F21 CONTROLLED T.P.M. ASSEMBLIES

(FIELD EXCITERS)

I. INTRODUCTION

F21 Field Exciters are variable voltage packages consisting of single-phase, semi-converter thyristor modules and integral field current controller boards. Pictures of the two physical assemblies are given in Figure 2. Assembly S#1752A06G01 shown in Figure 2a utilizes an integral thyristor-diode bridge package mounted on a large heat sink and is rated for 180 VDC output maximum. Assembly S#1775A93G01 shown in Figure 2b utilizes individual thyristors and diodes on heat sinks and is rated for 280 VDC maximum. Both assemblies use the same field current controller board. Except for ac input and dc output voltage ratings, both assemblies have identical functional characteristics and are rated for 20 Amps.

A front view of the controller board locating all components by schematic identification is shown on the last page of the instruction leaflet.

II. SCOPE OF APPLICATION

The F21 Field Exciter package described here constitutes the basic power converter for motor or generator field excitation systems for control of current, flux, cemf, speed or any other variable of a drive subsystem. Refer to the appropriate IL's listed at the end for a description of applicable control systems and controller kits.

III. ELECTRICAL DESCRIPTION

A simplified schematic representation of the F21 field exciter is given in Figure 3. The detail schematics for the two sizes of TPM assemblies are given in Figures 4a and 4b. The field current controller schematic representation appears in Figures 5a, 5b and 5c.

The F21 TPM's consist of a single phase semiconverter power bridge with a free wheeling diode, four 0.5 ohm, 25 watt resistors for current sensing, self starting resistor (used with highly inductive loads to initiate conduction) and surge suppression networks as shown in Figure 4a and 4b. The values and connections of the RC suppression networks and of the loading resistor vary between the two ratings due to the difference in the incoming ac voltages (230 and 345 VAC).

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During free-wheeling periods, the current waveform becomes a decreasing exponential with a time constant equal to the time constant of the equivalent DC circuit.

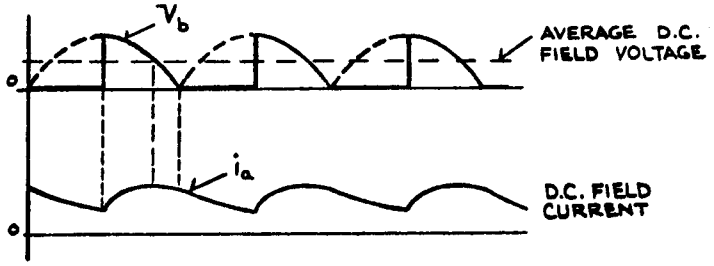
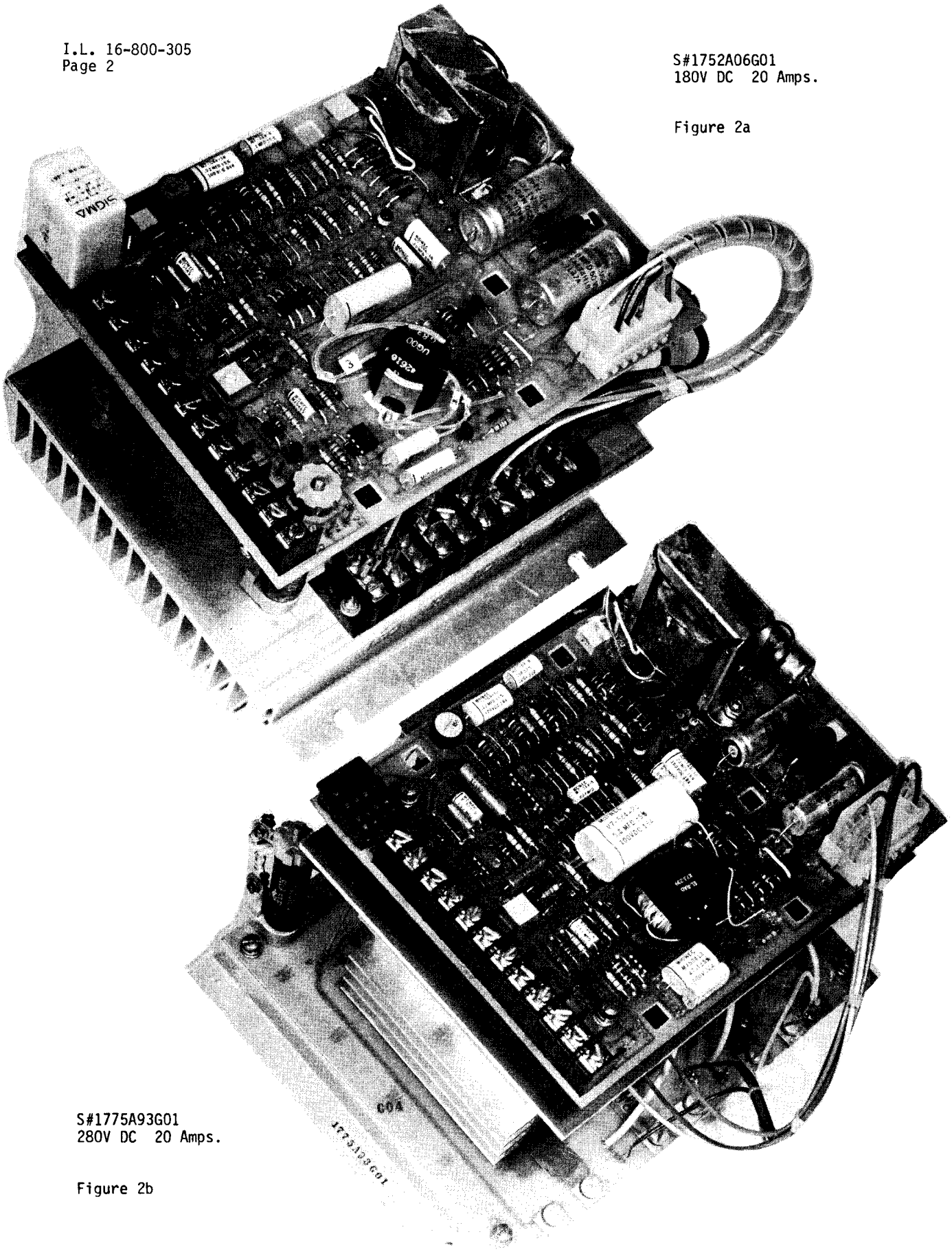


