

**EAI**

ELECTRONIC ASSOCIATES, INC. ■ LONG BRANCH, NEW JERSEY

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**SERVO MECHANICAL  
MULTIPLIERS  
26 SERIES  
MODELS 7.017, 7.083 & 7.084**

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1. Please specify the type number and serial number of the basic unit as well as the identification of the part when inquiring about replacement items as potentiometer assemblies or cups, relays, transformers, precision resistors, etc.
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## SECTION I

### SERVO MECHANICAL MULTIPLIERS

#### 1. GENERAL

The 26 Series Servo Mechanical Multipliers, manufactured by Electronic Associates, Inc., are high-speed computer elements of maximum reliability, designed to perform the following mathematical computations:

Division  
Multiplication  
Generation of non-linear functions  
Computation of roots and powers

The multipliers are constructed in the form of plug-in units to provide rapid replacement and interchangeability. These units fit into the multiplier cradles of standard Electronic Associates, Inc., computer consoles and racks.

The multipliers consist of ganged potentiometers up to eight sections (four or six sections on commonly used models) and associated follow-up systems. All models are protected against electrical damage by a fuse connected in series with the wiper arm of each cup (potentiometer section). Mechanical protection is provided by mechanical end stops; some models include an electrical stop positioned slightly ahead of the mechanical end stops.

#### 2. INTERCHANGEABILITY CONSIDERATIONS

Whenever possible, maximum interchangeability features are incorporated in the design of Electronic Associates, Inc., multipliers and resolvers. Many different models are directly interchangeable; some require minor wiring changes.

In most cases, a comparison of schematic and wiring diagrams will readily indicate the extent of modifications necessary to affect interchangeability. However, caution must be exercised to prevent damage to the equipment when one multiplier is to be used in a cradle originally wired for a different model.

Since the number of combinations is relatively large, literature is available to assist in determining the extent of necessary modifications. A variety of publications can be obtained from EAI upon request.

#### 3. MULTIPLIER TYPES

At present three series of servo multipliers are available from EAI. The following paragraphs briefly describe these series. Detailed descriptions and maintenance data are covered in subsequent sections of this handbook.

##### a. 7.017 Multiplier Series (See Figure 1.)

This multiplier is provided with a 400 cps servo system to achieve excellent high speed acceleration and velocity characteristics. All standard models of this series are equipped with single-turn, *wirewound* potentiometer configurations (up to 8 sections) of linear, center-tapped cups, and multi-tapped (11 taps) cups with 0.1% linearity chosen to meet the majority of customer requirements. Mechanical stops are provided.

##### b. 7.083 (26-7M) Multiplier Series (See Figure 2.)

This series of multipliers provides an extremely accurate, medium speed (60 cps) multiplying device. From one to three *10-turn, dual* wirewound potentiometers are available (center-tapped and multi-tapped with 0.025% linearity) from standard stock. Both electrical and mechanical stops are provided in all models.

##### c. 7.084 (26-7N) Multiplier Series (See Figure 3.)

Features of this unit are a 60 cps servo system, single-turn, wirewound potentiometers with 0.12% linearity and both electrical and mechanical stops, to provide a medium speed multiplier with maximum reliability and very good accuracy.

Standard models contain up to 7-cup potentiometers, in many combinations of center-tapped cups, to facilitate the use of the unit in all phases of multiplication, division and function generation.



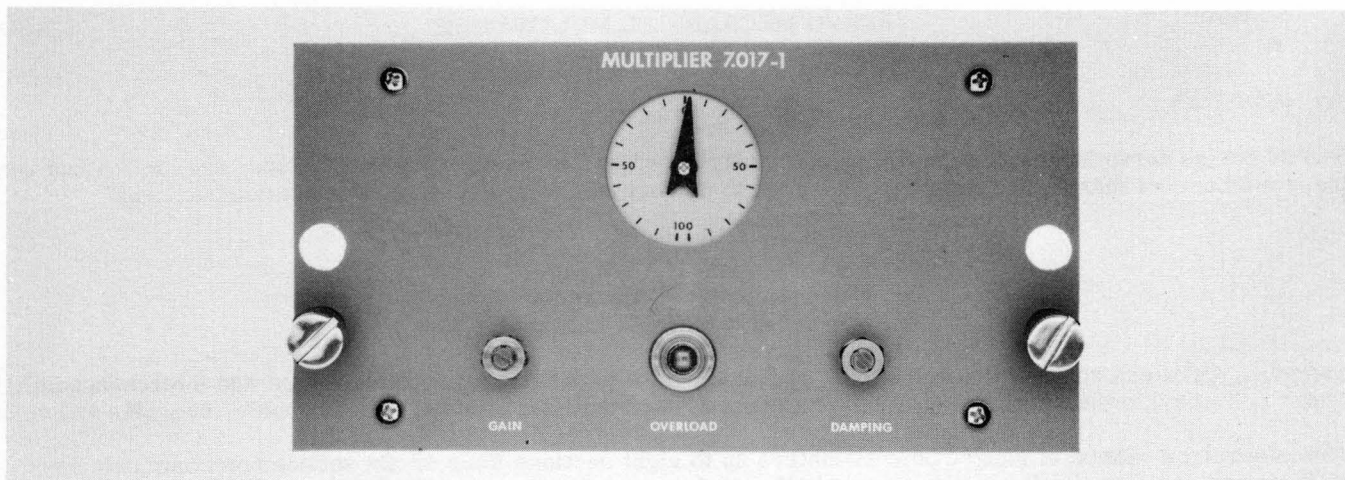


Figure 1. Servo Mechanical Multiplier 7.017

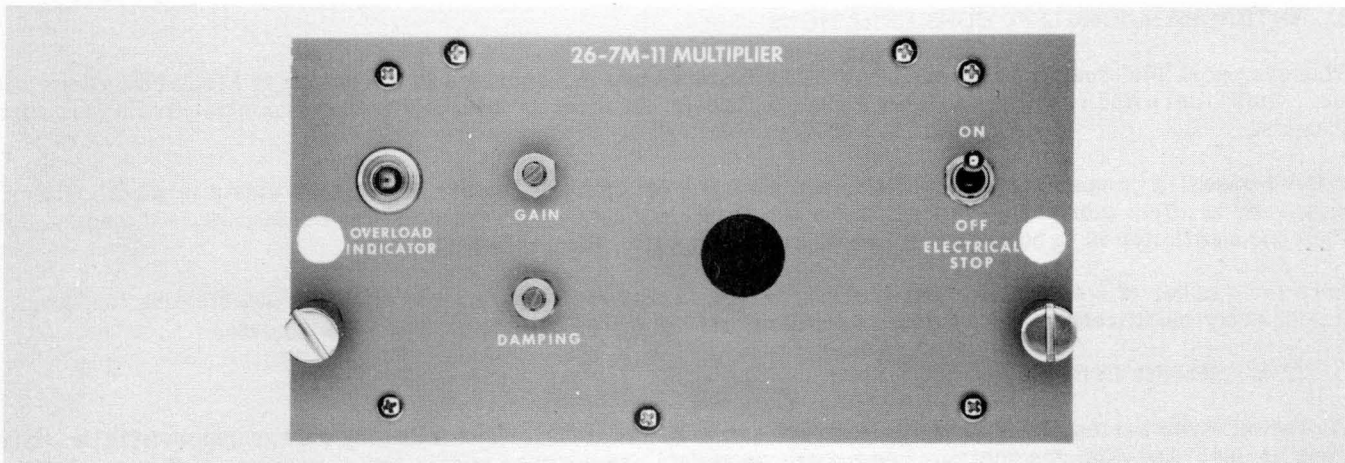


Figure 2. Servo Mechanical Multiplier 7.082 (26-7M)

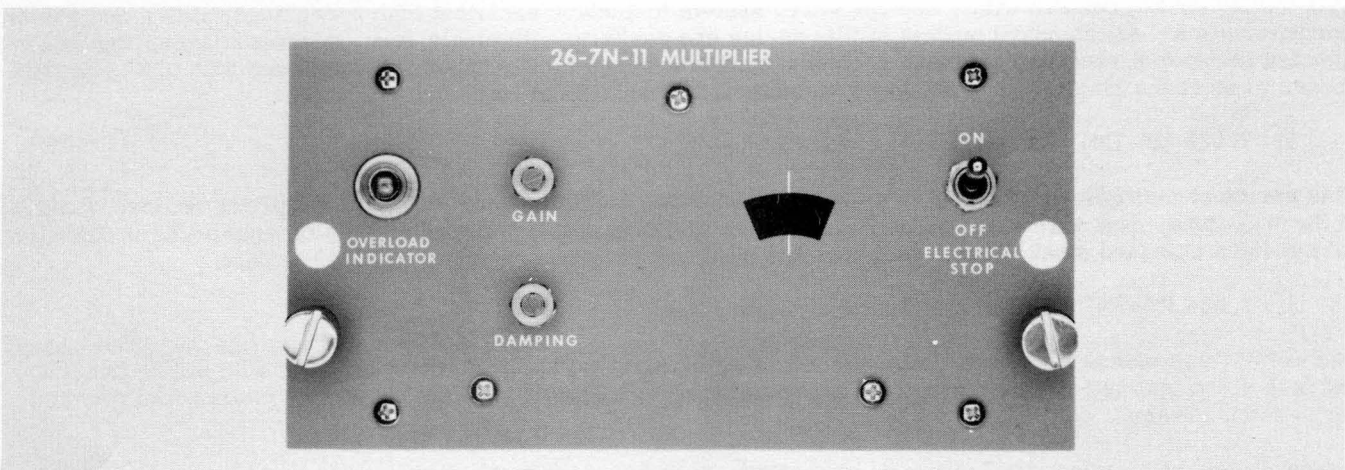


Figure 3. Servo Mechanical Multiplier 7.084 (26-7N)

#### 4. APPLICATION CIRCUITRY

The following paragraphs and associated circuit diagrams illustrate some of the configurations possible for utilizing the servo mechanical multiplier as a computing element. Due to the direct interchangeability of the units described in this manual, the application diagrams and patching schemes are identical for all. For illustrative purposes, only a portion of the multiplier cup configuration is shown on each circuit. Additional calculations are derived by repetition of the patching scheme.

##### a. Multiplier Circuits

Figure 4 illustrates a simplified schematic and patching diagram for multiplying two variables (A and B) by a common variable (X). (The inverting amplifiers indicated in this example are not supplied with the multiplier.)

The common variable (X) is connected to the input of the servo amplifier (designated SM1 in Figure 4). This input is compared with the wiper arm output of the feedback (follow-up) cup on the ganged potentiometer.

The difference between these two voltages causes the amplifier output to drive the two-phase servo motor, which rotates the potentiometer assembly until the potential at the FB potentiometer is equal to the input potential. This null-seeking, closed-loop servo system is designed to position the potentiometer shaft so that the output of the feedback cup is equal to the common variable input voltage X.

If a second variable (A) is applied across Cup A of the potentiometer, the voltage  $E_{10}$  will appear at the wiper.  $E_{10}$  is the product of X and A divided by a constant (the value of the reference voltage). This configuration illustrates one method of deriving the product of two variables.

##### b. Dividing Circuits

The following suggested dividing circuits are provided for normal computational use. These dividing circuits utilize the same elements employed in the multiplier circuits, the only difference being the method of connecting the various components.

(1) *Method 1.* Figure 5 illustrates one mathematical variation and patching method with which division can be accomplished by multiplication in an operational amplifier feedback circuit.

If only a positive value of A is available, +REF should be applied to the number 10 terminal (+F) of the multiplier and the minus terminal (-F terminal B) of the feedback cup should be grounded; also, the connections to +A and -A must be reversed.

(2) *Method 2.* Another method of dividing is shown in Figure 6. This method is recommended only when variations in the value of A can be closely limited ( $\pm 10\%$ ). Since A is a part of the servo loop, operational stability will not be maintained for any wide variations in loop gain.

##### c. Square Root Circuit

In square root derivation (Figure 7) limiting values apply to both X (input) and the reference voltage. Stabilization can only be obtained by observing the following conditions:

When X is *positive*, reference (REF) must be *negative*.

When X is *negative*, reference (REF) must be *positive*.

At no time can both the input (X) and the reference voltage be of the same polarity.

##### d. Computation of Non-Linear Functions

Various models of multipliers, containing multi-tapped cups, may be utilized for multiplication and/or computation of non-linear functions through the use of padding resistors as shown in Figure 8. The use of the tapped cups of the potentiometer permits the variations of voltage gradients necessary to produce the required function.

When using pot padding equipment with the multipliers that contain multi-tapped cups, the jumper plugs in connectors P2A through P2E (where used) must be removed. The jumper plug(s) are then replaced by an inter-rack cable from the pot padding equipment.

