E09 VOLTAGE SENSOR
For Use In S-56F

I. INTRODUCTION

The voltage sensor card (E09) is one of five printed circuit cards comprising field regulators for S-56F systems. Other standard cards, explained in separate instruction leaflets, are: E05, Gate Pulse Generator; E06, Field Current Controller; E07, Power Supply; and E08, Field Function Generator.

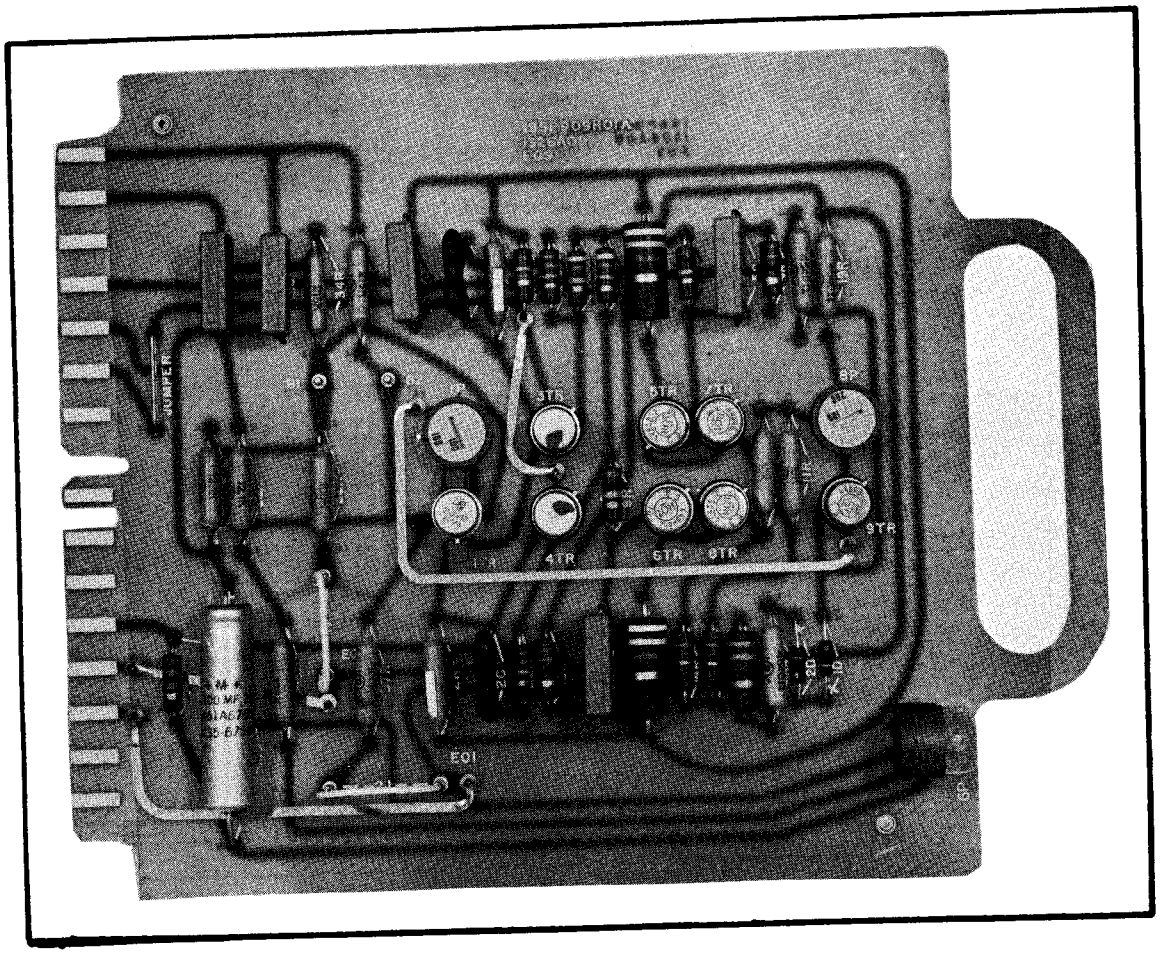

FIGURE 1
E09 PC CARD

The voltage sensor provides a signal voltage proportional to motor cemf by mixing signals proportional to IR drop and motor armature terminal voltage.

Printed circuit cards designed for S-56 systems are plug-in cards for insertion into AMP connector type number 67131-1 or equivalent. Each card type (designated by "E" number) is uniquely keyed to prevent insertion in improper regulator positions. Overall board dimensions are 6" X 7.6". A handle is machined in the card which facilitates insertion or removal, and prevents inadvertant component breakage or board contamination. All electrical inputs and outputs are taken through the 15 terminals located at the rear edge of the card. Reading from the top of the pc card to the bottom, terminals will always be identified on schematics by numbers 31, 33, 35, 37, ... 59. Potentiometers required for system adjustments are right-angle pots located along the front edge of the pc card.

II. DESCRIPTION

The E09 voltage sensor card is comprised of a C-105C differential operational amplifier and its associated feedback and input networks. A general discussion of differential operational amplifiers is contained in I.L. 16-800-125.

