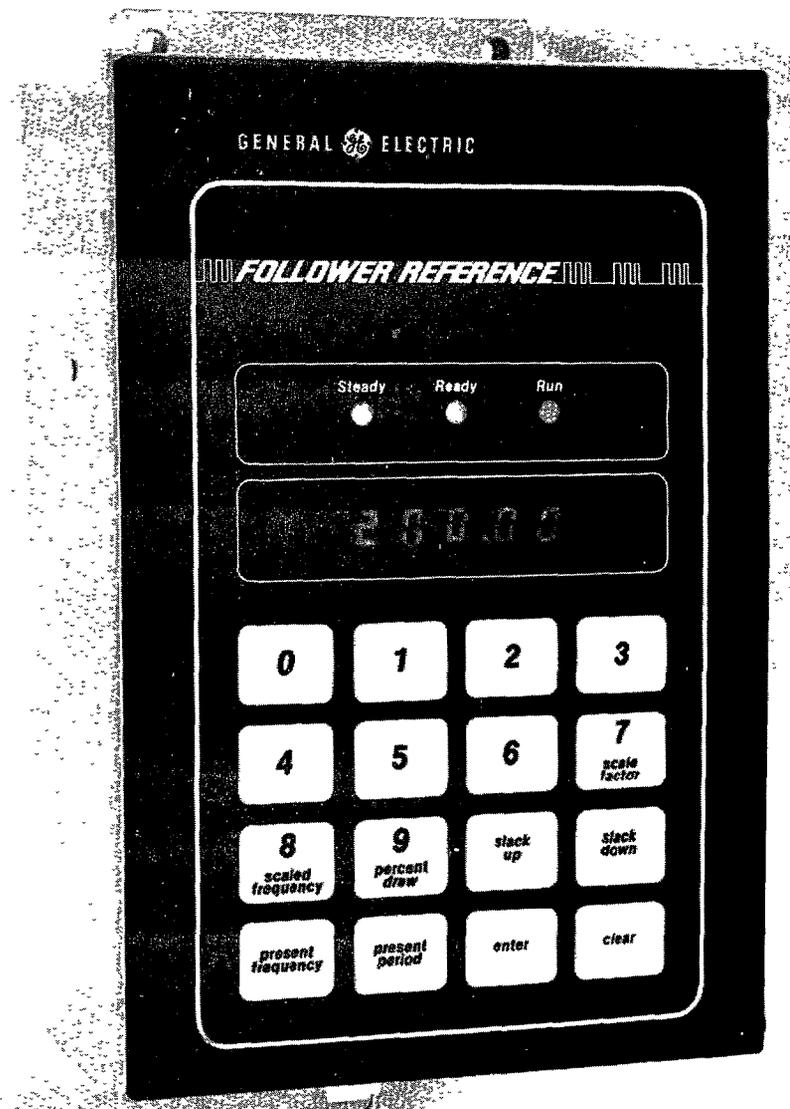


INSTRUCTIONS

Preliminary GEK-24978

FOLLOWER DIGITAL REFERENCE



These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to General Electric Company.

GENERAL  **ELECTRIC**



INSTRUCTIONS

Preliminary GEK-24978

ERRATA SHEET NO. 01

JULY 1982

PAGE 1

FOLLOWER DIGITAL REFERENCE

This Errata Sheet affects GEK-24978. It should be attached to that book and retained as a portion of it. The text of the original publication should be updated in accordance with the following information:

- Page 7

The statement: "To assist in local electrical code acceptance, U.L. listing for the unit is pending". should be changed to

"To assist in local electrical code acceptance, the unit is U.L. listed."

- Page 16

Figure 7 should be replaced by the attached.

- Page 29

Figure 14 should be replaced by the attached.

- Various pages:

References to 193X482AAGO1 should be changed to 193X482BAGO1.

References to 6VDFR10A1 should be changed to 6VDFR10B1.

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GENERAL  **ELECTRIC**

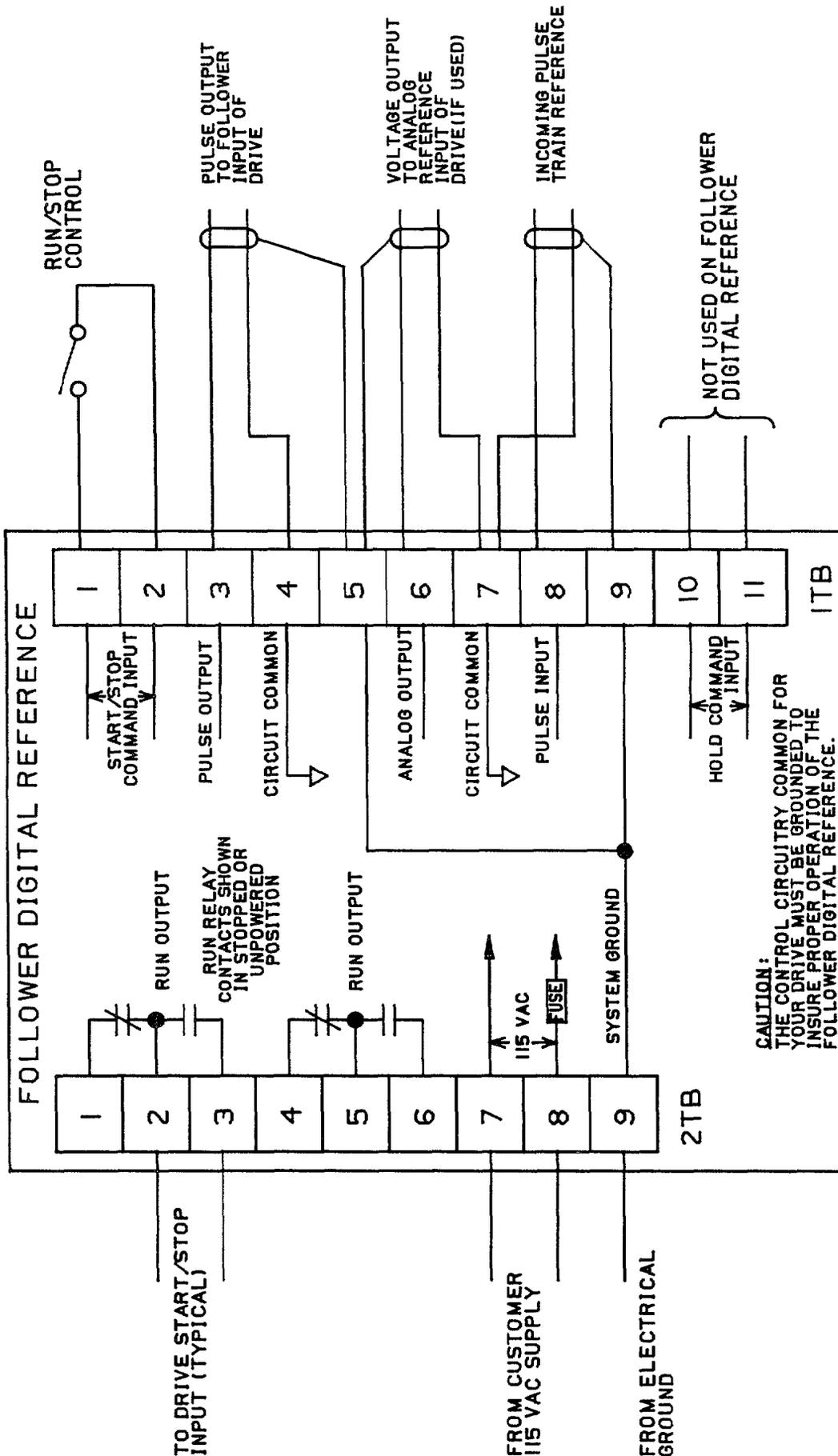


FIGURE 7
CONNECTION DIAGRAM FOR ITB AND 2TB

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GENERAL  **ELECTRIC**

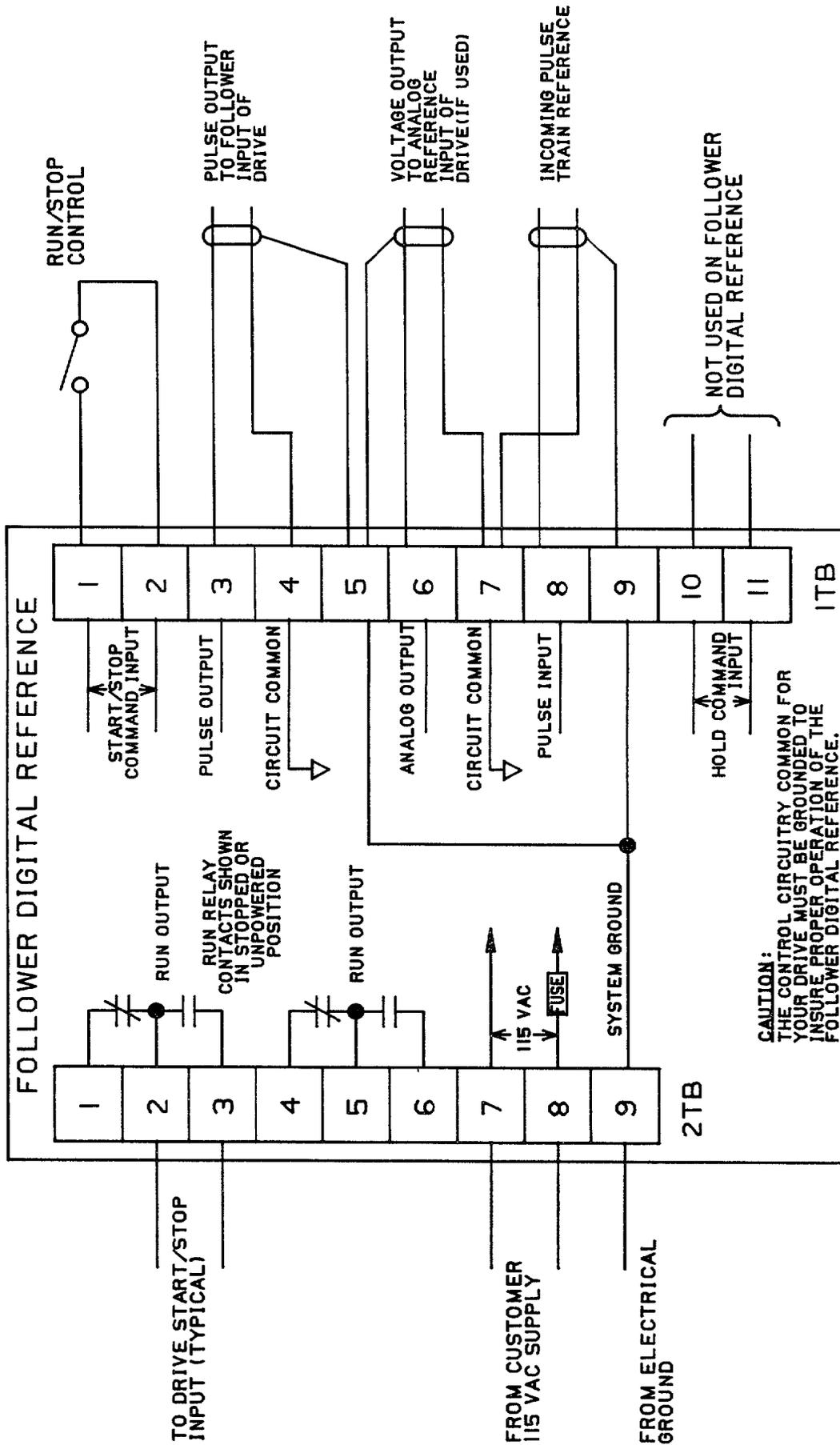
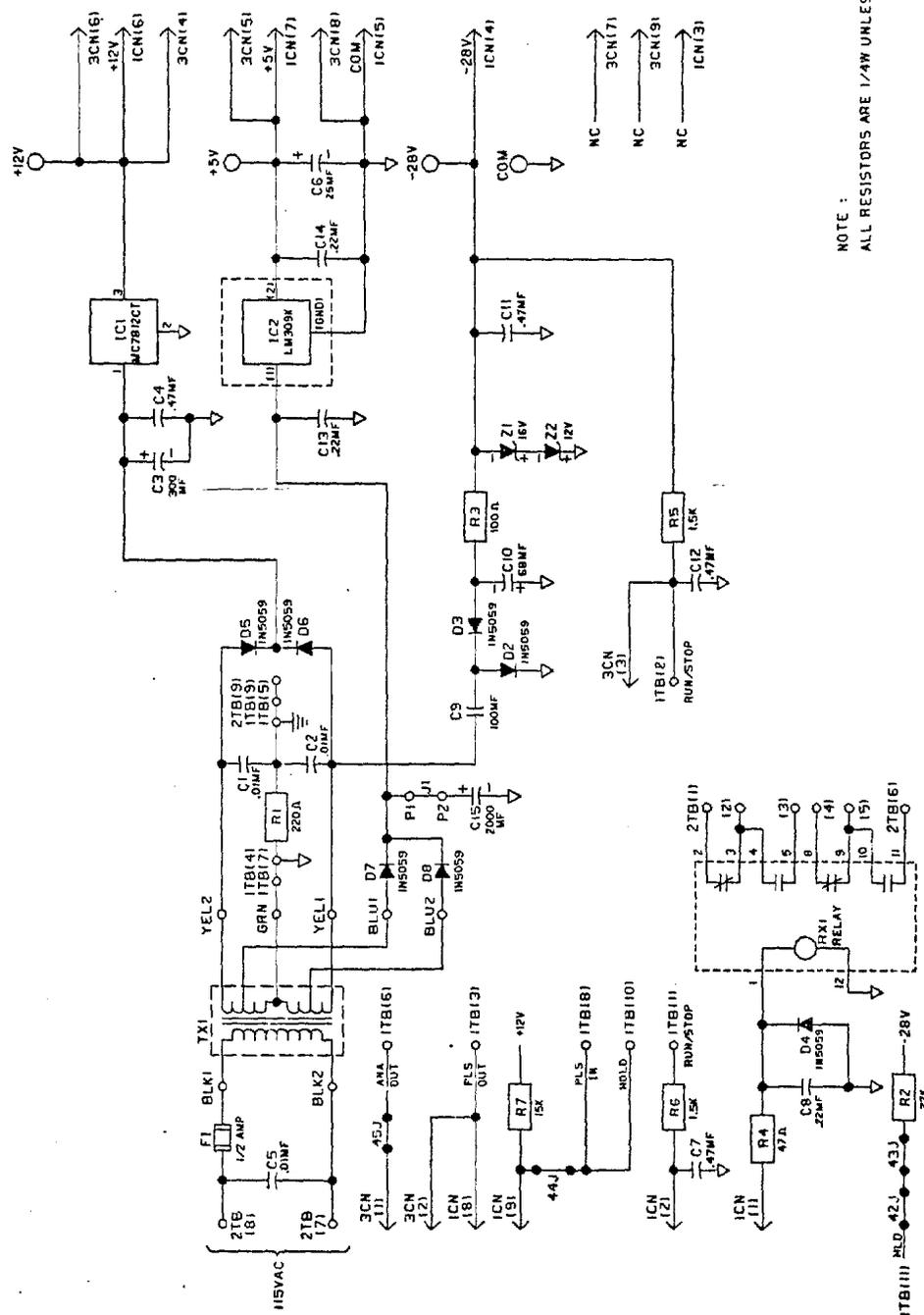


FIGURE 7
CONNECTION DIAGRAM FOR ITB AND 2TB



NOTE:
 ALL RESISTORS ARE 1/4W UNLESS OTHERWISE NOTED

REVNO 0

REVNO	DATE	BY	REVISIONS
501910	JAG/CO		
501210	SJ/WH		
501210	W/51-501		
501810	SE/AL		
501210	SP/15W		
501210	CA		

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INTRODUCTION AND DESCRIPTION

This instruction book contains the information needed to place the Follower Digital Reference into service. It contains specific details on the application, installation, operation, maintenance, and troubleshooting of this equipment. This book is intended for electrical technicians or engineers who possess an understanding of electronic terms and concepts.

SAFETY FOR PERSONNEL AND EQUIPMENT

The following paragraphs list some general safety reminders and safety recommendations to be followed when operating or installing this equipment.

WARNING

DENOTES OPERATING PROCEDURES AND PRACTICES THAT MAY RESULT IN PERSONAL INJURY OR LOSS OF LIFE IF NOT CORRECTLY FOLLOWED.