FIGURE 1

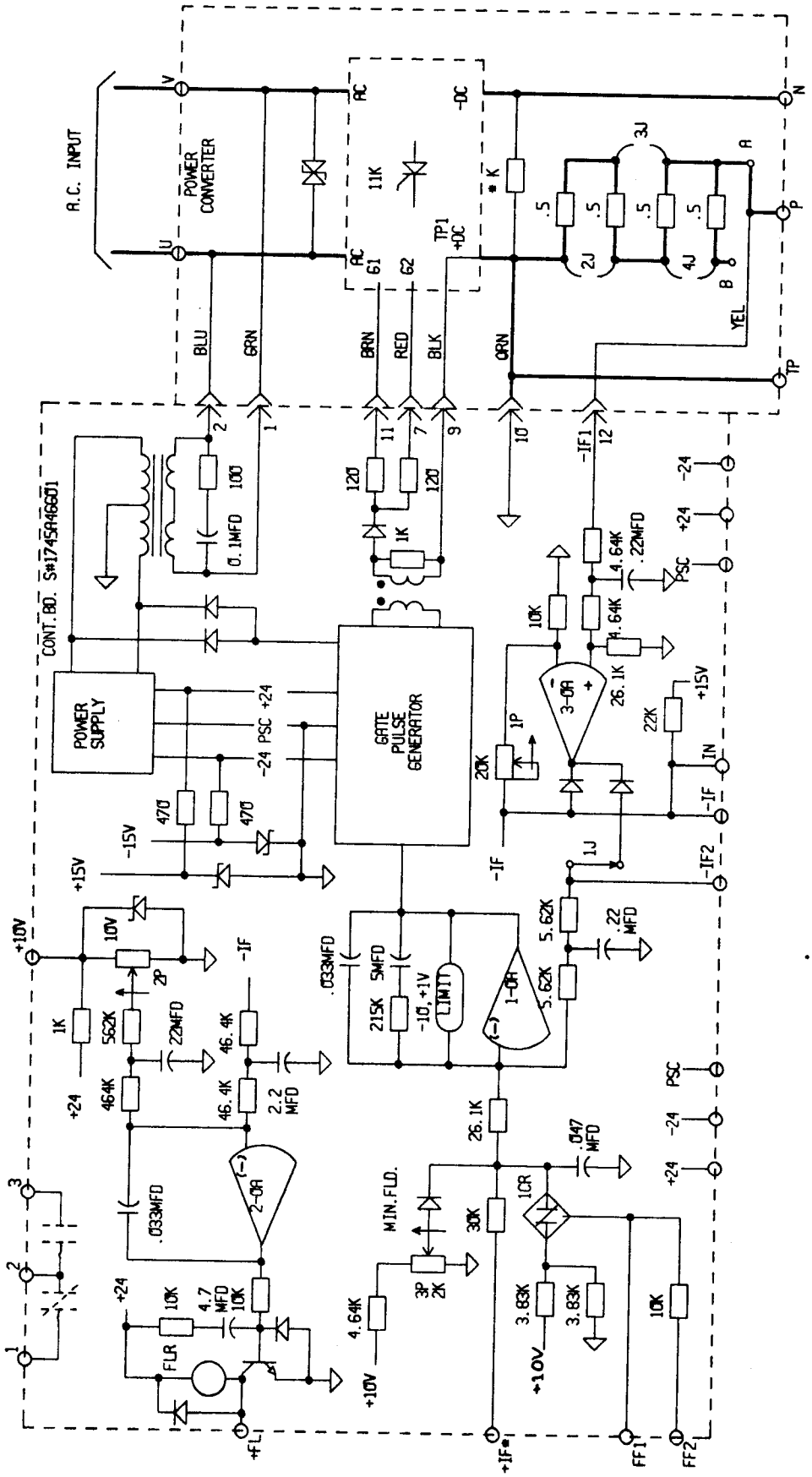
S#1752A06G01
180V DC 20 Amps.

Figure 2a



S#1775A93G01
280V DC 20 Amps.