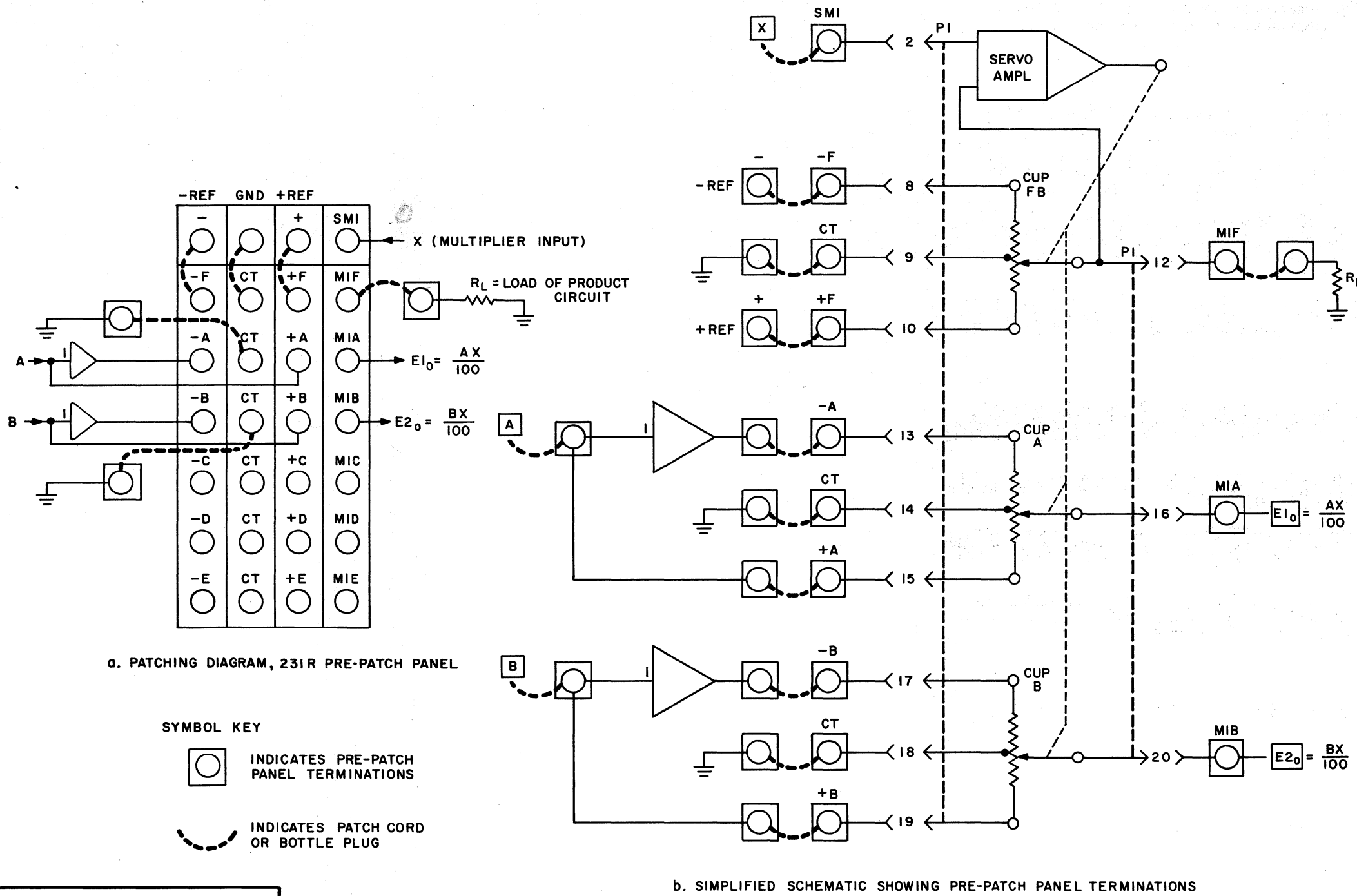
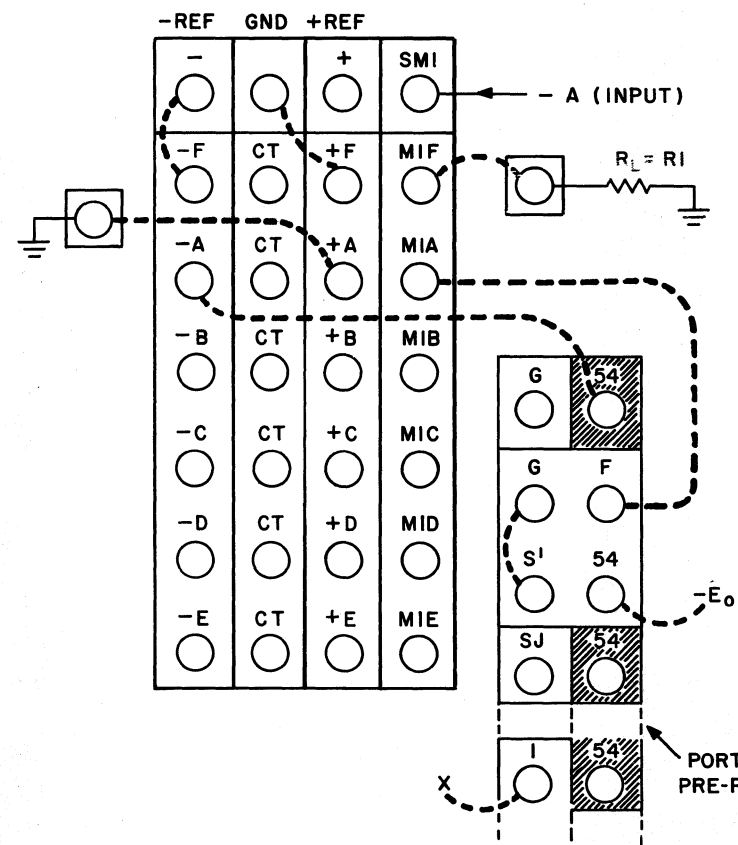


Figure 4.  
Multiplying Circuit

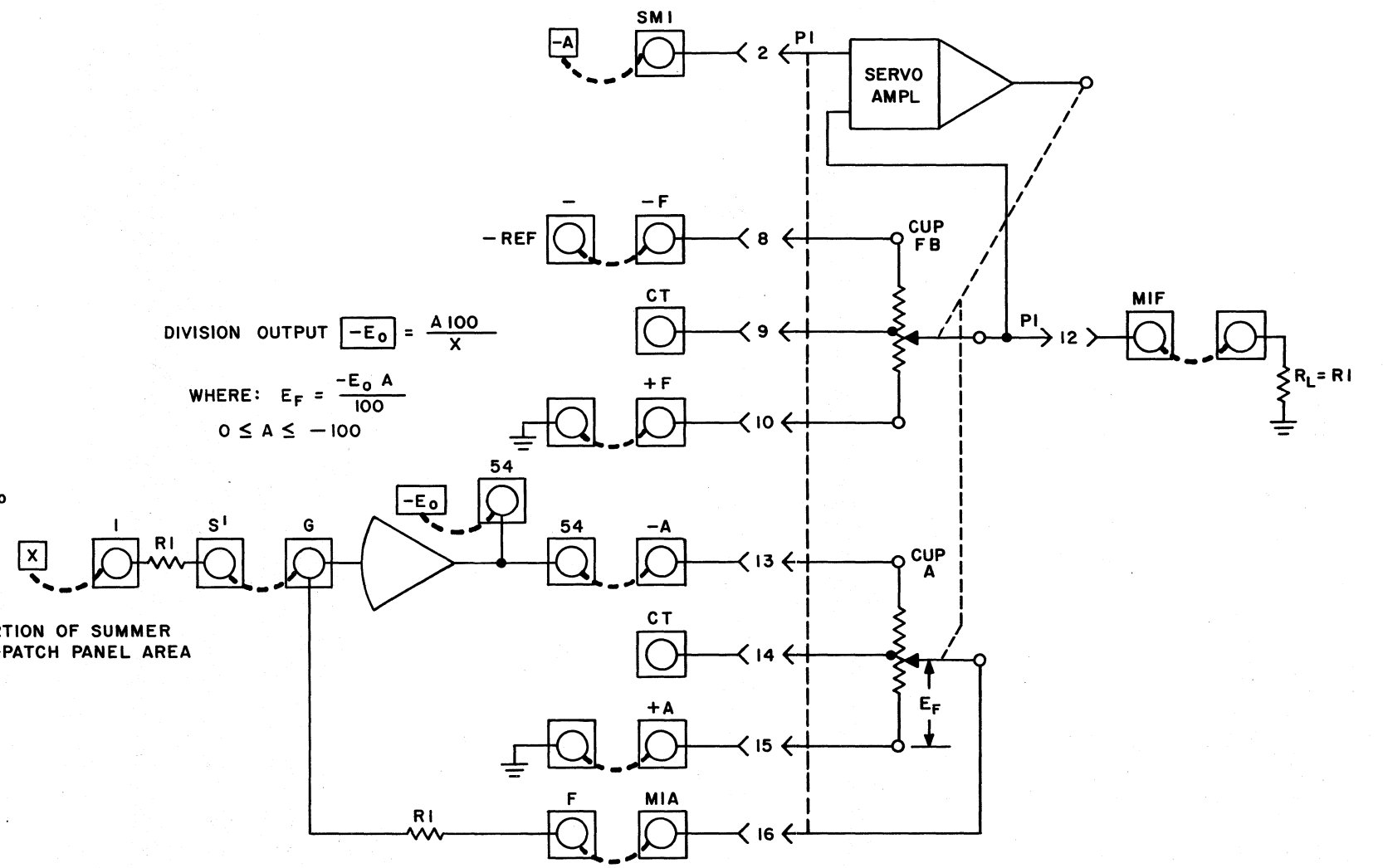


a. PATCHING DIAGRAM, 231R PRE-PATCH PANEL

SYMBOL KEY

INDICATES PRE-PATCH PANEL TERMINATIONS.

INDICATES PATCH CORD OR BOTTLE PLUG.



DIVISION OUTPUT  $-E_o = \frac{A \cdot 100}{X}$   
 WHERE:  $E_f = \frac{-E_o \cdot A}{100}$   
 $0 \leq A \leq -100$