COLOR — BLACK OR WHITE LETTERING ON RED FIELD.

CAUTION

DENOTES OPERATING PROCEDURES AND PRACTICES THAT, IF NOT STRICTLY OBSERVED, MAY RESULT IN DAMAGE TO, OR DESTRUCTION OF, THE EQUIPMENT

COLOR — BLACK LETTERING ON AMBER FIELD.

NOTE

DENOTES AN OPERATING PROCEDURE OR CONDITION WHICH SHOULD BE HIGHLIGHTED.

WARNING

IMPROPER LIFTING PRACTICES CAN CAUSE SERIOUS OR FATAL INJURY. LIFT ONLY WITH ADEQUATE EQUIPMENT AND TRAINED PERSONNEL.

WARNING: HIGH VOLTAGE

ELECTRIC SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. WHETHER THE AC VOLTAGE SUPPLY IS GROUNDED OR NOT, HIGH VOLTAGE WILL BE PRESENT AT MANY POINTS. WHEN INSTRUMENTS ARE USED TO WORK ON LIVE EQUIPMENT, GREAT CAUTION MUST BE USED. WHEN ONE OF THE INSTRUMENT LEADS IS CONNECTED TO THE CASE OR OTHER METAL PARTS OF THE INSTRUMENT, ***THIS LEAD SHOULD NOT BE CONNECTED TO AN UNGROUNDED PART OF THE SYSTEM UNLESS THE INSTRUMENT IS ISOLATED FROM, GROUND AND ITS METAL PARTS TREATED AS LIVE EQUIPMENT.*** USE OF AN INSTRUMENT HAVING BOTH LEADS ISOLATED FROM THE CASE PERMITS GROUNDING OF THE CASE, EVEN WHEN MEASUREMENTS MUST BE MADE BETWEEN TWO LIVE PARTS.

WARNING

DO NOT SERVICE THE EQUIPMENT WHILE POWER IS APPLIED.

NOTE

ALWAYS READ THE COMPLETE INSTRUCTIONS PRIOR TO APPLYING POWER OR TROUBLESHOOTING THE EQUIPMENT. FOLLOW THE START UP PROCEDURE STEP BY STEP.

READ AND HEED ALL WARNING, CAUTION AND NOTE LABELS POSTED ON THE EQUIPMENT.

CAUTION

DO NOT REMOVE INPUT POWER FROM THE DRIVE UNTIL IT HAS FULLY EXECUTED A STOP SEQUENCE, AS THIS CAN DAMAGE THE DRIVE SYSTEM.

WARNING

SHOCK HAZARD. THIS EQUIPMENT CONTAINS A POTENTIAL HAZARD OF ELECTRICAL SHOCK OR BURN. ONLY PERSONNEL WHO ARE ADEQUATELY TRAINED AND THOROUGHLY FAMILIAR WITH THE EQUIPMENT AND THESE INSTRUCTIONS SHOULD INSTALL, OPERATE, OR SERVICE THIS EQUIPMENT.

FUNCTIONAL DESCRIPTION

The Follower Digital Reference, pictured in Figure 1, is designed to provide a precise reference pulse train output which is locked in frequency to an incoming pulse train. The ratio between the output and input pulse train frequencies, hereafter referred to as percent draw, may be set by the user anywhere in the range from 50.00 to 200.00%. The intended application of the Follower Digital Reference is in coordinated adjustable speed drive systems where two or more motors must be operated at precisely coordinated speeds. In such a system, one drive would be considered the master unit and would be controlled by a master reference such as the Master Digital Reference (described at the end of this section). The rest of the drives would be follower or slave units and would consist of a Follower Digital Reference set for the desired percent draw and an AC or DC adjustable speed drive with control circuit capable of following a digital pulse speed (or frequency) command signal. Typical applications are illustrated in Figure 2.

The Follower Digital Reference is compatible with a variety of adjustable speed drives manufactured by the Speed Variator Products Operation of General Electric Company. Further details may be obtained by consulting the Speed Variator Products Operation or your local General Electric representative:

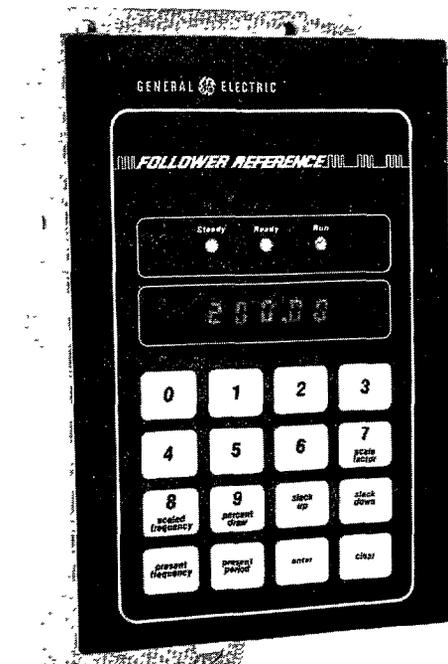


FIGURE 1

Perspective view of Follower Digital Reference

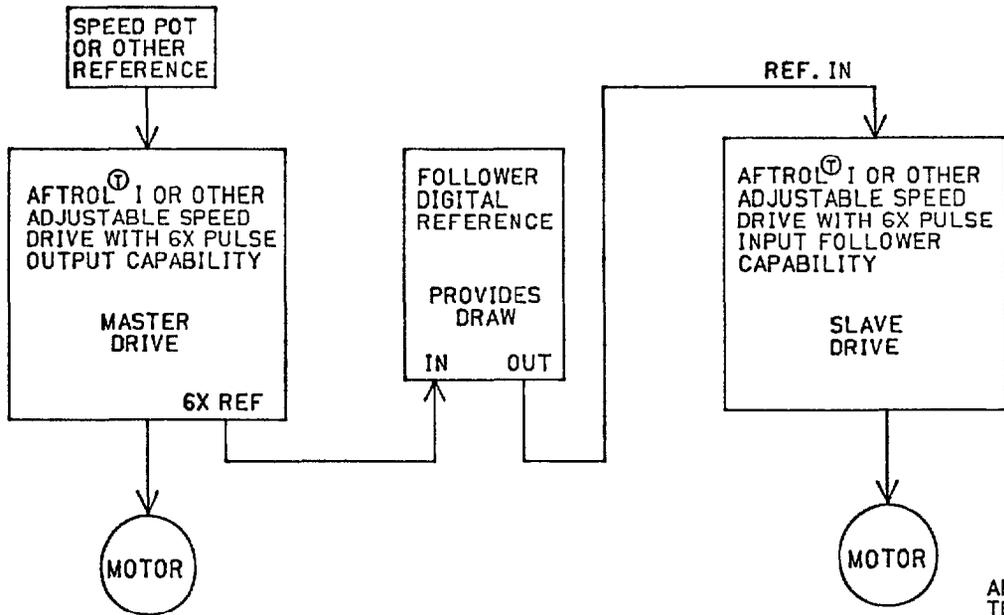
The front panel of the Follower Digital Reference, as shown in Figure 3, contains a keypad and numeric display for entry and readout of the two user programmable operating parameters, percent draw and scale factor, and to allow readout of the present pulse output frequency or period, or scaled frequency. Scale factor is used in conjunction with the scaled frequency readout to give a readout that is the product of the scale factor and the present frequency. This is useful in certain processes for direct readout of process units such as "feet per second" or "gallons per minute". Readout of present frequency, present period, or scaled frequency is available at any time on the display. Because the Follower Reference is designed primarily for use with three-phase AC drives which require a reference pulse at six times the drive output frequency, the pulse train output frequency is actually six times the displayed frequency. Invalid keypad entries are identified by displaying descriptive messages to aid the operator in proper use.

To enhance the reliability of the display, it will automatically blank after 35 seconds if there are no keypad inputs and the input pulse train frequency remains constant. During transitions, the display will automatically readout either present frequency or present period, depending on the setting of an internal jumper.

Another internal jumper is provided which may be removed to disable entry of percent draw changes. This may be used to prevent unauthorized or accidental reprogramming of this parameter after initial set-up.

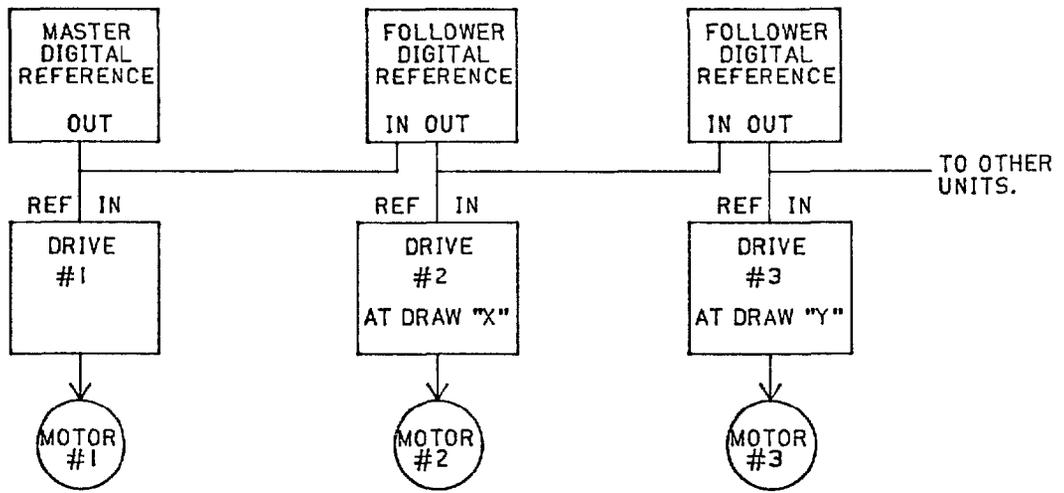
The pulse output frequency is generally always locked at the desired draw to the incoming pulse train provided the frequencies are within the required maximum and minimum limits. The output can follow ramps in the incoming pulse frequency with no slip in the draw ratio provided the ramp rate does not exceed the internally limited ramp rate. This internal limit is non-adjustable and protects the output from step changes in response to step changes in the input or changes to the percent draw setting.

Two keys are provided on the keypad to allow momentary override of the programmed percent draw. While the SLACK-UP key is depressed, the pulse output frequency will increase slightly above normal to allow process material take-up. Likewise, the SLACK-DOWN key allows a momentary decrease in frequency.



AFTROL IS A TRADEMARK OF GENERAL ELECTRIC COMPANY, USA.

A) USING A DRIVE AS THE REFERENCE TO THE FOLLOWER. SLAVE DRIVE FOLLOWS MASTER.



B) CASCADING MASTER AND FOLLOWER DIGITAL REFERENCES. EACH DRIVE FOLLOWS THE REFERENCE FROM THE PRECEEDING STAGE. DRIVES MAY BE ANY CAPABLE OF FOLLOWING THE PULSE OR VOLTAGE OUTPUT REFERENCES PROVIDED.

FIGURE 2
Typical applications of Follower Digital Reference

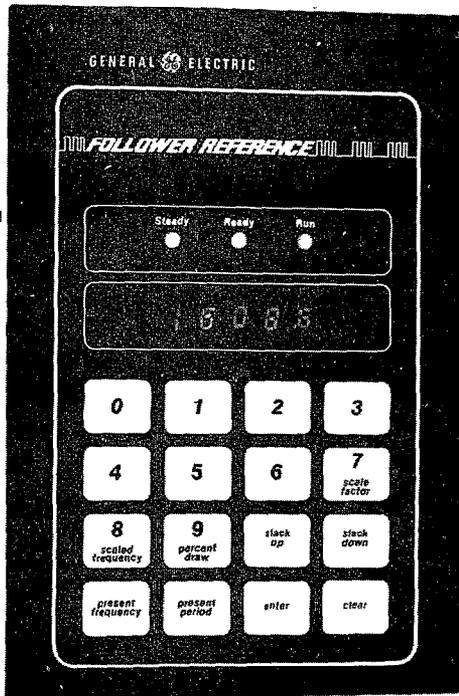


FIGURE 3
Front view of Follower Digital Reference showing Keypad, Display and Status Leds.

The Follower Digital Reference enclosure is oil resistant, totally enclosed, and non-ventilated which is suitable for most industrial environments. Provision is made on the enclosure for either wall or panel mounting. To assist in local electrical code acceptance, UL listing for the unit is pending.

An option (order option kit #6VFVR10A1) is available for use with the Follower Digital Reference which provides a DC output voltage with an amplitude that is proportional to the pulse output frequency. This option is described within this instruction book.

Also available is a companion unit (order model 6VDMR10A1) called the Master Digital Reference, which may be used to provide the incoming pulse train required by the Follower Digital Reference. The Master Digital Reference is designed to provide a precise reference pulse train with a frequency and ramp rate set by a keypad. Refer to instruction book GEK-24977 for details on installation and use of this unit.

A pair of START/STOP terminals and an internal RUN relay are provided to coordinate the Follower Reference with the controlled drive and the master control station. When the START/STOP terminals are connected together through an external switch or relay, the RUN relay with its two form "C" contacts is energized. At the same time, a red RUN LED status indicator will light. When the START/STOP terminals are open, the RUN is deenergized and a green READY LED status indicator is lit. The START/STOP terminals do not affect the pulse train output frequency. The RUN relay is used to provide a start/stop command for the drive being controlled by the Follower Digital Reference. A third status LED, the amber STEADY indicator is lit when pulse output frequency is not changing.

The unit is powered from a standard 115V AC supply. When power is removed from the unit, percent draw and scale factor are stored in a special memory device capable of retaining these settings even in the absence of power. When power is re-applied, the previous settings will still be in effect until changed by new keypad inputs.

SPECIFICATIONS

The Follower Digital Reference, model 6VDFR10A1, may be ordered as either of two model variations, depending on whether it is desired to have automatic readout of the output pulse in units of period. Unless specifically ordered otherwise, the unit will be shipped as a Follower Frequency Reference. The Follower Frequency Reference may be converted to a Follower Period Reference by removing jumper J1 on the microprocessor card as described in FINAL INSPECTION.

The option kit, 6VFVR10A1, may be used with either model variation to provide a DC voltage output proportional to pulse frequency output. Specifications of these units are given below.

ENVIRONMENTAL SPECIFICATIONS

Ambient operating temperature	0 to +50°C
Ambient storage temperature	-20 to +70°C
Operating and storage relative humidity	0 to 90%
Operating and storage altitude	Sea Level to 3300 ft.
Enclosure	TENV
Mounting	Wall or flush

INCOMING PULSE TRAIN REQUIREMENTS

Low level voltage range	-.7V to +.7V, 1mA
High level voltage range	2.4V to 16V, .2mA
Minimum low level pulse duration	40us
Minimum high level pulse duration	415us
Frequency range (actual)	0 to 2100 Hz
Frequency range (drive fundamental)	0 to 350 Hz
Maximum frequency, square wave input (actual)	1200 Hz

OTHER INPUT REQUIREMENTS

Power requirements	115V AC $\pm 10\%$, 50/60 Hz, 1/4 Amp
Power interruption ride-through, maximum	5 cycles at 60 Hz
Internal fault interrupter	1/2 Amp, type 3AG SLO-BLO pigtail fuse
Customer supplied START/STOP contact rating	28V DC, 5mA

OUTPUTS SUPPLIED

Inverted pulse train reference
DC voltage reference (by option only)
RUN relay with 2 form "C" contacts

PULSE OUTPUT SPECIFICATIONS

Minimum high level voltage at 2mA maximum loading	9.75V
Maximum low level voltage at 10mA maximum loading	0.7V
Maximum high level voltage	12.5V
Low level pulse width	50 us
Maximum pulse width jitter	-0, +35 us
Maximum pulse position jitter	±18 us
Average pulse frequency resolution	.01%
Fundamental frequency range (Pulse frequency 6 times fundamental)	.6 to 339 Hz
Maximum long term drift between input and output	.01% per day
Temperature stability	.01% from 0-50°C
Maximum cable length on output	300 ft.
Percent Draw Range	50.00 to 200.00%

VOLTAGE OUTPUT SPECIFICATIONS

(for option kit 6VFVR10A1)

Voltage range at 10mA maximum loading	0 to 5V
Maximum voltage output	12.5V
Fundamental frequency output at 5V voltage output (Selectable by internal jumper and V/Hz trim pot)	80, 160, 320 or 640 Hz
Regulation	.25%
Linearity error	1%
Ripple	0.1% to 1%

OTHER SPECIFICATIONS

RUN relay contact maximum rating	125V AC, 30V DC, 1 amp
RUN relay contact minimum rating	5V AC, or DC, 1mA
Accuracy of displayed present frequency or period	±.3% or ±1 digit, (whichever is larger)
Scaled frequency display range in % of fundamental	0.0 to 999.9%
Unpowered parameter retention time	10 years
Maximum allowable parameter reprogramming cycles	10,000
Minimum display auto-blanking time	35 sec.
Keypad contact debounce time	200ms
Electrical terminations	15 Amp terminal strip
Dimensions excluding mounting flanges	10.5"H x 7.1"W x 4.2"D

HANDLING AND INSTALLATION

RECEIVING AND STORAGE

The equipment should be placed under adequate cover immediately upon receipt. Each shipment should be carefully examined upon arrival and checked with the packing list. Any shortage or damage should be reported promptly to the carrier. If required, assistance may be obtained from General Electric Company, Speed Variator Products Operation, Erie, Pa 16531. When seeking assistance, please use the model and serial numbers to identify the equipment. The telephone number is (814) 455-3219

If the equipment is not to be installed immediately, it should be stored in a clean, dry location at ambient temperatures between -20°C and 70°C (-4°F and 158°F) and relative humidities less than 90%. The surrounding air should be free of chemical, corrosive, or electrically conductive contaminants.

