INSTRUCTIONS
VOLTS PER HERTZ REGULATOR PANEL
3S7932JA111

INTRODUCTION

The Volts per Hertz, (V/Hz) regulator panel, 3S7932JA111, is designed for protection of transformers and other magnetic components connected to a generator.

Potential transformers on the generator terminals are used to obtain a three-phase voltage signal that is used as the input of three saturable transformers.

By use of rectifying, filtering, and clipping circuits, an average DC output voltage exactly proportional to input frequency, regardless of input voltage, is obtained. This DC output signal is used to reduce the AC regulator set point as frequency is decreased below 57 Hz if the generator is operated at reduced speed while the AC regulator is in control and the generator breaker open.

RECEIVING AND HANDLING

Immediately upon receipt, the equipment should be carefully unpacked to avoid damage. As soon as the equipment is unpacked, it should be examined for any damage that may have been 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.

INSTALLATION

The 3S7932JA111 panel is furnished on a 8 1/2" high by 36" wide base and can be applied to all existing units where an analog tachometer previously supplied the voltage proportional to frequency signal.

This panel is now standard on all new units whether the analog tachometer is furnished or not.

The normal assembly of the panel will be such that all wiring and connections will be on the front. The panel will be properly interconnected with its associated circuits when it is furnished with new excitation controls.

Points L1, L2, and L3 on the panel should be connected directly to the generator signal potential transfomers.

If the panel is to be installed in the field, proper instructions will be issued with the panel.

PRINCIPLES OF OPERATION

The points referenced in the following discussion may be found on Figure 2. Also, contact 52/Aux. is open, the unit on "Auto" regulator and the generator is not on the line.

A three-phase voltage signal is taken from the generator signal potential transformer secondaries and fed to the primary windings of the saturating transformers L1ST, L2ST, and L3ST. Each of these potential transformers consists of a primary and a dual secondary.

One of the secondary outputs is clipped to approximately 36 volts to provide a circuit that is voltage insensitive, within a reasonable range. The output of the other secondary is rectified to produce a DC voltage across L1P. This voltage is proportional to generator speed (frequency).

At this point, it would be helpful to describe how this average DC voltage across L1P is obtained.

The saturable transformers used in this circuit are designed so that they will saturate in about 2/3 of each half-cycle during 60 Hz operation. The output from the saturable transformers is rectified and the three-phases summed to give an average voltage of 2.25 P.U. at 60 Hz which is exactly proportional to input frequency.

The waveforms in Figure 1 illustrate how the average DC voltage of 2.25 P.U. at 60 Hz is obtained. For other frequencies, say 40 Hz the above analysis still holds true. The only difference is that the saturable transformers saturate in about 1/2 of each half-cycle. Therefore the average DC voltage will be 1.5 P.U.

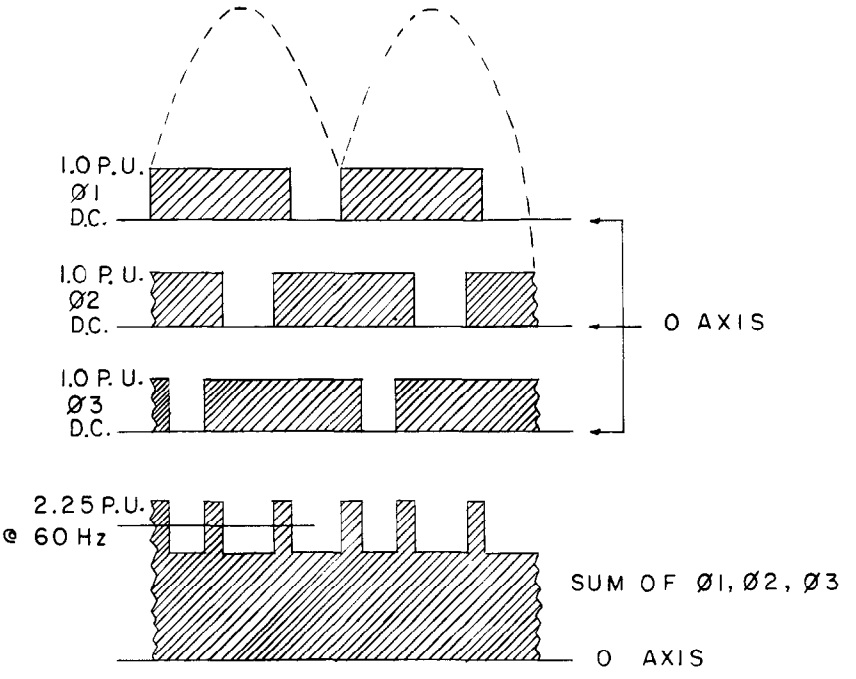

Figure 1. DC OUTPUT VOLTAGE WAVEFORMS

The following discussion may be followed on Figure 2.