b. SIMPLIFIED SCHEMATIC SHOWING PRE-PATCH PANEL TERMINATIONS

Figure 5.  
Dividing Circuit, Method 1

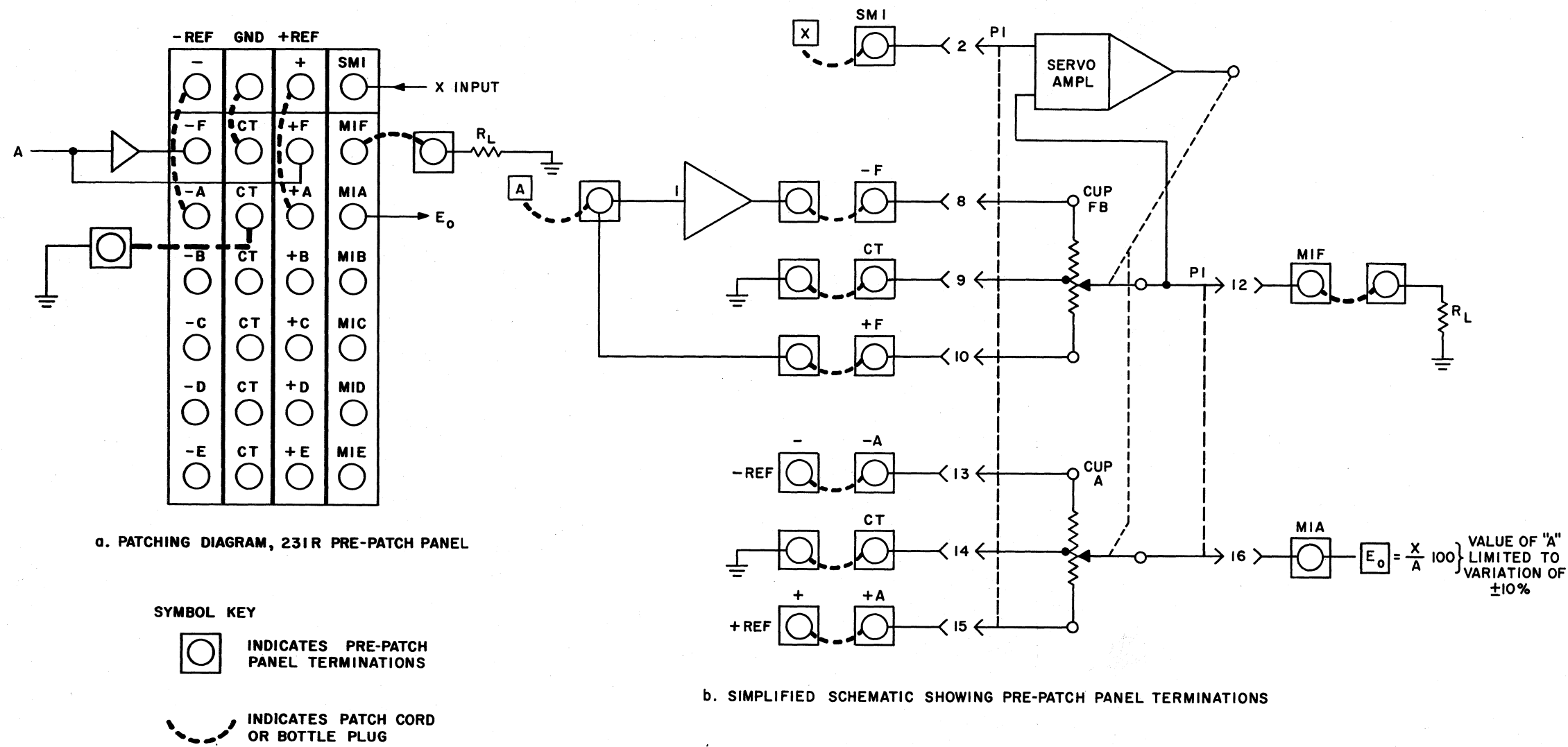


Figure 6.  
Dividing Circuit, Method 2

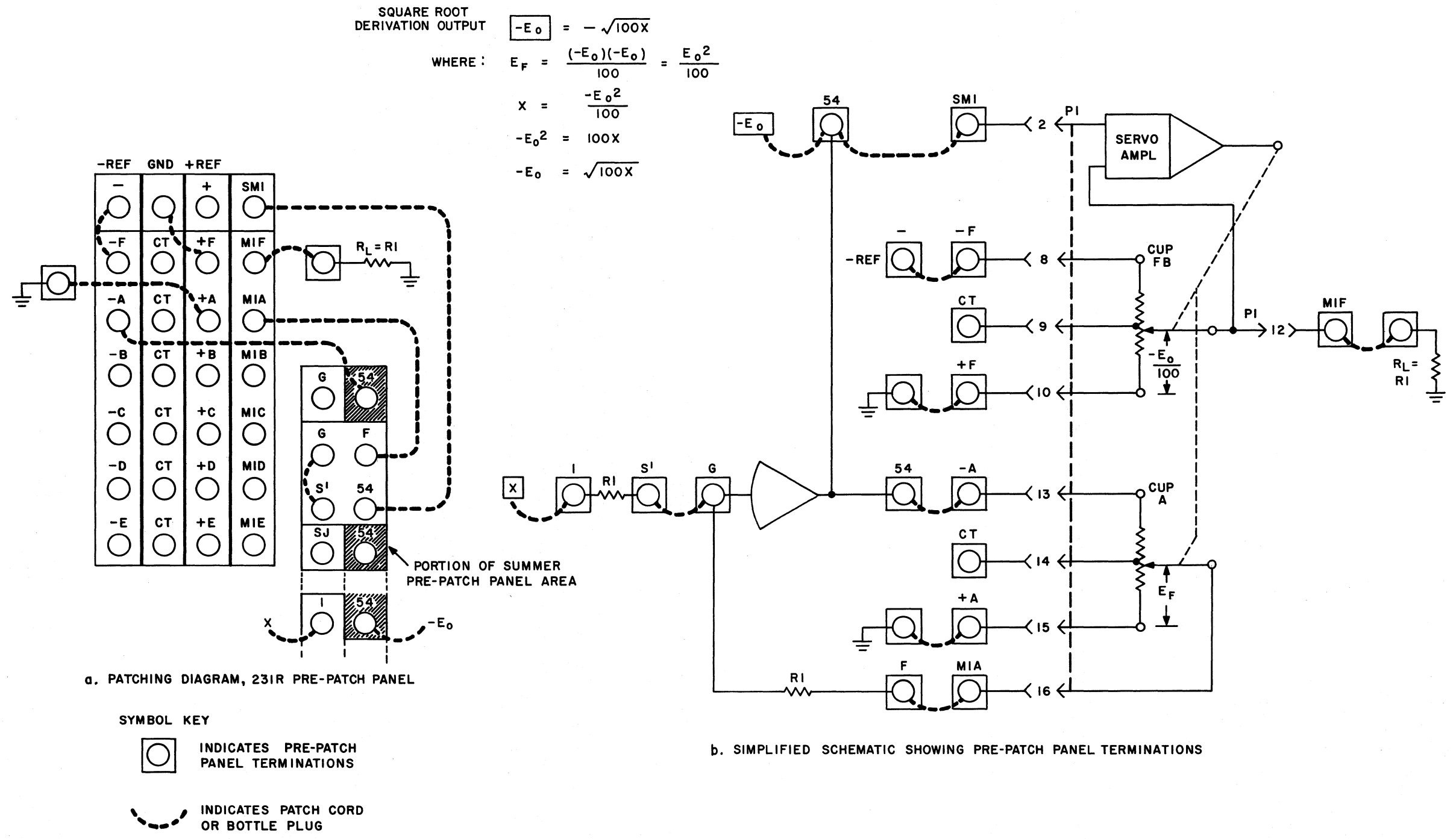


Figure 7.  
Square Root Circuit

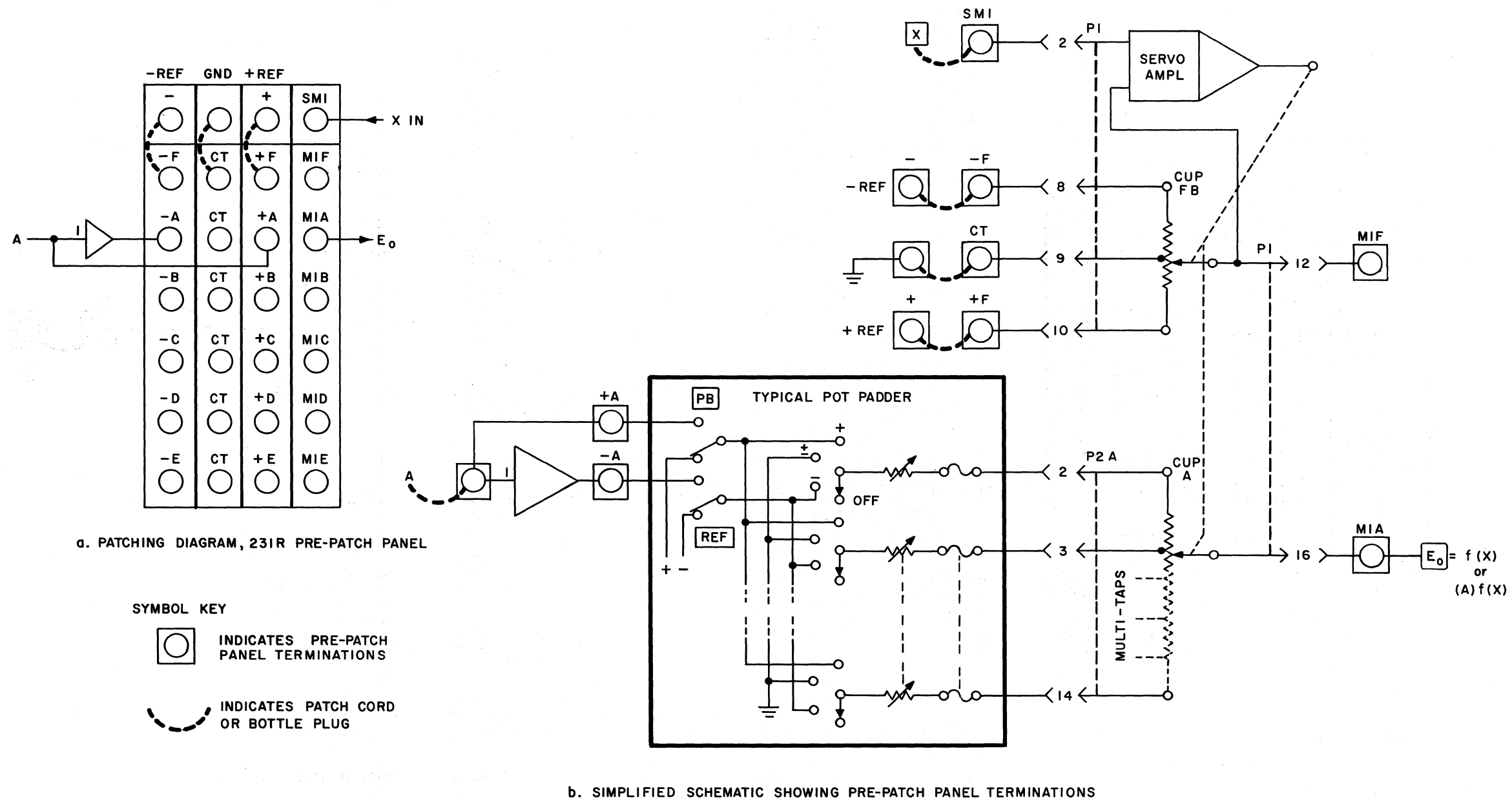


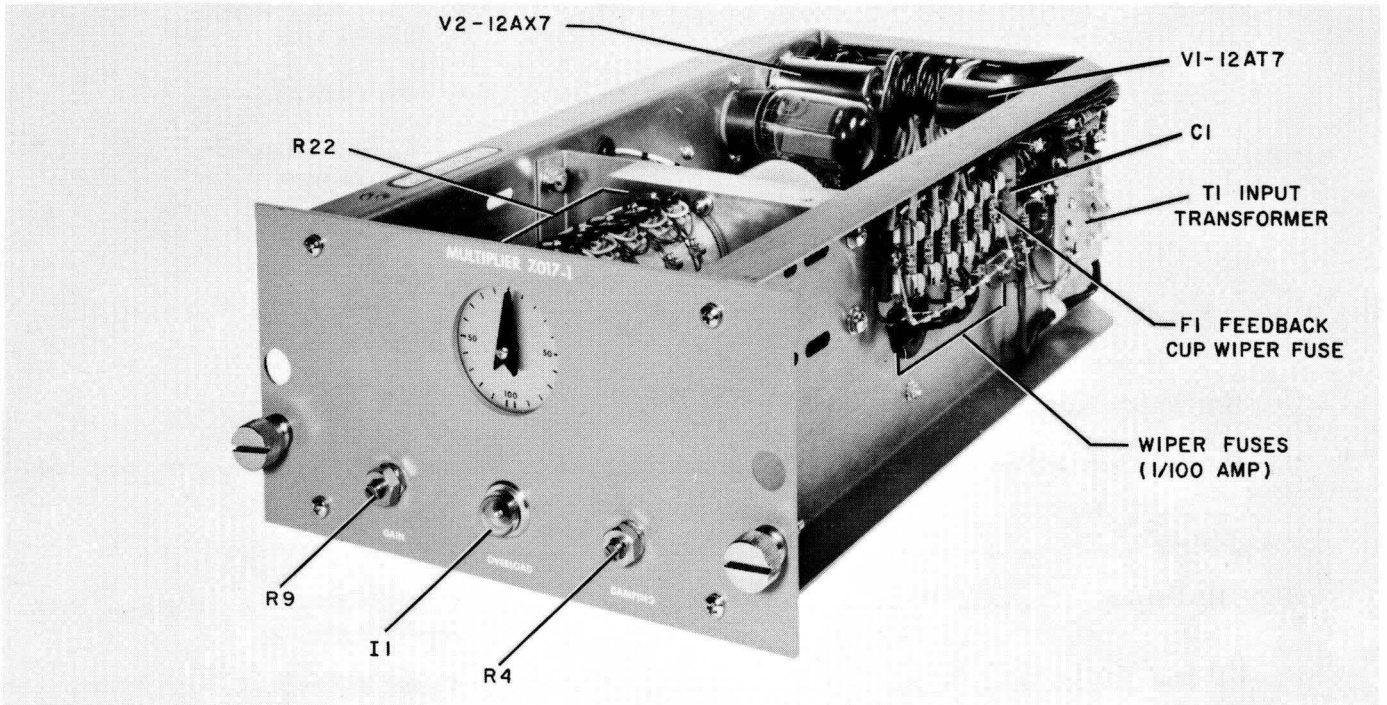
Figure 8.  
Computation of Non-Linear Functions

## SECTION II

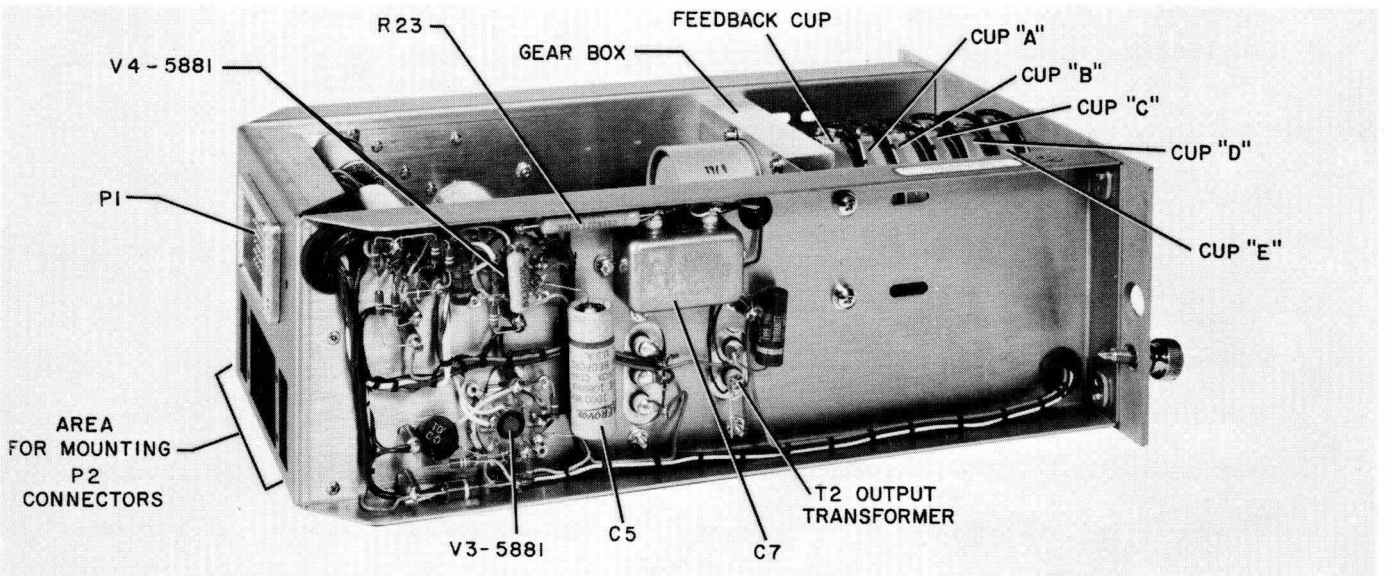
### SERVO MECHANICAL MULTIPLIER 7.017

#### 1. GENERAL

Servo Multiplier, Type 7.017 (Figures 9 and 10) is a single-turn multiplier utilizing a 400 cps servo system for very high speed and dynamic accuracy. This multiplier is operationally identical with the 16-7S Multiplier except for the use of long-life, high-resolution, low torque, 2-inch diameter, *wirewound* potentiometers and extremely quiet servo motor operation.



