in a clean, dry place and protected from accidental damage.

DESCRIPTION

GENERAL

Figure 4 is a typical signal converter elementary diagram. Figure 1 is a block diagram of the control. The input signal to be converted is compared with the actual speed/load changer position along with a bias level to obtain a position error signal. The error is fed through an amplifier and then fed into a half-wave motor speed control. The speed/load changer motor is driven at a speed and direction determined by the magnitude and polarity of the amplified error signal.



BLOCK DIAGRAM OF SIGNAL CONVERTER MODEL 3S7513TC108
Figure 1

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

GENERAL ELECTRIC

POWER SUPPLY

Regulated positive and negative 15 volts DC is obtained from the secondary of 2T and associated resistors, capacitors, and Zener diodes as shown on the elementary diagram. Additional power supply elements include transformer 4T having a 6.3 volts secondary for the chopper stabilized amplifier, and isolation transformer 5T for the motor control. All grounds shown on the elementary are insulated from the cabinet and tied to station ground at the main terminal board.

AMPLIFIER

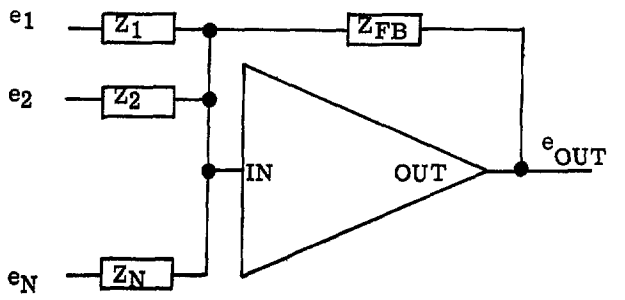
The amplifiers are transistorized inverting DC amplifiers with chopper stabilization to reduce drift. They are capable of supplying ± 10 volts at 20 milliamperes. The effective gain is determined by input and feedback impedance as shown in Figure 2. In the signal converter the amplifier output is limited to approximately ± 9 volts by standard and zener diodes not shown on the elementary diagram. The diodes are normally reverse biased and non-conducting. If the amplifier is driven positive or negative by the sum of a Zener diode drop and a diode drop, one of the diodes becomes forward biased and prevents further increases in amplifier output. This is necessary to prevent internal saturation of the amplifier which would result in a long recovery time due to the use of chopper stabilization.

CONTROLLER

Figure 3 is a block diagram of the black box on the elementary diagram identified as Controller. Excitation for the valve position transducer (differental transformer or LVDT) is generated by a high frequency oscillator, which gives the system a high speed of response and excellent temperature stability. The stability of the oscillator is insured by providing stable DC voltage from the voltage regulator, which draws its power from the power supply. The AC output of the LVDT, is stepped up by transformers 6T and 7T and converted into DC by a demodulator made up of 1D, 2D, 8R, 9R, 10R, and 11C. This DC signal is then amplified by the controller's noninverting amplifier to a high level signal exactly related to the mechanical displacement of the LVDT.

POSITION FEEDBACK

A signal proportional to speed/load changer position is obtained from a linear variable differential transformer (LVDT). The differential transformer is a device which translates a mechanical displacement into a directly proportional electrical signal. It consists of a movable iron core located within a hollow cylindrical bobbin on which are located primary and secondary transformer windings. The position of the core determines the degree of coupling between the primary and each secondary winding and hence the voltage induced in each. The output



$$e_{OUT} = -e_1 \frac{Z_{FB}}{Z_1} - e_2 \frac{Z_{FB}}{Z_2} \cdots\cdots - e_N \frac{Z_{FB}}{Z_N}$$

AMPLIFIER GAIN

Figure 2

is an AC signal which is the net difference between the two voltages. The AC output signal is converted to DC by a demodulator circuit made up of 1D, 2D, 8R, 9R, 10R, and 11C.

MOTOR CONTROL

The motor control is described in supplementary instructions GEI-93161. A parts list for the specific model furnished is included in this book.

