# E08 FIELD FUNCTION GENERATOR
For Use in S-56F

## I. INTRODUCTION

The field function generator card (E08) 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 E09, Voltage Sensor.

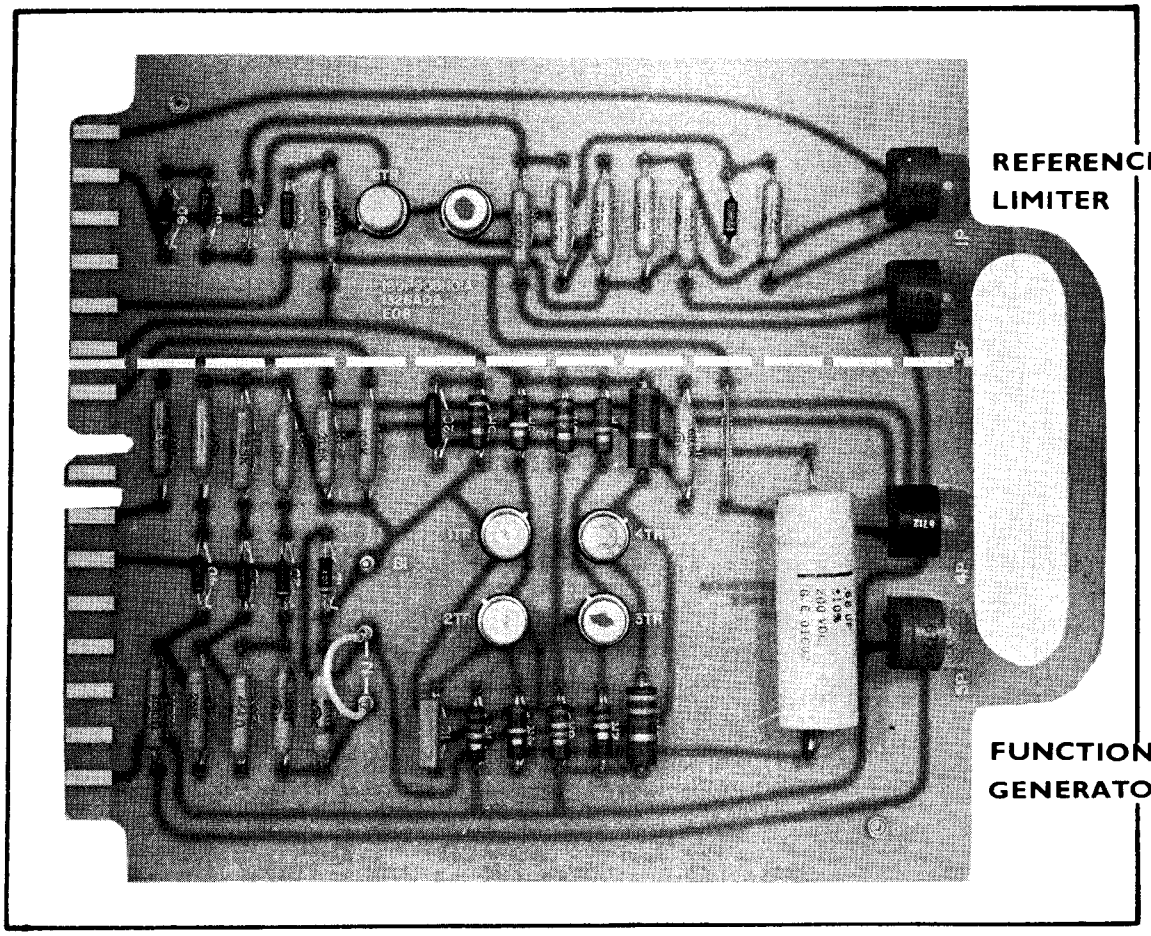


FIGURE 1
E08 PC CARD

The dotted lines on Figure 1 delineate the function generator and reference limiter functions which will be explained later in the Instruction Leaflet.