*Figure 9. Servo Mechanical Multiplier 7.017, Three-Quarter Front View*



*Figure 10. Servo Mechanical Multiplier 7.017, Three-Quarter Rear View*



2. MULTIPLYING POTENTIOMETER CONFIGURATIONS

7.017 (16-7S) Multiplier

| <u>Model Number</u>   | <u>Potentiometer Description</u>                                  |
|---|---|
| 7.017-1 (16-7S-1)   | *6 linear cups, 30K, center tapped                                |
| 7.017-2 (16-7S-2)   | *2 linear cups, 30K, center tapped<br>4 linear cups, 30K, 11 taps |
| 7.017-3 (16-7S-3)   | *4 linear cups, 30K, center tapped<br>2 linear cups, 30K, 11 taps |
| 7.017-5 (16-7S-5)   | *4 linear cups, 30K, center tapped                                |
| 7.017-6 (16-7S-6)   | *1 linear cup, 30K, center tapped<br>5 linear cups, 30K, 11 taps  |
| 7.017-9 (16-7S-9)   | *6 linear cups, 30K, 11 taps                                      |
| 7.047 (This unit is a 7.017<br>Chassis with 8 linear cups.) | *8 linear cups, 30K   |

3. CONTROLS AND INDICATORS

The following indicators and controls are provided on the front panel of the multiplier unit for operational convenience.

- GAIN Control ..... Controls servo amplifier gain.
- DAMPING Control ..... Controls degree of damping of servo feedback system.
- Indicator Dial .. Visual indicator dial divided into twenty parts and calibrated from -100V to +100V to indicate the position of the servo.
- External OVERLOAD Indicator ..... Neon lamp to provide a visual indication of servo overload.

4. TECHNICAL DATA, PHYSICAL

- Height ..... 5 inches
- Width ..... 9-1/2 inches
- Chassis
  - Height ..... 4-3/4 inches
  - Width ..... 8 inches
  - Depth ..... 15 inches
  - Weight ..... 17 pounds

---

\*Configuration of feedback cup.

## Tube Complement

Type 12AT7 - 1 each

Type 12AX7 - 1 each

Type 5881 - 2 each

## 5. TECHNICAL DATA, ELECTRICAL

## Power Input

| <u>Quiescent</u>     |         | <u>Slewing</u>       |         |
|----------------------|---------|----------------------|---------|
| +300V DC .....       | 8 ma    | +300V DC .....       | 15 ma   |
| +390V DC .....       | 80 ma   | +390V DC .....       | 130 ma  |
| 115V AC (400~) ..... | 180 ma  | 115V AC (400~) ..... | 220 ma  |
| 6.3V AC .....        | 2.4 amp | 6.3V AC .....        | 2.4 amp |

The external reference voltage should be within the range of plus and minus 25 to 100 volts. The load on the reference source varies in accordance with the circuit connections.

## 6. TECHNICAL DATA, OPERATIONAL

*Potentiometer Characteristics (Wirewound)*

## Linear Potentiometers:

|                               |                        |
|-------------------------------|------------------------|
| Resistance .....              | 30,000 ohms $\pm 10\%$ |
| Independent Linearity .....   | 0.1%                   |
| Electrical Rotation .....     | 350° $\pm 1\%$         |
| Center Tap Tolerance .....    | 0.1% *                 |
| Resolution .....              | 0.029%                 |
| Temperature Coefficient ..... | 20 PPM                 |

## Linear Tapped Potentiometers:

|   |                        |
|---|------------------------|
| Resistance .....                                  | 30,000 ohms $\pm 10\%$ |
| Independent Linearity .....                       | 0.1%                   |
| Electrical Rotation .....                         | 350° $\pm 1\%$         |
| Number of taps equally spaced counting C. T. .... | 11                     |
| Tolerance of all tap locations .....              | 0.1% *                 |
| Resolution .....                                  | 0.029%                 |
| Temperature Coefficient .....                     | 20 PPM                 |

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\* The tolerance on the deviation between the actual and ideal tap voltages. The tolerance is expressed as a percentage of the total reference voltage, a nominal 200 volts.

*Servo Static Nulling Error:*

Error between input and feedback signal  
as percentage of full scale (200V) ..... less than 0.02%

*Acceleration:*

The acceleration limit based on 200V across feedback potentiometer is ... 190,000V/sec<sup>2</sup>

*Velocity:*

The velocity limit based on 200V across feedback potentiometer is ..... 4000V/sec

*Dynamic Error:*

The overall dynamic errors of the servo system are shown as frequency versus input curves in Figure 11.

*Loading Error:*

The output channel terminations should operate into a load of between 1 megohm and infinity. A resistor equal in value to the load on the multiplying channels should be included in the feedback circuit in order to cancel out the error due to external loading. This resistor, R<sub>L</sub>, (Figures 4 through 8, Section I) should be connected from the feedback cup (Terminal 12) to ground, as shown in the applicable schematics.

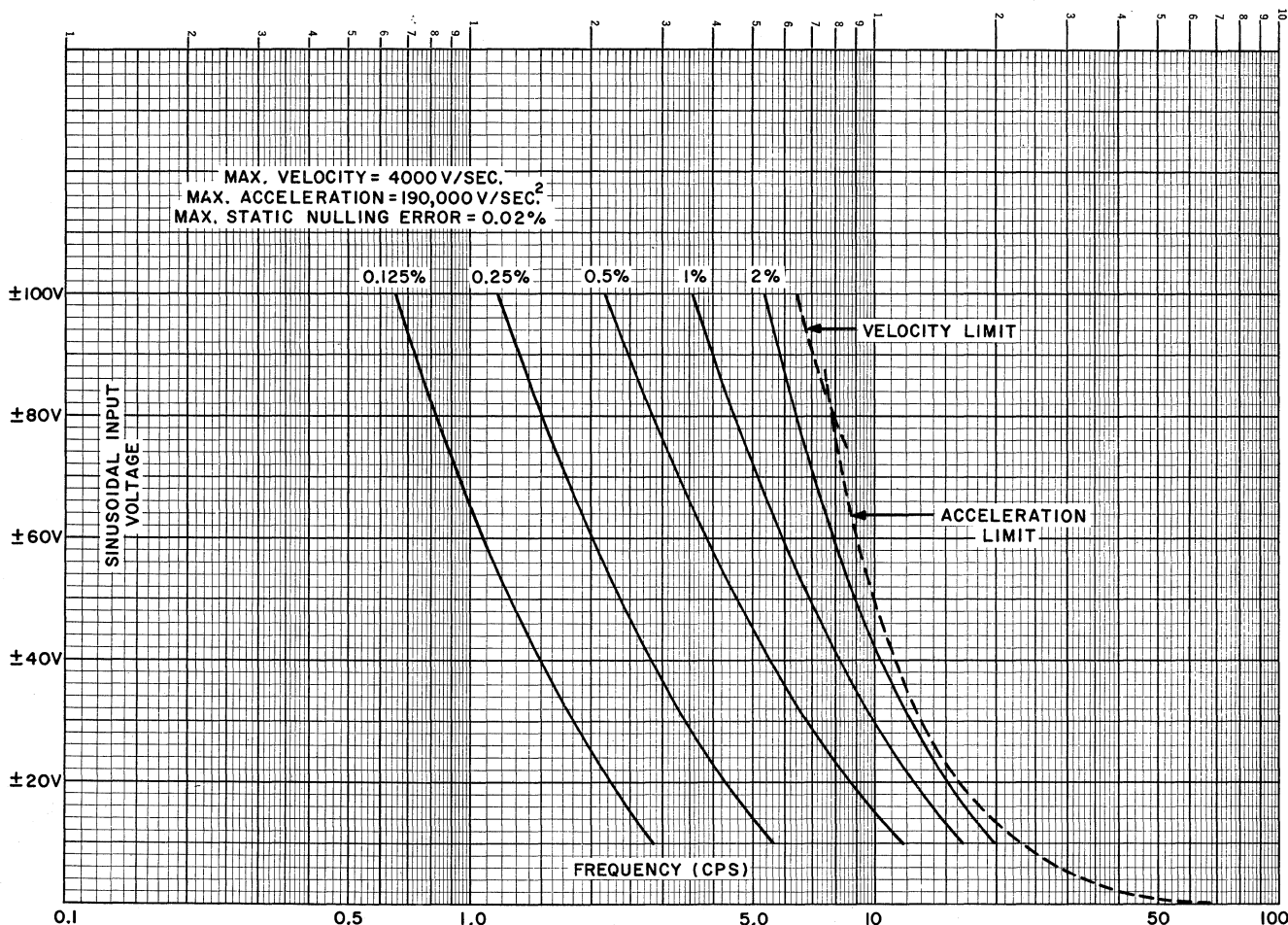


Figure 11. Dynamic Error Curves, 7.017 Multiplier

## 7. INPUT AND OUTPUT TERMINATIONS

All connections to the multiplier are made through connectors located at the rear of the chassis. On models utilizing tapped cups for function generation, connector P1 and as many P2 connectors as required are furnished. Connector P1 provides for power inputs, and potentiometer end-tap, wiper arm and center-tap connections. Connectors P2A through P2E (as required) provide the additional connections required by multi-tapped potentiometers. Each multi-tapped cup of the potentiometer is provided with a separate connector to facilitate termination of the tapped cup during function generation. An internal connector (J4) is provided to facilitate potentiometer removal.

## 8. INSTALLATION AND ADJUSTMENTS

### a. Installation

The 7.017 Series of multipliers is completely interchangeable with other EAI multipliers such as the 7.083 (26-7M) and the 7.084 (26-7N) Series when used in PACE<sup>®</sup> Computers and associated expansion racks. However, a source of 115 volts, 400 cps power must be supplied to terminals 37 and 38 of P1 for operation of the chopper and servo motor reference phase.

CAUTION

*Compare schematic diagrams of units being interchanged, to prevent damage to the potentiometers.*

Use of the overload indicator circuitry requires connection of terminal 6 (P1) to the input of the overload alarm unit such as EAI Models 16-13A and 13.001. If an overload alarm unit is not provided, connect terminal 6 of P1 to terminal 3. Overload can then be observed at the OVERLOAD indicator located on the front panel.

Multipliers supplied with multi-tapped cups require a cable from the appropriate P2 connector to a pot padder, or a jumper plug (provided with the unit). The jumper plug is utilized to connect the end tap, center tap, and wiper arm connections of the multi-tapped cups back to P1 and to the pre-patch panel area of the computer.

Reference voltages in the range of  $\pm 25$  to  $\pm 100$  volts may be used on the feedback cup (F). Reference voltages applied should never exceed  $\pm 100$  volts; that is, the total voltage applied across the cup between pins 8 and 10 of connector P1 (+F and -F on the computer pre-patch panel) should never be over 200 volts. The multiplier dial is graduated in twenty equal divisions of  $17\text{-}1/2^\circ$  each, calibrated in increments of ten, both in the positive and negative direction. With a known reference being applied to the feedback cup, the indicator dial then displays an approximate indication of servo input. More accurate measurement can be made using the VTVM or DVM provided in the computer.

### b. Adjustments

The GAIN and DAMPING controls are adjusted after installation and thereafter at the discretion of the operator. These controls interact to some degree so that the adjustment steps should be repeated until satisfactory response is obtained.

(1) *Gain Adjustment.* Apply a step function to the servo system and adjust the GAIN control just below the point where servo oscillations occur.

(2) *Damping Adjustment.* The DAMPING control is adjusted so that, in a step function, one overshoot occurs before the servo nulls. No overshoot indicates over-damping. Re-adjust the GAIN control if required.

CAUTION

**DO NOT UNDER ANY CIRCUMSTANCES PERMIT THE SERVO TO JITTER MORE THAN A FEW SECONDS.**

## 9. THEORY OF OPERATION

## a. General

The multiplier circuitry consists of a servo amplifier (with input network and modulator) servo motor, gear train and a multiplying potentiometer. (See Figures 12 and 13.) The servo amplifier develops a motor-positioning signal from two sources: (1) a common variable signal coupled to the signal input, and (2), the feedback voltage (FB). The signal input represents the magnitude of the common variable by which the other variables are to be multiplied. The feedback voltage is derived from the wiper arm of the feedback cup of the multiplying potentiometer (see Schematic Diagram D007 017 0S). Coupling of the servo motor to the multiplying potentiometer is provided by a gear train with a ratio of 5.5:1 (motor to potentiometer).