Figure 2b



Simplified Schematic
Figure 3

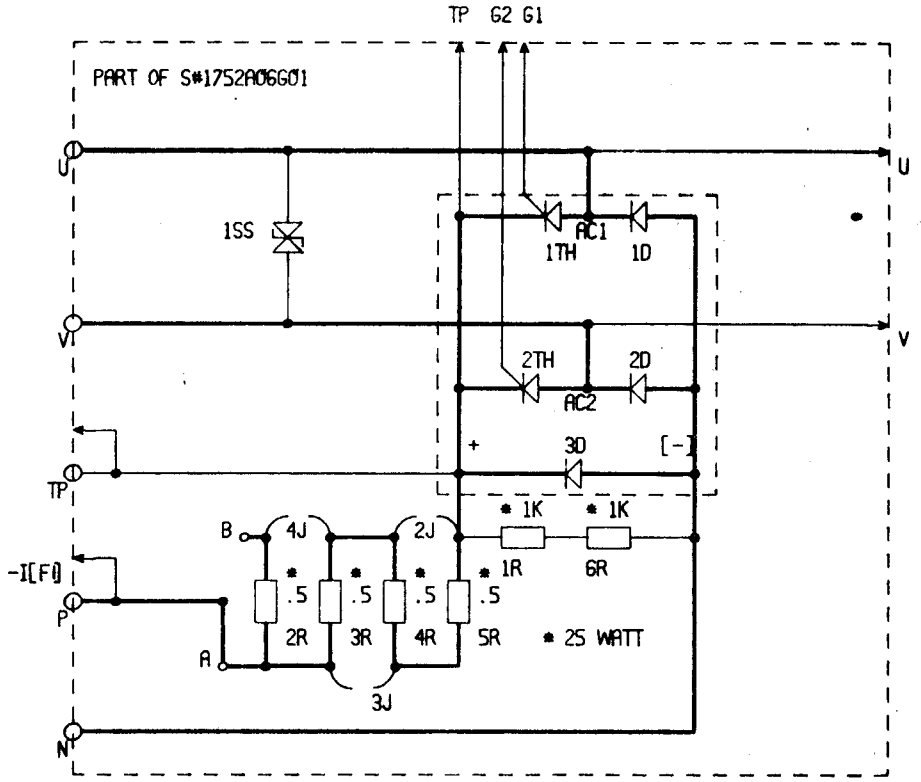


FIGURE 4a: POWER CONVERTER CIRCUIT FOR 180VDC UNIT S#1752A06G01

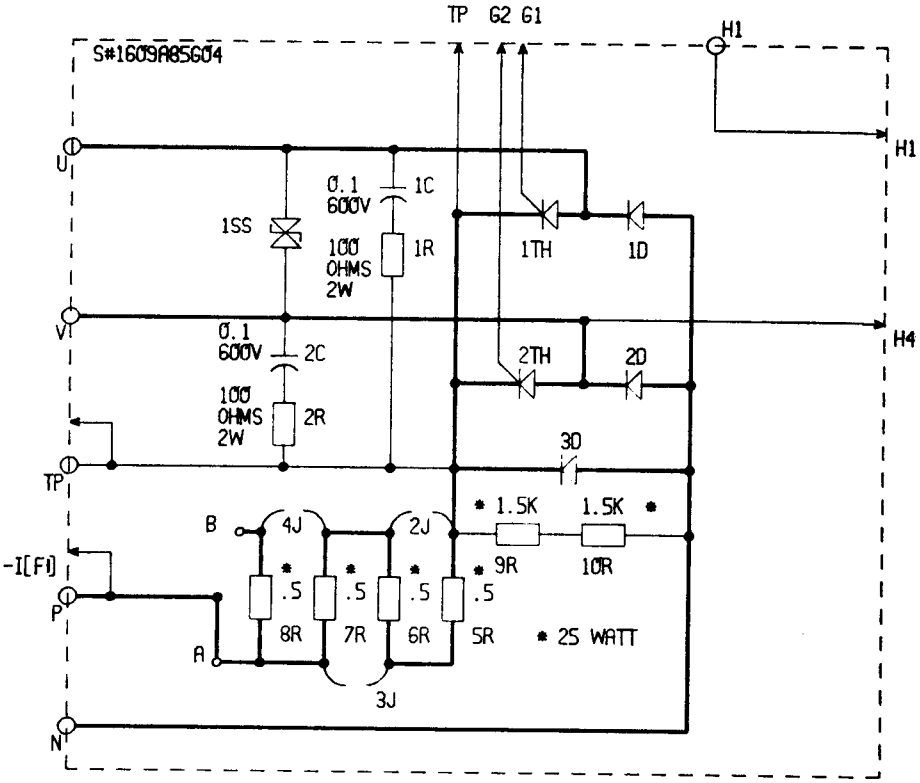


FIGURE 4b: POWER CONVERTER CKT. FOR 280VDC UNIT S#1775A93G01

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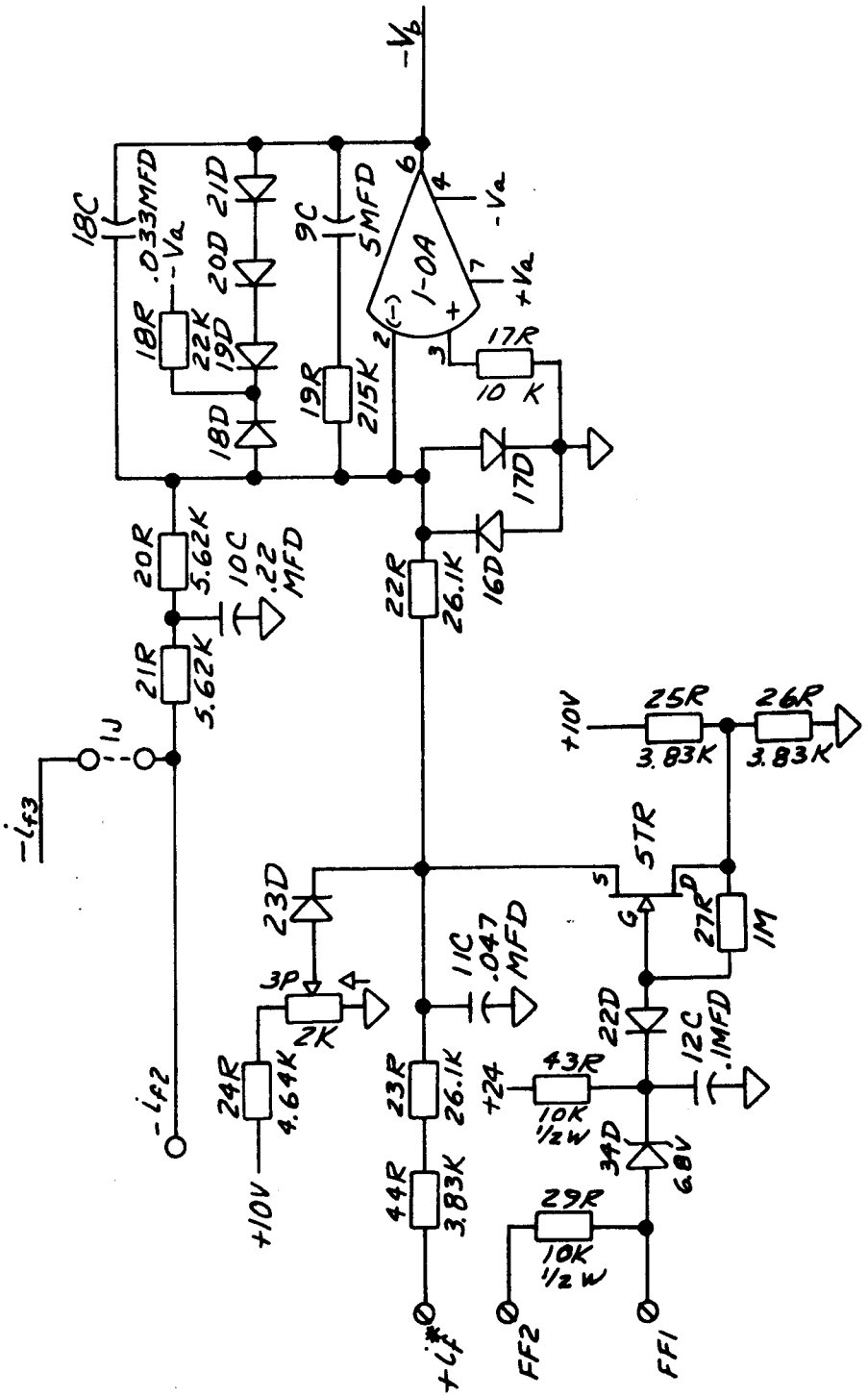
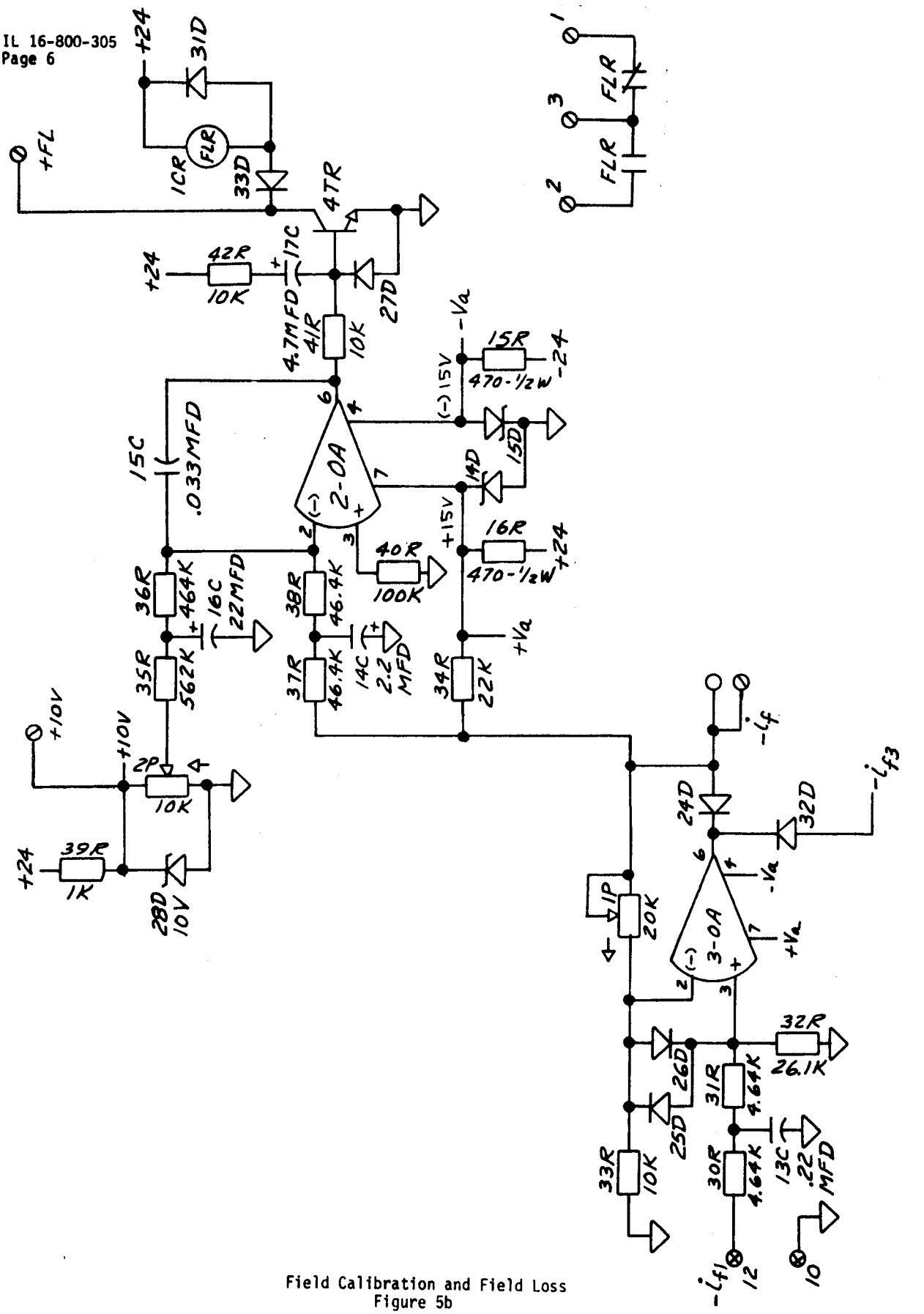
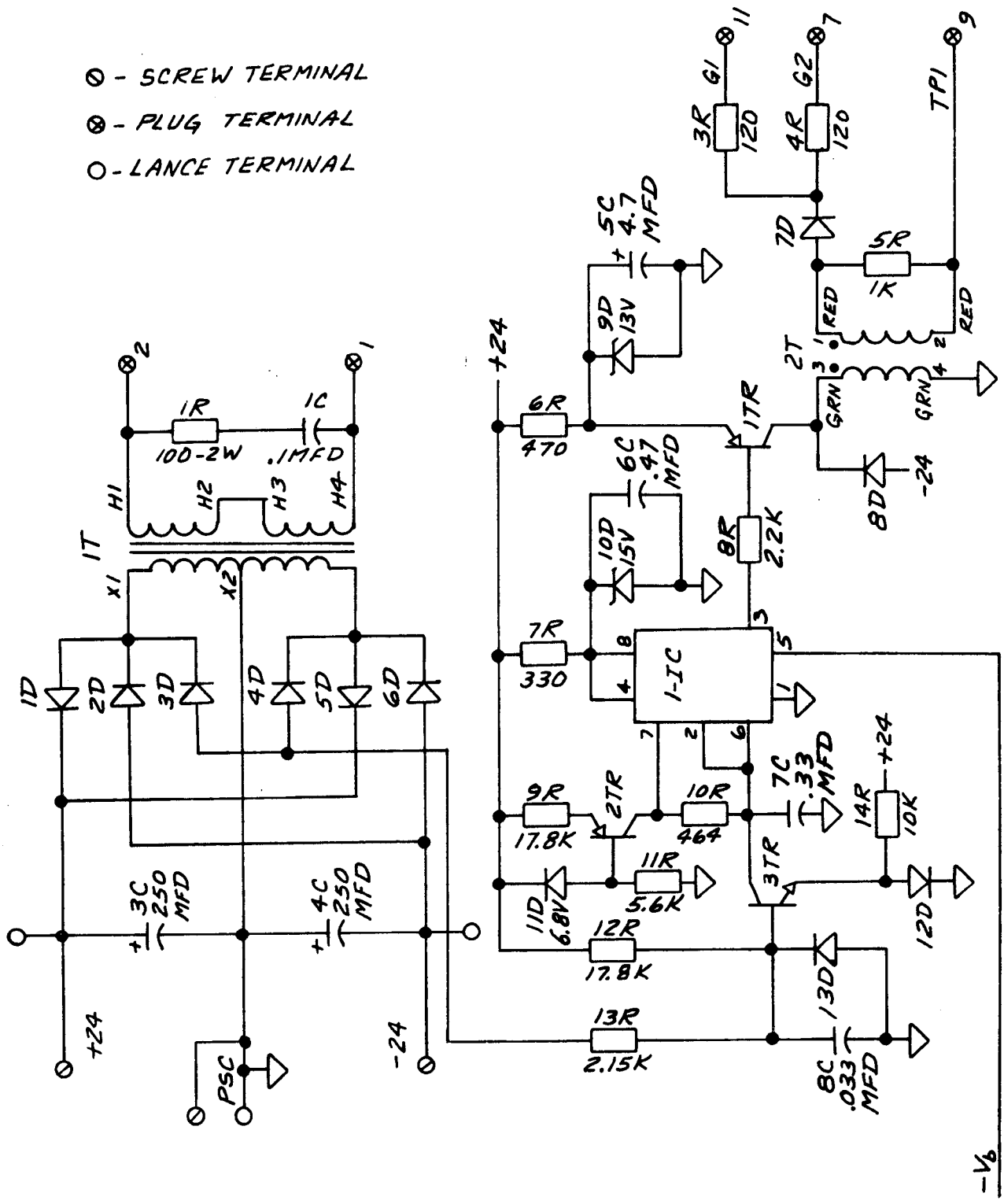