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 two functions provided by the E08 card were outlined on Figure 1 and will be explained with reference to the schematic diagram, Figure 2.

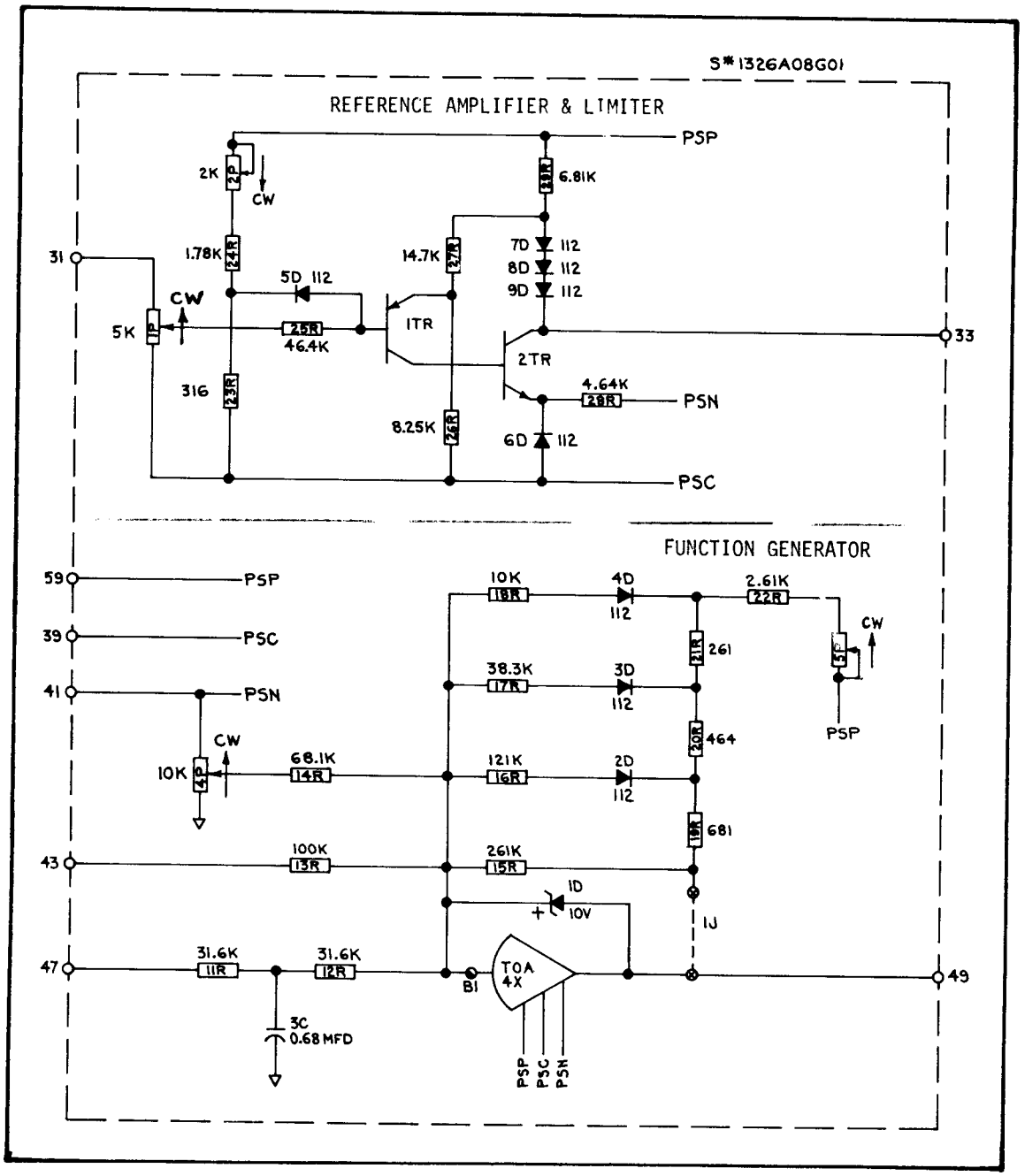


FIGURE 2
E08 SCHEMATIC DIAGRAM

A. Function Generator

DC amplifier (TOA-4X) and associated feedback components comprise the function generator used in S-56F systems. A general discussion of operational amplifiers is contained in I.L. 16-800-48.

