



E06 FIELD CURRENT CONTROLLER For Use With S-56F

I. INTRODUCTION

The field current controller card (E06) 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; E07, power supply; E08, field function generator; and E09, voltage sensor.

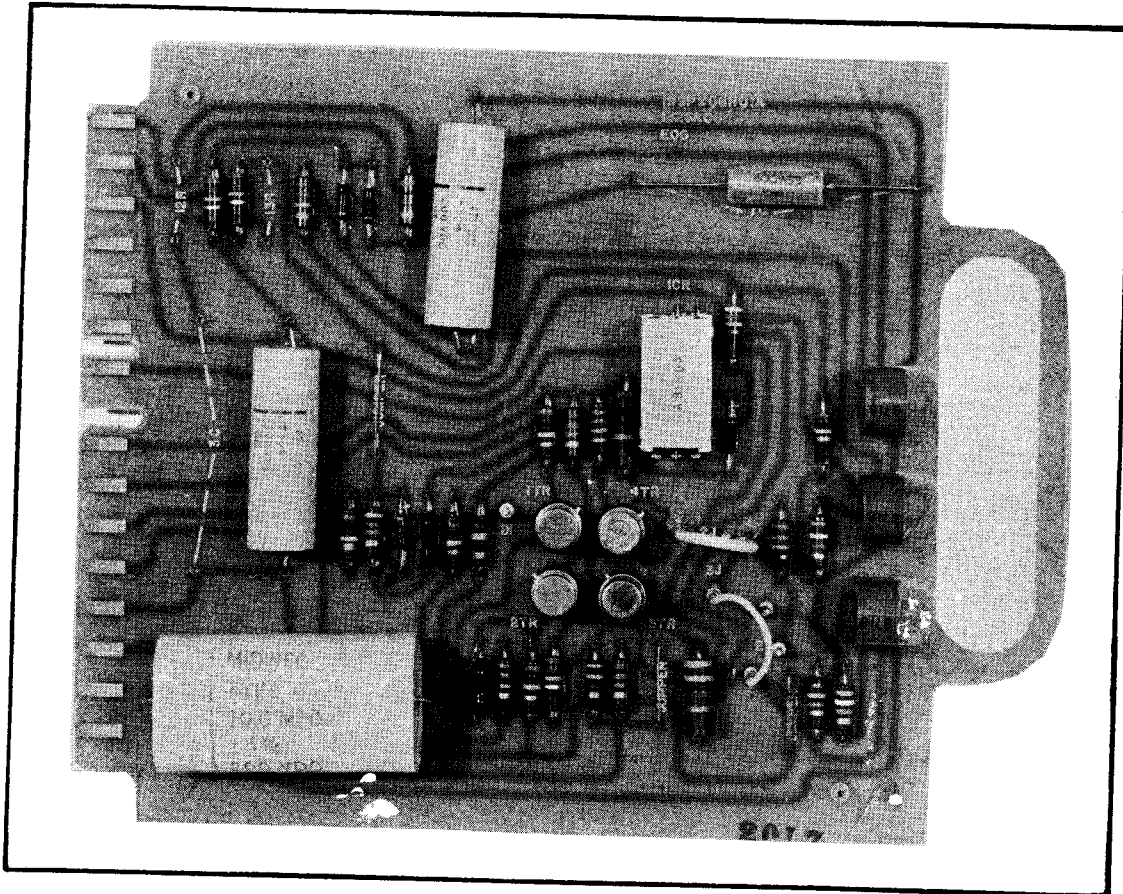


FIGURE 1
E06 PC Card

Figure 1 is a picture of the E06 pc card as used in speed regulators. By adding or eliminating components, and changing jumper positions, the same board is used in both S-56F field regulators.

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 inadvertent 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 E06 field current controller card is comprised of a TOA-4X operational amplifier and its associated feedback and input networks. A general discussion of operational amplifiers is contained in I.L. 16-800-48.