Basic Current Controller
Figure 5a



Field Calibration and Field Loss
Figure 5b



Power Supply and G.P.G.
Figure 5c

Printed in USA

All dc current including freewheel current must pass through the four 0.5 ohm feedback resistors. These resistors are connected in series/parallel configurations so as to provide a feedback signal (IR drop) of 0.75V to 2.5V at rated field current. This signal is then calibrated to -2V on the field current controller board.

The Field Current Controller board (Figures 5a, 5b, and 5c) is functionally divided into five circuits: Basic Current Controller (Figure 5a), Field Calibration and Field Loss (Figure 5b), Power Supply and GPG (Figure 5c).

Operational amplifier 1-OA and its associated circuitry provide the analog controller function. The approximate transfer function relating the current feedback ($-I_f$) signal and the output control voltage (v_c) can be expressed as follows:

$$v_c(s) = -\left(\frac{18\ (1 + 1.1S)}{S}\right) I_f(s)$$

Since the current feedback ($-I_f$) is calibrated for 2V at the rated field current, the reference signal required to match the feedback is given by

$$+I_f^* = -\left(\frac{22R + 23R + 44R}{20R + 21R}\right) I_f = -\left(\frac{26.1 + 26.1 + 3.83}{5.62 + 5.62}\right) \cdot (-2) = 9.97 \simeq 10 \text{ Volts.}$$

The 5TR FET (Field Effect Transistor) Circuit along with 25R and 26R provide means for establishing full field reference irrespective of the signal level at If*. The 5TR FET is controlled by a -15V or -24V potential signal at the FFI terminal. A -15V logic signal connected to FFI opens the FET circuit and, therefore, establishes either the minimum field set by 3P or that dictated by the signal at the $+I_f$ terminal whichever is higher. A zero volt logic potential or open circuit at terminal FFI establishes full field reference. The 10k resistor between terminals FF2 and FF1 is provided for loading when relay contacts are used at terminal FF1. Terminal FF2 is connected to PSP (+24V) and terminal FF1 is connected to PSN (-24V) through a low energy relay contact. Resistor 24R, potentiometer 3P and diode 3D provide means for adjusting the minimum field current level.

Operational amplifier 2-OA and its associated circuitry constitute a voltage detector circuit with the 4TR transistor output circuit for field loss detection. The +FL terminal is used for static field loss. The FLR relay is a plug-in relay and is used for field loss protection where isolated contacts are required.

3-OA and associated circuitry comprise a non-inverting operational amplifier circuit with a variable gain. As described earlier, potentiometer 1P is used for calibrating the current feedback for -2V rated field current.

Transformer 1T and its associated components provide unregulated ±24V for the control circuitry.

Integrated circuit 1-IC, pulse transformer 2T and the associated components constitute the gate pulse generator producing one pulse for each half cycle of the ac input voltage. A ramp intersect gating method is used with the control voltage output for controlling the phase shift of the gate pulse.

IV. SPECIFICATIONS AND RATINGS

A. TPM

1. Single-Phase full wave semiconverter.
2. 50/60 Hz.
   a. 230 VAC/345 VAC terminals U to V.
   b. 230 VAC only - terminals H1 to V. (HI to V must be in phase with U to V).
3. DC Circuit
   a. 180 VDC/240 VDC terminals P to N with 230 VAC/345 VAC on terminals U to V above.
   b. Load Current - 0 to 20A. DC

4. Jumper Positions for current feedback resistors (Refer to the schematic)

For Rated Field Current Of:	Equivalent Resistance-Ohm	Jumpers Used	Jumper 5J To Point
12.0 to 20.0A	0.125	2,3, & 4J	A
8.0 to 12.0A	0.167	2 & 3J	A
5.0 to 8.0A	0.250	2 & 4J	B
3.5 to 5.0A	0.500	3J	A
2.0 to 3.5A	0.667	3 & 4J	B
1.0 to 2.0A	1.000	4J	B

B. Field Controller

1. Normal forcing factor: 1.5 for 180 VDC unit with 120V fields and 280 VDC unit with 180V fields

2. Maximum Field Current: Adjust (1P) for -2V feedback at rated field current (I_f).

3. Minimum field current: Adjust (3P)-Range 0 to 60% rated I_f.

4. Field Loss: Adjust (2P)-Range full field to zero.

5. Inputs: (Ref. to PSC)

$+I_f^*$ = 10V for rated field amps.

FF1 = -15V logic signal for field control from $+I_f^*$ terminal.

= -24V FET drive signal for field control from $+I_f^*$ terminal.

= -24V through relay contact with FF2 at +24V for field control from $+I_f^*$ terminal.

FF1 = open circuit or zero to +15V for full field.