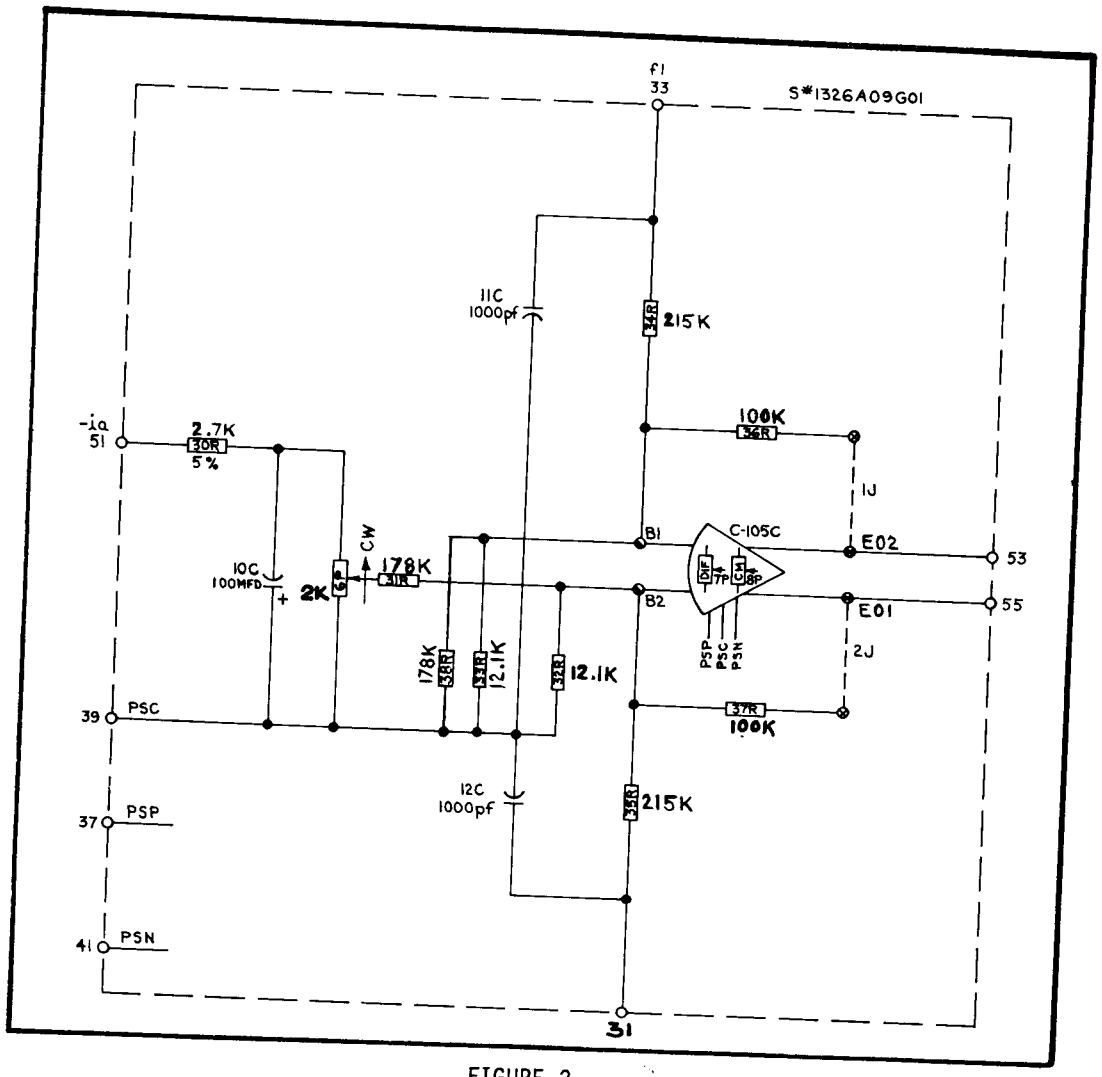

FIGURE 2
E09 SCHEMATIC DIAGRAM

Figure 3 is the schematic diagram of the C-105C.

A small difference voltage applied between B1 and B2 is amplified through two differential stages. The first stage includes transistor 1TR which has a matched pair of high-gain silicon transistors in a single TO-5 can, and the second stage includes transistors 3TR and 4TR. These two stages provide a dc differential voltage gain of approximately 4,000.

A darlington connection of transistors (5TR-7TR and 6TR-8TR) is used as the output stage to achieve the required current gain, and minimize loading of the second differential stage.

It should be noted that a positive differential error signal (B1 + with respect to B2) will yield a + output from E01 and an equal and opposite - output from E02.