1. TOA-4X Circuit Operation

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

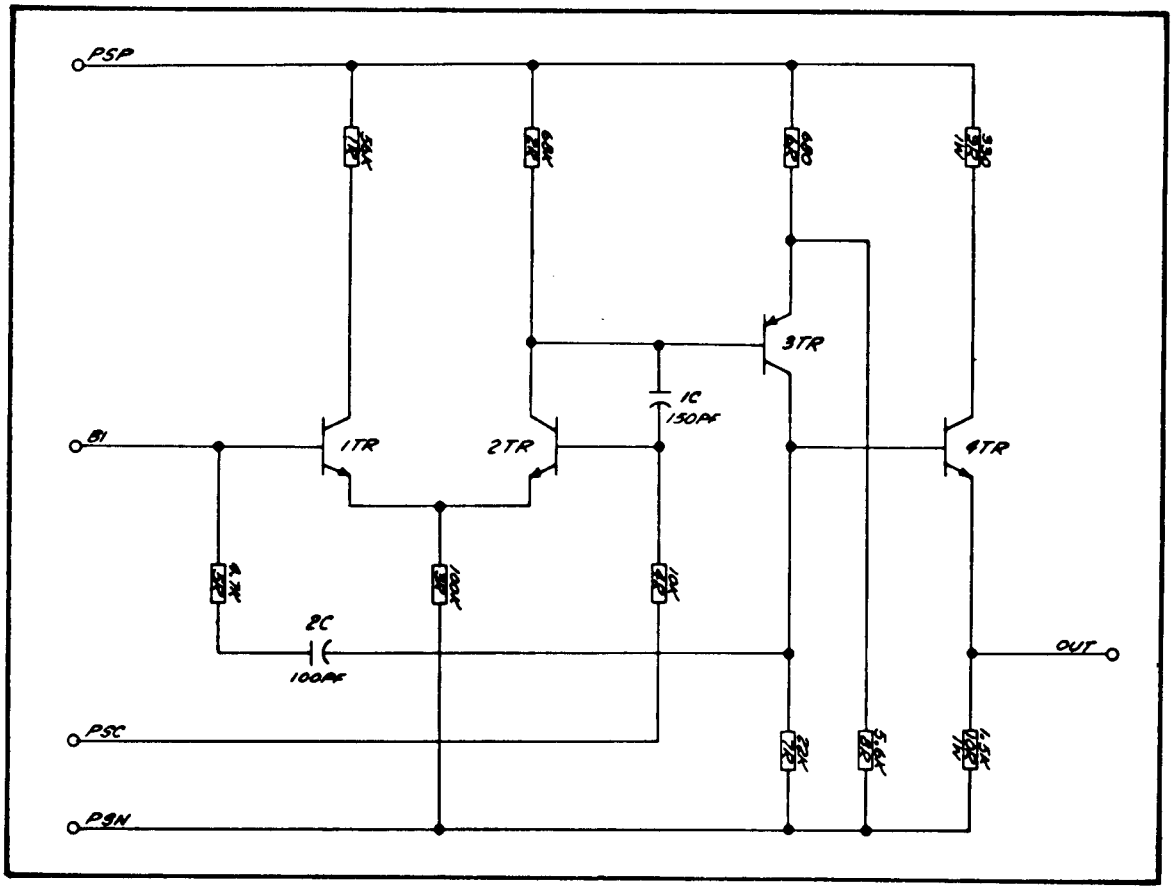


FIGURE 3

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.