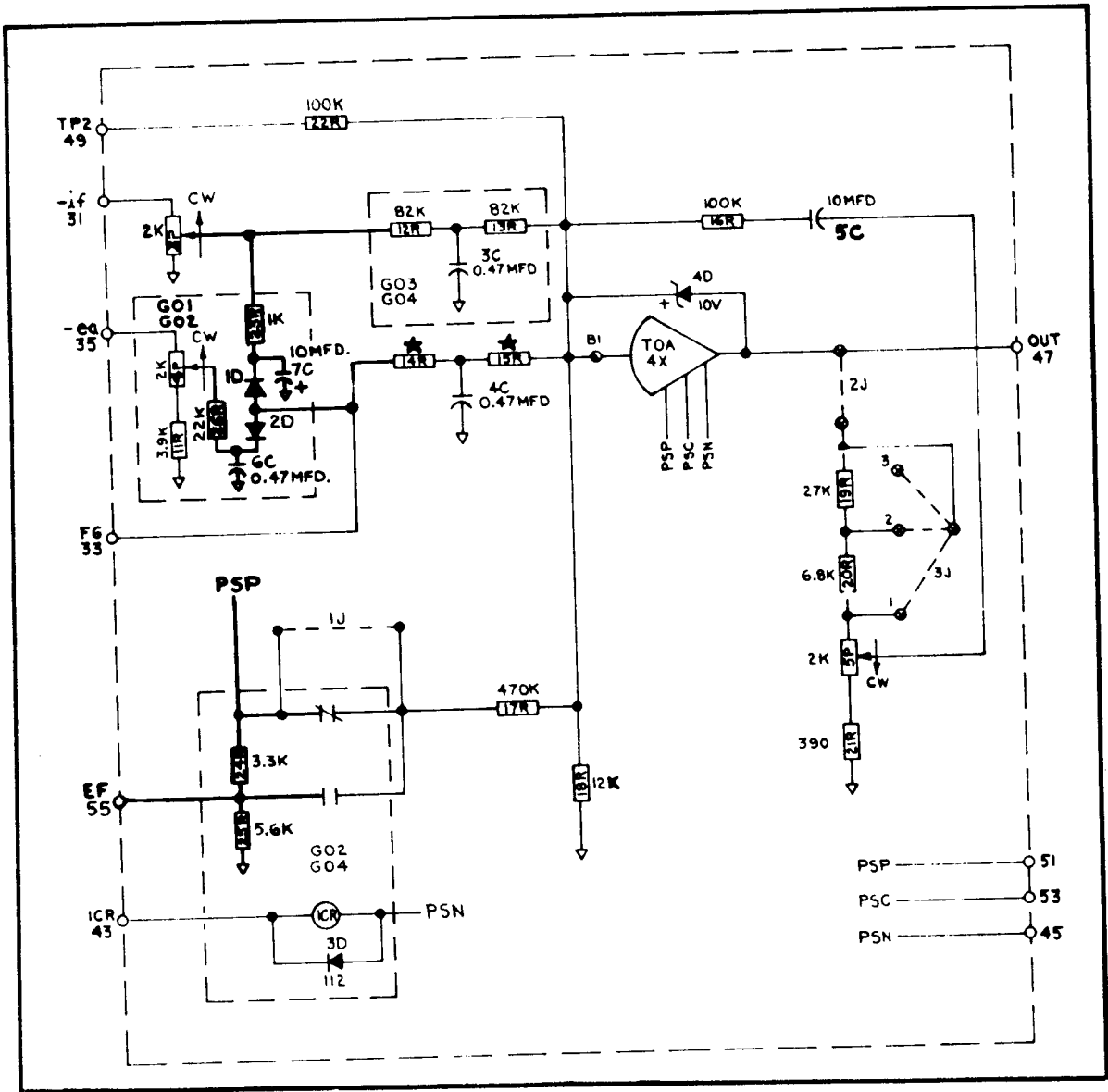


FIGURE 2
 E06 SCHEMATIC DIAGRAM

A. TOA-4X Circuit Operation

Figure 3 is a schematic diagram of dc amplifier TOA-4X.

With the base of 2TR connected through 4R to PSC, a signal voltage applied to B1 is amplified by three stages. The first stage is a differential amplifier consisting of 1TR and 2TR, the second stage is the inverting amplifier 3TR, and the final stage 4TR is an emitter follower for the

required current gain. Signals are inverted, plus input to B1 will yield a negative output from out, and an open loop dc gain of approximately 2000 is achieved by the three stages.

Capacitors 1C, 2C, and their associated resistors serve as shaping networks to optimize the frequency and phase shift characteristics of the amplifier.