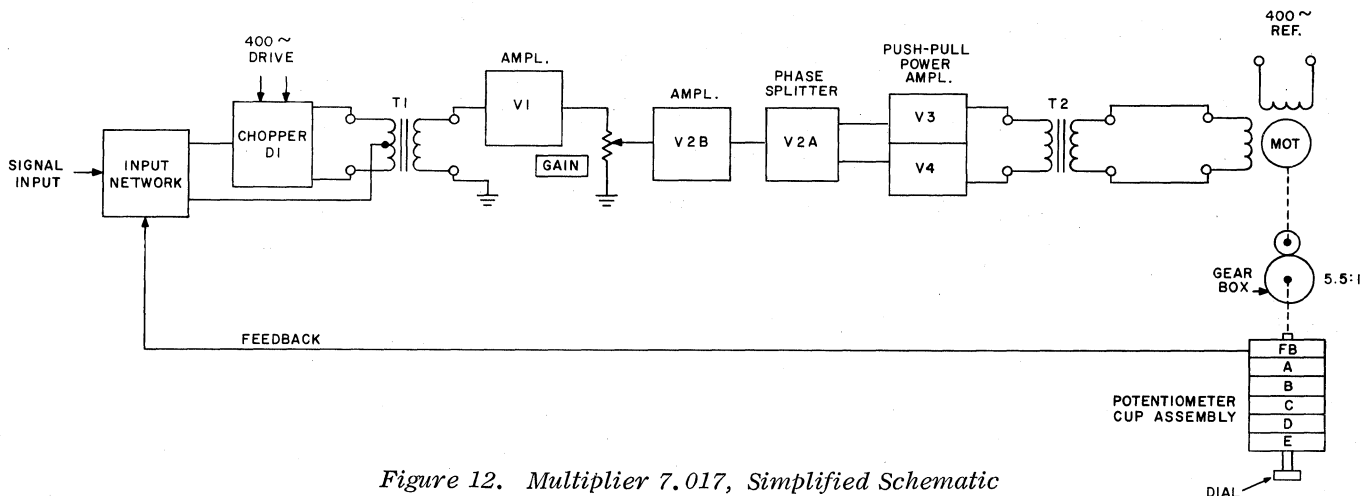


Figure 12. Multiplier 7.017, Simplified Schematic

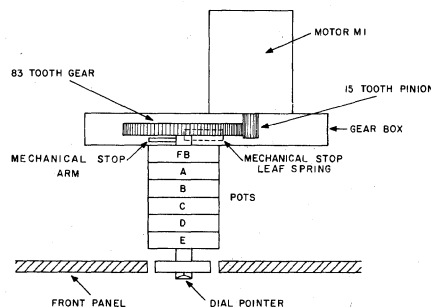


Figure 13. 7.017 Gear Train Schematic

## b. Input Network and Chopper

The signal input and the feedback voltage are applied to opposite ends of the input network formed by R2, R3, R4 (DAMPING control) and C1. The voltage across this network is equal to the difference between the two inputs. The output of the network, taken across R2, is a proportional-plus-derivative representation of the servo loop error. The function of the voltage divider is to provide the proportional error voltage, and capacitor C1 provides the derivative error voltage (an error signal proportional to the rate of change). This method of control functions to provide a large error voltage when the servo is displaced from null, and an effective braking force when the servo approaches the new null.

The d-c error voltage appearing across R2 is modulated at a 400-cycle rate by chopper D1 (electro-mechanical vibrator). The vibrating reed of the chopper alternately connects the high and the low end of the primary winding of transformer T1 to one side of the error voltage. The other side of the error voltage resistor is connected to the center tap of the primary winding. This applies the error signal alternately across one or the other half of the winding. The resultant action of current (proportional to the error) flowing for one half cycle in one direction and for the other half cycle in the opposite direction, induces a 400-cycle square wave into the secondary of T1. The amplitude of this signal is proportional to the error and the phase is determined by the error voltage polarity.

c. Amplifier Circuitry

The output of T1 is coupled to the first amplifier stage which is a dual triode type 12AT7 (V1). The output of V1 is R-C coupled to V2 (12AX7). The servo gain is controlled by potentiometer R9 in the grid circuit of V2. The output of the second amplifier is coupled directly to the phase splitter (second section of V2), which is employed to obtain balanced drive for the push-pull output stage consisting of V3 and V4. The output of the amplifier is taken from T2 and applied directly to the control phase of servo motor M1. An overload condition of the servo is provided by indicator I1 which is connected between ground and Pin 5 of the secondary of output transformer T2.

Inverse feedback is provided by resistors R16 and R18. Resistor R20 is employed to prevent screen coupling between the power output tubes V3 and V4. C5 resonates the output transformer primary to 400 cycles and reduces the harmonic content of the amplifier. The servo requires no external balancing and draws no load from the source circuits at balance (steady state).

10. POTENTIOMETER MAINTENANCE

A convenient method of checking the accuracy of the cup alignment, as well as other operational characteristics, is afforded by the subsequent test setup. (See Figure 14.) The diagram indicates a configuration using a computer and a strip-chart recorder. Equivalent equipment may, of course, be utilized to perform the same functions, but most users of EAI servo multipliers will possess the required items.

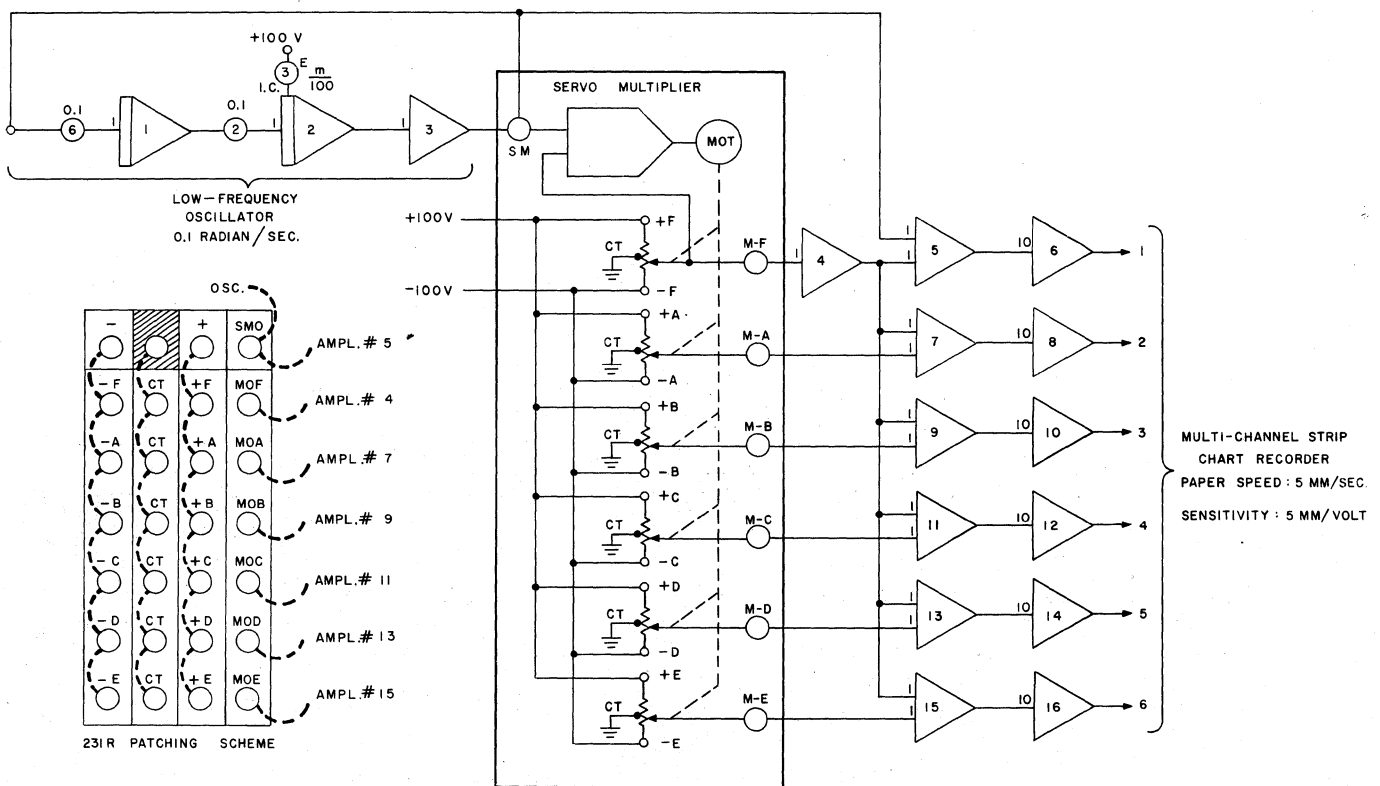


Figure 14. Potentiometer Test Setup, Schematic Diagram

As indicated in the diagram, an oscillator is used to drive the servo at a frequency of 0.1 radians per second. The output of the feedback cup is compared with the driving voltage and also with the output of each of the remaining cups. These difference voltages are then multiplied by ten and recorded. The recorder gain may be increased to 0.2 millimeters per volt if desired, and amplifiers 6, 8, 10, 12, 14, and 16 omitted. The first channel thus shows the total static and dynamic error of the servo drive system. The remaining channels indicate tracking of the multiplying cups with respect to the feedback cup. In addition to errors in alignment and linearity, the traces indicate any noise outputs due to dirt or discontinuities in the cup windings.

If a cup is misaligned, an oscillating trace results. (The trace is best observed with a zero input; thus the ideal output should be a straight line at the center of the recording area.) Misalignment may be corrected by loosening the cup clamp and rotating the cup with respect to the feedback cup. When more than one cup is out of adjustment, the one nearest the feedback cup must be corrected first.

When the cups are "noisy", the whole potentiometer assembly must be removed. It is recommended that customers carry spare assemblies for replacement purposes. The replaced component may then be returned to Electronic Associates, Inc., at Long Branch, New Jersey for reconditioning.

Disassembly is a delicate operation and should not be attempted without a clear understanding of the configuration of the potentiometer cups. With care and experience, a technician may replace a noisy cup in an assembly if spare cups are available. The following instructions are for the disassembly, cleaning, and adjustment of the assembly.

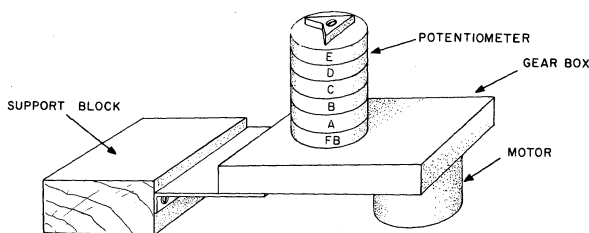


Figure 15. Assembly Mounting Method

The operation must be performed in a relatively dust-free area. Removal of the potentiometer (gear box and motor) is accomplished by unsoldering the potentiometer wiper leads at the fuse terminal and unsoldering the motor leads. Also unplug P4 and remove mounting hardware from P2 connector(s) (if used). Remove the gear box mounting hardware. Access to the cups is facilitated when the potentiometer shaft is in a downward position. If the gear box is still attached, it should be positioned according to Figure 15. If the gear box must be removed, a stand of some sort should be improvised. With the potentiometer mounted in the shaft-down position, perform the following steps:

- a. Remove the cover plate and the associated clamping ring.

**CAUTION**

*Observe the very small wires connecting the taps on the winding to the terminals. Exercise extreme care to avoid damaging these delicate wires when handling and cleaning the cups. Also avoid exerting any lateral force on the assembly since only one end of the shaft is supported.*

- b. Release the first cup by removing the clamping ring while exerting a slight downward pressure on the cup. This pressure must be maintained to prevent the center brush spring from raising the cup. Allow the cup to raise slowly and remove it from the assembly, easing the brush away from the winding to avoid damaging it. At this time, note the distance between the top brush and the edge of the cup below for later reference in assembly.
- c. The brush may be removed by releasing the setscrew with a Bristol (spline) wrench and sliding it upward. If the brush does not slide off easily, check the shaft to see if any burrs are present.
- d. Repeat steps b and c for each of the remaining cups and brushes, keeping each item in its proper sequence.
- e. Check the bearing surface of the brush for wear. If a deep groove has been worn in the face, the brush must be replaced. An excessive amount of brush contact area will result in loss of resolution.

- f.* The windings and brushes may be cleaned with any good grade of potentiometer contact cleaner. *Do not use any abrasive material since it will remove the silver plating from the contact surfaces.* Apply solvent to the resistance windings in a direction parallel to the direction of the windings. Again, exercise extreme care to avoid damaging the delicate tap wires. After cleaning the cups, stack them in their proper order with the cover plate in place to keep the dust out.
- g.* Slide the first brush onto the shaft and tighten the setscrews. The brush must fit against the front cover plate tightly enough to prevent end play but must not bind.
- h.* Insert the first cup, holding it at a slight angle so that the winding is eased against the brush. Set the cup firmly in place.
- i.* Before installing the clamping ring, check the brush for the correct tension. The pressure must be only enough to insure good contact for the entire length of the winding. Be sure that the center of the brush makes contact with the winding. If this is not so, it may be due to a bent arm or the assembly may not be properly positioned on the shaft. The cup must be removed before positioning the brush assembly and the brush assembly must be removed before bending the arm.
- j.* Check the wiper for positioning, making certain that it does not touch the rivets on the wiper assembly.
- k.* Install and tighten the clamping ring.
- l.* Position the second brush assembly on the shaft approximately 1/16" above the top of the first cup. Align the brush with the one below it and tighten the setscrews.
- m.* Repeat steps *h* through *i* for the remaining cups and the cover plate. Align each brush with the one below it and each cup by setting corresponding terminals in a line. Tighten the setscrews on the brushes after positioning them.
- n.* The cups may now be roughly aligned electrically by measuring the resistance between the brush and center tap of each cup with the brush set to zero for the follow-up cup. Loosen the clamping ring and set each cup for minimum resistance between brush and center tap without moving the assembly. If a 20,000 ohm-per-volt meter is used, *set the ohmmeter to a scale of R X 1,000 or more,* since a lower scale may exceed the current rating of the cup windings. For a precise electrical setting, follow the instructions presented in the earlier portion of this section.