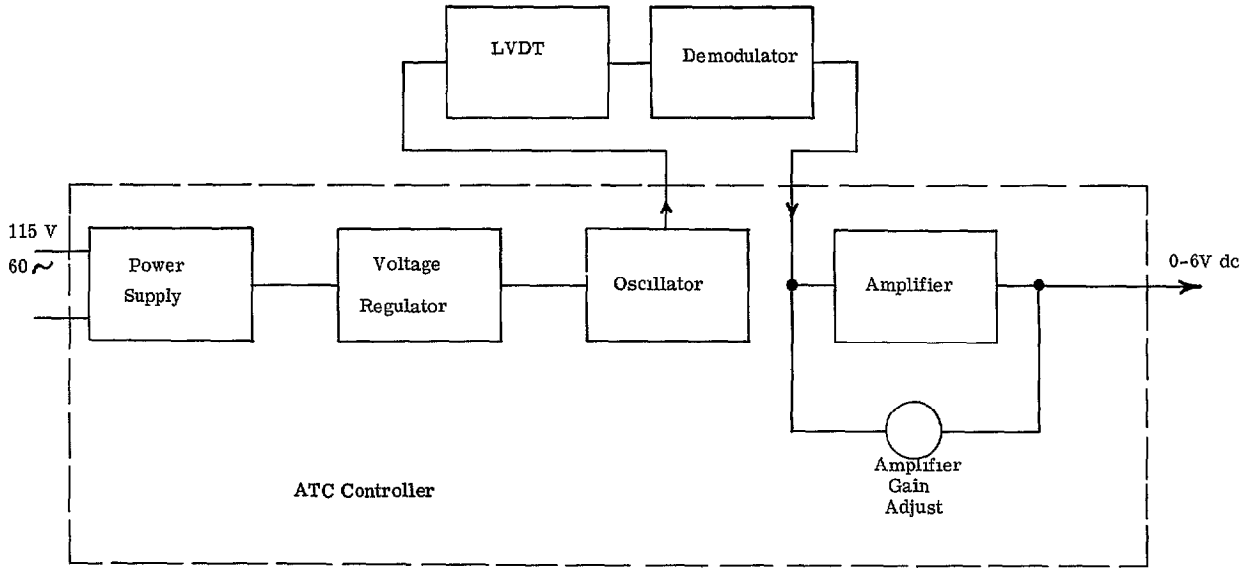
PROTECTION DEVICES

This equipment is used for a critical function in the operation of a power plant and a number of devices are furnished to provide protection against malfunction. An undervoltage relay (27) with time delay protects against loss of AC power. A loss of field relay (40) should be provided by the user for the motor field. Two undervoltage relays, 27X and 27Y, are furnished where a differential transformer is used to detect loss of position feedback.

The input control signal can have a value of zero volts in normal operation and loss of input cannot be detected by a relay. Upon loss of input signal the speed/load changer would of course be positioned as if there were an input of zero volts.

INSTALLATION

The equipment should be installed in a clean dry location where the ambient temperature does not exceed 50°C. Interconnection should be made in accordance with diagrams furnished with the equipment.



BLOCK DIAGRAM OF CONTROLLER
Figure 3

ADJUSTMENT

Initial tests and adjustments should be made with the turbine shut down so that the speed/load changer motor can be freely operated. The low speed stop and high speed stop positions and their load equivalents should be known.

1. Apply power to the signal converter by closing SW. 1 leaving SW. 2 in off position.

2. VALVE POSITION FEEDBACK.

2.1 Manually position the speed/load changer and adjust the position of the LVDT core so that the voltages at the output of the controller (30) are equal in magnitude at low speed stop and the high speed stop.

2.2 Adjust the output of the Controller to -6 volts DC at the low speed stop using the Controller range potentiometer. This would force the output at the high speed stop to be +6 volts DC.

2.3 Either relay 27X or 27Y should energize if any of the three leads from the LVDT secondary are disconnected. Check operation of these relays by alternately disconnecting the secondary leads (T11, T12, and T13).

3. INPUT.

3.1 Run the speed/load changer to the high speed stop and apply the appropriate input signal corresponding to maximum load. If the reference input is 9 volts DC, 5 volts DC, 15 volts DC or 50 ma., a jumper must be added between terminal T18 and T19 and potentiometer 9P set according to the table below.

Reference Signal	9P Setting
15 volts DC	-4 volts DC
9 volts DC	-5 volts DC
5 volts DC	-3 volts DC
*50 ma.	-6 volts DC

*Note: A jumper must also be added between T5 and T6.