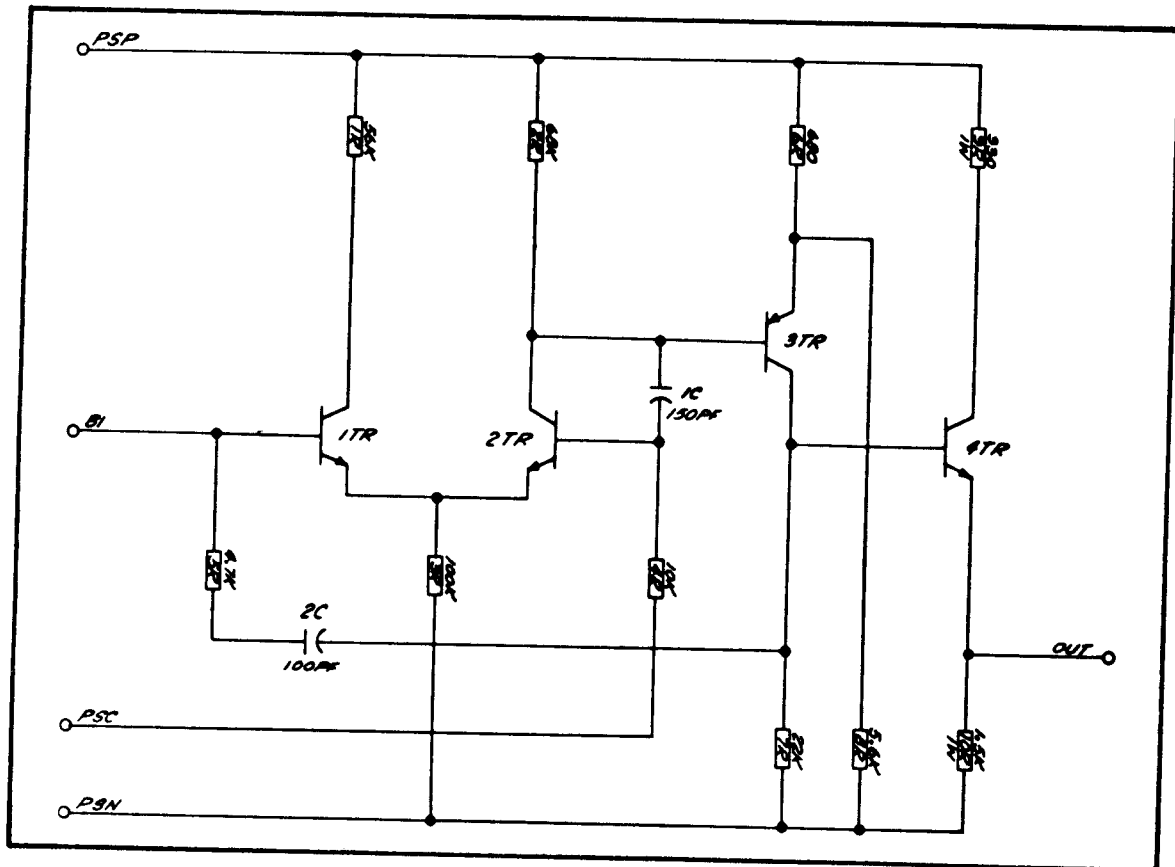


FIGURE 3

B. Controller Function

Feedback components associated with TOA-4X (see Figure 2) commit its use as a PI controller. The general form of the transfer equation is:

$$\frac{e_{OUT}}{e_{IN}} = - \frac{(1 + sT_c)}{KsT_y} = - \frac{(1 + R_f C_s)}{K R_i C_s}$$

$$K \leq 1$$

To prevent the amplifier from saturating, the output is limited to +0.6 and -10 volts by diode 4D. 3J determines the range of gain adjustment by 5P. Gain increases as 3J is moved from position 1 to position 3. Relay 1CR provides a means of lowering the field current reference signal for economy field operation.

With the changes shown in Figure 4, the E06 board is used in field regulators with either armature speed regulators or armature voltage regulators.

STYLE NO.	USE FOR	JUMPERS USED	ITEMS ELIMINATED
1326A06G01	SPEED REGULATOR	1J, 2J, 3J	12R, 13R, 3C, 1CR, 3D, 24R, 25R
1326A06G02	SPEED REG., FIELD ECONOMY	2J, 3J	12R, 13R, 3C
1326A06G03	VOLTAGE REGULATOR	1J, 2J, 3J	1D, 2D, 4P, 1CR, 3D, 11R, 23R, 24R, 25R, 26R, 6C, 7C
1326A06G04	VOLT. REG., FIELD ECONOMY	2J, 3J	1D, 2D, 4P, 11R, 23R, 26R, 6C, 7C

FIGURE 4

1. Operation With an Armature Speed Regulator

Diodes 1D and 2D provide switching from full field below base speed to field weakening with constant cemf above base speed. Diode conduction is determined by which diode cathode voltage is most negative. 3P determines the cemf value at crossover and 4P provides a range of cemf adjustment around the crossover point. Below base speed, 1D is conducting and the field current reference and feedback signals balance each other at the full field operating point. As the cemf increases, it reaches a point when 2D just becomes conductive. At this point, 1D blocks and the cemf error signal causes the PI controller to weaken the field until the desired speed is reached. At this weak field operating point, the field reference and cemf signals balance each other.