APPENDIX II-1

REPLACEABLE PARTS LISTS

This appendix lists all replaceable parts in the Multiplier 7.017. In each case a brief description of the part and a manufacturer's number are listed. Where applicable, a reference symbol (schematic designation) is included. To enable a particular sheet to be readily located, an index precedes the individual spare parts lists.

The category column in the parts list is intended to indicate the availability of each listed part so that a replacement part can be obtained as quickly as possible. The components in category-A are standard electronic items that are usually available from any commercial electronic supplier. In order to expedite obtaining items of this nature, it is suggested that they be purchased from a local source whenever possible. If necessary, these parts may be ordered from EAI.

The components in category-B are items that can be obtained from EAI or any of the listed manufacturers. However, in most cases EAI is in a position to offer the most rapid service on items in this category.

The parts in category-C are custom-made components and proprietary items that are available only from EAI. When ordering items of this type, please specify the type number and serial number of the basic unit in which the part is located, as well as the part identification.

Where possible, sufficient information is given for category-C items to permit an *electrically-similar* replacement part to be obtained locally. Thus, if desired, a temporary repair may be made while the *exact* replacement is being obtained from EAI. *Note, however, that EAI does not guarantee that the affected unit will operate within specifications when the specified category-C part is not used.*

PLEASE NOTE THAT EAI RESERVES THE RIGHT TO MAKE PART SUBSTITUTIONS WHEN REQUIRED. IN ALL CASES EAI GUARANTEES THAT THESE SUBSTITUTIONS ARE ELECTRICALLY AND PHYSICALLY COMPATIBLE WITH THE ORIGINAL COMPONENT.

PARTS LIST INDEX

MULTIPLIER 7.017 and 7.047

|    | <u>Model Number</u> | <u>Component</u> | <u>Page</u> |
|----|---------------------|------------------|-------------|
| 1. | 7.017               | Multiplier ..... | AII-1-2     |
| 2. | 7.047               | Multiplier ..... | AII-1-5     |

| ITEM | REF. DESIG. | DESCRIPTION  | EAI NO.                 | *CAT. |
|------|-------------|--|-------------------------|-------|
| 1    | C1          | Capacitor, Fixed, Plastic: .008 $\mu$ F $\pm$ 20%,<br>600V; J.E. Fast and Co. 30FS21               | 521 005 0               | B     |
| 2    | C2          | Capacitor, Fixed, Mica: .01 $\mu$ F $\pm$ 10%, 500V;<br>CM35B103K                                  | 519 051 0               | A     |
| 3    | C3          | Capacitor, Fixed, Paper: .01 $\mu$ F $\pm$ 20%, 400V;<br>Aerovox P88N                              | 520 047 0               | A     |
| 4    | C4          | Capacitor, Fixed, Ceramic: .01 $\mu$ F GMV, 600V;<br>Cornell-Dubilier BYA6S1                       | Order By<br>Description | A     |
| 5    | C5          | Capacitor, Fixed, Paper: .1 $\mu$ F $\pm$ 20%, 1000V;<br>Aerovox P89MX                             | 520 077 0               | A     |
| 6    | C6          | Capacitor, Fixed, Paper: .047 $\mu$ F $\pm$ 20%, 400V;<br>Aerovox P88N                             | 520 053 0               | A     |
| 7    | C7          | Capacitor, Fixed, Paper: .75 $\mu$ F $\pm$ 10%, 600V;<br>Aerovox 630D                              | 520 066 0               | A     |
| 8    | C8          | Capacitor, Fixed, Ceramic: 1500 $\mu$ F $\pm$ 10%,<br>600V; Erie Resistor Corp GP2L-1500 $\pm$ 150 | 515 052 0               | A     |
| 9    | D1          | Chopper: 6.3V 400 CPS Coil, SPDT BBM<br>Contacts; Airpax 300                                       | 530 004 0               | C     |
| 10   | F1-6        | Fuse, Cartridge, Fast Acting Type: 1/32<br>Amp, 250V; Buss Type AGX                                | 570 004 0               | A     |
| 11   | I1          | Lamp, Glow: Neon; NE51 Type  | 578 004 0               | A     |
| 12   | M1          | Motor: Bendix CK2011-13-A1   | A594 007 0              | C     |
| 13   | R2,5        | Resistor, Fixed, Composition: 10K Ohms $\pm$<br>10%, 1/2W; Allen-Bradley EB                        | 626 103 1               | A     |
| 14   | R3          | Resistor, Fixed, Composition: 330K Ohms $\pm$<br>10%, 1/2W; Allen-Bradley EB                       | 626 334 1               | A     |
| 15   | R4          | Resistor, Variable, Composition: 250K Ohms $\pm$<br>10%, 2W; Allen-Bradley JA1L040S254UC           | 642 018 0               | A     |
| 16   | R6,15,17    | Resistor, Fixed, Composition: 270K Ohms $\pm$<br>10%, 1/2W; Allen-Bradley EB                       | 626 274 1               | A     |
| 17   | R7          | Resistor, Fixed, Composition: 1K Ohm $\pm$ 10%,<br>1/2W; Allen-Bradley EB                          | 626 102 1               | A     |

\*NOTE: THE CATEGORY COLUMN IS DESIGNED TO INDICATE AVAILABILITY OF PARTS.  
A - INDICATES PARTS THAT SHOULD BE PURCHASED LOCALLY.  
B - INDICATES PARTS THAT CAN BE PURCHASED LOCALLY OR FROM EAI.  
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UNIT TITLE

MULTIPLIER

MODEL NO.

7.017

Sht. 1 of 3

| ITEM | REF. DESIG. | DESCRIPTION   | EAI NO.    | *CAT. |
|------|-------------|---|------------|-------|
| 18   | R8          | Resistor, Fixed, Composition: 47K ohms $\pm 10\%$ ,<br>1W; Allen-Bradley GB                                   | 627 473 1  | A     |
| 19   | R9          | Resistor, Variable, Composition: 1 megohm<br>$\pm 20\%$ , 2W; Allen-Bradley JA1L040S105MC                     | 642 020 0  | A     |
| 20   | R10         | Resistor, Fixed, Composition: 820 ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                 | 626 821 1  | A     |
| 21   | R11,16      | Resistor, Fixed, Composition: 1 megohm $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                 | 626 105 1  | A     |
| 22   | R12         | Resistor, Fixed, Composition: 2.7K ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                | 626 272 1  | A     |
| 23   | R13,14      | Resistor, Fixed, Composition: 100K ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                | 626 104 1  | A     |
| 24   | R18         | Resistor, Fixed, Composition: 820K ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                | 626 824 1  | A     |
| 25   | R19         | Resistor, Fixed, Wirewound: 300 ohms $\pm 5\%$ ,<br>5W; Ward Leonard 5X300                                    | 636 059 0  | A     |
| 26   | R20         | Resistor, Fixed, Composition: 100 ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                 | 626 101 1  | A     |
| 27   | R21         | Resistor, Fixed, Composition: 1K ohms $\pm 10\%$ ,<br>2W; Allen-Bradley HB                                    | 628 102 1  | A     |
| 28   | R23         | Resistor, Fixed, Wirewound: 5K ohms $\pm 5\%$ ,<br>10W; Ward Leonard 10X5000WL                                | 636 072 0  | A     |
| 29   | T1          | Transformer, Audio Frequency: 380 ohms CT<br>Primary, 7400 ohms Secondary;<br>Leeds and Northrup STD-21178-39 | B684 015 0 | B     |
| 30   | T2          | Transformer, Servo Output: 9K ohms CT Primary<br>700 ohms Secondary; Freed 31240                              | B684 117 0 | C     |
| 31   | V1          | Electron Tube: 12AT7 Type   | 562 033 0  | A     |
| 32   | V2          | Electron Tube: 12AX7 Type   | 562 035 0  | A     |
| 33   | V3,4        | Electron Tube: Tung-Sol 5881 Type   | 562 072 0  | A     |

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UNIT TITLE

MULTIPLIER

MODEL NO.

7.017

Sh. 2 of 3 Sh.

| ITEM | REF. DESIG. | DESCRIPTION                              | EAI NO.                        | *CAT.        |            |   |
|------|-------------|--|--------------------------------|--------------|------------|---|
| 34   |             | Resistor, Variable, Wirewound: See Table | See Table                      | C            |            |   |
|      |             | Unit                                     | Potentiometer                  | Fairchild No |            |   |
|      |             | 7.017                                    | _____                          | _____        | _____      |   |
|      |             | 7.017-1                                  | 6 Cup, 30K Ohms $\pm 10\%$ Ea. | 754-6003     | B642 215 0 | C |
|      |             | 7.017-2                                  | 6 Cup, 30K Ohms $\pm 10\%$ Ea. | 754-6003     | B642 216 0 | C |
|      |             | 7.017-3                                  | 6 Cup, 30K Ohms $\pm 10\%$ Ea. | 754-6003     | B642 217 0 | C |
|      |             | 7.017-4                                  | _____                          | _____        | _____      | — |
|      |             | 7.017-5                                  | 4 Cup, 30K Ohms $\pm 10\%$ Ea. | 754-6003     | B642 218 0 | C |
|      |             | 7.017-6                                  | 6 Cup, 30K Ohms $\pm 10\%$ Ea. | 754-6003     | B642 219 0 | C |
|      |             | 7.017-7                                  | _____                          | _____        | _____      | — |
|      |             | 7.017-8                                  | _____                          | _____        | _____      | — |
|      | 7.017-9     | 6 Cup, 30K Ohms $\pm 10\%$ Ea.           | 754-6062                       | C642 499 0   | C          |   |

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UNIT TITLE

MULTIPLIER

MODEL NO.

7.017

SH3

| ITEM | REF. DESIG. | DESCRIPTION   | EAI NO.              | *CAT. |
|------|-------------|---|----------------------|-------|
| 1    | C1          | Capacitor, Fixed, Plastic: .008 $\mu$ F $\pm$ 20%, 600V; J.E. Fast and Co. 30FS21               | 521 005 0            | B     |
| 2    | C2          | Capacitor, Fixed, Mica: .01 $\mu$ F $\pm$ 10%, 500V; CM35B103K                                  | 519 051 0            | A     |
| 3    | C3          | Capacitor, Fixed, Paper: .01 $\mu$ F $\pm$ 20%, 400V; Aerovox P88N                              | 520 047 0            | A     |
| 4    | C4          | Capacitor, Fixed, Ceramic: .01 $\mu$ F GMV, 600V; Cornell-Dubilier BYA6S1                       | Order By Description | A     |
| 5    | C5          | Capacitor, Fixed, Paper: .1 $\mu$ F $\pm$ 20%, 1000V; Aerovox P89MX                             | 520 077 0            | A     |
| 6    | C6          | Capacitor, Fixed, Paper: .047 $\mu$ F $\pm$ 20%, 400V; Aerovox P88N                             | 520 053 0            | A     |
| 7    | C7          | Capacitor, Fixed, Paper: .75 $\mu$ F $\pm$ 10%, 600V; Aerovox 630D                              | 520 066 0            | A     |
| 8    | C8          | Capacitor, Fixed, Ceramic: 1500 $\mu$ F $\pm$ 10%, 600V; Erie Resistor Corp GP2L-1500 $\pm$ 150 | 515 052 0            | A     |
| 9    | D1          | Chopper: 6.3V 400 CPS Coil, SPDT BBM Contacts; Airpax 300                                       | 530 004 0            | C     |
| 10   | F1-         | Fuse, Cartridge, Fast Acting Type: 1/100 Amp, 250V; Buss Type AGX                               | 570 003 0            | A     |
| 11   | I1          | Lamp, Glow: Neon; NE51 Type   | 578 004 0            | A     |
| 12   | M1          | Motor: Bendix CK2011-13-A1  | A594 007 0           | C     |
| 13   | R2,5        | Resistor, Fixed, Composition: 10K Ohms $\pm$ 10%, 1/2W; Allen-Bradley EB                        | 626 103 1            | A     |
| 14   | R3          | Resistor, Fixed, Composition: 330K Ohms $\pm$ 10%, 1/2W; Allen-Bradley EB                       | 626 334 1            | A     |
| 15   | R4          | Resistor, Variable, Composition: 250K Ohms $\pm$ 10%, 2W; Allen-Bradley JAL1040S254UC           | 642 018 0            | A     |
| 16   | R6,15,17    | Resistor, Fixed, Composition: 270K Ohms $\pm$ 10%, 1/2W; Allen-Bradley EB                       | 626 274 1            | A     |
| 17   | R7          | Resistor, Fixed, Composition: 1K Ohm $\pm$ 10%, 1/2W; Allen-Bradley EB                          | 626 102 1            | A     |

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UNIT TITLE

MULTIPLIER

MODEL NO.