CAUTION

CAPACITOR DEFORMING. THIS EQUIPMENT USES ELECTROLYTIC CAPACITORS, AN ELECTRONIC DEVICE WHICH IS SUBJECT TO A PROCESS KNOWN AS DEFORMING WHICH OCCURS AS A FUNCTION OF TIME AND TEMPERATURE WHEN DEENERGIZED. A DEFORMED CAPACITOR MAY FAIL WHEN POWER IS APPLIED TO IT, UNLESS IT IS REFORMED BY A GRADUAL APPLICATION OF VOLTAGE TO EACH CAPACITOR IN THE ASSEMBLY. EQUIPMENT SHIPPED FROM THE FACTORY SHOULD HAVE A SHELF LIFE OF AT LEAST 3 YEARS AT 25°C BEFORE REFORMING IS NECESSARY. CONTACT THE SPEED VARIATOR PRODUCTS OPERATION FOR ANY ADDITIONAL INFORMATION.

INSTALLATION LOCATION

The Follower Digital Reference is suitable for most factory areas where other industrial equipment is installed. The unit is designed to operate reliably in non-ventilated areas with ambient temperatures up to 50°C (122°F) and relative humidities up to 90%. As with most electronic equipment, however, longer component life can be expected if these extreme conditions are avoided.

The totally enclosed, non-ventilated, cabinet of the Follower Digital Reference is oil and dust resistant and will protect the internal electronics from moderately poor environments. For best service, however, the unit should be installed where it will be protected from:

- o Dirt, dust and other particulates
- o Vibration and shock
- o Extremes of temperature or fluctuating temperature
- o Moisture and corrosive vapors or fumes

WARNING

FIRE SAFETY. THIS UNIT IS NOT DESIGNED FOR INSTALLATION IN HAZARDOUS LOCATIONS WHERE COMBUSTIBLE VAPORS OR DUSTS ARE PRESENT.

CAUTION

RF INTERFERENCE. RADIO TRANSMITTERS GENERATE ELECTROMAGNETIC WAVES WHICH MAY CAUSE NEARBY ELECTRONIC EQUIPMENT TO MISOPERATE. IT IS RECOMMENDED THAT THIS UNIT BE INSTALLED IN AN AREA WHERE FIXED OR PORTABLE TRANSMITTERS ARE NOT LIKELY TO BE OPERATED IN THE IMMEDIATE VICINITY.

The Follower Digital Reference should be installed in an easily accessible location where the front keypad and display can be conveniently viewed and reached. The unit must be located such that the total length of all wires connected to the pulse output terminal does not exceed 300 feet.

MOUNTING

The Follower Digital Reference is designed to be either surface or flush (panel) mounted. Holes are provided in the enclosure to accept conduits or other fittings. The suggested conduit connector is a Thomas and Betts No. 5333 connector for 3/4" liquid tight flexible conduit or a No. 371 connector for 3/4" rigid metal conduit. In either case use a No. 5303 "O" ring between the connector and box to maintain the enclosure seal.

To mount, remove the cover by unscrewing the four screws in each corner and carefully lifting the cover off. Take care not to damage the printed circuit card mounted to the back of the cover or the interconnecting cables.

CAUTION

STATIC SENSITIVITY. THIS UNIT USES ELECTRONIC COMPONENTS WHICH MAY BE DESTROYED BY DISCHARGES OF STATIC ELECTRICITY. DRY ENVIRONMENTS, CARPETED AREAS, AND SYNTHETIC OR WOOL CLOTHING AGGRAVATE THE BUILD-UP OF STATIC CHARGES ON THE BODY. TO PREVENT DAMAGE TO THE FOLLOWER DIGITAL REFERENCE, DO NOT TOUCH THE CIRCUITRY OR COMPONENTS ON THE CARD MOUNTED TO THE COVER.

To disconnect the cover, grasp the ribbon cable connector at the power supply card inside the enclosure and pull straight off with a steady force. Mentally note the orientation for ease in reinstalling. Remove the cover grounding wire and lay the cover assembly aside where it will be protected from damage and static electricity. Refer to Figure 4 for details.

The recommended wiring method is to use the conduit opening near terminal strip 1TB to feed wires to 1TB and use the conduit opening near terminal strip 2TB to feed wires to 2TB. For bottom entry, the enclosure may be mounted upside down since the cover will mount either way.

For wall mounting, mounting flanges are provided on the outside of the enclosure. For flush mounting, a rectangular panel cutout 8-3/4" x 5-5/8" is required with the box mounting behind the panel and cover seal in front. There are eight inserts in the lip of the enclosure for #10 - 32 screws. Flat head screws may be used to fasten the enclosure to the panel using the four box inserts not used to fasten the cover to the enclosure. Figure 6 shows dimensions required to lay out the cutout and eight holes.

CONNECTIONS

The following wiring must be provided to the Follower Digital Reference.

- | | |
|-------------------------------|--|
| 1. 115V AC and grounding wire | - 3 conductor #14 AWG |
| 2. Start/Stop Control Input | - 2 conductor #18 AWG twisted pairs |
| 3. Pulse Input | - 2 conductor #18 or larger shielded cable |
| 4. Run Control Output | - 2 to 6 conductor #18 AWG twisted pairs as required |
| 5. Pulse Output | - 2 conductor #18 or larger shielded cable |
| 6. Voltage output (if used) | - 2 conductor #18 or larger shielded cable |

Suggested wire is Belden type 8460 twisted pair or type 8760 or 8719 shielded cable.

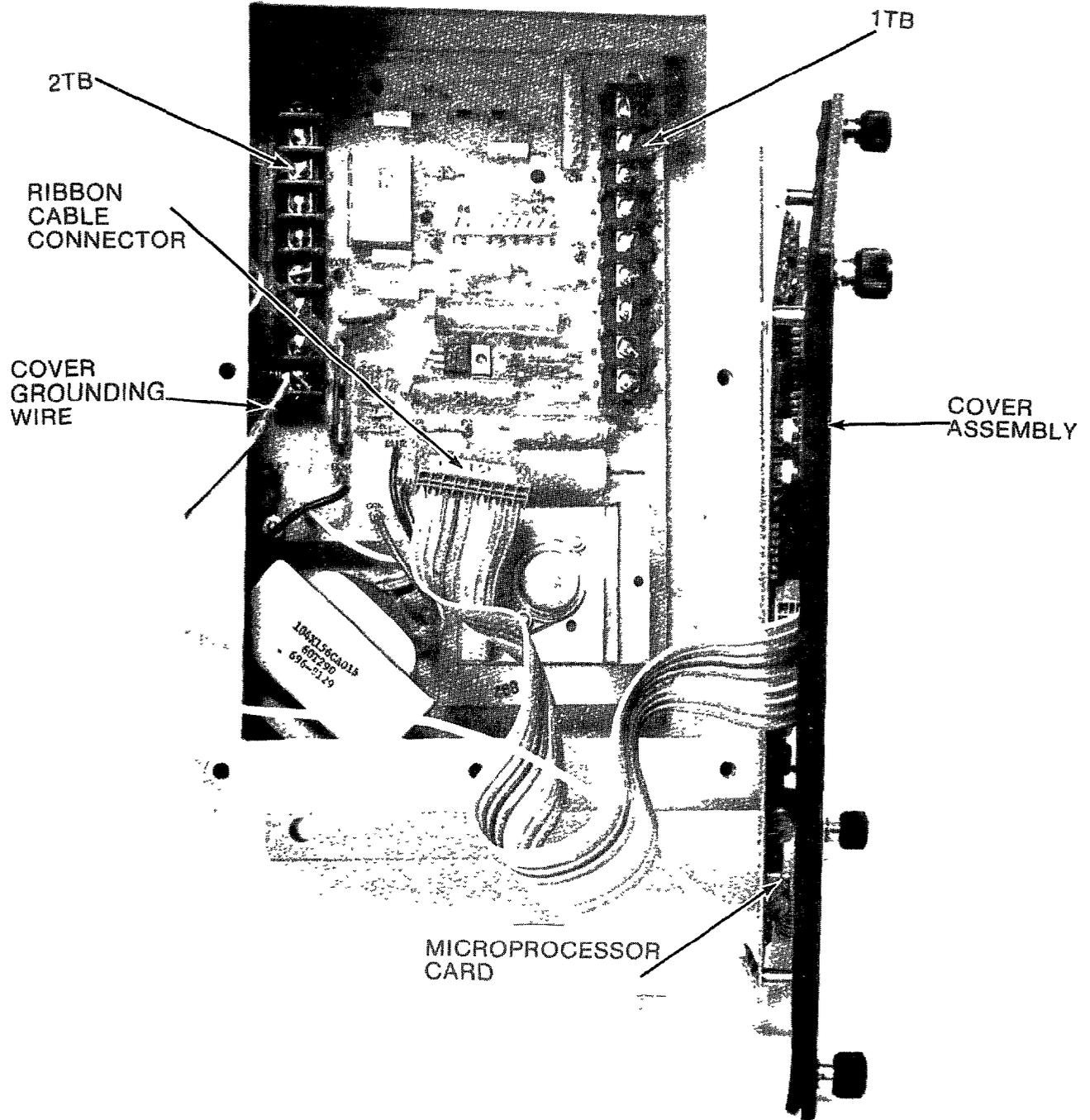


FIGURE 4
Disconnecting the cover and view of all cards and parts

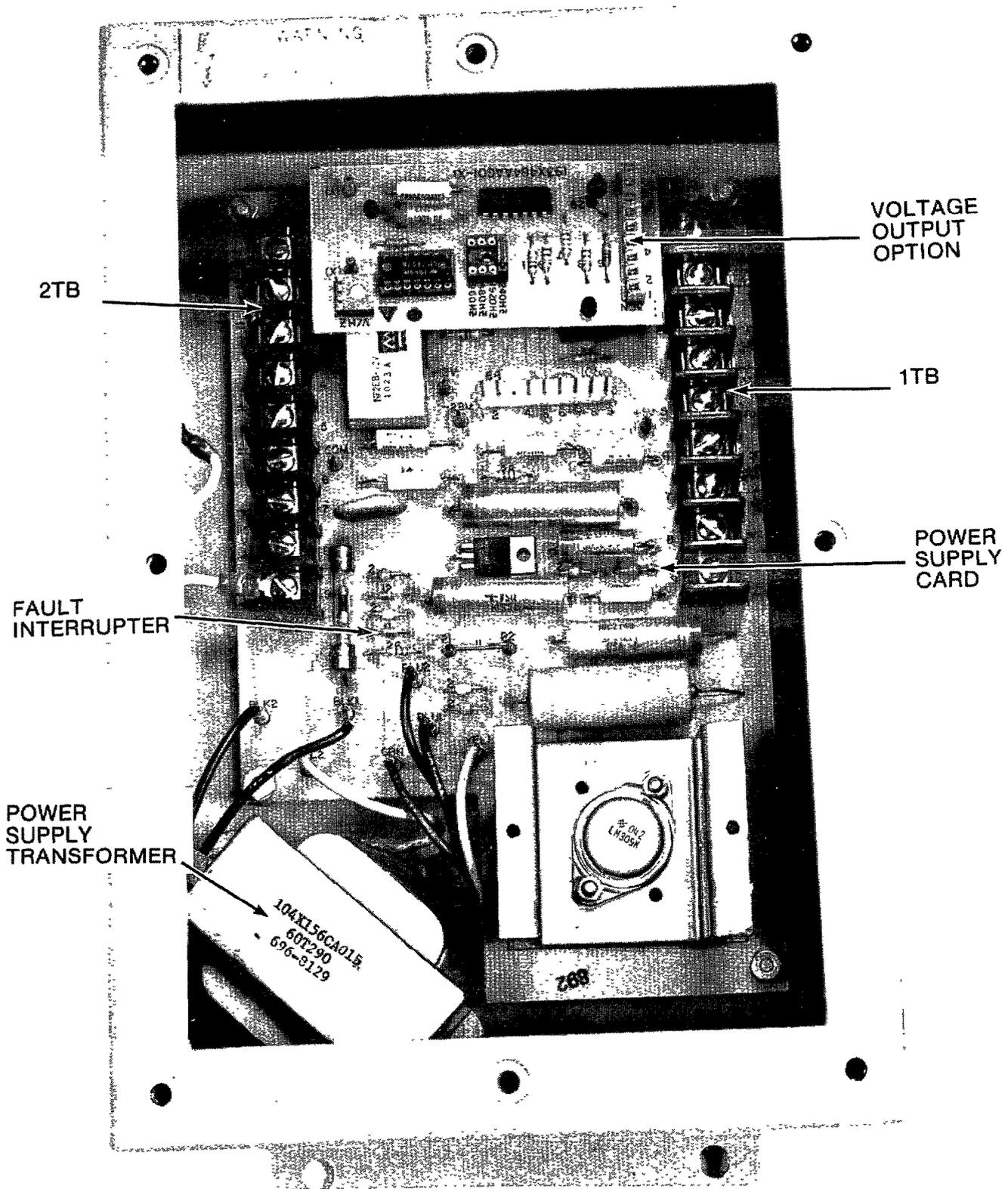


FIGURE 5
View of unit interior

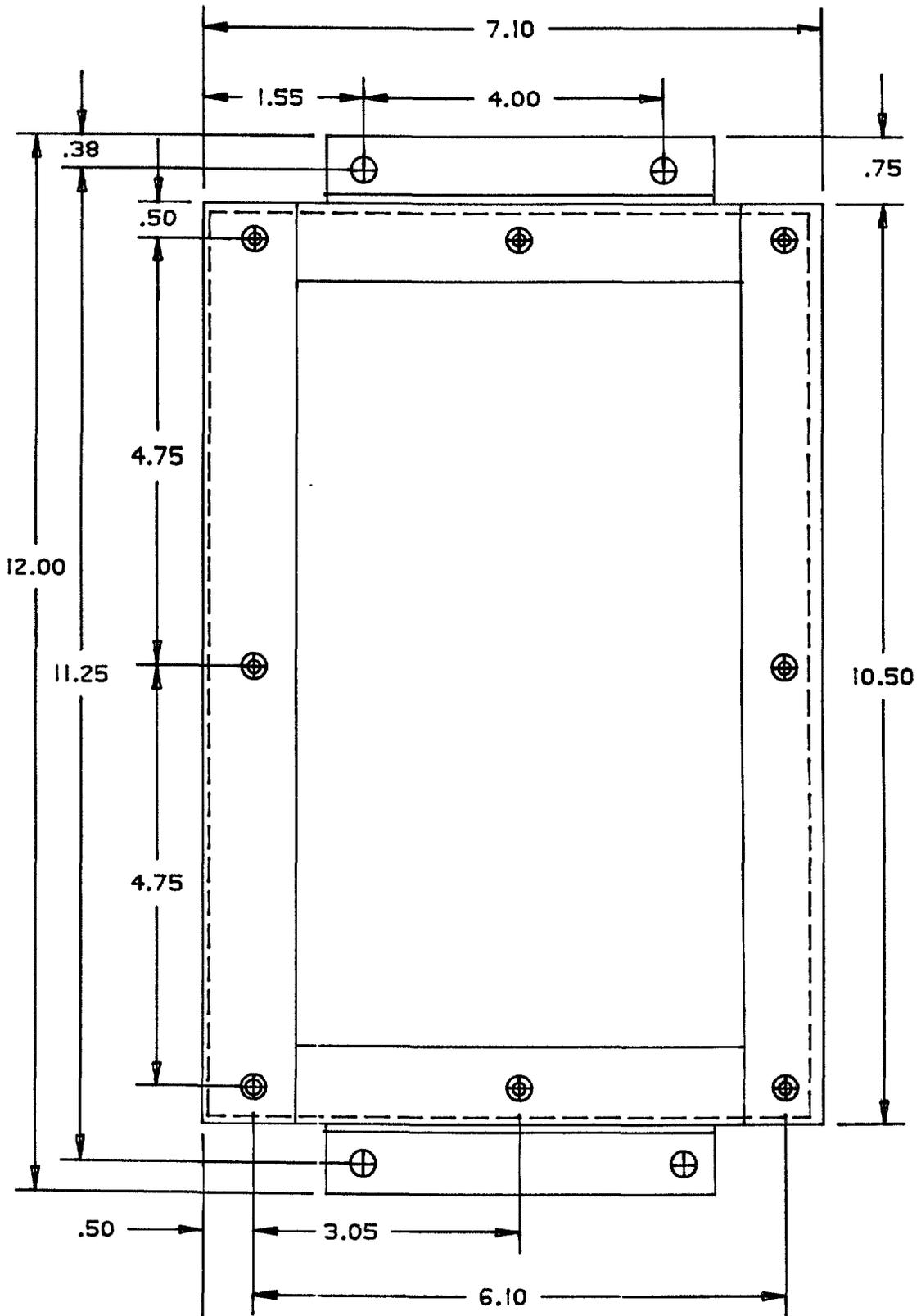


FIGURE 6
 Dimensions of unit, location of mounting holes

For short distances, twisted pairs may be used in place of the shielded cable. If shielded wire is used, the shield should be terminated to ground at only one end, preferably at the Follower Digital Reference. The wiring may be placed in a common conduit provided all wires are insulated for the maximum voltage of any conductor (300V minimum) and only wires functionally associated with the equipment are in the conduit. Care should be taken to see that all interconnecting wiring is sized and installed in accordance with the latest edition of the National Electrical Code and all applicable local codes.