Adjust and lock potentiometer 3P for zero output from 1A as indicated by 2VM.

3.2 Apply the appropriate input signal corresponding to minimum load. Proper adjustments in step

3. 1 will be indicated by 2VM nulling when the speed load changer reaches the low speed stop. If 2VM does not null, repeat step 3. 1.

4. GAIN. The gain of amplifier 1A and of the motor control is dictated by the length of the fulcrum nut stroke. The control is designed to give a maximum stroking time of 10 seconds from the low speed stop to the high speed stop. If stroking time is slow, it may be adjusted with potentiometer 2P.

   The gain of amplifier 1A is adjusted with potentiometer 4P. The gain should be set high enough so that there is a slight overshoot with a step change of reference voltage. The overshoot is indicated on 2VM when the pointer passes through zero volts and returns quickly. To test gain setting, a step input reference signal calling for high speed stop should be applied with the speed/load changer at the low speed stop. If the high speed stop limit switch is tripped, the gain is too high and should be reduced. (See turbine drawings for limit switch settings.)

5. MOTOR CONTROL. The adjustments are factory set and should not require further adjustment. Refer to GEI-93161 if adjustment is required upon replacement of component parts.

6. VALVE POSITION INDICATOR. The valve position signal is zero ma. at the low speed stop and 1 ma. at the high speed stop. With the valve at the low speed stop, adjust the output of 3A to zero ma. with 7P. With the valve at the high speed stop, adjust the 3A output to 1 ma. using 8P.

NOTE: The signal converter should be allowed to warm up a minimum of thirty seconds before being put in control of the speed/load changer to allow the amplifiers time to stabilize.

MAINTENANCE

The signal converter contains all static components and no periodic maintenance is required. Since the speed/load changer motor will be continuously energized with this equipment, it should receiver additiona attention, particularly the brushes and commutator.

RENEWAL PARTS

When ordering renewal parts, the following information should be given:

1. Catalog number stamped on the part with the complete description including use and location.

2. Complete nameplate data appearing on the assembly of which the part is a component.

PRINCIPAL RENEWAL PARTS LIST

FOR: 3S7513TC108

DIAGRAM SYMBOL	QUANTITY	ORDERING NUMBER	DESCRIPTION
	1	3S7513KF212G12	Signal Converter
1A	1	44C238439-G02	Amplifier Board
2A	1	44C238457-G01	Amplifier Board
3A	1	44C238458-G02	Amplifier Board
1VM	1	933B579P12	Voltmeter 150-0-150 VDC
2VM	1	933B574P15	Voltmeter 10-0-10 VDC
1, 2SW	2	K9658246P4	Switch DPDT
9, 10, 11, 12, 20, 21D	6	44B232019-005	Rectifier 1A
6, 15, 48R	3	M6986159E56	Resistor
49, 50R	2	M6986159C47	Resistor
51, 52R	2	K8622212D75	Resistor
57R	1	M6986159E47	Resistor
58R	1	M6986159F10	Resistor
3, 4C	2	44B211536-016	Cap. 1000 mf 50V
3, 4Z	2	1N3314B	Zener 15V 50W
1, 7, 9P	3	L8205216G10	Potentiometer
3P	1	L8205216G50	Potentiometer
4P	1	L8205216H25	Potentiometer
2P	1	M9729433F50	Potentiometer