V. REFERENCE MATERIAL

Optional Controllers	B/M Dwg.	I.L.
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Flux Function Gen.	1745A47	16-800-306
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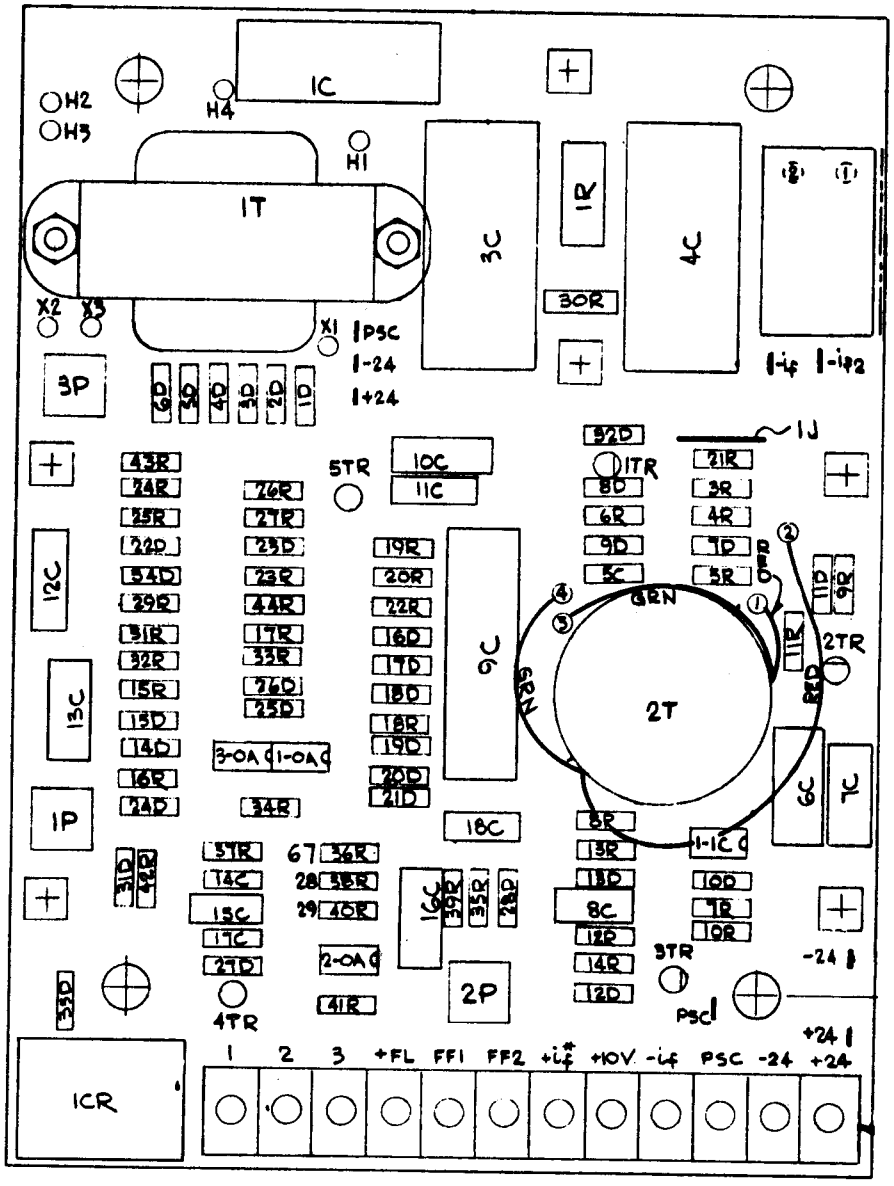

F21 CONTROLLER BOARD ASSEMBLY

FIGURE 6

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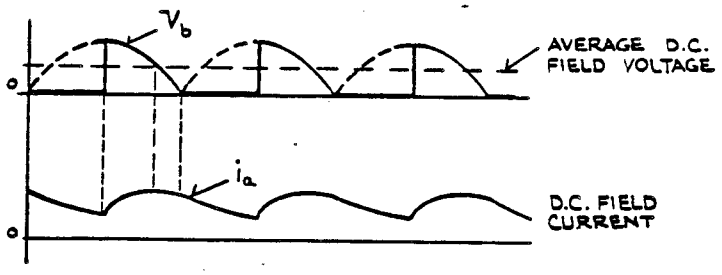
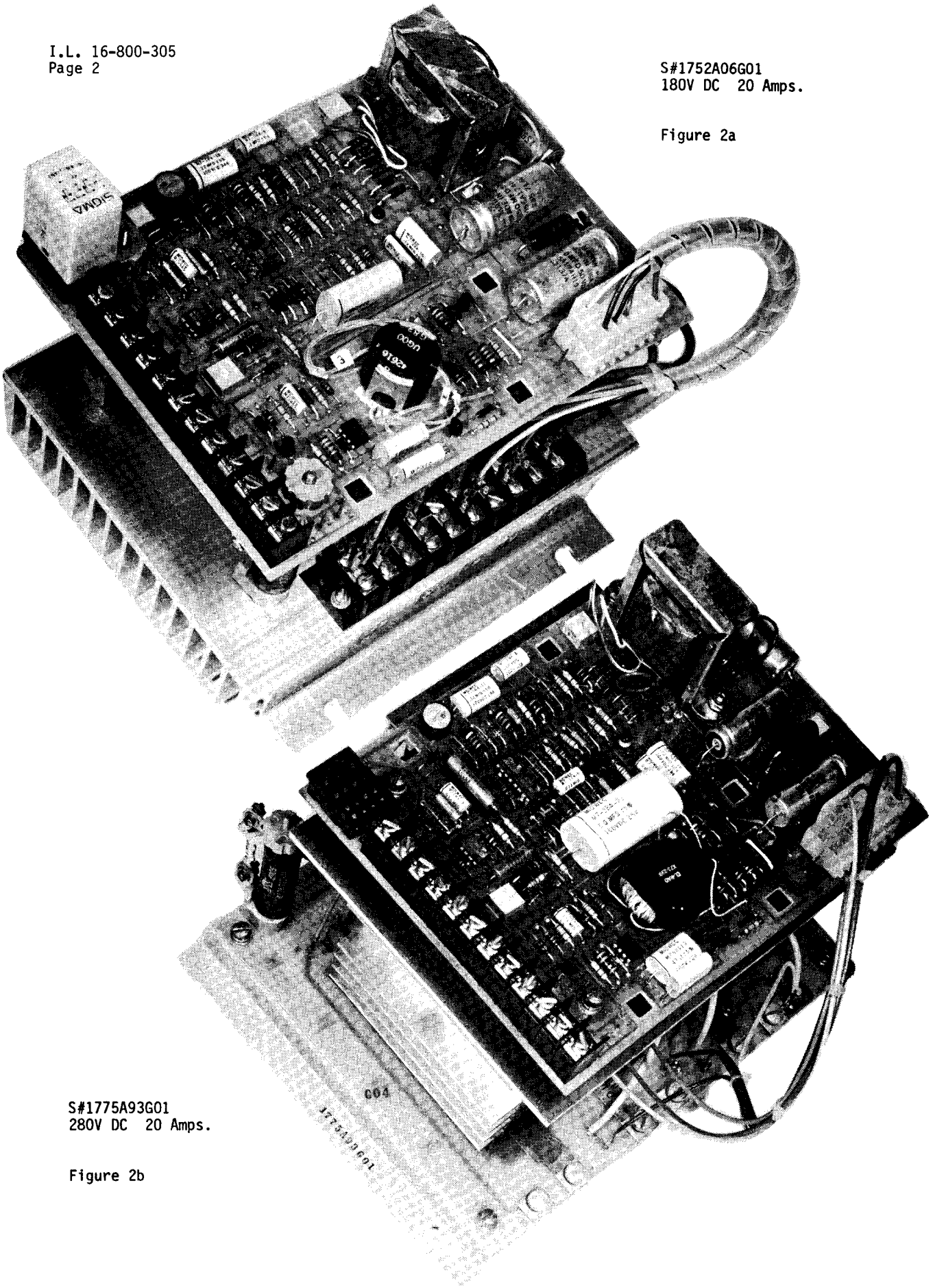


FIGURE 1

S#1752A06G01
180V DC 20 Amps.