2. Controller Function

The desired control of motor speed is shown in Figure 4(a); the motor speed follows a linear ramp reference signal. Below base speed, control is by armature voltage with constant field flux. The motor equation is:

$$n = \frac{Ea}{k\phi}$$

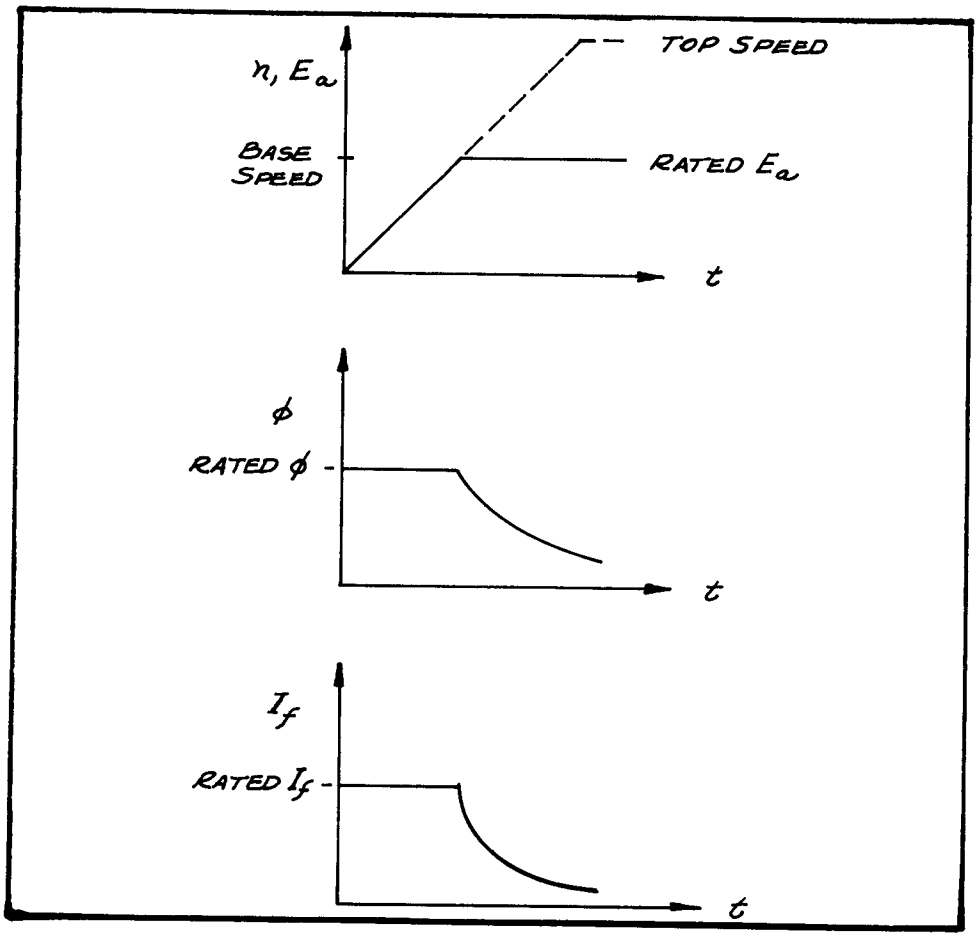


Figure 4

Above base speed, armature voltage is held constant and the field flux is decreased to increase speed. Flux and speed are related inversely, however, which requires that the flux be decreased as an inverse (hyperbolic) function; see Figure 4(b). Since the field control system controls current rather than flux, another relation must be introduced into the function generator to relate field current and field flux. This relation is the saturation curve of the machine; see figure 5.