CAUTION

EM INTERFERENCE. NEARBY RELAYS AND SOLENOIDS CAN CAUSE ERRATIC OPERATION OF THE FOLLOWER DIGITAL REFERENCE AND NEARBY DRIVE EQUIPMENT DUE TO ELECTRICAL TRANSIENTS. TO ELIMINATE THIS POSSIBILITY, AN RC SUPPRESSOR SHOULD BE ADDED ACROSS THE COILS OF THESE DEVICES. A 220 OHM 2 WATT RESISTOR IN SERIES WITH 0.5 uf, 600 VOLT CAPACITOR CAN BE USED IN 115V AC OR 230V AC CIRCUITS. CONTACT THE FACTORY FOR OTHER SUPPRESSOR RECOMMENDATIONS.

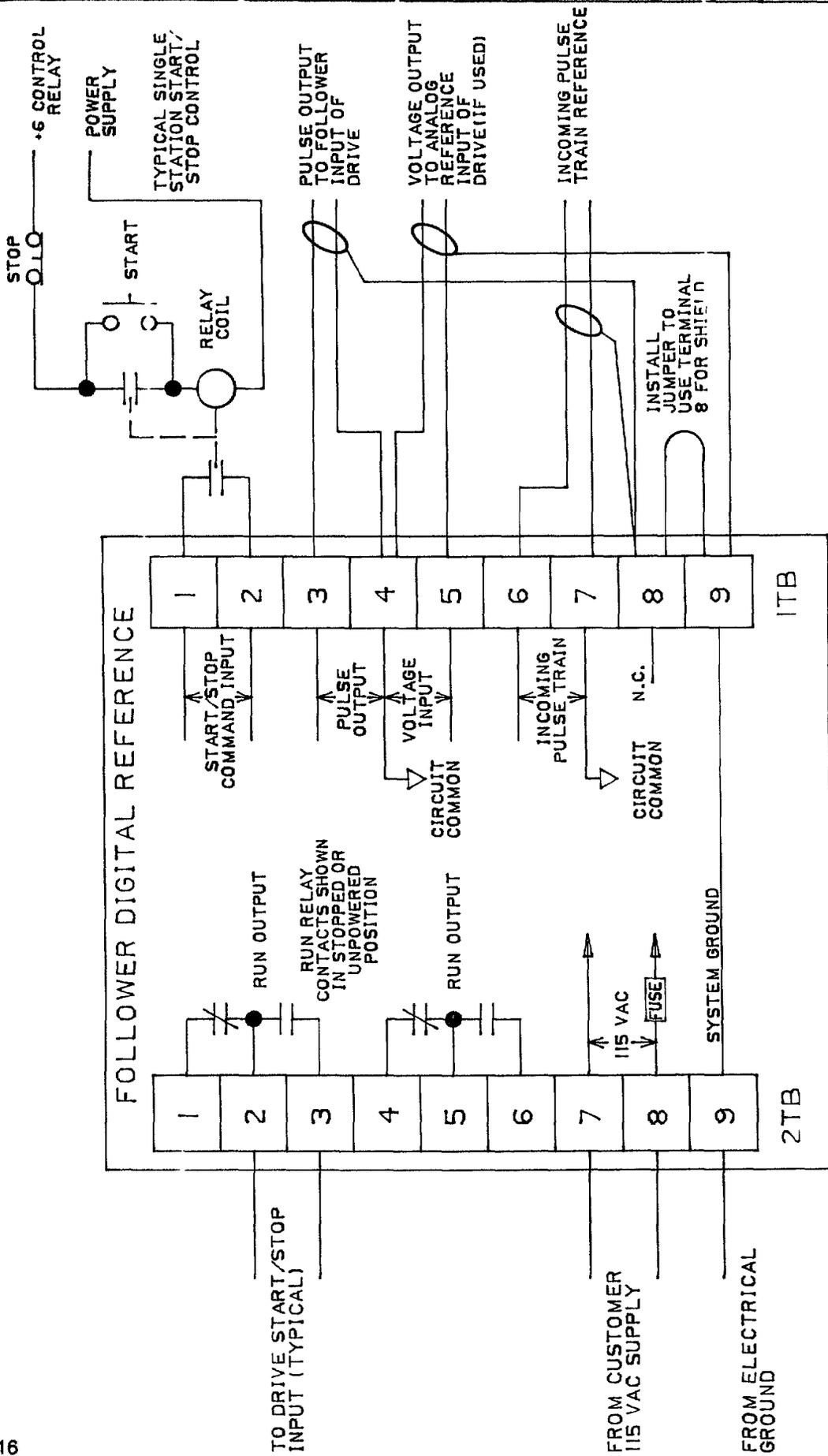
Be sure power is disconnected from all power supply and control wires before wiring. Wire terminal boards 1TB and 2TB according to the connection diagram in Figure 7. Consult the instruction book for your adjustable speed drive control for information on connecting the pulse or voltage outputs and RUN contacts to your system.

CAUTION

GROUNDING. THE CONTROL CIRCUITRY COMMON FOR YOUR DRIVE MUST BE GROUNDED TO INSURE PROPER OPERATION OF THE FOLLOWER DIGITAL REFERENCE. CONTACT THE FACTORY FOR INFORMATION ON OPERATION WITH A DRIVE THAT REQUIRES A COMMON ISOLATED FROM EARTH GROUND.

INSTALLATION OF OPTION KIT, 6VFVR10A1

If the option kit 6VFVR10A1 is ordered as a field modification to provide a voltage output in addition to the pulse output, it should be installed at this time. The kit consists of a frequency to voltage card (part No. 193X484AAG01) which plugs into connector 3CN on the power supply card using two snap-in mounting posts. Insert the mounting posts into the two holes on the power supply located to the left of connector 3CN (see Figure 10). Then align the frequency to voltage card with posts and connector pins and plug the card in until it seats on the posts as shown in Figure 10.



CAUTION:
 THE CONTROL CIRCUITRY COMMON
 FOR EQUIPMENT CONNECTED TO THE
 FOLLOWER DIGITAL REFERENCE MUST
 BE GROUNDED.

FIGURE 7
 Customer connection diagram for the Follower Digital Reference

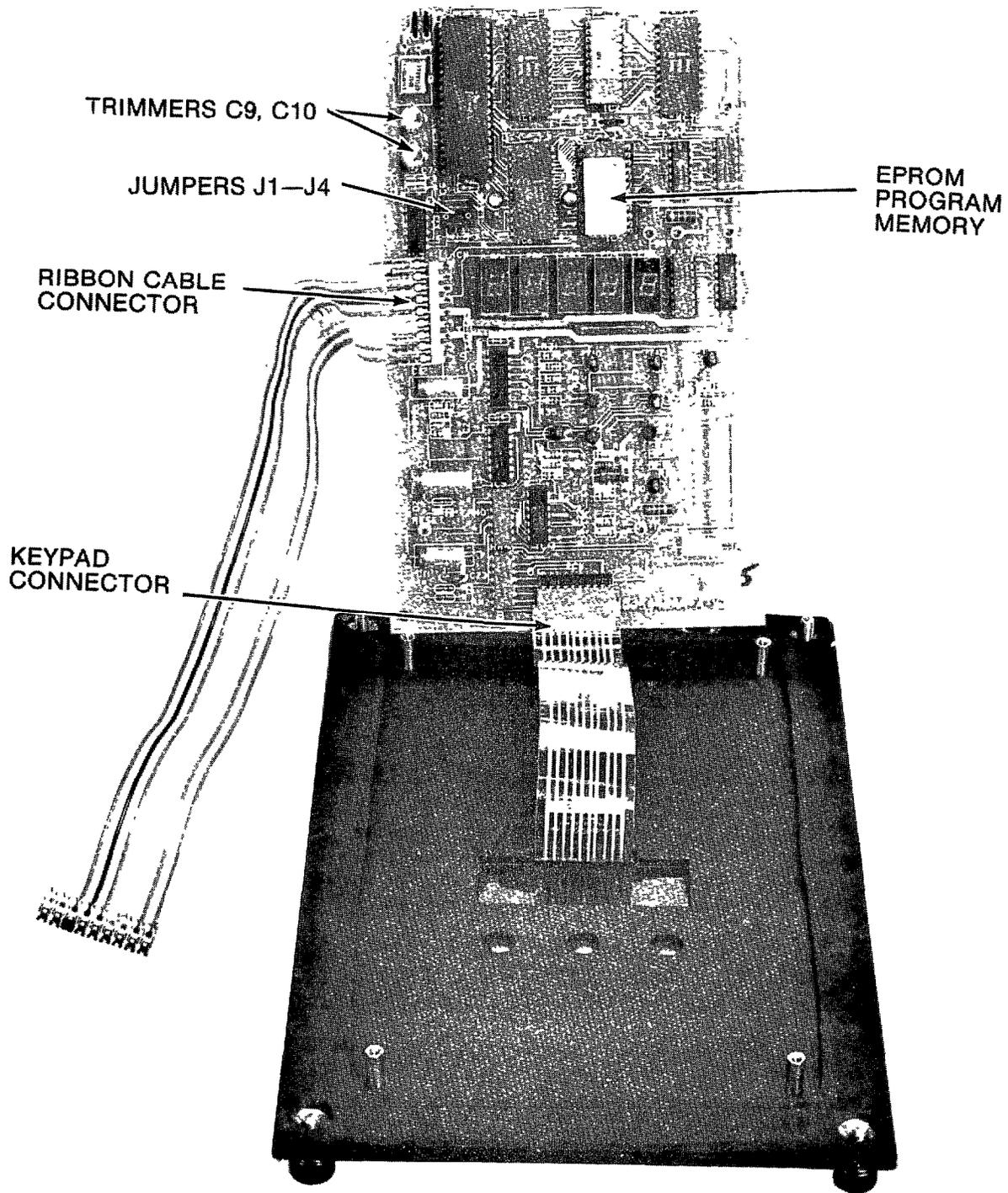


FIGURE 8
View of Microprocessor Card

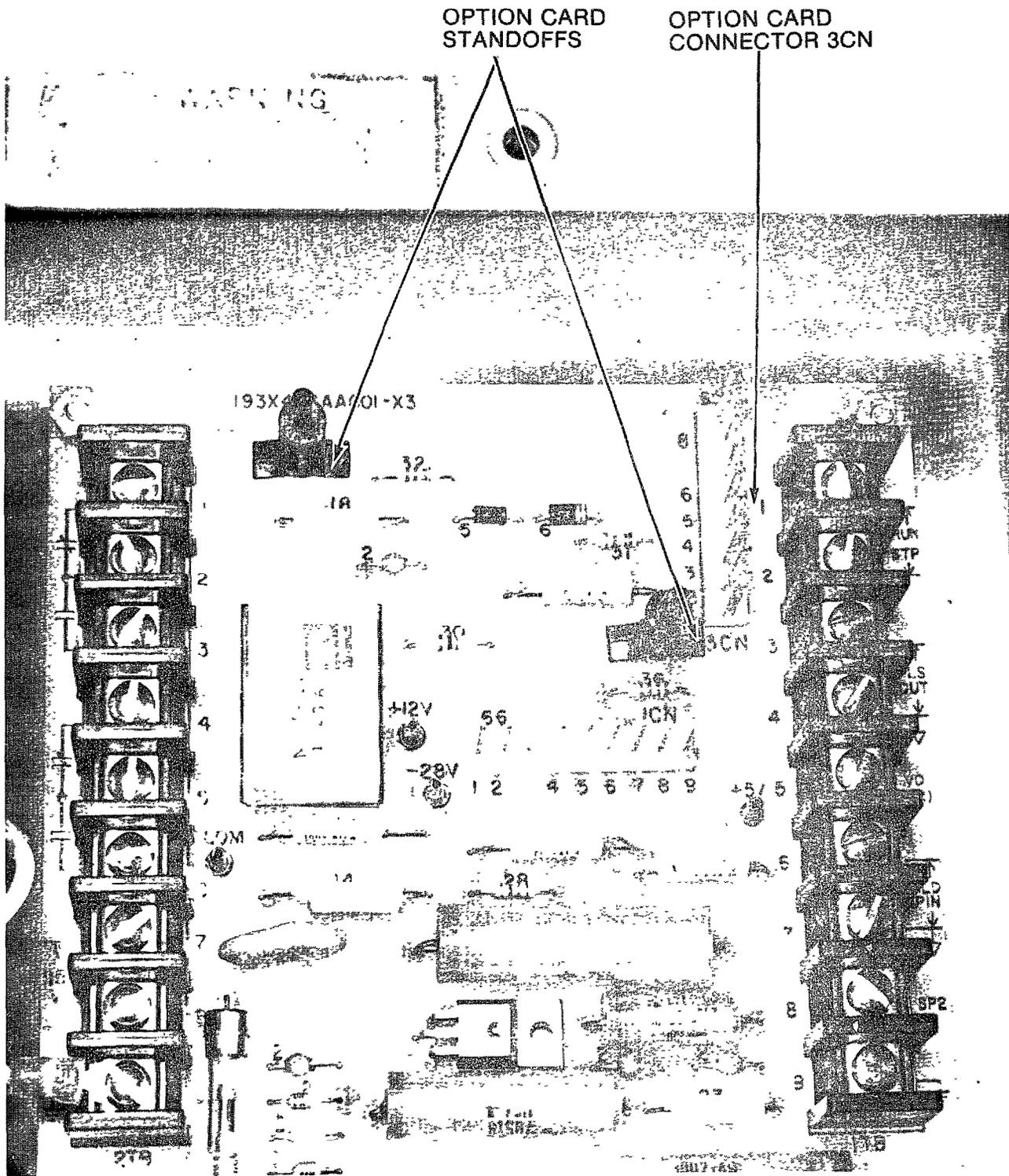
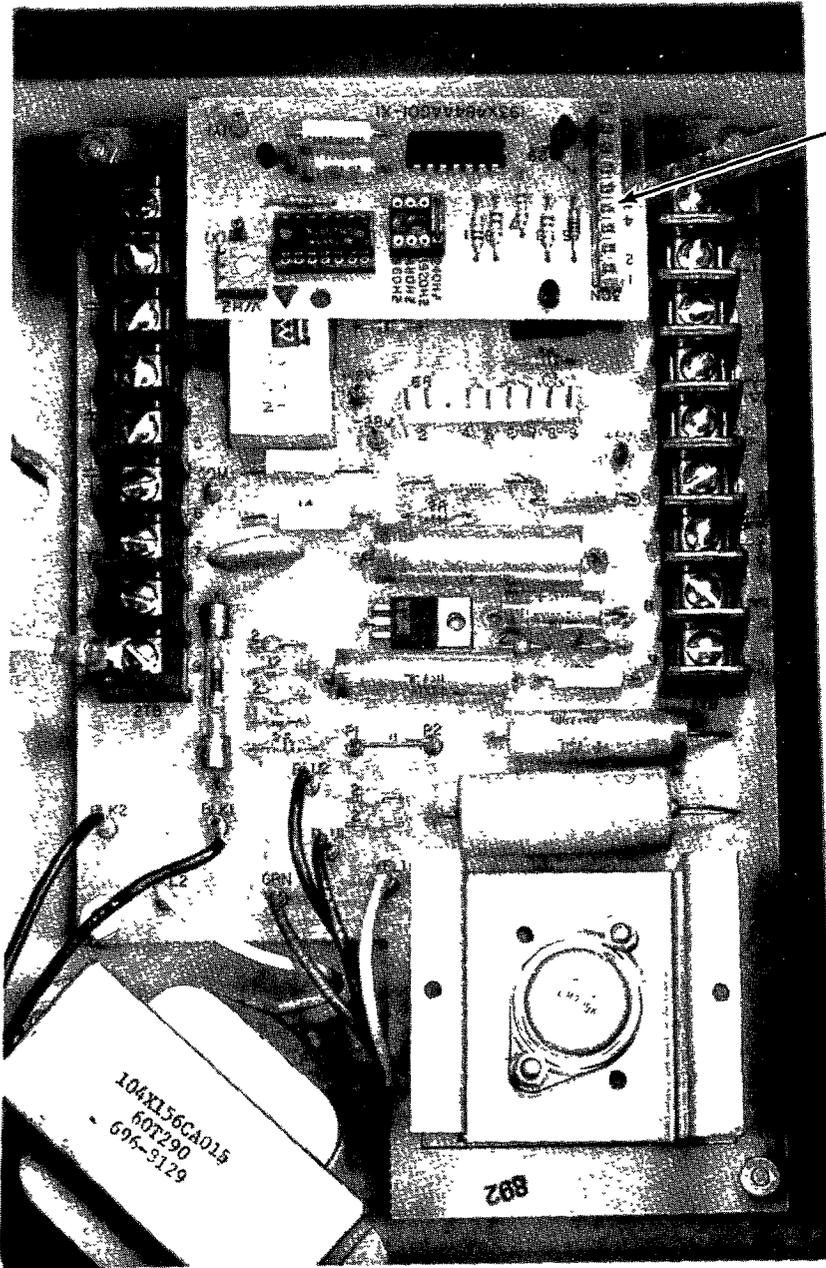