2. Operation With an Armature Voltage Regulator

With the component changes shown in Figure 4, two separate inputs are provided, one for field current feedback and one from the field function generator. 3P provides adjustment of the current feedback signal to a nominal value of 10 volts.

C. Characteristics and Ratings

1. Allowable operating ambient temperature: 0 to 55°C
2. Output: $V_{OUT} (47-53) = +0.6V, -10V \pm 0.5V$
 $I_{OUT} (Max.) = 5 \text{ ma}$
3. Gain adjustment by 5P: 3J position 1 $1 \leq \frac{1}{K} \leq 6$
3J position 2 $4 \leq \frac{1}{K} \leq 23$
3J position 3 $.15 \leq \frac{1}{K} \leq 90$

III. SERVICE

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

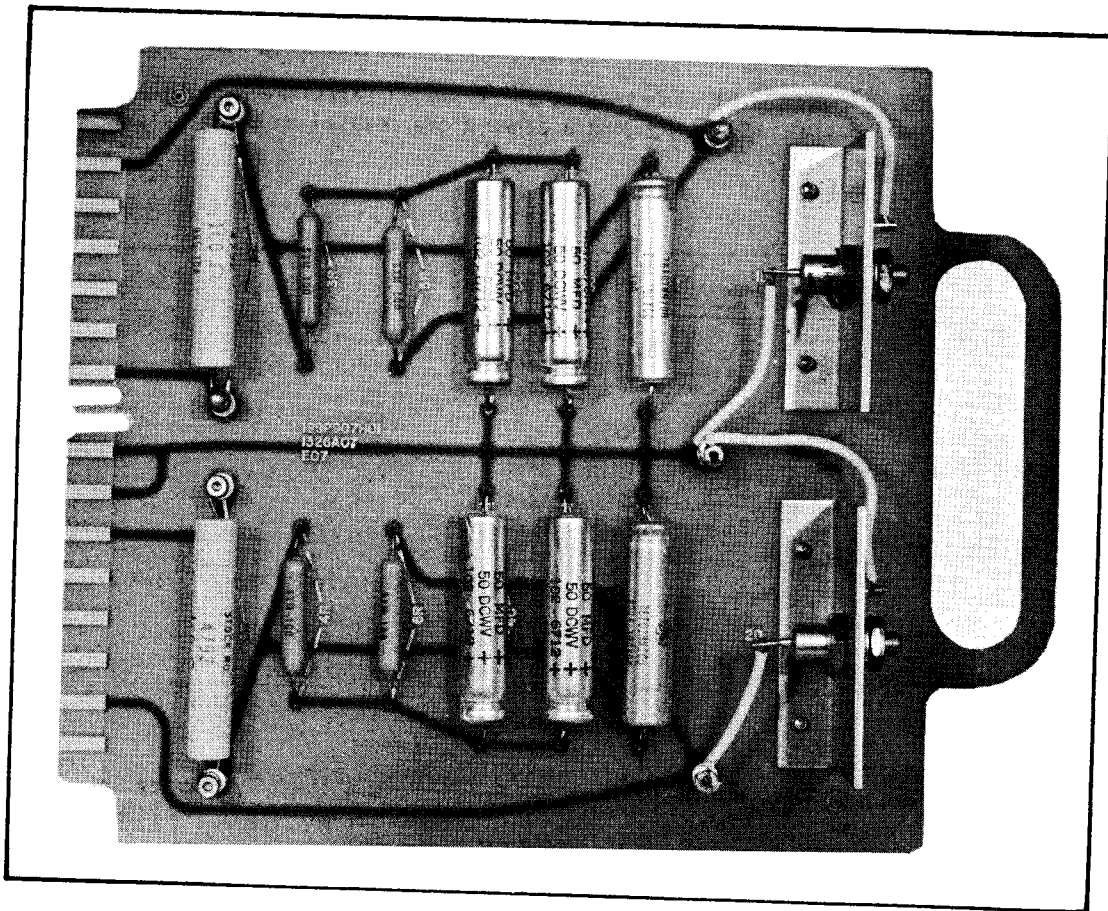
Semiautomatic equipment is available at the factory to test static and dynamic performance of all edge-connected printed circuit cards. Generally, repair of modules is facilitated by returning them to Westinghouse Electric Corporation, Industrial Systems Division, P.O. Box 225, Buffalo, New York 14240.