A portion of this DC voltage is taken from L1P and applied to Point A. L1P is adjusted so that current flows through L2R and L7D to keep point A at approximately 8 volts positive at normal frequency (60Hz). Below 57 Hz, the AC regulator reference signal is derived from the generator frequency and generator terminal voltage.

As the frequency decreases, L1P potentiometer will become more negative until L7D no longer conducts. Point A moves down (becomes less positive) moving point A2 down (more negative). This provides a "turn-off" signal through the AC regulator to decrease excitation. Point A3 moves up to correct the original error, so the generator is now regulating a lower voltage consistent with the frequency.

This action continues providing V/Hz regulation until the exciter saturates at some low speed or the system returns to normal frequency (57 Hz). Upon return of the system frequency to normal, the AC regulator will revert back to the normal reference of generator terminal voltage.

Resistor L1R and 52/Aux. contact provide a source of current to keep L7D conducting when the main line breaker (52) is closed. This is so the V/Hz limit takeover functions only when the generator is not on the line.

SETTINGS AND ADJUSTMENTS

Since the underfrequency detection and output circuits (saturable transformers, rectifier bridges and clipping circuits) have no relays or other moving components and are composed of completely static elements, the only adjustment that can be made is that of the V/Hz takeover point. This is set at the factory to takeover from the AC regulator at 57 Hz.

Since this setting could possibly change in the field due to rough handling or inadvertent mis-adjustments, the calibration should be checked by the following procedure.

1. Apply 120 VAC, 60 Hz from the signal P. T. S to L1, L2, and L3.
2. Lower frequency to 55 Hz
3. Adjust L1P until the V/Hz regulator starts to takeover from the AC regulator.
4. Raise generator frequency to 60 Hz and then lower it to 57 Hz.
5. Adjust L1P until the V/Hz regulator starts to takeover from the AC regulator.
6. Raise the frequency to 60 Hz and check to make sure that the V/Hz regulator does not interfere with the AC regulator action.
7. Lock L1P in position.