FIGURE 9
Installation of standoff posts for Option Kit 6VFVR10A1



OPTION CARD
SEATED ON
STANDOFFS AND
CONNECTOR 3CN

FIGURE 10
Installation of Option Kit, 6VFVR10A1

The output voltage from this card is available on the power supply card or terminal board 1TB, referred to common. The voltage for a given frequency input depends on the jumper selection in jumper socket JS1 and the setting of the volts/hertz gain adjust potentiometer, P1, both located on the frequency to voltage card. For start-up, set P1 mid-range and install the jumper according to the following table based on the maximum frequency to be input.

<u>Max. Fundamental</u>	<u>Six times Fundamental</u>	<u>Jumper</u>
40 to 80 Hz	240 to 480 Hz	240
80 to 160 Hz	480 to 960 Hz	480
160 to 320 Hz	960 to 1920 Hz	960
320 to 500 Hz	1920 to 3000 Hz	1920

FINAL INSPECTION

Unless specifically ordered as a Follower Period Reference, the unit is shipped as a Follower Frequency Reference. This means that during changes in the pulse output, its present frequency will automatically be displayed. If it is desired to have automatic readout in units of period rather than frequency, jumper J1 on the microprocessor card, mounted to the cover, must be removed. To do this, remove the four card mounting screws and carefully unplug jumper J1 from the jumper socket. Take care not to damage the ribbon cable connectors or any other parts on the card. Jumpers J2 and J4 must be left intact and there should be no jumper in J3. Carefully remount the card on the cover taking care that the LEDs line up with the holes in the cover assembly. Refer to Figure 8.

Before replacing the cover, check that all connections are correct and tight. Be sure all wires are pushed out of the way of the circuit cards and are not near the large heatsink. If the voltage option card is used, be sure it is correctly installed with the proper jumper and pot settings as described in the previous section. Check that the leads from the transformer are securely fastened to the stab-on posts on the power supply card and that the fault interrupter is in place and not blown. A ground wire must be present from the outside power supply and must ground the enclosure, cover, and terminal 2TB-9. Reattach the cover ground wire disconnected earlier when the cover was removed and plug the connector from the microprocessor card on the cover back into the power supply card connector, ICN. Also be sure this cable is still seated fully into the connector on the microprocessor card.

CAUTION

GROUNDING. THE CONTROL CIRCUITRY COMMON FOR YOUR DRIVE MUST BE GROUNDED TO INSURE PROPER OPERATION OF THE FOLLOWER DIGITAL REFERENCE. CONTACT THE FACTORY FOR INFORMATION ON OPERATION WITH A DRIVE THAT REQUIRES COMMON ISOLATED FROM EARTH GROUND.

As you are replacing the cover, fold the connecting cable such that it clears the heat producing components and does not stress any connections or the connectors. Also take care that the ribbon cable between the card and the keypad does not get pinched between the box lip and the cover. Do not overtighten the cover mounting screws.

START-UP AND OPERATION

For initial start-up, programming of parameters, and verification of proper operation, it is recommended that the drive controlled by the Follower Digital Reference not be energized. Verification of the pulse output is best obtained by using a frequency counter instrument so that the actual output frequency can be measured and trimmed if necessary. If this is not available, a standard DC Voltmeter with a scale of at least 12 volts may be used to give an indication of the presence of a pulse output since the average voltage of the pulse output decreases with frequency, as detailed below.

It is assumed in the discussion below that a Master Digital Reference is the source of the pulse train input to the Follower Digital Reference. Any other source may be used provided it satisfies the pulse input specifications given in Section, SPECIFICATIONS.

CAUTION

DRIVE PROTECTION. ALTHOUGH THE FOLLOWER DIGITAL REFERENCE LIMITS THE RAMP RATES AND MAXIMUM FREQUENCY OF THE PULSE OUTPUT WHEN IT IS OPERATING PROPERLY, THERE IS NO ASSURANCE THAT THESE LIMITS WILL PROVIDE AN OUTPUT WITHIN THE MAXIMUM CURRENT AND SPEED RATINGS OF THE DRIVE AND CONTROLLED MOTOR. THE DRIVE MUST HAVE ITS OWN SELF-PROTECTING AND MOTOR PROTECTING FEATURES WHICH WILL OVERRIDE AN IMPROPER REFERENCE INPUT. PRECAUTION SHOULD ALSO BE TAKEN TO ENSURE THAT THE INPUT PULSE TRAIN TO THE FOLLOWER REFERENCE DOES NOT EXCEED THE MAXIMUM SPECIFIED FREQUENCY GIVEN IN SECTION, SPECIFICATIONS.

After checking that all wiring to the Follower Digital Reference is correct and that power to the drive is off, turn on the 115 AC power to the Follower. The pulse input train should be off or at its minimum frequency and the START/STOP control signal should be calling for STOP (contacts open). The "READY" green status indicator should come on and the display should read out a small frequency (for the Follower Frequency Reference) or large period (for the Follower Period Reference), dependent on the pulse input frequency. If the display instead reads "RESET", the unit was energized with the START/STOP contacts closed. They must be opened, or any keypad key pressed, before the keypad and pulse output will become operative. Double check the START/STOP wiring to be sure it is correct and calling for a STOP. If correct operation cannot be obtained, refer to the section on TROUBLESHOOTING

NOTE: **AUTO-BLANKING.** IT IS NORMAL FOR THE DISPLAY TO AUTOMATICALLY BLANK OUT AFTER 35 SECONDS IF NO KEYPAD INPUTS OR PULSE INPUT CHANGES ARE MADE. THE CURRENT PULSE OUTPUT STATUS CAN BE RESTORED TO THE DISPLAY BY PRESSING THE "PRESENT FREQUENCY" OR "PRESENT PERIOD" KEYS. LEAVE THE START/STOP CONTACT IN THE STOP POSITION UNTIL ALL PARAMETERS HAVE BEEN ENTERED AS THE DESCRIBED IN THE FOLLOWING SUBSECTION ON KEYPAD OPERATION.

KEYPAD OPERATION

The keypad and display on the Follower Digital Reference are used to examine and change the programmable parameters and to display the current operating status of the unit. The programmable parameters are percent draw and scale factor. Current operating status may be displayed as present frequency, present period, or present scaled frequency. Two keys are used to provide a slack-up or slack-down over-ride control of the pulse output. This section will describe how the keypad and display are used.

The keypad consists of 16 keys which use reliable membrane switch technology to provide mechanical switch contacts. Because the contacts only move a few thousandths of an inch, there is no discernible movement as they are pressed. Instead, the display blinks to give a visual indication that the key has been depressed. The keys include the ten decimal digits plus the necessary "command" function keys, as shown in Figure 3. Note that some of the keys are dual function keys since they can represent either a command or a number depending on when they are pressed in a key sequence. If they are pressed as the first key in a sequence, the microprocessor interprets the key as a command function. Otherwise, the key is assumed to be numerical.

Readout of the present value of any of the programmable or status parameters is obtained by simply pressing the appropriate function key, assuming the display was previously clear. If the parameter is programmable, it may be changed by keying in the new value and pressing the ENTER key. Depending on the parameter, either 4 or 5 digits will have to be keyed in. Once the first digit of a new parameter value is keyed in, the unit automatically prompts for the correct number of digits required by displaying a prompting bar in each position for which a key entry is required. Since a parameter entry will not be accepted if too few or too many digits are keyed in, a degree of protection is provided against accidental or unauthorized entry of incorrect parameters

Improper or erroneous key sequences are indicated by the message "ERROR" on the display. The following key sequences will result in an "ERROR" message:

- Pressing a digit key as the first key in a sequence.
- Pressing ENTER before the key sequence is completed.
- Pressing too many digit keys in a sequence
- Keying in a number larger than 65535

To extend the life of the display, an automatic blanking feature is incorporated into the design. When the unit is in steady state as indicated by the "STEADY" LED and no keys have been pressed, the display will automatically blank after about 35 seconds. As a convenience, if the display is blank or no parameter entry is in progress, the display will, depending on the setting of the jumper J1 on the microprocessor card, automatically readout present pulse output frequency (J1 installed) or present period (J1 removed) when the unit is ramping up or down in response to the input pulse ramps.

The following is a description of each of the command keys and examples of parameter reprogramming.

CLEAR

This key may be pushed at any time to blank the display. If the unit is ramping up or down, however, the automatic display of present frequency or period will override display blanking. This key is also used to cancel an incorrect key sequence. CLEAR must be pressed ahead of any dual-function key if percent draw or scale factor is being displayed and it is desired to display the parameter controlled by the key. Otherwise, the unit will interpret the key as a number rather than a command.

ENTER

This key is used to enter the displayed number as the new value of either percent draw or scale factor. It is pressed after the correct number of digits for the parameter have been keyed in. The number displayed is not stored until ENTER is pressed. When ENTER is pressed the display will automatically blank unless the unit is ramping, in which case present frequency or period will be displayed. If ENTER is pressed before all digits of the new parameter value have been keyed in, "ERROR" will be displayed.

PRESENT FREQUENCY

This key may be pressed at any time to display pulse output frequency. The readout is the fundamental frequency in hertz. The actual pulse frequency is six times the displayed value. During pulse frequency ramps, this parameter is automatically displayed in the Follower Frequency Reference (jumper J1 installed on the microprocessor card).

PRESENT PERIOD

This key may be pressed at any time to display the pulse output period in milliseconds. The actual pulse period is 1/6 the displayed number. During pulse frequency ramps, this parameter is automatically displayed in the Follower Period Reference (jumper J1 removed from the microprocessor card).

SCALED FREQUENCY

This key may be pressed any time the display is blank or is displaying a non-programmable parameter (otherwise the key is interpreted as an "8"). The number displayed will be the product of present frequency and the parameter scale factor, described below. Scaled frequency may be used in certain processes where the rate of output is a known proportion of motor frequency (or speed). Scaled frequency may then be used to give direct readout of output in meaningful units such as feet per minute or RPM.

SCALE FACTOR

This key is used to display and change the scale factor used in conjunction with the SCALED FREQUENCY key. This key may be pressed any time as the first key in a sequence (when the display is blank or displaying a non-programmable parameter) to display the present setting of scale factor. If a different setting is desired, simply key in the desired number and press the ENTER key. The range of allowable values is 0.000 to 9.999. Note that in order for the entry to be accepted exactly four digits must be keyed in, and that the digits key in from the left. Thus all leading and trailing zeroes must be keyed in. After the first digit is keyed in, a prompting bar is displayed in each position for which another digit must be keyed in. If this procedure is not followed properly, "ERROR" will be displayed. This procedure makes it more difficult for someone unfamiliar with the unit to accidentally change the parameter settings.

PERCENT DRAW

This key is used to display and change the ratio between the pulse output frequency and the incoming pulse frequency. The range of values for this parameter is 050.00 to 200.00%. A percent draw of 090.00 indicates the pulse output frequency will be 0.9000 times the pulse input frequency. The PERCENT DRAW key may be pressed any time as the first key in a sequence. If a different setting is desired, simply key in the new five digit value, including leading and trailing zeroes, and press ENTER. Once this parameter has been set, further reprogramming may be inhibited by removing jumper J2 on the microprocessor card. Attempting to reprogram this parameter when J2 is removed will result in the display of a diagnostic message

"NO ENT" indicating the entry was not accepted. If a number less than 048.64% or greater than 200.24% is entered, the unit will automatically clamp the percent draw to these limiting values.

SLACK-UP, SLACK-DOWN

These keys are used to momentarily override the programmed percent draw to allow the take-up or let-down of material between drives in coordinated system. While the SLACK-UP key is held down, the pulse output frequency will increase about 3%. While the SLACK-DOWN key is held down, the pulse output frequency will decrease about 3%.

PROGRAMMING EXAMPLE

This example describes how to set the following parameter values on the Follower Digital Reference:

Percent Draw - 89.2%
Scale Factor - 0.53

To program percent draw:

Press	Display
PERCENT DRAW	XXX.XX (previous value)
0	0—.—.—
8	08—.—
9	089.—
2	089.2—
0	089.20

The percent draw of 89.2% is now stored.

To program scale factor:

Press	Display
SCALE FACTOR	X.XXX (previous value)
0	0.—.—.—
5	0.5—
3	0.53—
0	0.530

The scale factor of 0.53 is now stored.

After becoming familiar with the keypad operation, program in the desired settings. It is recommended that written records of these settings be kept for future reference. These settings will remain in effect, even if the unit is deenergized, until changed by new keypad entries. Reprogramming of percent draw can be inhibited by removing jumper J2 on the microprocessor card. (refer to Section TROUBLESHOOTING on Card Removal).

EXTERNAL CONTROLS AND OUTPUTS

This section will describe the START/STOP control for the Follower Digital Reference, the pulse and voltage reference outputs provided from the unit, and the RUN relay contacts available within the unit to control the drive system the unit is connected to. It is recommended that for initial check-out of the unit that power not be applied to the drive system. After proper operation and set-up of the Follower Digital Reference are verified, the complete system may be tested.

It is assumed that all keypad programmable parameters have been properly adjusted as described in the previous sub-section and that a Master Digital Reference or other suitable input is connected to the pulse input terminals.

START/STOP CONTACTS and RUN RELAY

Two form "C" contacts are provided as shown in Figure 7 for controlling the drive system the Follower Reference is connected to. The relay is deenergized when the START/STOP contacts are open or power is off and is energized when the START/STOP contacts are closed. The START/STOP contacts do not affect the pulse or voltage reference outputs.