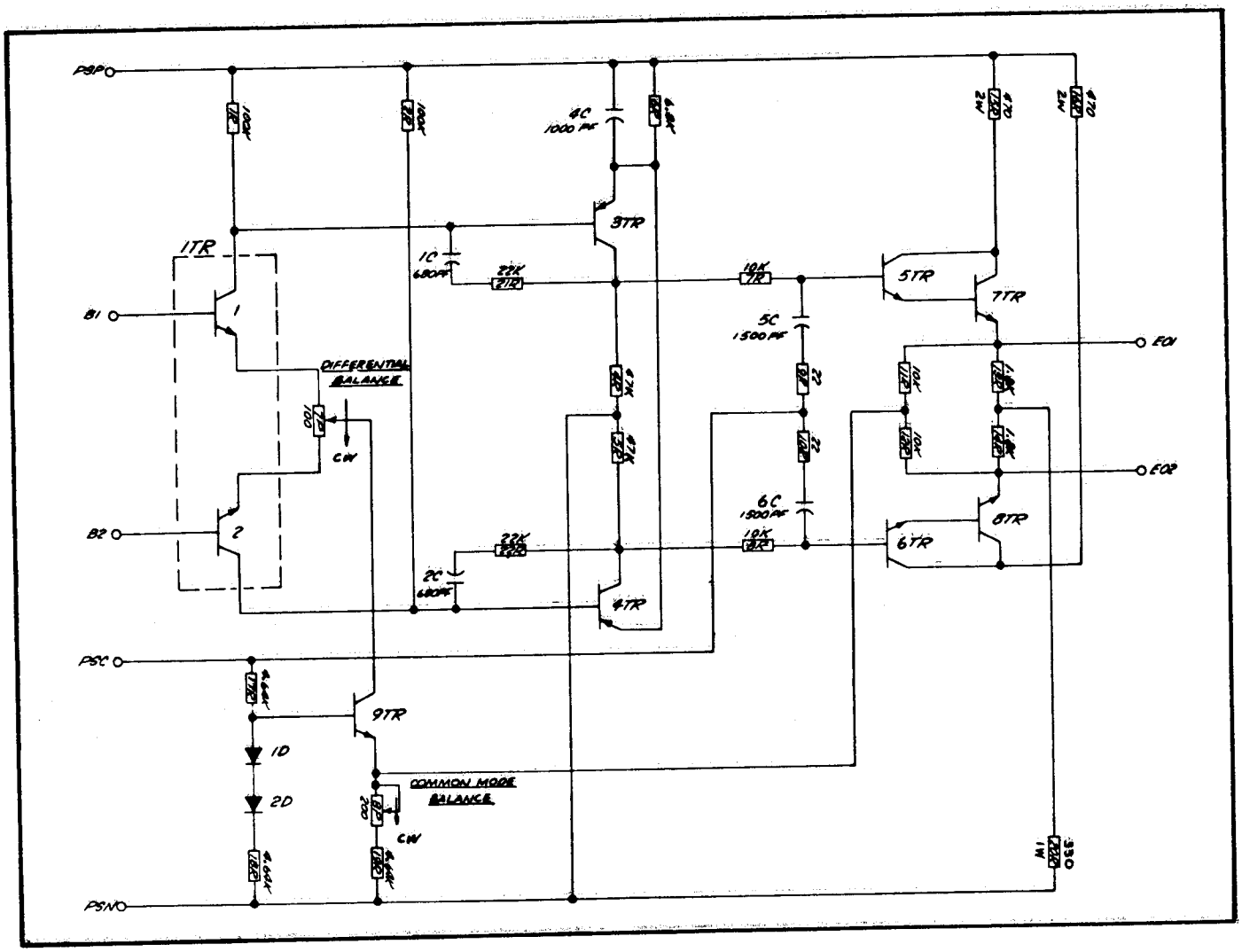

FIGURE 3

The various capacitors with their related resistors serve as shaping networks to optimize frequency and phase shift characteristics of the amplifier.

To balance the amplifier (refer to Figure 2), connect terminals 51, 31, and 33 to PSC.

(a) Connect a multimeter from E01 to E02 and using the differential pot 7P, adjust for zero.

(b) Connect the multimeter from either E01 or E02 to PSC and adjust the common-mode pot 8P for zero output.

(c) Recheck (a) above and repeat steps a and b until both measurements read zero without adjustment.

A. Controller Function

In this application, the operational amplifier is connected as a proportional amplifier with both differential and, unless one armature terminal is grounded, common mode input signals. The differential input provides adjustable IR compensation by 6P. 30R and 10C provide filtering of the armature current sensor signal. Inputs (31,33) are connected to the motor armature terminals through external dropping resistors. Figure 4 lists the values of these resistors for various armature voltages. Signal isolation to ground from either armature terminal is a minimum of one megohm.

Armature Voltage	Dropping Resistors Megohms
250	1.0
375	1.56
500	2.0

FIGURE 4

B. Characteristics & Ratings

1. Allowable operating ambient temperature: 0 to 55°C.

2. Output: V_{OUT}(55-39) = -11.5v max (saturation)
I_{OUT} = 3 ma maximum.

III. SERVICE

Personnel familiar with electrical equipment utilizing semiconductors can isolate most problems using an oscilloscope, multimeter, and information contained in relative instruction leaflets.

Semiautomatic equipment is available at the factory to test static and dynamic performance of all edge-connected printed circuit cards. Generally, repair of modules is facilitated by returning them to Westinghouse Electric Corporation, Industrial Systems Division, P. O. Box 225, Buffalo, New York 14240.