Figure 2a



S#1775A93G01
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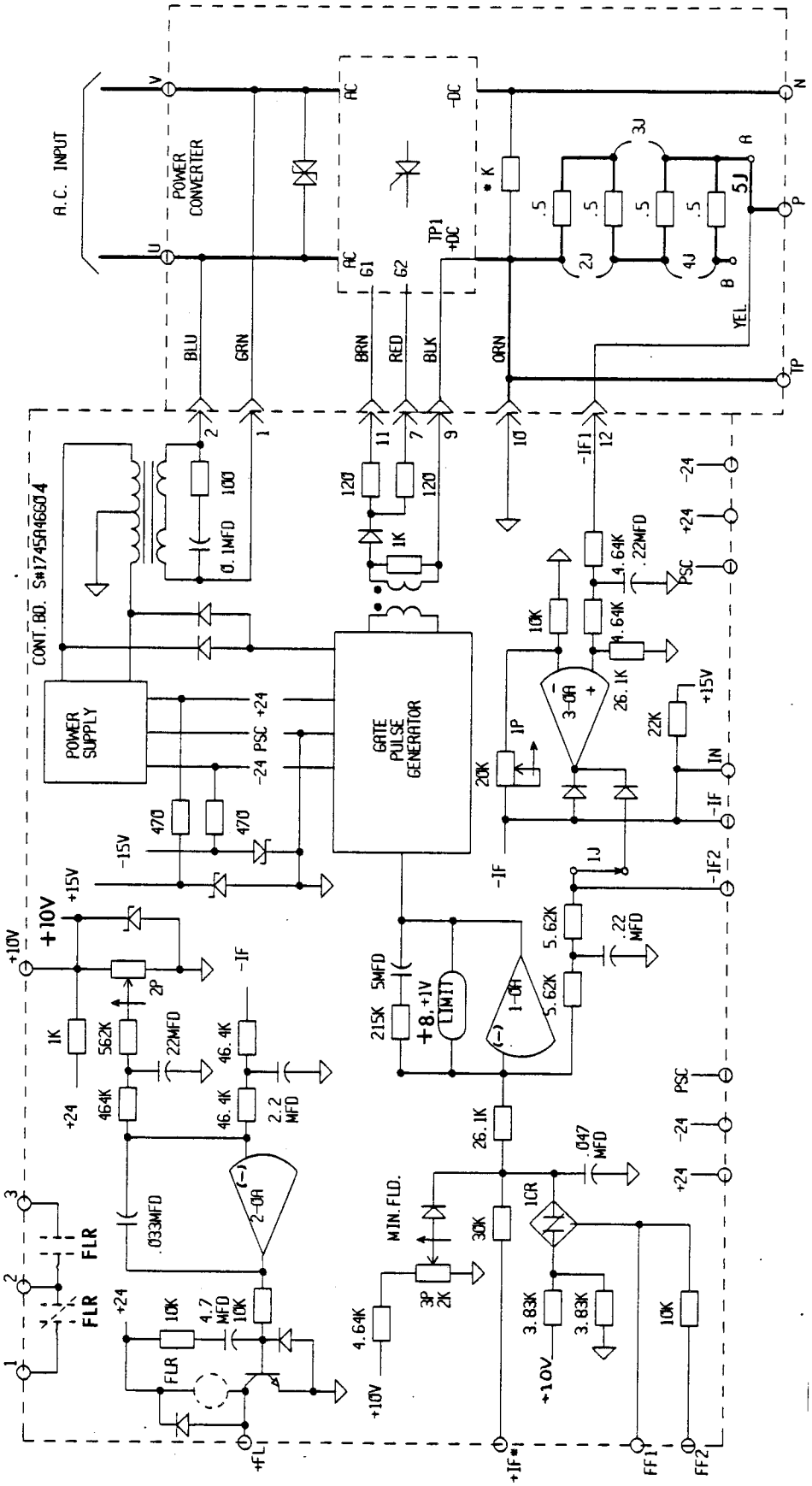

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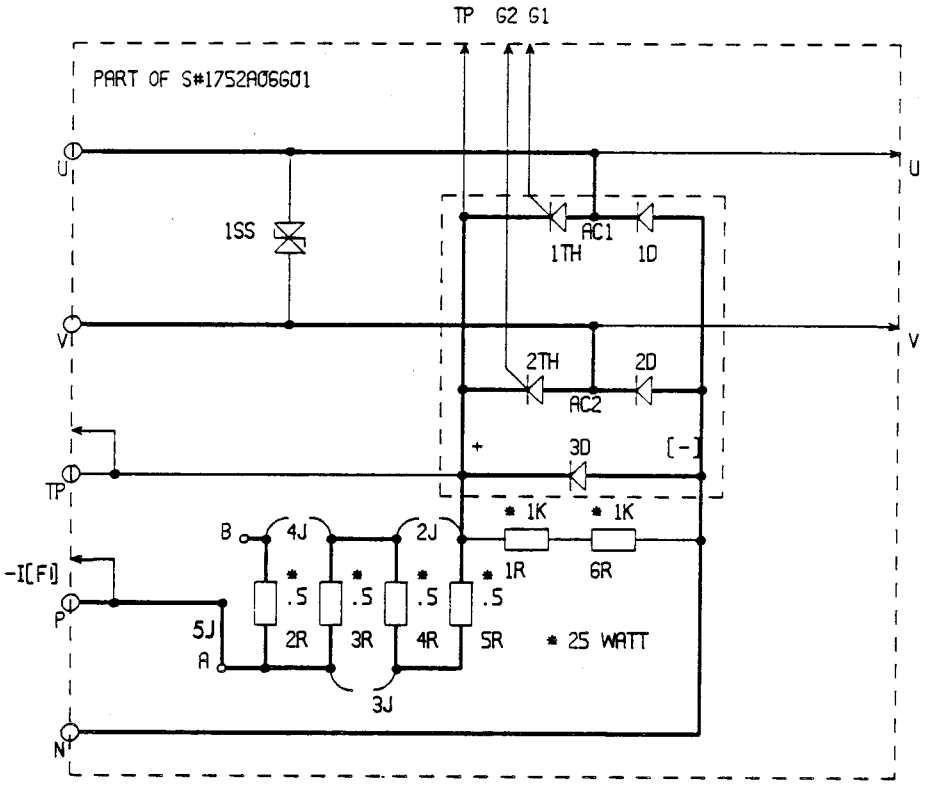

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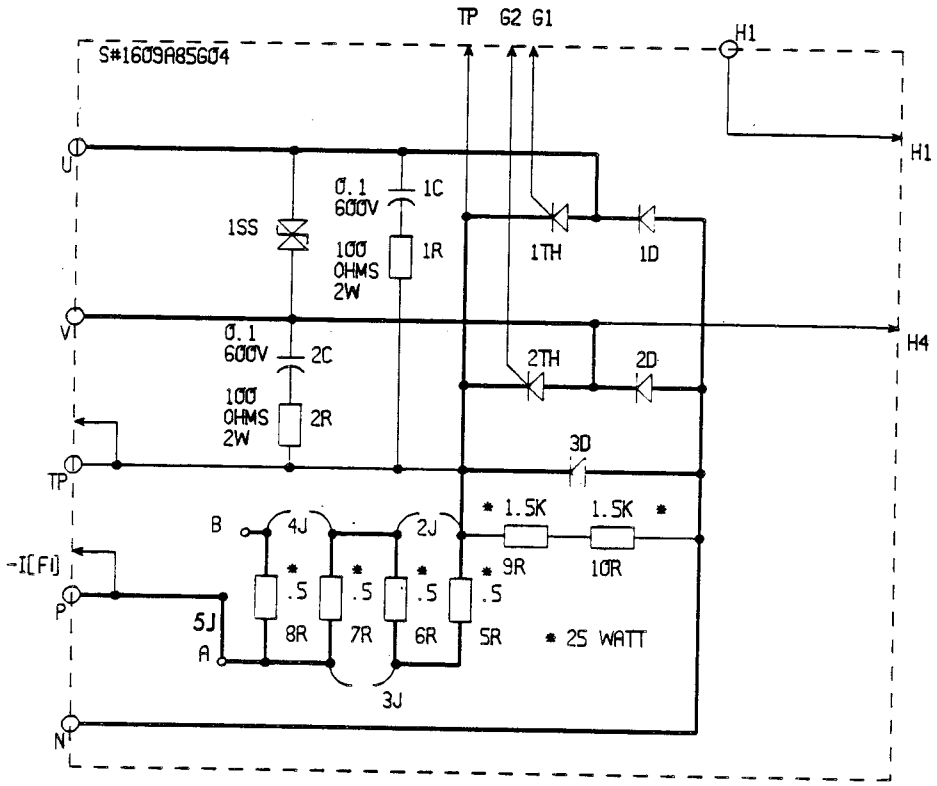