PULSE OUTPUT

The pulse output is a nominal 12 volt inverted pulse train with a frequency 6 times the indicated fundamental frequency on the display. It is related to the incoming pulse train frequency by the percent draw provided that the output pulse frequency is within its minimum and maximum limits of 0.6 and 339 Hz fundamental frequency and provided that the input frequency does not change faster than the maximum ramp rate it is capable of following.

For initial setup of the Follower Digital Reference, it is recommended that a frequency counter be used to verify the pulse output. An oscilloscope may be used to verify the pulse output and, for some percent draws, the ratio between the incoming and output pulse frequencies. The pulse will be difficult to see at low frequencies since the pulse width is only 50 microseconds. A DC voltmeter may also be used to verify the presence of a pulse output. With no load on the pulse output and a frequency less than 10 Hz, its average DC voltage should be about 11.4 volts. At a frequency of 339 Hz, the pulse output will decrease to an average DC voltage of approximately 10.6 volts. If measured pulse frequency does not correspond to six times the displayed pulse frequency, it may be trimmed as described in the following sub-section on internal adjustments. If no pulse output can be detected or the correct percent draw cannot be obtained, refer to the section on TROUBLESHOOTING

VOLTAGE OUTPUT

This output is available only if the option kit #6VFVR10A1 is installed on the Follower Digital Reference. The voltage output is proportional to the pulse frequency, with a value near 0V DC when the pulse output is at the minimum frequency, and a maximum value of about 6V DC. An internal jumper and potentiometer are used to adjust the voltage output at a given frequency (volts/hertz gain). The output ripple and response time may also be adjusted. See the following sub-section on internal adjustments for information on these adjustments.

After all controls, outputs, inputs, and adjustments have been verified to be correct, the unit may be checked out with the drive system energized.

INTERNAL ADJUSTMENTS

(See Section TROUBLESHOOTING for Card Removal)

Trimming of the displayed pulse output characteristics may be obtained by adjusting C9 and/or C10 on the microprocessor card. The percent draw between the input and output pulse trains is maintained independent of these trim capacitors and never requires adjustment. Trimming of the volts/hertz gain of the voltage output option is obtained by adjusting the potentiometer on the voltage output card. If the potentiometer has insufficient range to give the desired setting, move the jumper on the card to the next higher or lower frequency range as required. The voltage output ripple may be decreased by connecting a 10 to 50 microfarad electrolytic capacitor between posts "X" and "Y" on the card. The positive end of the capacitor should go to post "X". Adding capacitance will decrease the response time of the voltage output somewhat.

On the microprocessor card, jumper J2 may be removed to inhibit the reprogramming of percent draw. Jumper J1 may be removed to convert a Follower Frequency Reference to a Follower Period Reference or vice versa. **Do not** change the jumper settings on card while power is applied. **Do not** remove J4 or install jumper in J3.

CIRCUIT DESCRIPTION

The Follower Digital Reference consists of two printed circuit cards in the standard unit plus a third card if the voltage output option is specified. The power supply card mounts on the inside back surface of the enclosure. The microprocessor card mounts on the back of the cover and the voltage output card plugs into the power supply card. The power supply transformer mounts on the inside back of the enclosure and connects to the power supply card using stab-on post connectors. The keypad consists of 16 membrane switches built into the cover and wired to the microprocessor card through a ribbon cable and connector. An electrostatic shield is built into the cover to protect the circuits from static discharges. A description of each card is given below.

POWER SUPPLY CARD (193X482AAG01)

A block diagram of the power supply is shown in Figure 11 and an elementary diagram is shown in Figure 14. Three regulated voltages are required by the unit. The +5 and +12 volt DC supplies are developed by three-terminal regulators supplied from standard full-wave rectifier circuits. The -28 volt DC supply is produced by a voltage doubler circuit and zener regulator.

The card also contains the RUN relay for controlling the external adjustable speed drive, terminals for customer connections, and connectors to the microprocessor card and voltage output option card.

Test posts are provided for checking each of the regulated voltages. Each should be within 5% of its nominal voltage rating.

MICROPROCESSOR CARD (193X483AAG02)

The block diagram and elementary diagram for this card are shown in Figures 12 and 15. The heart of this card is an 8-bit single chip microcomputer, the 8039. This device contains a crystal controlled 11M Hz oscillator, a central processor unit capable of performing general logic and arithmetic operations, and 8-bit counter, general purpose read/write memory, and general purpose input/output ports.

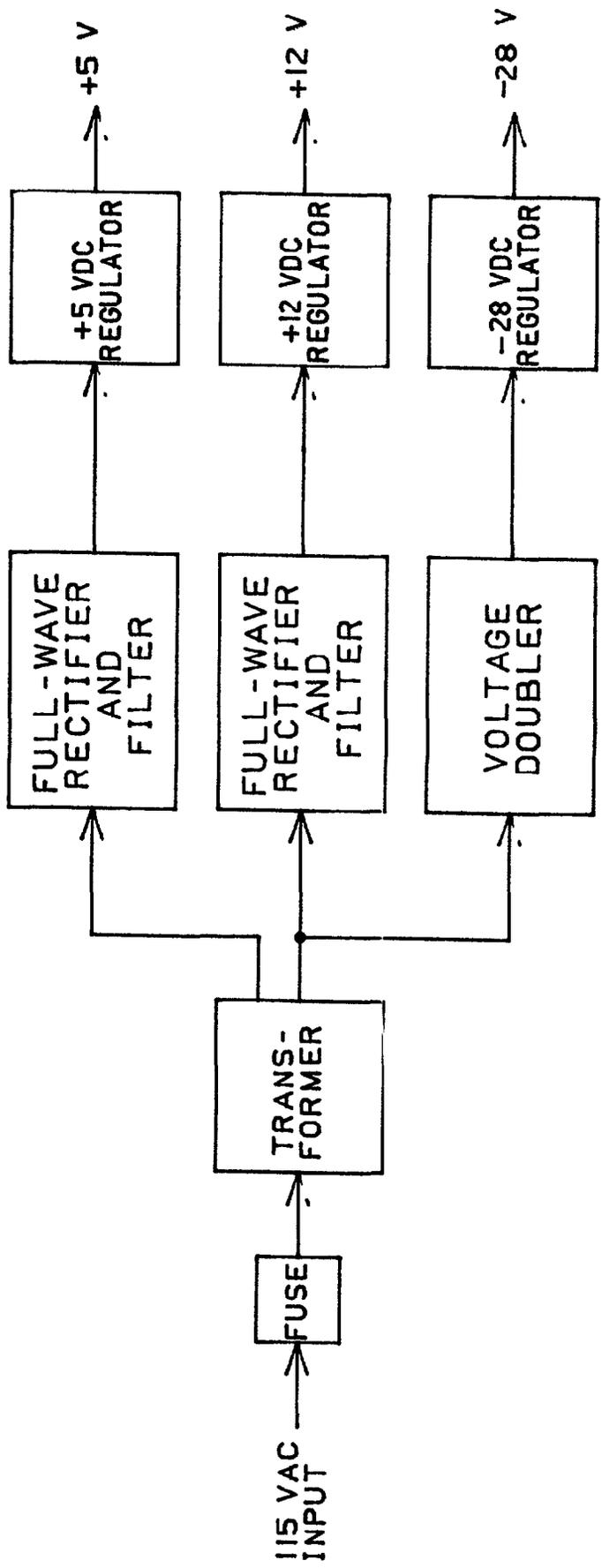


FIGURE 11
Power Supply Card Block Diagram

All operations performed by the microprocessor are controlled by the instructions contained in the program memory device, a 2716 ultra-violet erasable, electrically programmable read-only memory. Programmed on this device are instructions for the microprocessor to perform the following functions.

- o Scan the keypad, and START/STOP contact for inputs.
- o Send information to the display and LED indicators.
- o Measure the incoming pulse train frequency using the oscillator as a reference.
- o Produce the pulse output at the proper frequency based on the reference input and the percent draw setting.
- o Control the RUN relay.
- o Store settings from the keypad in permanent memory.

Other circuits and devices on this card include:

- o I/O Expanders - These devices increase the number of I/O (input/output) ports available to the microprocessor.
- o Display - Five 7-segment LED displays and drivers provide the capability to readout numbers and some alphabetic characters. The display is operated in multiplexed mode, i.e., only one digit is lit at a time. Successive digits are lit at such a high rate that the display appears continuously lit to the human eye.
- o LED indicators and driver circuits.
- o RUN relay driver circuit.
- o Pulse input buffer circuit.
- o Pulse output buffer circuit.
- o START/STOP input buffer circuit.
- o EAROM - This device is an electrically alterable read only memory. When power is available, the microprocessor can read or reprogram the EAROM. When power is off, the EAROM can retain its data for up to ten years. All settings entered from the keypad are stored in this device.

- o WATCHDOG - This circuit monitors whether the microprocessor is correctly stepping through its program. If an electrical transient or other problem causes the microprocessor to get out of step, this device resets it to the proper program. A reset is also sent if the 5 volt DC power supply is below specification.

There are several jumpers on this card. Jumpers J5, J6, J7 and J8 are soldered into place by the factory as required and should not be disturbed. Jumpers J3 and J4 are part of the frequency reference. Jumper J4 should always be present while J3 should never be installed. Jumper J2 must be present to allow reprogramming of percent draw. Removal of J2 disables reprogramming of this parameter. This jumper may be used to prevent unauthorized changing of percent draw.

Jumper J1 is the only electrical difference between the Follower Frequency Reference and the Follower Period Reference. Jumper J1 must not be present in the period reference unit and must be installed in the frequency reference unit. This jumper controls whether pulse frequency or period is automatically displayed during ramps.

Capacitors C9 and C10 are trimmers which may be used to adjust the oscillator frequency. These should not be adjusted unless an accurate frequency counter is available and the measured pulse frequency does not agree with the displayed present frequency. One or both trimmers may have to be adjusted to bring the oscillator into calibration.

VOLTAGE OUTPUT CARD (193X484AAGO1)

A block diagram and elementary diagram for this optional card are shown in Figures 13 and 16. This card converts the pulse output into a DC voltage with an amplitude proportional to pulse frequency using a frequency-to-voltage converting integrated circuit. A frequency prescaler and a trim pot are provided to allow adjustment of the volts/hertz gain. Refer to the section on the installation of option kit 6VFVR10A1 for information on setting these adjustments.