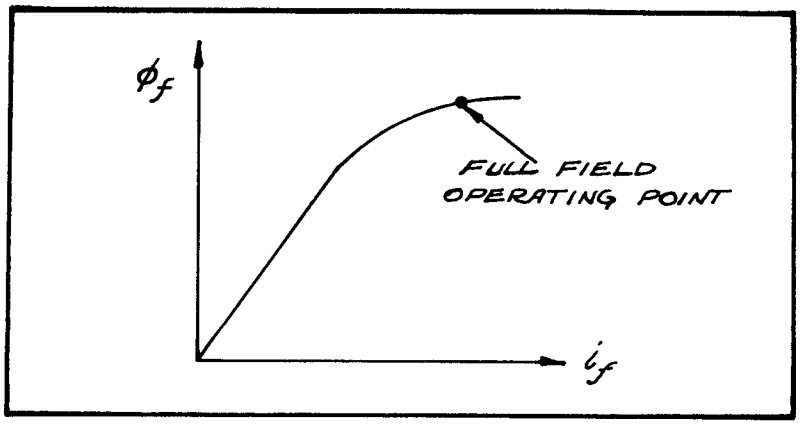


FIGURE 5

As the field current is reduced from full field, the field is operating over the range of greatest curvature of the saturation curve. This explains the difference in shape between Figures 4(b) and 4(c).

Referring to Figure 2, an input signal corresponding to Figure 4(a) is applied to terminals (47-39) and the output (49-39) then corresponds to Figure 4(c). This is accomplished by approximating Figure 4(c) with four linear segments. The actual output is shown in Figure 6.

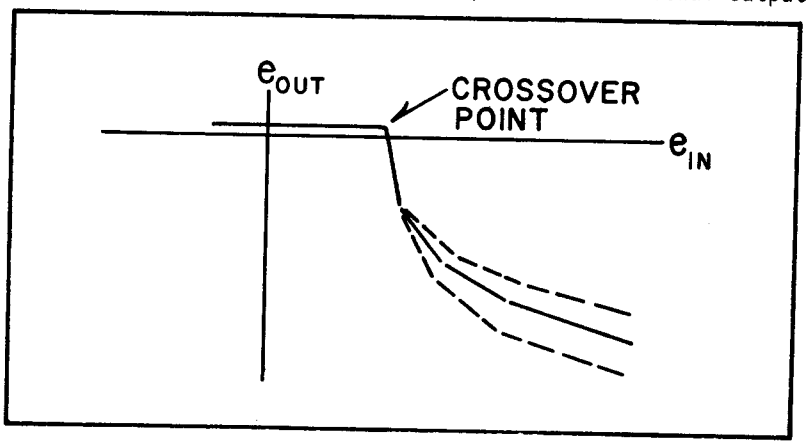


FIGURE 6

The crossover point is adjusted by 4P; 5P varies the shape of the curve as shown by the dotted lines.

B. Limiter Circuit Operation

Referring to Figure 2; 23R, 24R, 25R, and 5D comprise an input limiter. 1TR and 2TR and associated resistors comprise a non-inverting amplifier with a gain of approximately 2.5. Diodes 7D, 8D and 9D are for temperature compensation. 1P sets the point at which limiting begins (crossover point). 2P sets the magnitude of the output during limit.

C. Characteristics and Ratings

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

2. Output: Function Generator: $V_{out}$ (49-39) = +0.6v, -10v ±0.5v
   $I_{out}$ (MAX) = 5 ma
   Limiter: $V_{out}$ (33-39) = 0 to +11v
   $I_o$ (MAX) = 1 ma.

3. Adjustments: 1P . . . . limiter crossover point
   4P . . . . function generator crossover point
   NOTE: 1P and 4P must be set such that crossover occurs simultaneously. They provide adjustment of the field weakening range from 1:1 to 4:1.
   2P . . . . adjusts limit value of $v_b$*.
   5P . . . . adjusts shape of the function generator.

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.

**Westinghouse Electric Corporation**
Industrial Systems Division, Buffalo, New York

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