E07 POWER SUPPLY
For Use in S-56F

I. INTRODUCTION

The power supply card (E07) 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; E08, field function generator; and E09, voltage sensor.



E07 PC CARD
FIGURE 1

Figure 1 is a picture of the E07 pc card. The power supply provides dc power for the regulator functions of the control system. The output is ± 24 vdc, zener regulated

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.

II. DESCRIPTION

A. Specifications

Ambient Temperature 0 to 55°C

Input: 115-volt single-phase full-wave bridge-rectified dc with center-tap connection.

Output: PSP, +24 vdc $\pm 1.2V$; 90 ma maximum
 PSN, -24 vdc $\pm 1.2V$; 90 ma maximum.
 Peak-to-Peak Ripple, 100 mv maximum, 10 mv typical.

B. Circuit Operation

The power supply is composed of two circuits which are identical except for polarity. Each circuit has a two section RC filter, and a zener diode mounted on a heat sink. The schematic is shown in Figure 2.

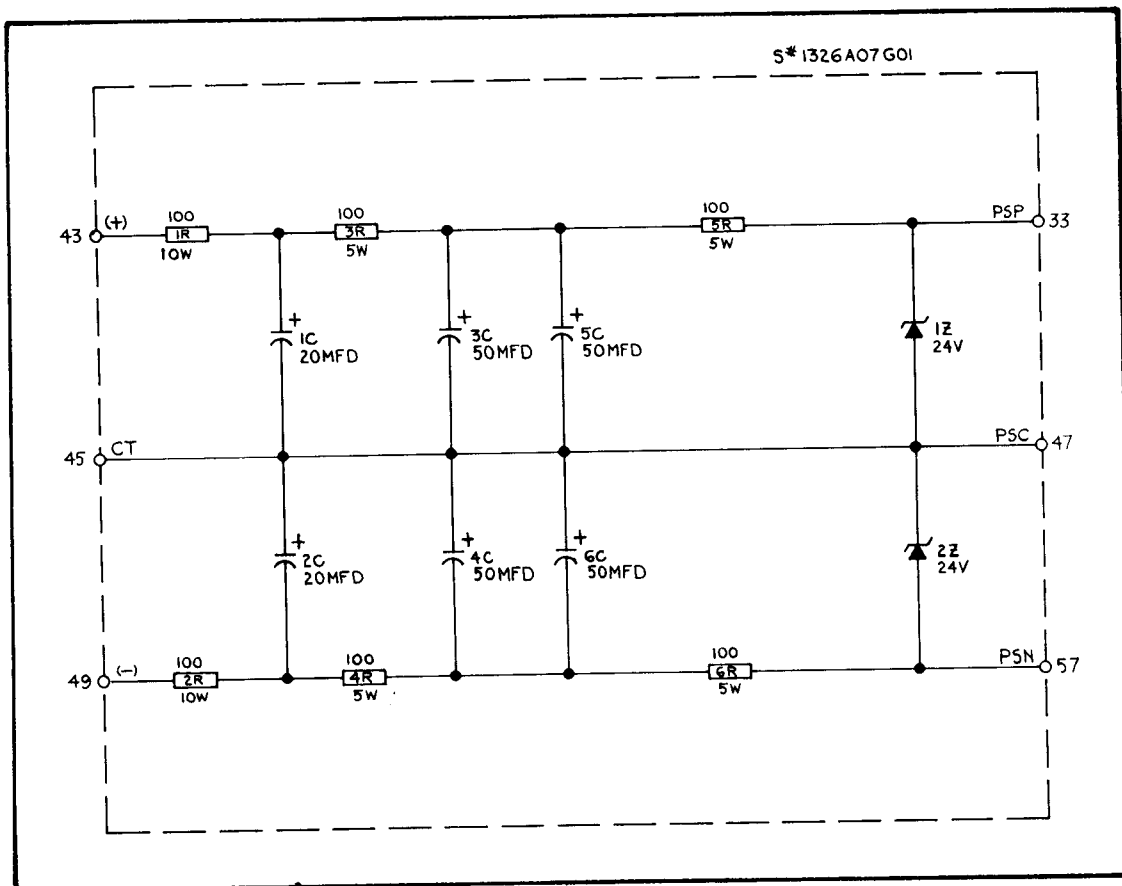


FIGURE 2

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:

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Industrial Systems Division
P.O. Box 225
Buffalo, New York 14240.