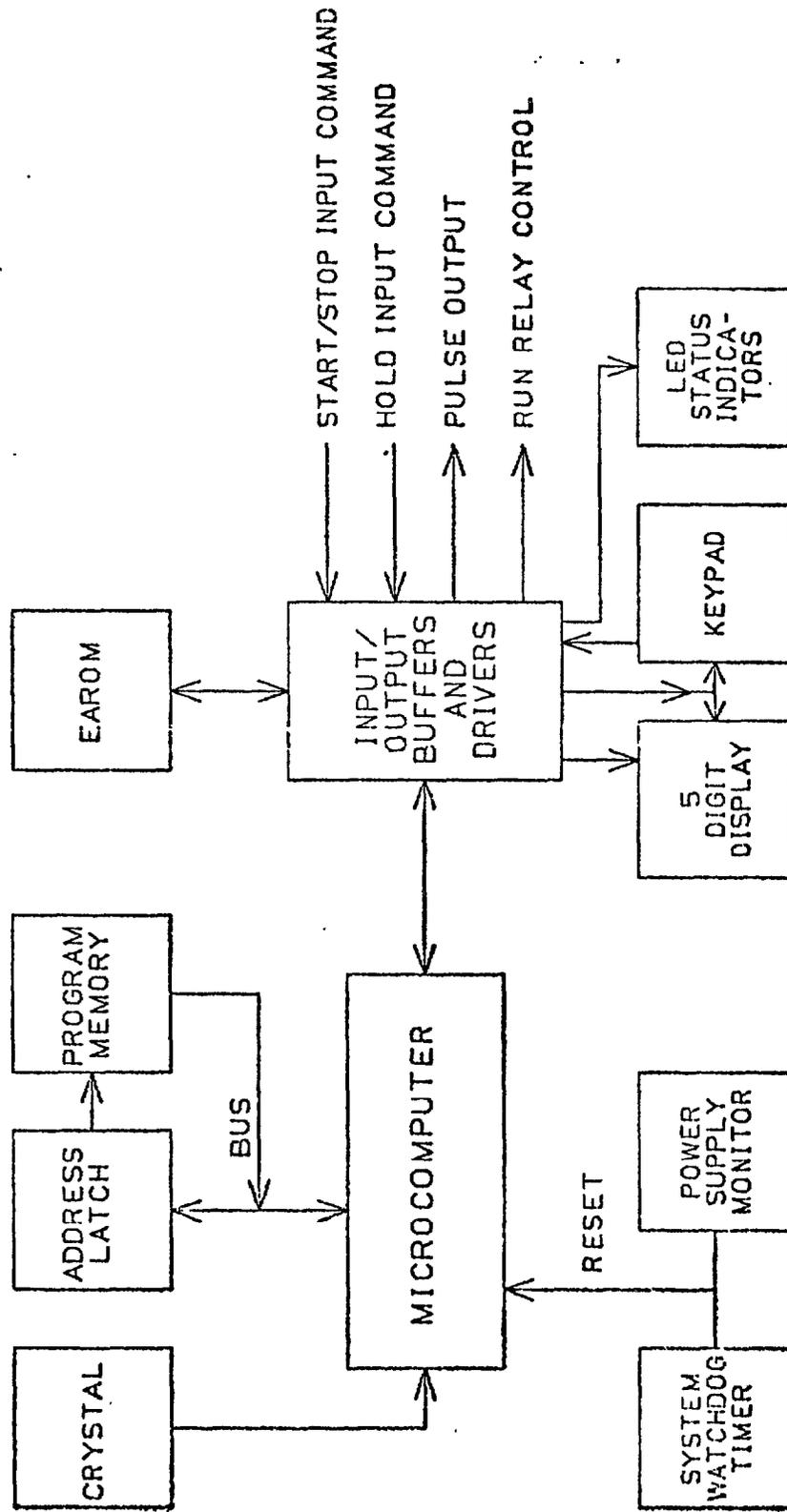


FIGURE 12
Microprocessor Card Block Diagram

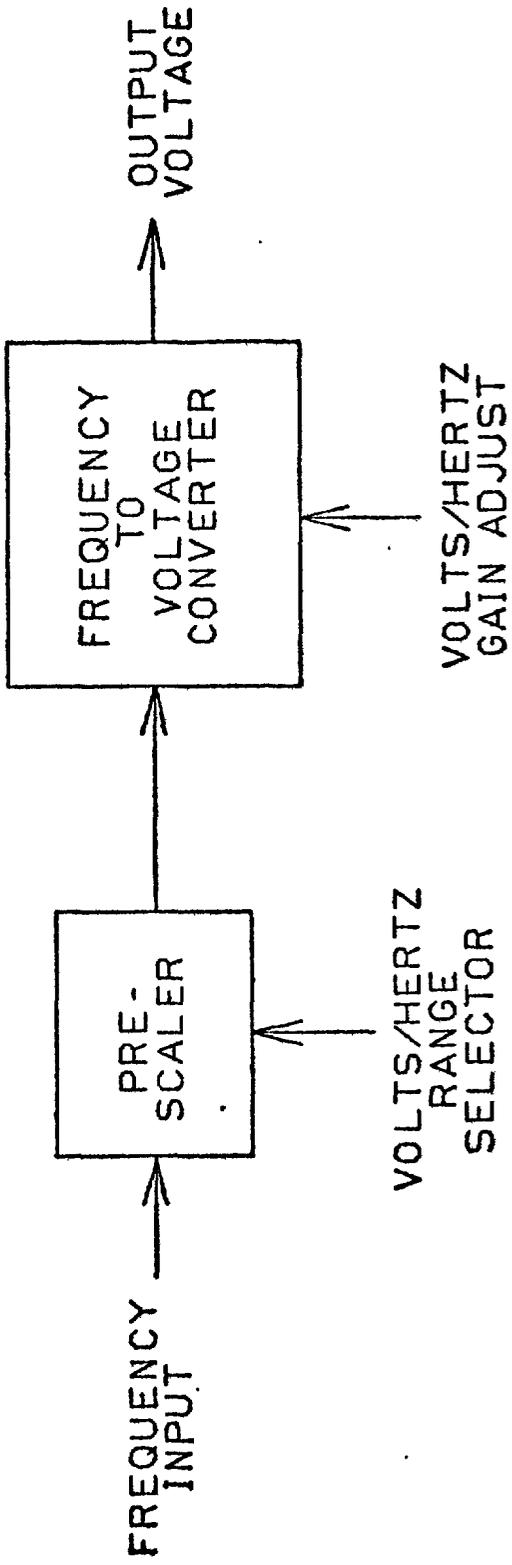
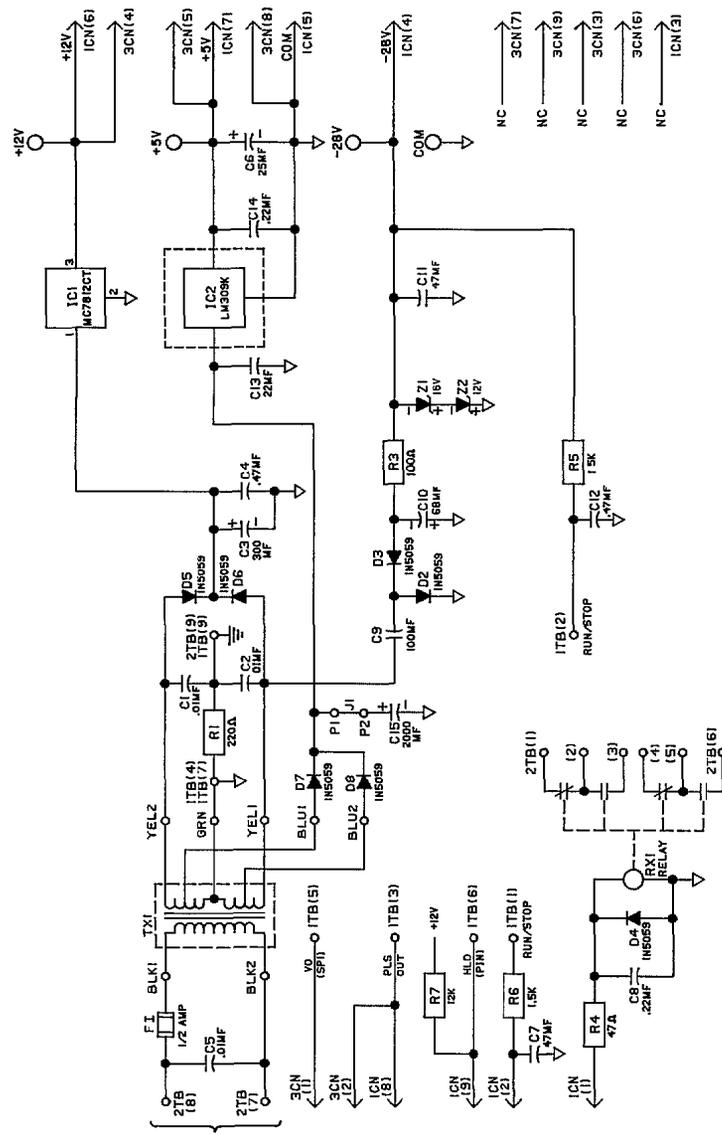


FIGURE 13
Voltage Output Card Block Diagram

GENERAL ELECTRIC
36C764413AA
CURT DIB BK
POWER SUPPLY CARD - MASTER REFERENCE OSCILLATOR
FIRST MADE FOR STD LINE
193X-482A901



NOTE :
 ALL RESISTORS ARE 1/4W UNLESS OTHERWISE NOTED

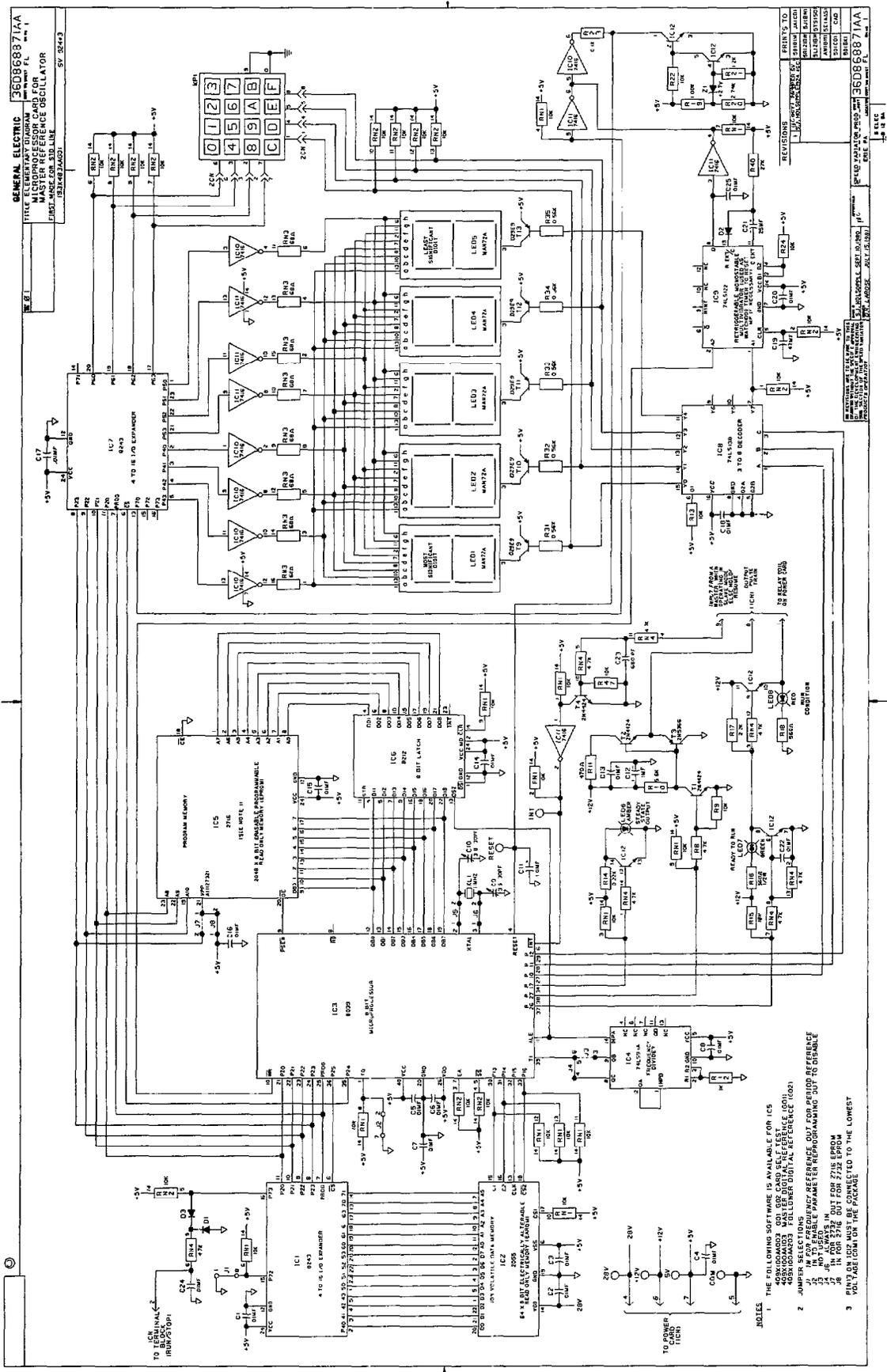
NO REVISIONS ARE TO BE MADE TO THIS DRAWING UNLESS AUTHORIZED BY THE DEVELOPMENT ENGINEERING DEPARTMENT OF THE MANUFACTURING DEPARTMENT.

REV NO.	REV W.C.
0	

REV NO.	REV W.C.	PRINTS TO
0		5B(10)X JAN(2D)
		5R(12)B W 5J(B)W
		5L(12)B W 5T(5)5D
		5A(18)W 5E(1-4)B
		5D(12)C 5AD
		5D(16)K 1

MADE BY **BLANK** **FRS.4.1M2** **18/C**
18/10/71
36C764413AA
CURT DIB BK
SPEED VARIATOR PROD. SUPPLY
ERIE, PA. LOCATION
5 ELEC

FIGURE 14
Power Supply Card Elementary Diagram



GENERAL ELECTRIC 36D86871AA
 TITLE ELEMENTARY DIAGRAM
 MICROPROCESSOR CARD FOR
 LINEAR OSCILLATOR
 PART NUMBER 36D86871AA
 REV. 1

- NOTES
- 1 THE FOLLOWING SOFTWARE IS AVAILABLE FOR IC5
 485000M03 001 000 CARD SELF TEST (L001)
 485000M23 FOLLOWER DIGITAL REFERENCE (L02)
 485000M33 PARAMETER REFERENCE OUT FOR PERIOD REFERENCE
 485000M43 PARAMETER REFERENCE OUT FOR PERIOD REFERENCE
 485000M53 OUT FOR 2716 EPROM
 485000M63 OUT FOR 2732 EPROM
 - 2 JUMPER SELLER'S OPTION
 3 JUMPER SELLER'S OPTION
 4 JUMPER SELLER'S OPTION
 5 JUMPER SELLER'S OPTION
 6 JUMPER SELLER'S OPTION
 - 3 POLYTABLE DRAW FOR THE PACKAGE LED TO THE LOWEST