PRINCIPAL RENEWAL PARTS LIST

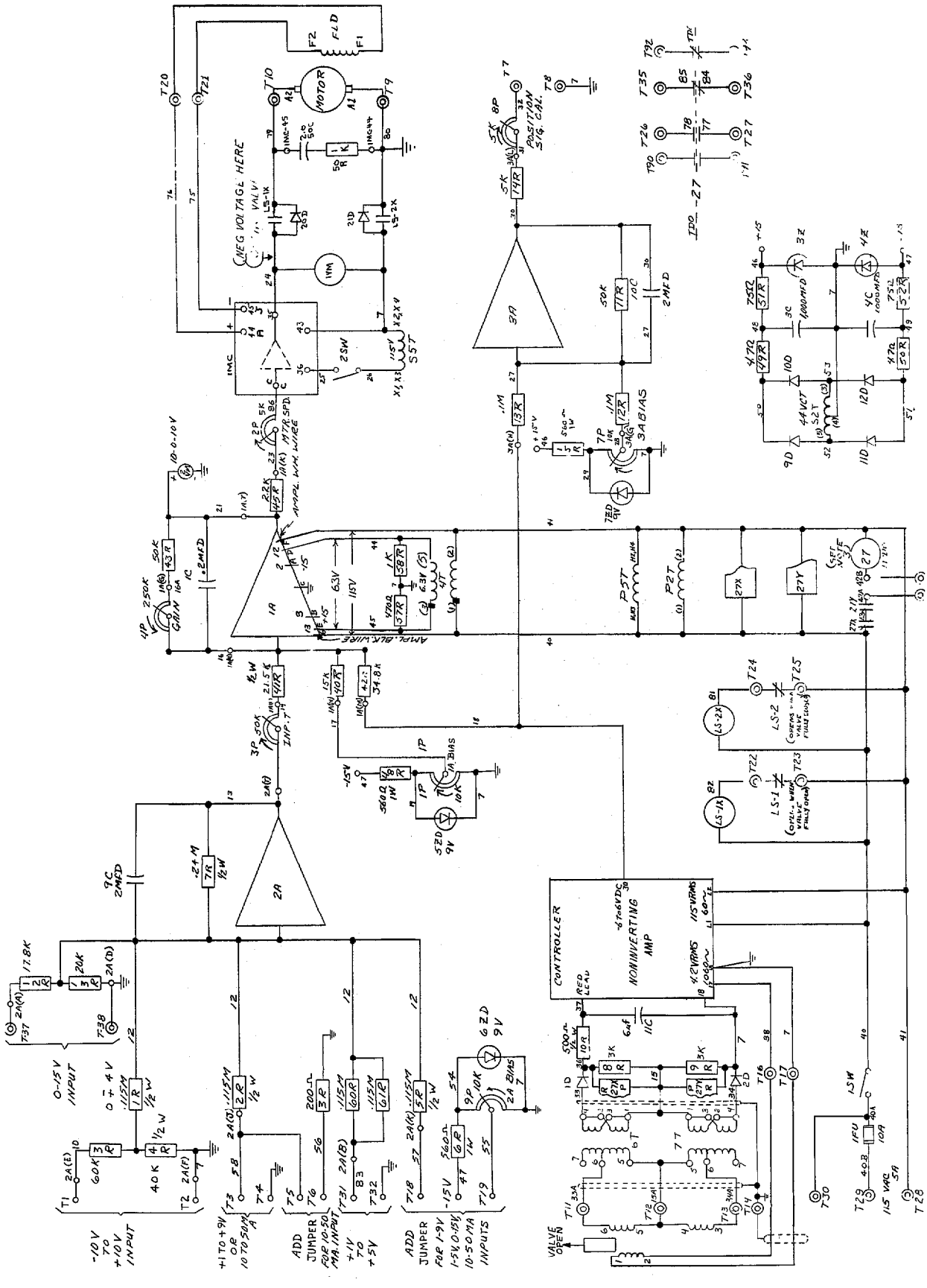
FOR: 3S7513TC108 (CONTINUED)