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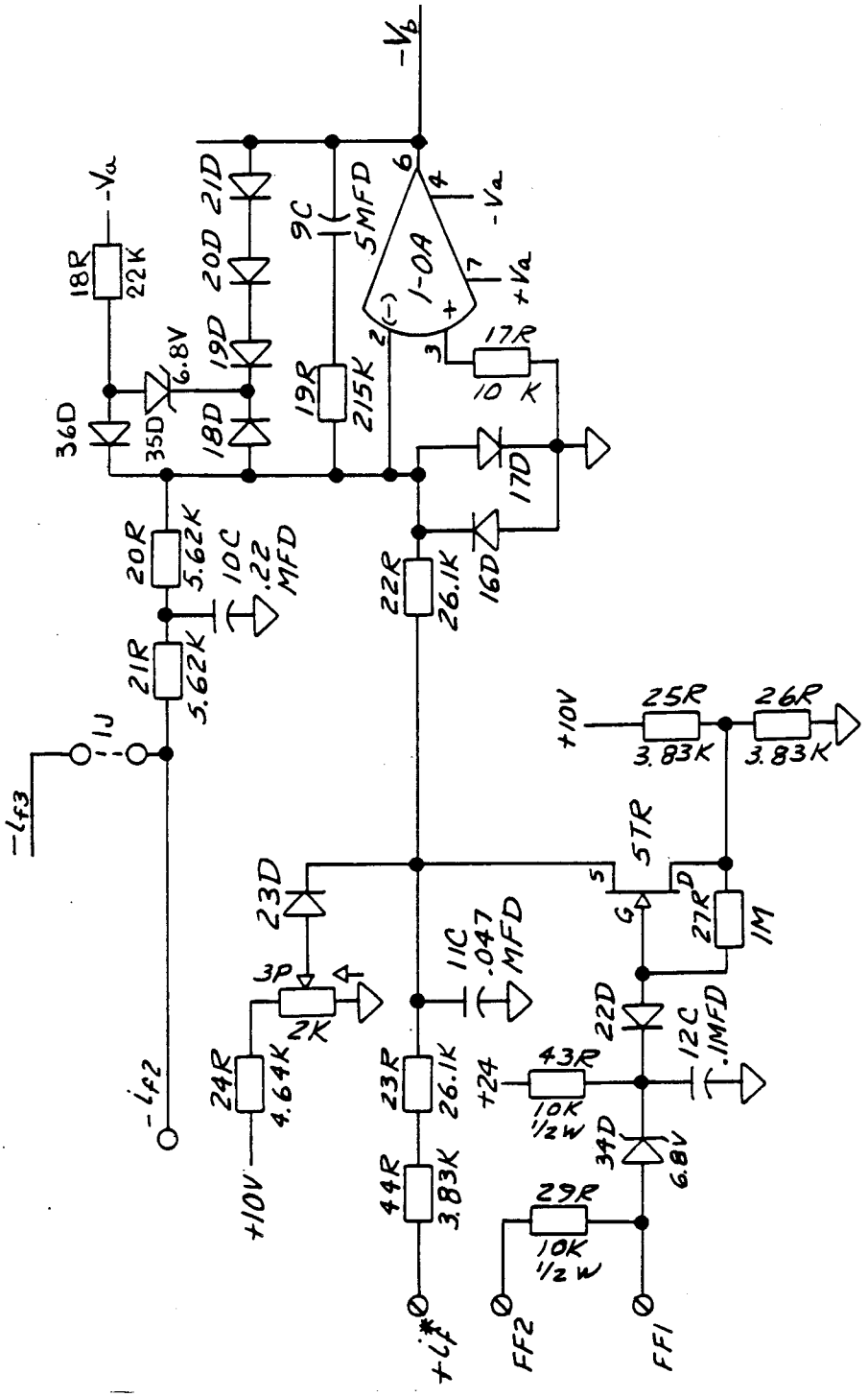

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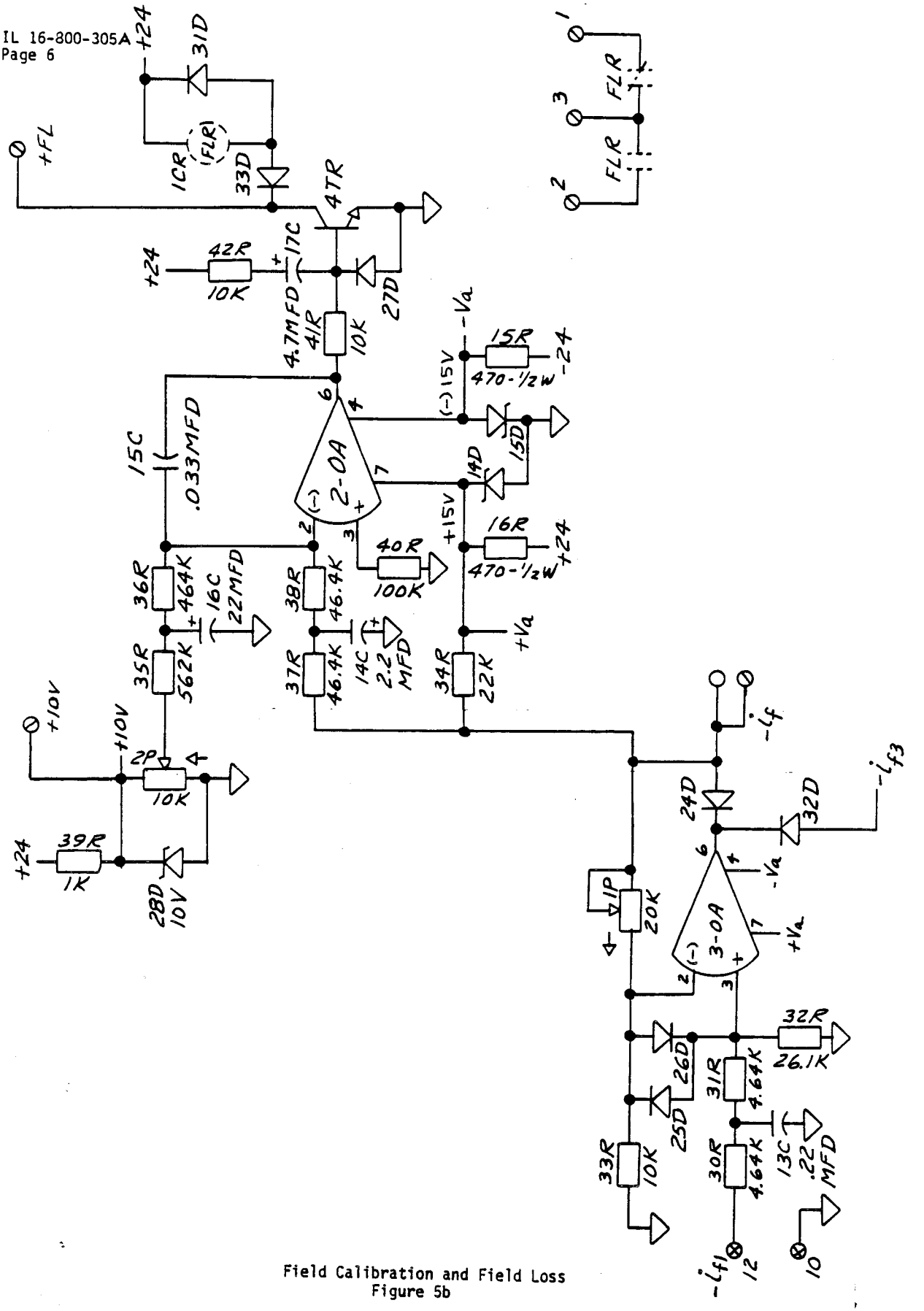