FIGURE 15
 Microprocessor Card Elementary Diagram

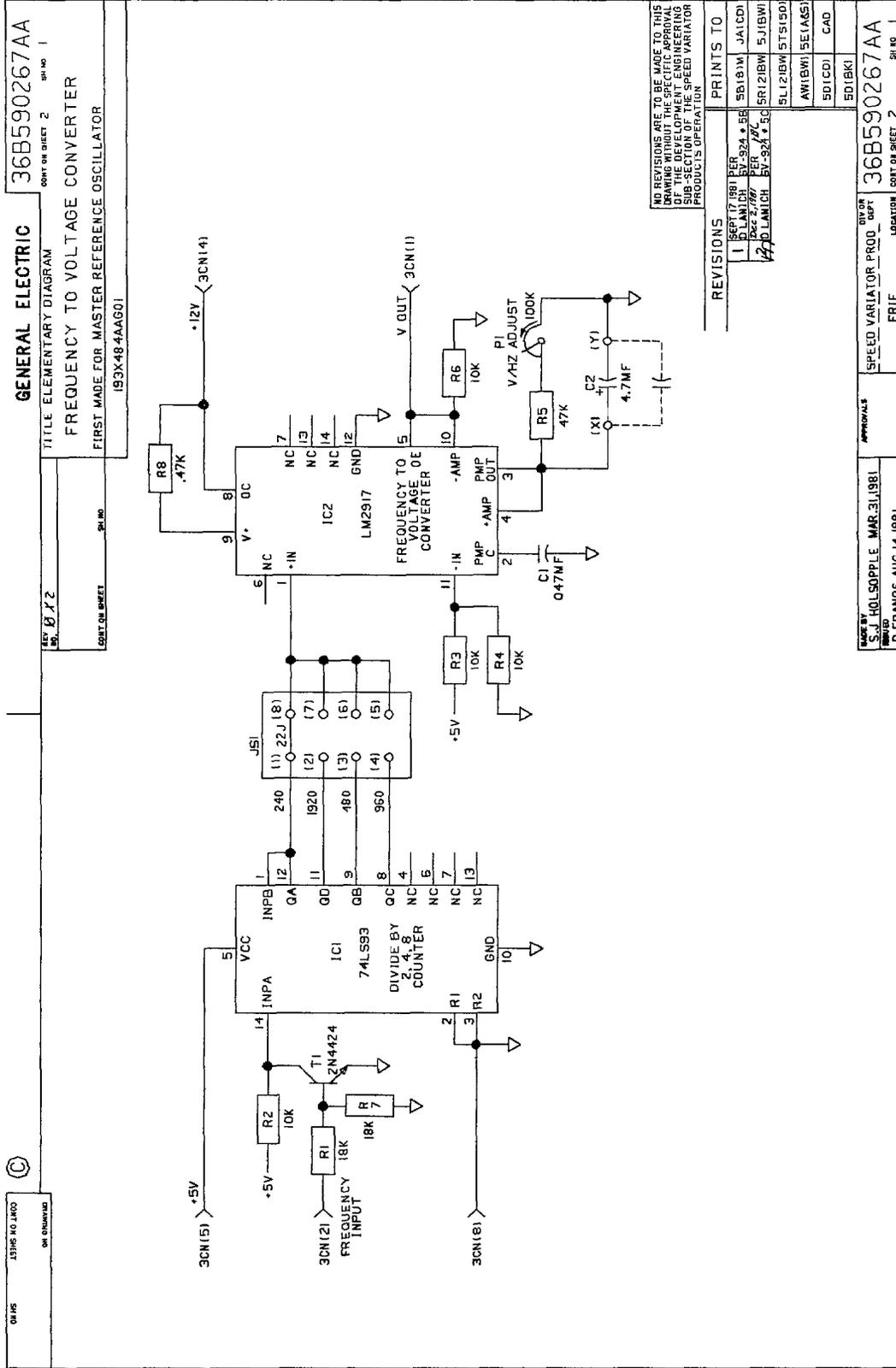


FIGURE 16
Voltage Output Card Elementary Diagram

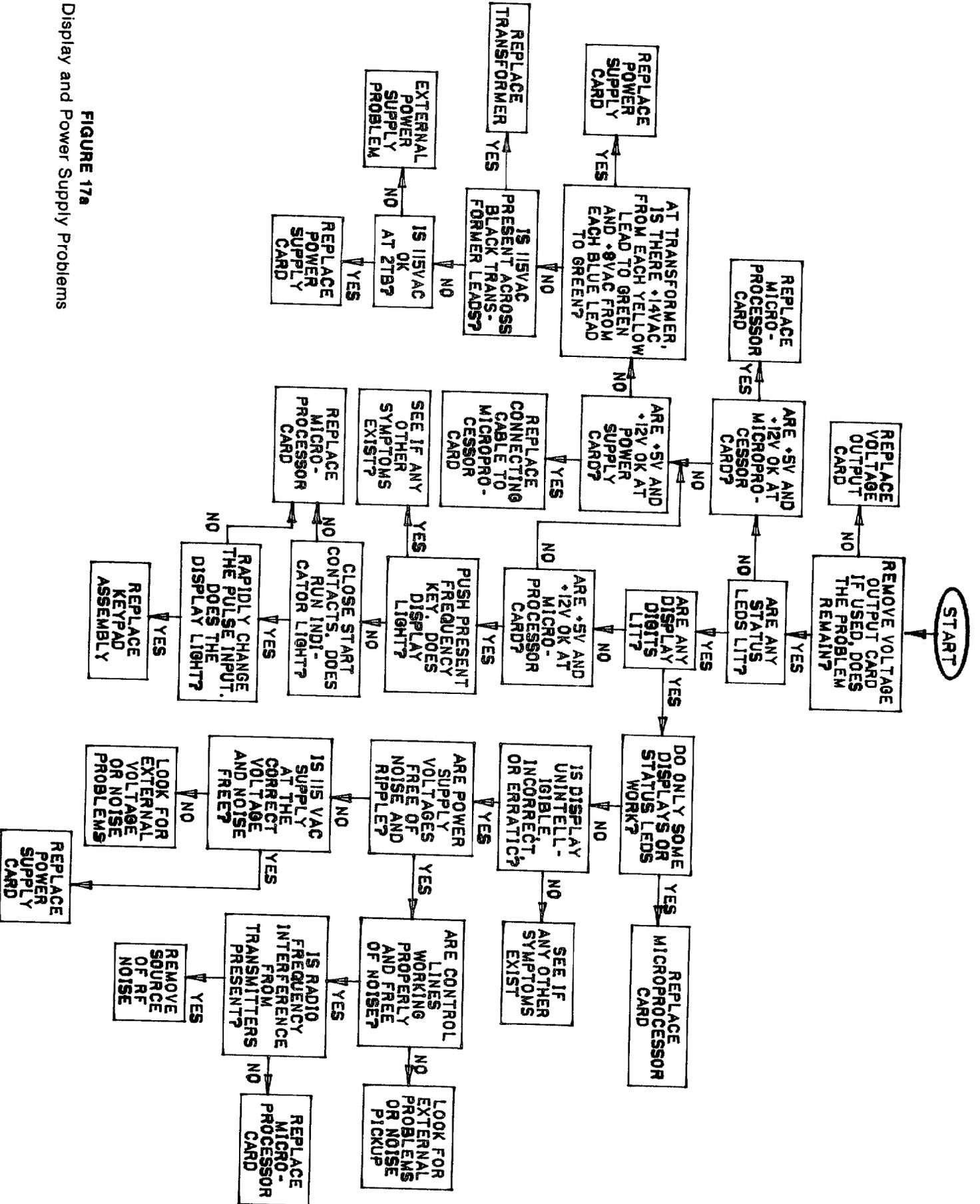


FIGURE 17a

Display and Power Supply Problems

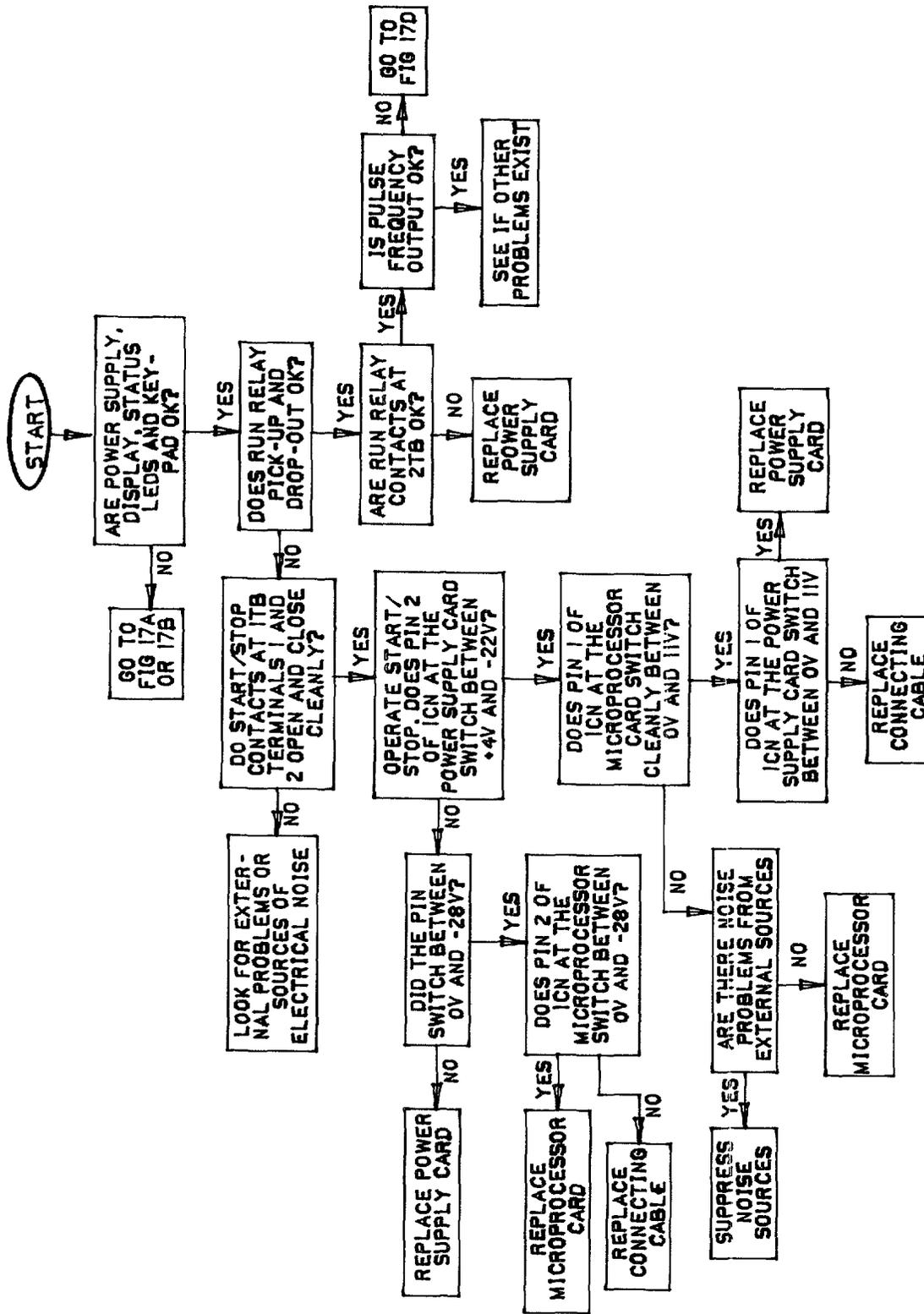


FIGURE 17c
START/STOP or RUN Problems

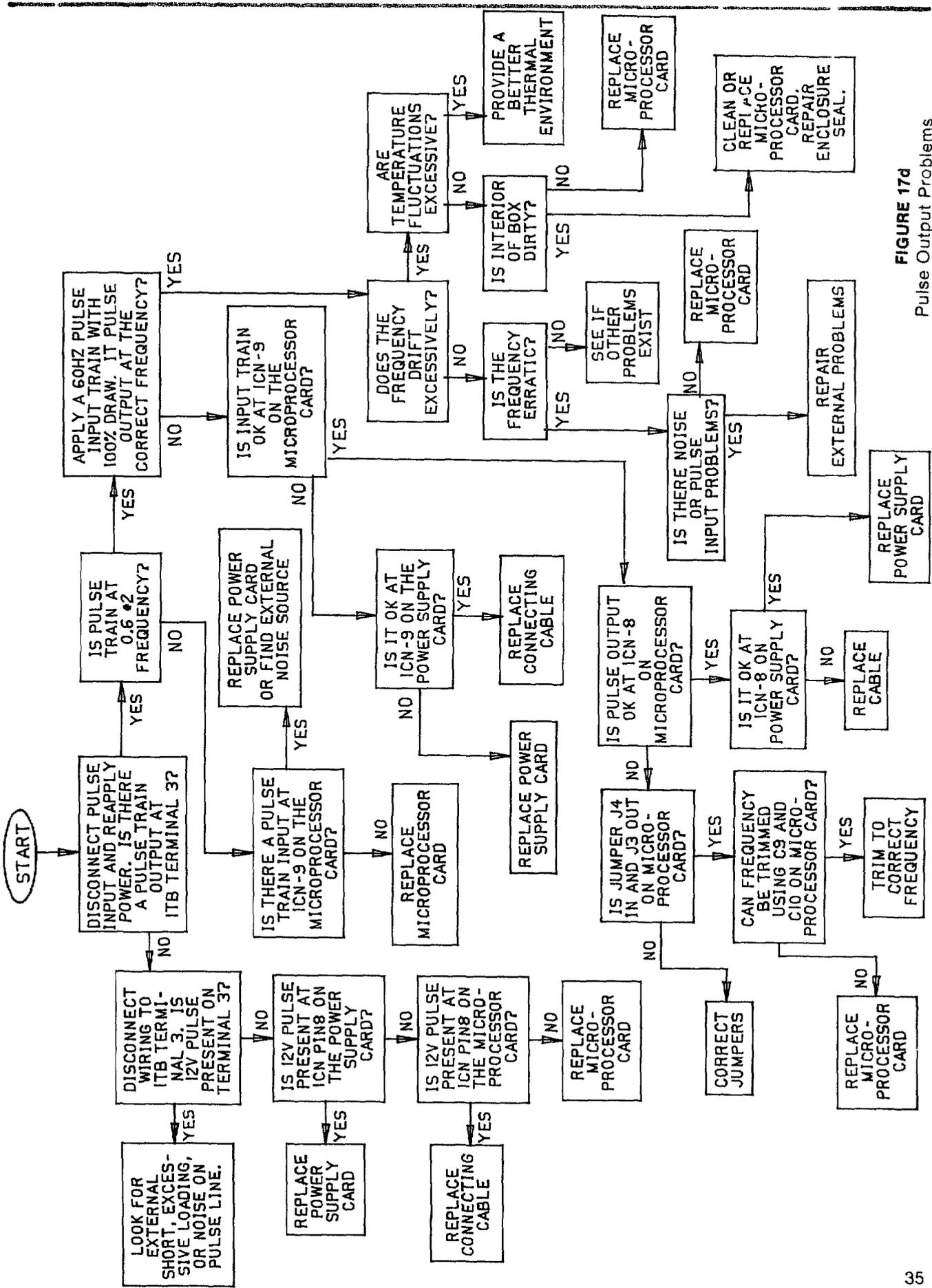


FIGURE 17d
Pulse Output Problems

TROUBLESHOOTING

This section contains general checks and a troubleshooting "fault tree" to systematically isolate most problems based on identification of the symptoms of the problem. Once the faulty part or printed circuit card has been identified, refer to Section MAINTENANCE AND RENEWAL PARTS for information on ordering parts.

TEST EQUIPMENT REQUIRED

These troubleshooting notes are written so that most problems can be isolated with a good quality multimeter or volt-ohmmeter. While not generally necessary, an oscilloscope may be useful in some situations. For precise calibration of the pulse frequency, an accurate frequency counter will be required.

TESTING SAFETY PRECAUTIONS

WARNING

SHOCK HAZARD. ELECTRICAL SHOCK CAN CAUSE PERSONAL INJURY OR LOSS OF LIFE. NEVER ASSUME ANY TERMINAL OR CONNECTION IS A SAFE VOLTAGE POTENTIAL. HAZARDOUS VOLTAGES CAN BE INSIDE THE FOLLOWER DIGITAL REFERENCE ON THE AC POWER SUPPLY LINES AS WELL AS ON THE CONTROL LINES.

BECAUSE SOME READINGS MUST BE TAKEN WHILE POWER IS APPLIED TO THE UNIT, THE TROUBLESHOOTER MUST TAKE CARE TO AVOID ELECTRIC SHOCK TO HIMSELF OR DAMAGE TO THE UNIT. BY FOLLOWING RECOMMENDED SAFETY PRECAUTIONS AND OBSERVING GOOD TESTING PRACTICES, THESE HAZARDS CAN BE REDUCED.

Whenever possible, troubleshooting of the Follower Digital Reference should be done with power disconnected from the Follower Digital Reference.

CAUTION

PROTECTION OF CIRCUITRY. TO PREVENT DAMAGE TO THE CIRCUITRY, TAKE NOTE OF THE FOLLOWING PRECAUTIONS:

1. DO NOT DISCONNECT OR CONNECT PRINTED CIRCUIT CARD, COMPONENTS, OR CONNECTORS WHILE POWER IS APPLIED TO THE UNIT.

2. DO NOT SHORT BETWEEN CIRCUITS, CONNECTOR PINS, OR IC DEVICE PINS WHILE TAKING READINGS WITH A METER OR PROBING THE CIRCUIT. USE INSULATING SLEEVES WHERE NECESSARY TO PREVENT SHORTING.
3. PROTECT THE ELECTRONIC DEVICES FROM ELECTROSTATIC DISCHARGE. AVOID NYLON CLOTHING AND OTHER STATIC GENERATING MATERIALS. IF THERE IS ANY RISK OF STATIC CHARGES BEING PRESENT, TOOLS, TEST EQUIPMENT AND PERSONNEL SHOULD BE DISCHARGED TO GROUND BEFORE TOUCHING CIRCUITS IN THE FOLLOWER DIGITAL REFERENCE.

CARD REMOVAL AND GENERAL CHECKS

The printed circuit cards in the Follower Digital Reference are designed to be easily removed through the use of quick-connect connectors and machine screw mounting. Sufficient cable length from the microprocessor card on the back of the cover to the keypad and to the power supply card is provided to allow the card to be removed from the cover for access to test points with all connections intact. Care must be taken however, to avoid stress on the cables and connectors.

The following general checks and inspections should be made as a first step in troubleshooting:

- o Check that all terminal connections on the power supply card are correct and tight.
- o Check that all connectors are correctly installed and seated in their sockets.
- o Check that all stab-on connections on the power supply card are correct and fit snugly. The stab-on posts for the transformer are identified by color of the transformer leads.
- o Check that the following jumper settings are correct on the microprocessor card:

J1 - In for Follower Frequency Reference

Out for the Follower Period Reference

J2 - In to enable present draw reprogramming

Out to disable reprogramming

J3 - Always out

J4 - Always in

- o If the voltage reference option card is used, be sure a single jumper is installed in one of the four positions.
- o Check for poor or broken solder connections.
- o Check for solder bridges or other shorts on both sides of the cards.

- o Remove any loose chips of metal.
 - o Be sure the fault interrupter fuse is not blown.
 - o Be sure there are no unsuppressed relay or solenoid coils in the vicinity. Check for other sources of electrical electromagnetic noise which might interfere with the unit.
 - o Be sure there are no fixed or portable radio transmitters operating in the immediate vicinity.
 - o Be sure the external START/STOP contact is operating correctly.
 - o Check that the 115V AC supply is present and at the correct voltage.
 - o Check that the +5V DC, -12V DC power are present and within 5% of the nominal value on both the power supply card and microprocessor card. Test posts are provided for this purpose.
- If none of these checks locate any problems, proceed with the troubleshooting chart in the following subsection.

4. Pulse output problems: (Fig. 17d)
 - No pulse output, or pulse stays at minimum frequency
 - Pulse frequency does not follow the pulse input
 - Pulse frequency is at the wrong percent draw
 - Pulse frequency drifts
 - Pulse output erratic
5. Voltage output problems (if option used: Fig. 17e)
 - No voltage output
 - Incorrect voltage output
 - Voltage drifts or is erratic
 - Too much ripple on voltage output

TROUBLESHOOTING CHART

Follow the Digital Reference: problem symptoms can be broken down into one of the following five general categories. For each category a troubleshooting tree is provided in Figure 18 for isolating the problem. To use the troubleshooting trees, first find the general category your symptom falls under. Then refer to the tree for that category. Start at the top of the tree, and at each branch, make the indicated check and take the branch based on your response to the question asked at that branch.

1. Display, status LED and power supply problems: (Fig. 17a)
 - No display segments or LEDs light
 - Status LEDs OK, no display
 - Some segments or LEDs do not light
 - Display readout is incorrect or not intelligible
 - Display is erratic
2. Keypad and parameter entry problems: (Fig. 17b)
 - Keypad fully inoperative
 - Keypad partially inoperative
 - Parameters will not reprogram or reprogram incorrectly
 - Parameters reprogram by themselves
3. START/STOP or RUN problems: (Fig. 17c)
 - RUN relay won't energize but pulse output OK
 - RUN relay energizes even when start contact open
 - RUN relay operates erratically or at the wrong time

MAINTENANCE AND RENEWAL PARTS

The Follower Digital Reference is designed to require a minimum of maintenance. The keypad display cover may be kept clean by using a mild detergent. Do not use abrasive cleaners or organic solvents.

The interior of the unit should not require cleaning provided the enclosure is maintained.

The oscillator which controls the displayed pulse output parameters may drift slightly with age. This may be trimmed back into agreement with your calibration instruments by adjusting one or both trimmers on the microprocessor card. (Refer to sub-section on internal adjustments).

The voltage output, if this option is used, may also be trimmed if necessary by adjusting the potentiometer on the voltage output card.

RENEWAL PARTS

<i>Description</i>	<i>Catalog Number</i>
FOLLOWER DIGITAL REFERENCE	6VDFR10A1
POWER SUPPLY TRANSFORMER	36A353243BC
POWER SUPPLY CARD	193X482AAGO1
MICROPROCESSOR CARD	193X483AAGO2
MICROPROCESSOR PROGRAM ON 2716 EPROM	409X100AA203
CABLE, POWER SUPPLY to MICROPROCESSOR CARD	36A358099RFGO1
FREQUENCY to VOLTAGE REFERENCE CARD	193X484AAGO1
FREQUENCY to VOLTAGE OPTION KIT	6VFVR10A1
ESCUTCHEON (KEYPAD + CABLE)	36B605463ACGO2
ENCLOSURE	36C774255AAGO1
INSTRUCTION BOOK	GEK-24978

For parts, contact your local General Electric Sales Office or your "Authorized" General Electric Parts Distributor.

The Contract Warranty for the Follower Digital Reference is stated in the General Electric Apparatus Handbook, Section 105, page 71.

In the event of failure or misapplication during "in-warranty", refer to this instruction book to identify the defective part or subassembly. When the defective part has been identified (or for assistance in identification) call:

**GENERAL ELECTRIC COMPANY
SPEED VARIATOR PRODUCTS OPERATION
ERIE, PENNSYLVANIA 16531
(814-455-3219)
(24 -hour phone service)**

Before calling, list catalog numbers for ready reference.

**GENERAL ELECTRIC COMPANY
SPEED VARIATOR PRODUCTS OPERATION
ERIE, PENNSYLVANIA 16531**

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