DIAGRAM SYMBOL	QUANTITY	ORDERING NUMBER	DESCRIPTION
8P	1	M9729433F50	Potentiometer
		K9196915G1	Knob for Pot.
		V9024057P1	Plate for Pot.
3, 4Z	2	44B217754-001	Heat Sink
TB1	1	K9189496G1	Terminal Board
		44B310878-001	Brkt. for 1 & 2 VM
		44A210076-002	Brkt. for 1 & 2 SW
	1	44B316101-001	Brkt. for Pot.
	2	44B211501-120	Terminal Board 12pt.
	2	44B211501-110	Terminal Board
Controller	1	44B313979-001	Oscillator & PC Amplifier
27	1	CR2820B128AA2	Relay
5T	1	9T51Y28	Supply Transformer
	30	44B230672-G06	Stand off Insulator
8, 9R	2	933B590F30	Resistor
10R	1	933B590E56	Resistor
5, 6, 7ZD	3	1N2620B	Zener 9.3V TC750
1, 2D	2	44B232019-004	Rectifier
3R	1	124A1819E20	Resistor 200 ohms
11C	1	K9381750J60	Capacitor
2T	1	44B211594-001	Transformer
4T	1	44B216093-001	Filament Transformer
27X, 27Y (voltage sensitive)	2	3S7513KF212G17	Voltage Sensitive Relay (See GEH-2172 for parts)
27X, 27Y	2	3S7505KH501A1	Relay (Insert for voltage sensitive relay)
MC	1	3S7513KF212G9	Reversing Motor Cont.
	1	3S7507RA104A3	Firing Circuit (See GEI-93161B for parts)
	1	3S7507RA105A1	D.C. Pwr. Supply (See GEI-93161B for parts)
	1	3S7507RA102C2	Preamplifier
	1	44B218088-001	Component Board
19, 20D	2	44B232011-001	Diode
5, 6Q	2	2N336A	Transistor
2P	1	128A4066G50	Potentiometer 50K
9C	1	275A388G10	Capacitor
22R	1	933B590G56	Resistor 56K
23R	1	933B590F68	Resistor 6.8K
25R	1	M9686159G75	Resistor 75K
26R	1	933B590G24	Resistor 24K
27R	1	933B590F47	Resistor 4.7K
28R	1	933B590G10	Resistor 10K
24R	1	933B590G51	Resistor 51K
21R1	1	933B590H10	Resistor 100K
	10	44B212725-001	Tab Terminal
	1	3S7507RA103C2	Phase Shift - Current Limit Panel
	1	44B370107-001	Component Board
1, 2, 3, 4D	4	44B232011-001	Diode
1C	1	983B532J20	Capacitor
8C	1	983B532J40	Capacitor

PRINCIPAL RENEWAL PARTS LIST

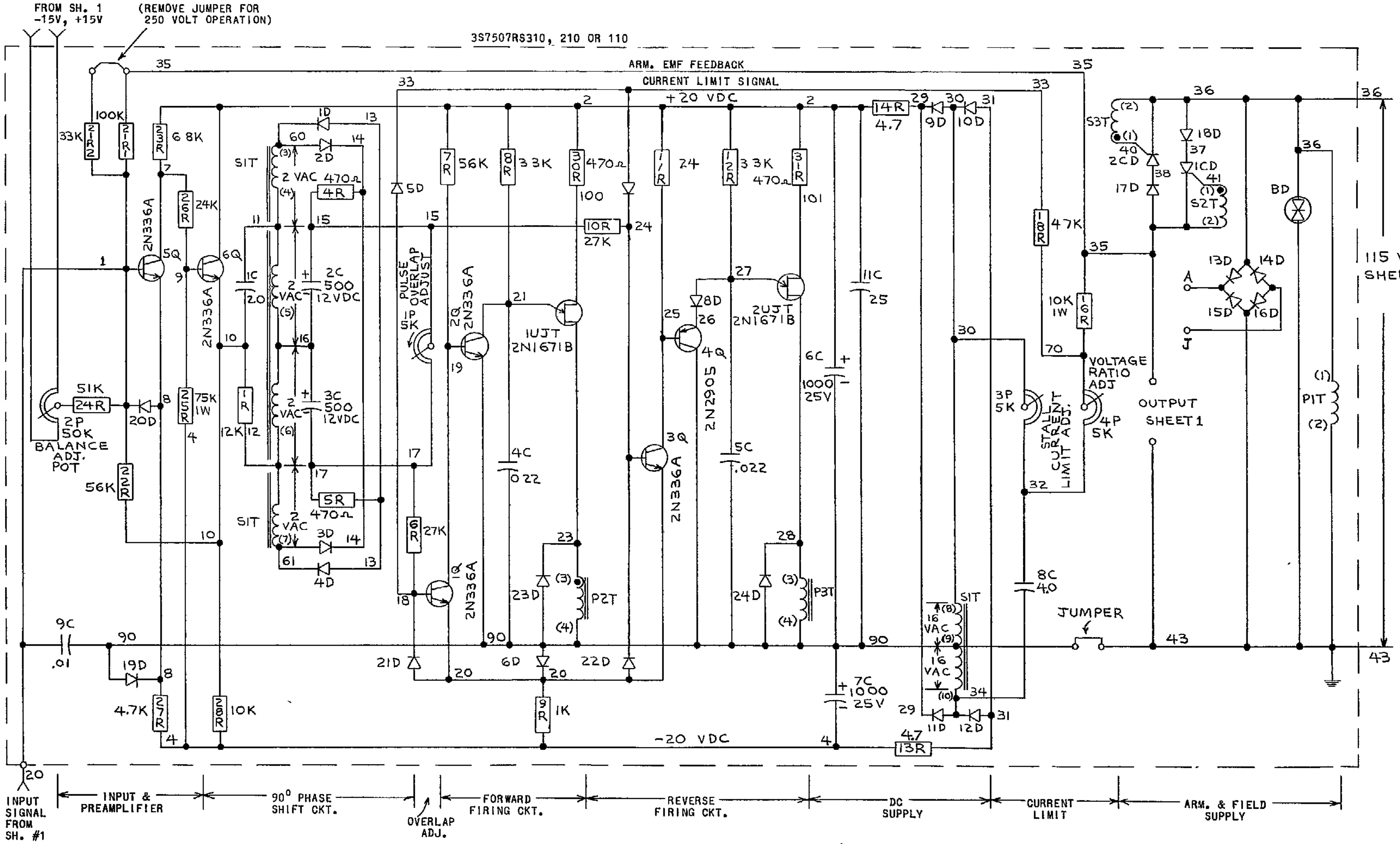
FOR: 3S7513TC108 (CONTINUED)