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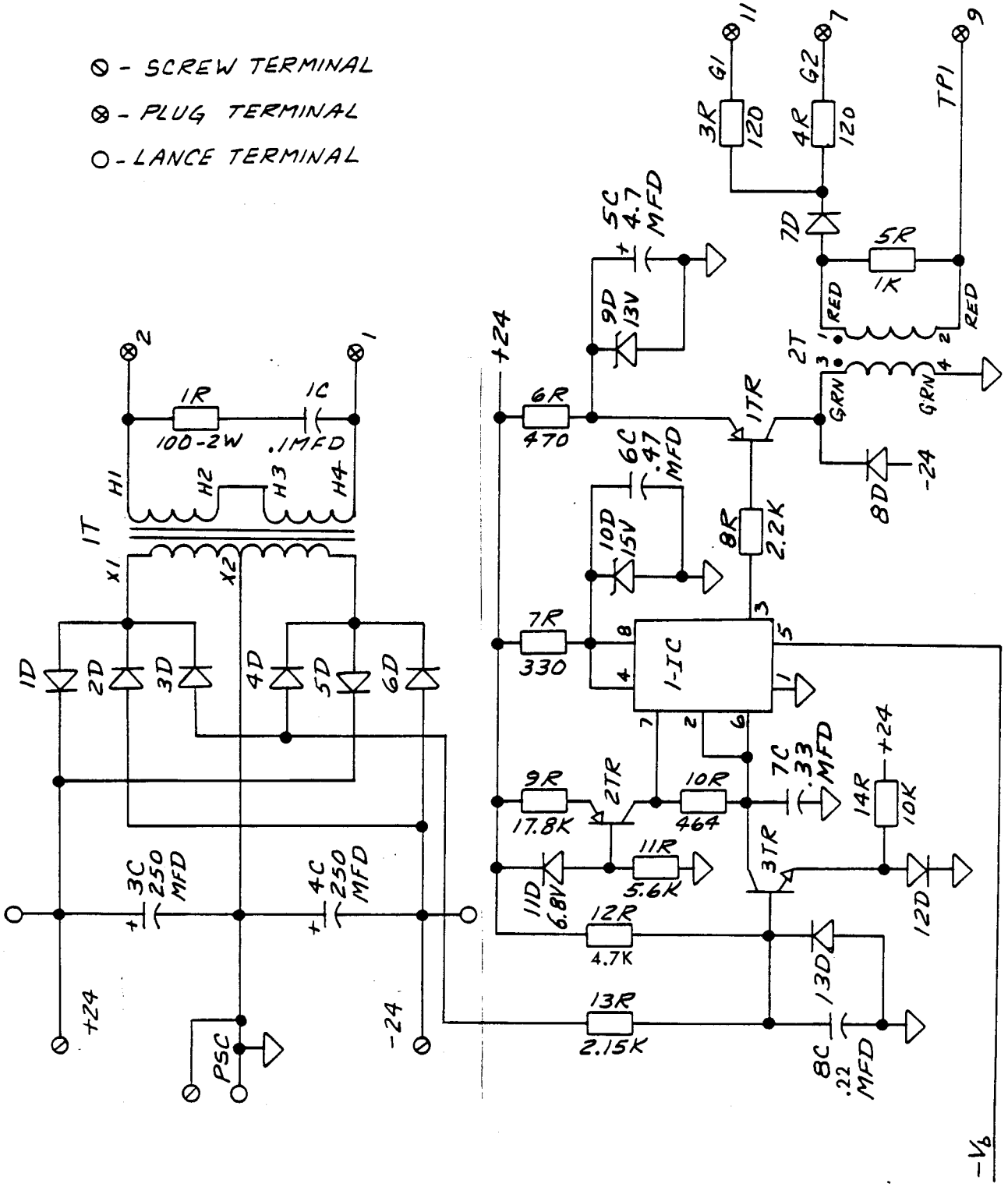

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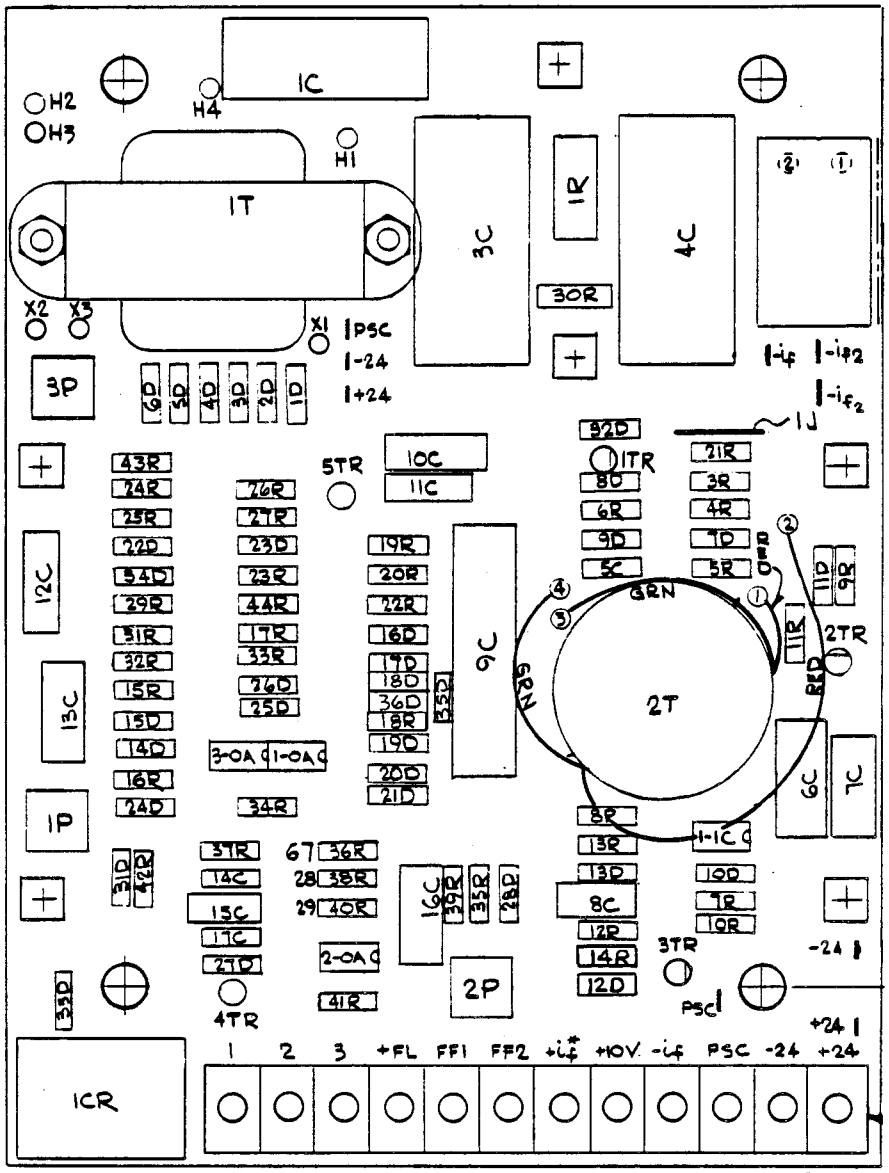

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