7.047

Sht. 1 of 2

| ITEM | REF. DESIG. | DESCRIPTION   | EAI NO.    | *CAT. |
|------|-------------|---|------------|-------|
| 18   | R8          | Resistor, Fixed, Composition: 47K ohms $\pm 10\%$ ,<br>1W; Allen-Bradley GB                                   | 627 473 1  | A     |
| 19   | R9          | Resistor, Variable, Composition: 1 megohm<br>$\pm 20\%$ , 2W; Allen-Bradley JA1L040S105MC                     | 642 020 0  | A     |
| 20   | R10         | Resistor, Fixed, Composition: 820 ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                 | 626 821 1  | A     |
| 21   | R11,16      | Resistor, Fixed, Composition: 1 megohm $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                 | 626 105 1  | A     |
| 22   | R12         | Resistor, Fixed, Composition: 2.7K ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                | 626 272 1  | A     |
| 23   | R13,14      | Resistor, Fixed, Composition: 100K ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                | 626 104 1  | A     |
| 24   | R18         | Resistor, Fixed, Composition: 820K ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                | 626 824 1  | A     |
| 25   | R19         | Resistor, Fixed, Wirewound: 300 ohms $\pm 5\%$ ,<br>5W; Ward Leonard 5X300                                    | 636 059 0  | A     |
| 26   | R20         | Resistor, Fixed, Composition: 100 ohms $\pm 10\%$ ,<br>1/2W; Allen-Bradley EB                                 | 626 101 1  | A     |
| 27   | R21         | Resistor, Fixed, Composition: 100 ohms $\pm 10\%$ ,<br>2W; Allen-Bradley HB                                   | 628 102 1  | A     |
| 28   | R23         | Resistor, Fixed, Wirewound: 5K ohms $\pm 5\%$ , 10W;<br>Ward Leonard 10X5000WL                                | 636 072 0  | A     |
| 29   | T1          | Transformer, Audio Frequency: 380 ohms CT<br>Primary, 7400 ohms Secondary;<br>Leeds and Northrup STD-21178-39 | B684 015 0 | B     |
| 30   | T2          | Transformer, Servo Output: 9K ohms CT Primary<br>700 ohms Secondary; Freed 31240                              | B684 117 0 | C     |
| 31   | V1          | Electron Tube: 12AT7 Type   | 562 033 0  | A     |
| 32   | V2          | Electron Tube: 12AX7 Type   | 562 035 0  | A     |
| 33   | V3,4        | Electron Tube: Tung-Sol 5881 Type   | 562 072 0  | A     |
|      |             | <u>POTENTIOMETER 7.054</u>  |            |       |
| 1    |             | Resistor, Variable, Wirewound: 8 Cups 30K<br>ohms $\pm 10\%$ ea.; Fairchild 754-6044                          | B642 434 0 | C     |

|  |  |
|--|--|
| <p>*NOTE: THE CATEGORY COLUMN IS DESIGNED TO INDICATE AVAILABILITY OF PARTS.<br/> A - INDICATES PARTS THAT SHOULD BE PURCHASED LOCALLY.<br/> B - INDICATES PARTS THAT CAN BE PURCHASED LOCALLY OR FROM EAI.<br/> C - INDICATES PARTS THAT SHOULD BE PURCHASED FROM EAI.<br/> THE PROPER EAI PART SHOULD BE INSTALLED FOR CATEGORY C ITEMS. A COMPLETE DESCRIPTION IS GIVEN TO PROVIDE FOR TEMPORARY REPAIRS; HOWEVER, EAI WILL NOT BE RESPONSIBLE IF UNIT IS NOT WITHIN SPECIFICATIONS UNDER THESE CONDITIONS.</p> | UNIT TITLE                               |
|  | <p>MULTIPLIER</p> <hr/> <p>MODEL NO.</p> |
| DATE 8/ 20/ 63   | 7.047 Sh. 2 of 2 Sh.                     |

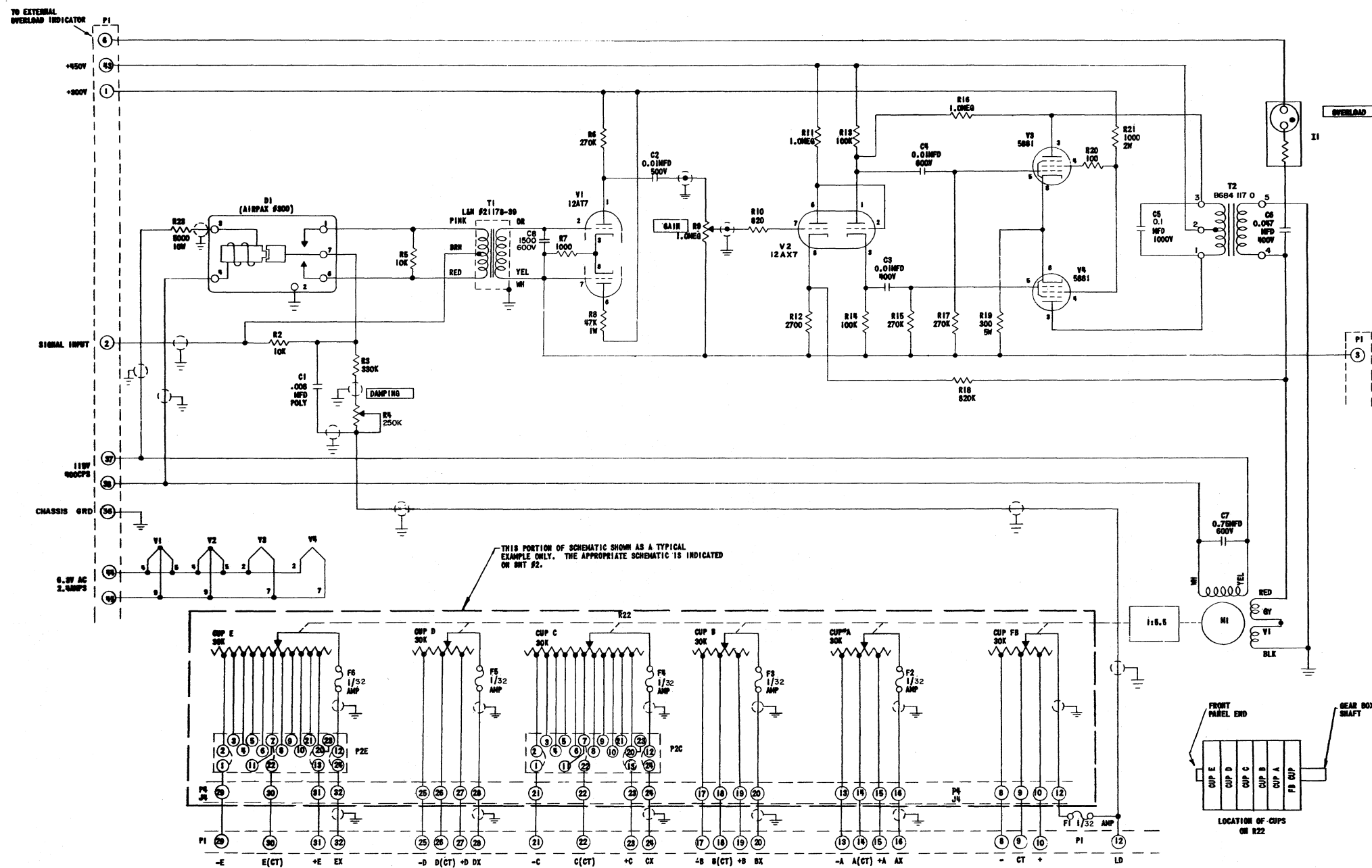
APPENDIX II-2

DRAWINGS

This appendix contains all of the schematic and wiring diagrams necessary for maintenance of the Multiplier 7.017.

| <u>Drawing<br/>Number</u> | <u>Title</u>                |
|---------------------------|-----------------------------|
| D007 017 OS               | 7.017 Multiplier, Schematic |
| D007 017 OW (Sheet 1)     | 7.017 Multiplier, Wiring    |
| D007 047 OS               | 7.047 Multiplier, Schematic |





FOR TABLE OF MODEL NUMBERS SEE SHY. 2

|                             |              |
|-----------------------------|--------------|
| ELECTRONIC ASSOCIATES, INC. |              |
| LONG BRANCH, NEW JERSEY     |              |
| SCHEMATIC DIAGRAM           |              |
| MULTIPLIER                  |              |
| SHY. NO.                    | E            |
| SIZE                        | C            |
| REV. NO.                    | f            |
| PROJ. NO.                   | 438          |
| REV. NO.                    | D 007 017 0S |

NOTE:  
 MULTIPLIER MODEL NO. 7.017 (D 007 017 OS) IS THE BASIC MULTIPLIER WITHOUT  
 MULTIPLYING POTENTIOMETER. PARTS LIST AND NEXT ASSEMBLY FOR THIS MODEL  
 IS A 007 017 OP. FOR POTENTIOMETER VARIATIONS SEE TABLE BELOW.

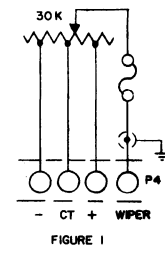


FIGURE 1

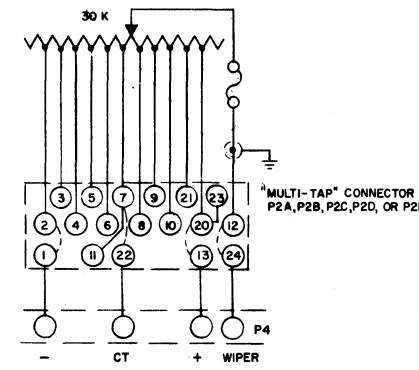


FIGURE 2

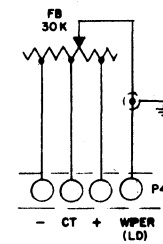


FIGURE 3

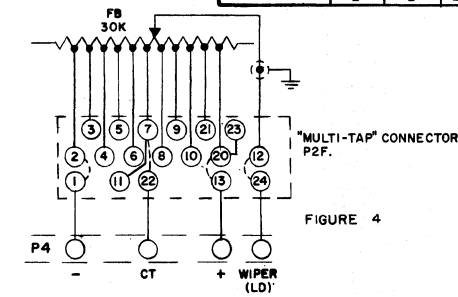
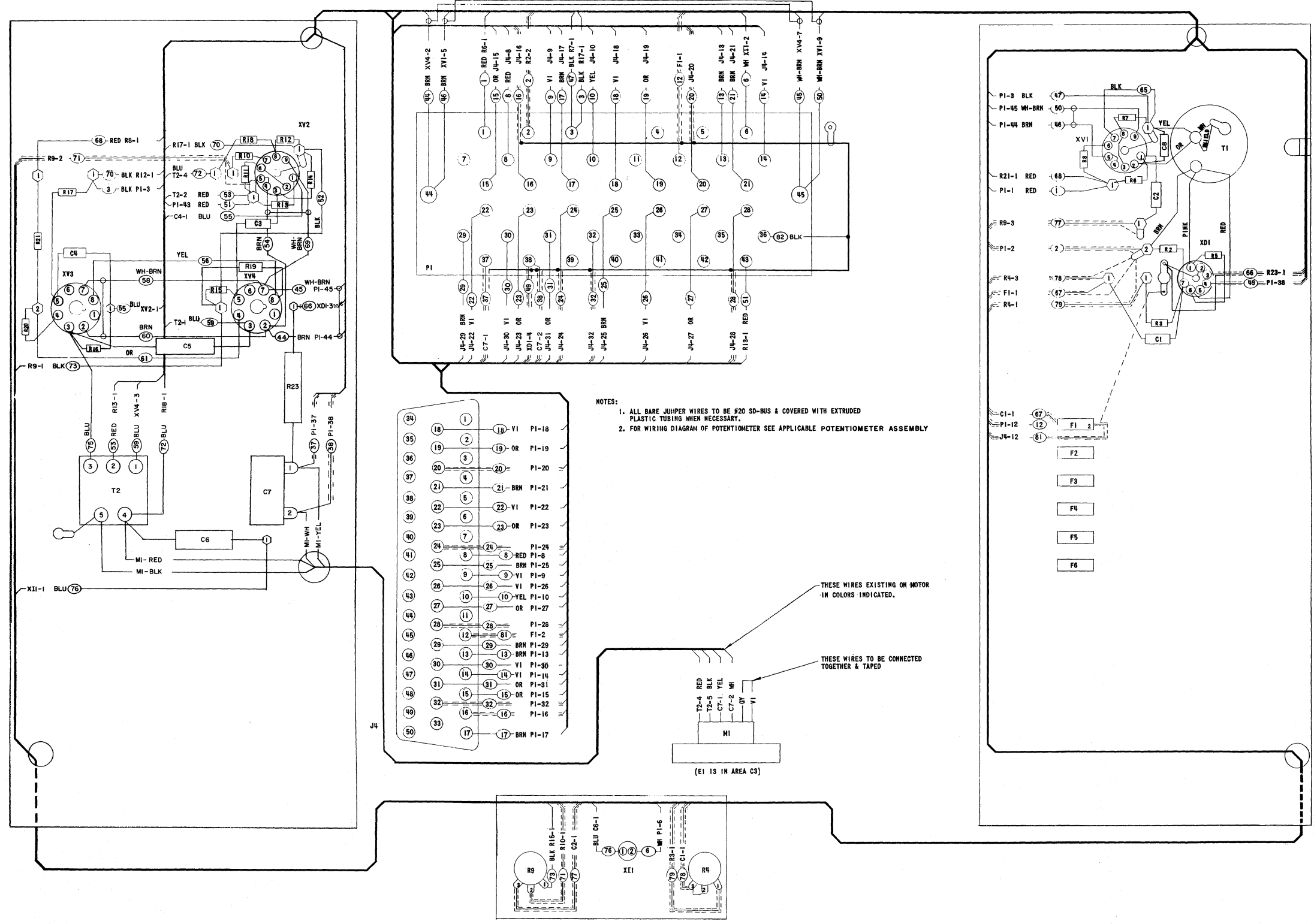