DIAGRAM SYMBOL	QUANTITY	ORDERING NUMBER	DESCRIPTION
2, 3C	2	983B533L50	Capacitor
4, 5R	2	933B590E47	Resistor 470 ohm
16R	1	M6986159G10	Resistor 10K
13, 14, 15			
16D	4	1N1095	Rectifier
1, 4P	2	128A4075F50	Potentiometer 5K
1R	1	933B590F12	Resistor 1.2K
18R	1	933B590F47	Resistor 4.7K
3P	1	M9729433F50	Potentiometer, 5K
	51	111A9208P1	Terminal
	17	44B212725-001	Tab Terminal
1T	1	44B215942-001	Transformer
1, 2CD	2	44B214606-006	Rectifier
17, 18D	2	1N1346A	Rectifier 6A, 400V
	2	44A213494-001	Heat Sink
	1	44B211501-109	Terminal Board
1BD	1	6RS20SC4D4AB	Thyrector
		K9189496G1	Terminal Board
21R2	1	933B590G33	Resistor 33K
50R	1	K8622213F10	Resistor 1K
50C	1	44B216129-002	Cap. 2μf
	1	3S7513KF212G15	Relay Panel
LS-1X			
LS-2X	2	12HGA11H70	Relay
	1	44A317689-001	Bracket for Relay
6T, 7T	1	44B213365-001	Transformer
1FU	1	K9774700P4	Fuse
	1	K9774759P1	Fuse Block



ELEMENTARY DIAGRAM OF SIGNAL CONVERTER, MODEL 3S7513TC108 (44C209904 Sh. 1 of 2 Rev. 8)

Figure 4



NOTES:

1. AMPLIFIERS ARE LIMITED TO RANGE BETWEEN -9VDC TO +9VDC BY ZENER DIODES NOT SHOWN ON THIS DIAGRAM. SEE ELEMENTARY DIAGRAMS FOR AMPLIFIER BOARDS (44C228922, 44C238457, 44C238458).
2. ALL UNUSED INPUTS TO AMPLIFIER 2A SHOULD BE GROUNDED.
3. RELAY 27 IS TIME DELAYED ON DE-ENERGIZATION. TIME DELAY IS ADJUSTABLE FROM .5 SEC. TO 180 SEC. DROP OUT VOLTAGE FOR 27 IS APPROX. 75% OF RATED.
4. CIRCUIT 7, INDICATED BY GROUND (⏚) SYMBOLS, IS NOT GROUNDED INTERNALLY. IT SHOULD BE CONNECTED TO A GROUND EITHER AT THE INPUT SIGNAL DEVICE OR STATION GROUND.
5. SEE TURBINE WIRING DIAGRAM FOR EXTERNAL CONNECTIONS AND JUMPERS REQUIRED FOR SPECIFIC INSTALLATIONS.

ELEMENTARY DIAGRAM OF SIGNAL CONVERTER, MODEL 3S7513TC108 (44C209904 Sh. 2 of 2 Rev. 3)
Figure 4

8-71 (100)

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