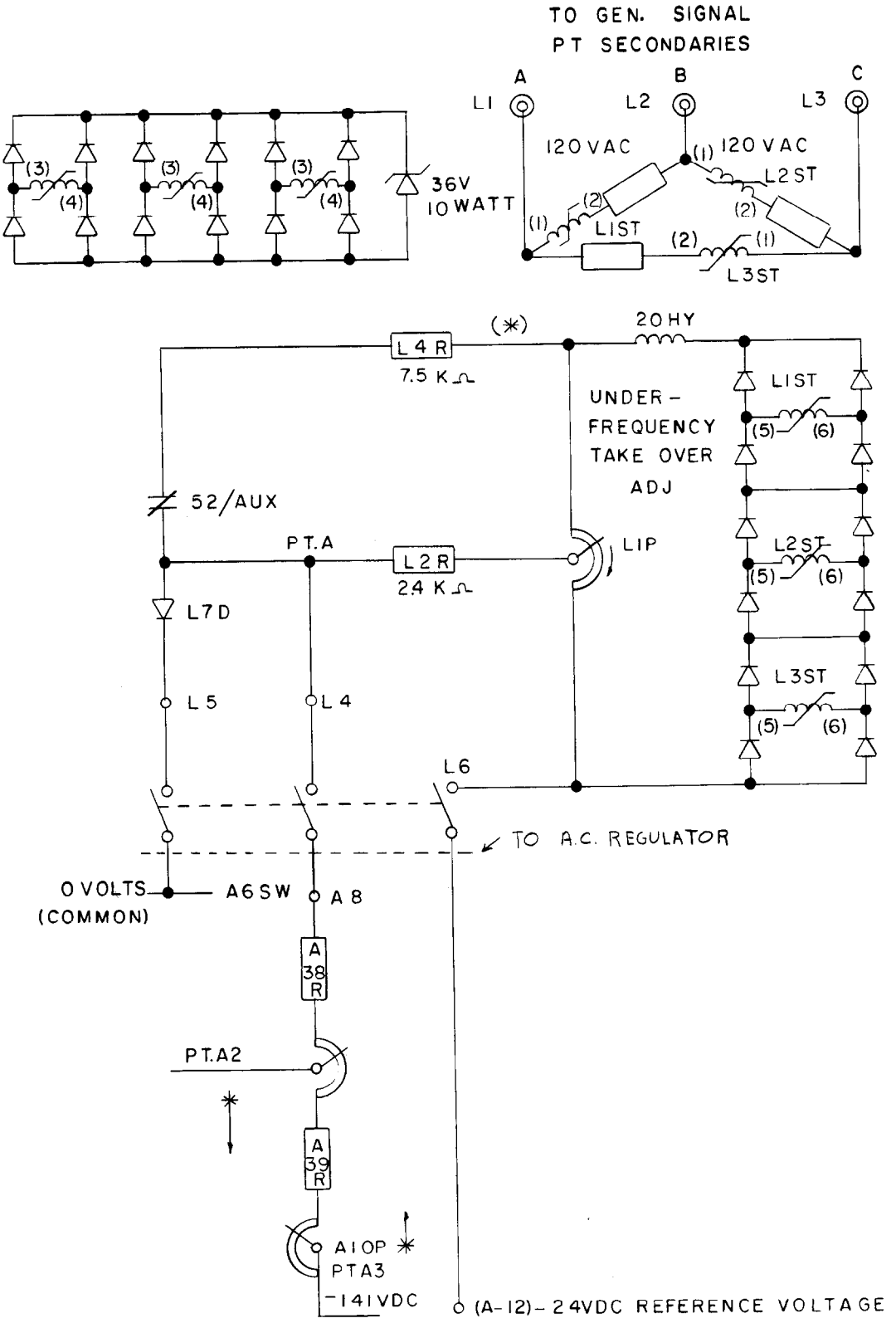

Figure 2. UNDERFREQUENCY LIMIT CIRCUIT

NOTE

This circuit is for all practical purposes, voltage insensitive. Therefore, varying the input voltage by as much as ± 20% of 120 VAC should have no appreciable effect on the circuit operation.

TROUBLESHOOTING

Because of the type of components used in the 3S7932JA111 panel, it has a very high inherent reliability. But if it does become necessary to troubleshoot the panel, the following information may prove helpful.

1. Switch A6SW is to be open, thus isolating the V/Hz regulator circuit from the AC regulator. Also, the 52/Aux contact in series with diode L7D must be open.

2. Apply 3-phase, 120 VAC at 60 Hz to L1, L2, and L3 and check the indicated points for the following voltage. The measured voltage may be within ± 5% of the values given.

Input Voltage	Frequency	Output Voltage Between L6 and L4R (*)
120 VAC	60 Hz	74.5 VDC

3. Observe the waveform across windings 3 and 4 of L1ST with an oscilloscope and compare with Figure 3.

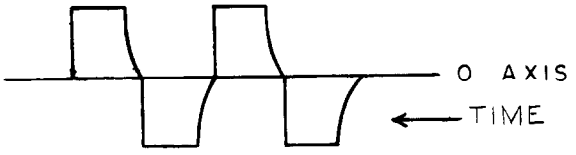

Figure 3
WAVEFORM ACROSS WINDING 3 AND 4 OF L1ST

4. If a 3-phase, 120 VAC Variable frequency source is available, further voltage measurements can be made at lower frequencies.

Input Voltage	Frequency	Output Voltage Between L6 and L4R (*)
120 VAC	50	62 VDC
120 VAC	30	37.2 VDC

5. Observe the waveform across windings 3 and 4 of L1ST with an oscilloscope and compare with Figure 4.

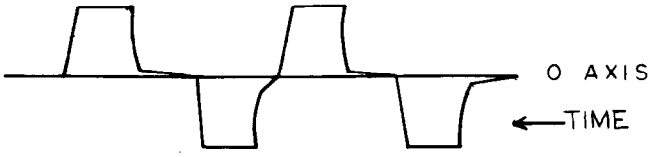

Figure 4
WAVEFORM ACROSS WINDING 3 AND 4 OF L1ST

6. If the above voltage and waveforms are not obtained, first check the diodes to determine if any of them are bad. Then check the resistors, potentiometers, and transformers.

MAINTENANCE

The equipment should be kept relatively clean and dry. If vibration is present, all screw type connection should be checked regularly to determine that they are tight.

RENEWAL PARTS

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

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

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

3. If possible, data on original order on which equipment was first supplied, including all numerical references.

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