FIGURE 4

| TABLE OF MODEL NUMBERS |     |        |                   |    |    |       |                       |      |             |                            |
|------------------------|-----|--------|-------------------|----|----|-------|-----------------------|------|-------------|----------------------------|
| MODEL NO.              | CUP | FIGURE | CONNECTIONS ON P4 |    |    |       | *MULTI-TAP* CONNECTOR | FUSE | DWG. NUMBER | PARTS LIST & NEXT ASSEMBLY |
|                        |     |        | -                 | CT | +  | WIPER |                       |      |             |                            |
| 7.017-1                | FB  | 3      | 8                 | 9  | 10 | 12    | NONE                  | F1   | 007 017 IS  | 007 017 IP                 |
|                        | A   | 1      | 13                | 14 | 15 | 16    |                       | F2   |             |                            |
|                        | B   | 1      | 17                | 18 | 19 | 20    |                       | F3   |             |                            |
|                        | C   | 1      | 21                | 22 | 23 | 24    |                       | F4   |             |                            |
|                        | D   | 1      | 25                | 26 | 27 | 28    |                       | F5   |             |                            |
| 7.017-2                | FB  | 3      | 8                 | 9  | 10 | 12    | NONE                  | F1   | 007 017 2S  | 007 017 2P                 |
|                        | A   | 2      | 13                | 14 | 15 | 16    | P2A                   | F2   |             |                            |
|                        | B   | 2      | 17                | 18 | 19 | 20    | P2B                   | F3   |             |                            |
|                        | C   | 2      | 21                | 22 | 23 | 24    | P2C                   | F4   |             |                            |
|                        | D   | 1      | 25                | 26 | 27 | 28    | NONE                  | F5   |             |                            |
| 7.017-3                | FB  | 3      | 8                 | 9  | 10 | 12    | NONE                  | F1   | 007 017 3S  | 007 017 3P                 |
|                        | A   | 1      | 13                | 14 | 15 | 16    | NONE                  | F2   |             |                            |
|                        | B   | 1      | 17                | 18 | 19 | 20    | NONE                  | F3   |             |                            |
|                        | C   | 2      | 21                | 22 | 23 | 24    | P2C                   | F4   |             |                            |
|                        | D   | 1      | 25                | 26 | 27 | 28    | NONE                  | F5   |             |                            |
| 7.017-5                | FB  | 3      | 8                 | 9  | 10 | 12    | NONE                  | F1   | 007 017 5S  | 007 017 5P                 |
|                        | A   | 1      | 13                | 14 | 15 | 16    |                       | F2   |             |                            |
|                        | B   | 1      | 17                | 18 | 19 | 20    |                       | F3   |             |                            |
|                        | C   | 1      | 21                | 22 | 23 | 24    |                       | F4   |             |                            |
|                        | E   | 2      | 29                | 30 | 31 | 32    |                       | F6   |             |                            |
| 7.017-6                | FB  | 3      | 8                 | 9  | 10 | 12    | NONE                  | F1   | 007 017 6S  | 007 017 6P                 |
|                        | A   | 2      | 13                | 14 | 15 | 16    | P2A                   | F2   |             |                            |
|                        | B   | 2      | 17                | 18 | 19 | 20    | P2B                   | F3   |             |                            |
|                        | C   | 2      | 21                | 22 | 23 | 24    | P2C                   | F4   |             |                            |
|                        | D   | 2      | 25                | 26 | 27 | 28    | P2D                   | F5   |             |                            |
| 7.017-9                | FB  | 4      | 8                 | 9  | 10 | 12    | P2F                   | F1   | 007 017 9S  | 007 017 9P                 |
|                        | A   | 2      | 13                | 14 | 15 | 16    | P2A                   | F2   |             |                            |
|                        | B   | 2      | 17                | 18 | 19 | 20    | P2B                   | F3   |             |                            |
|                        | C   | 2      | 21                | 22 | 23 | 24    | P2C                   | F4   |             |                            |
|                        | D   | 2      | 25                | 26 | 27 | 28    | P2D                   | F5   |             |                            |



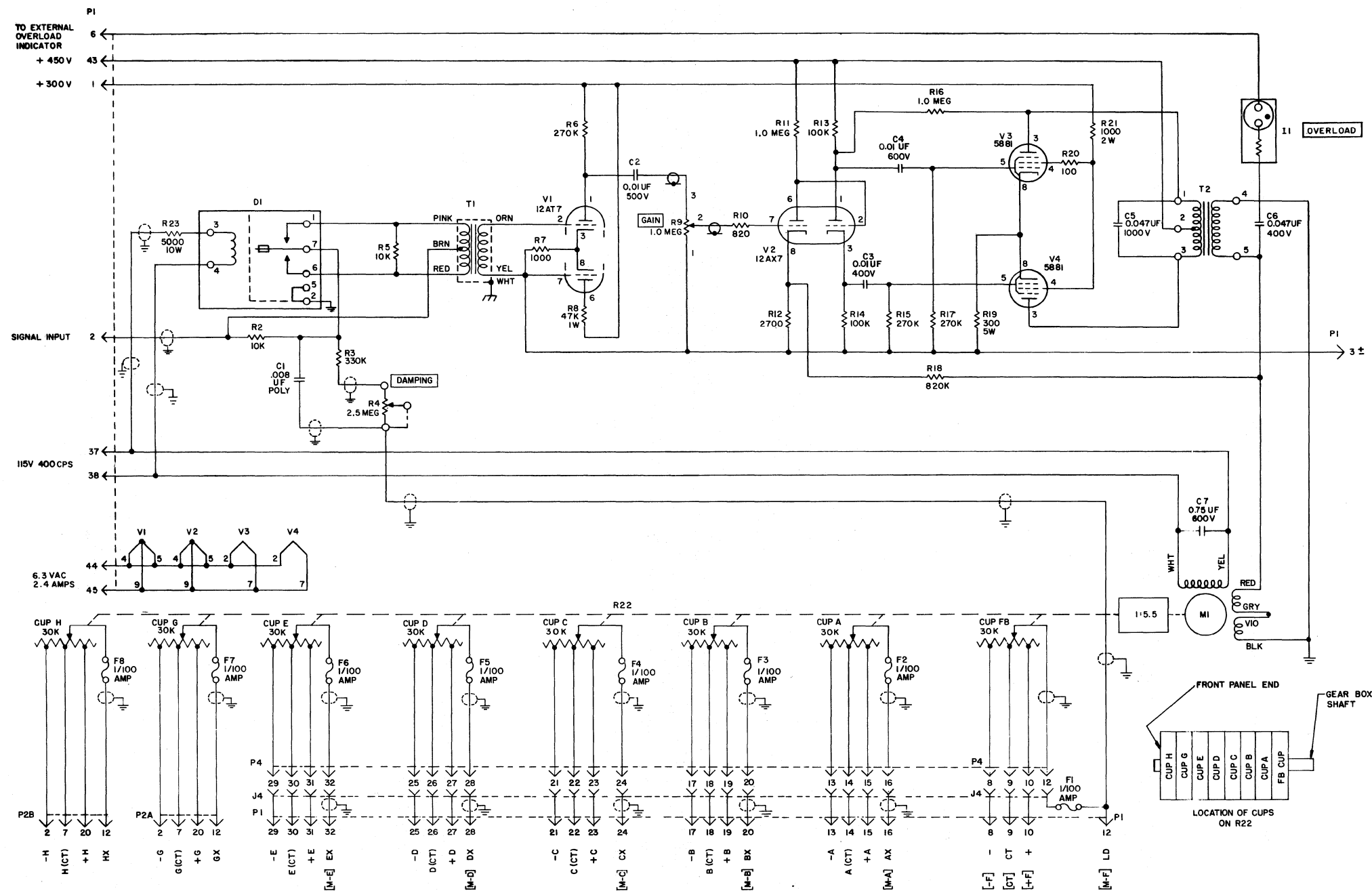
- NOTES:
1. ALL BARE JUMPER WIRES TO BE #20 SD-BUS & COVERED WITH EXTRUDED PLASTIC TUBING WHEN NECESSARY.
  2. FOR WIRING DIAGRAM OF POTENTIOMETER SEE APPLICABLE POTENTIOMETER ASSEMBLY

THESE WIRES EXISTING ON MOTOR IN COLORS INDICATED.

THESE WIRES TO BE CONNECTED TOGETHER & TAPED

(E1 IS IN AREA C3)

|  |                  |   |  |
|--|------------------|---|--|
| ELECTRONIC ASSOCIATES, INC.<br>LONG BRANCH, NEW JERSEY |                  |   |  |
| <b>WIRING DIAGRAM<br/>MULTIPLIER</b>                   |                  |   |  |
| SKT. NO.   | 2                | 3 |  |
| SIZE   | A                | A |  |
| REV. NO.   | 1                | 2 |  |
| PROJECT  | 438 D 007 017 OW |   |  |
| SHEET / OF 3 SHEETS                                    |                  |   |  |



NOTE: "L1" DENOTES PRE-PATCH PANEL IDENTIFICATION ON 231R COMPUTER

|                             |                  |
|-----------------------------|------------------|
| ELECTRONIC ASSOCIATES, INC. |                  |
| LONG BRANCH, NEW JERSEY     |                  |
| <b>SCHEMATIC MULTIPLIER</b> |                  |
| SWT. NO.                    |                  |
| SIZE                        |                  |
| REV. NO.                    |                  |
| PROJECT                     | 5646 D007 047 OS |
| SHEET                       | OF SHEETS        |

### SECTION III

#### SERVO MECHANICAL MULTIPLIER 7.083 (26-7M)

##### 1. GENERAL

Servo Multiplier, Type 7.083, (Figures 16 and 17) is a ten-turn multiplier utilizing a 60 cps servo system for medium speed and very high accuracy. This multiplier is identical with the 26-7M Multiplier.

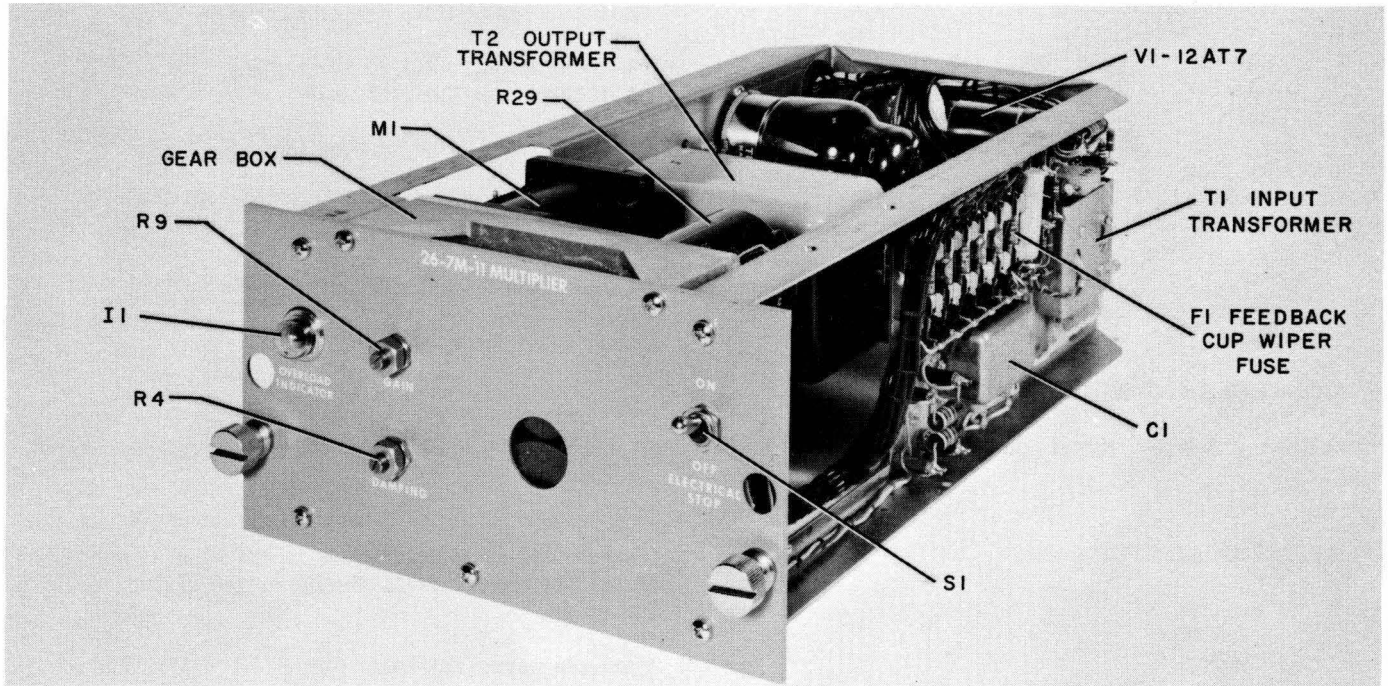


Figure 16. Servo Mechanical Multiplier 7.083 (26-7M), Three-Quarter Front View

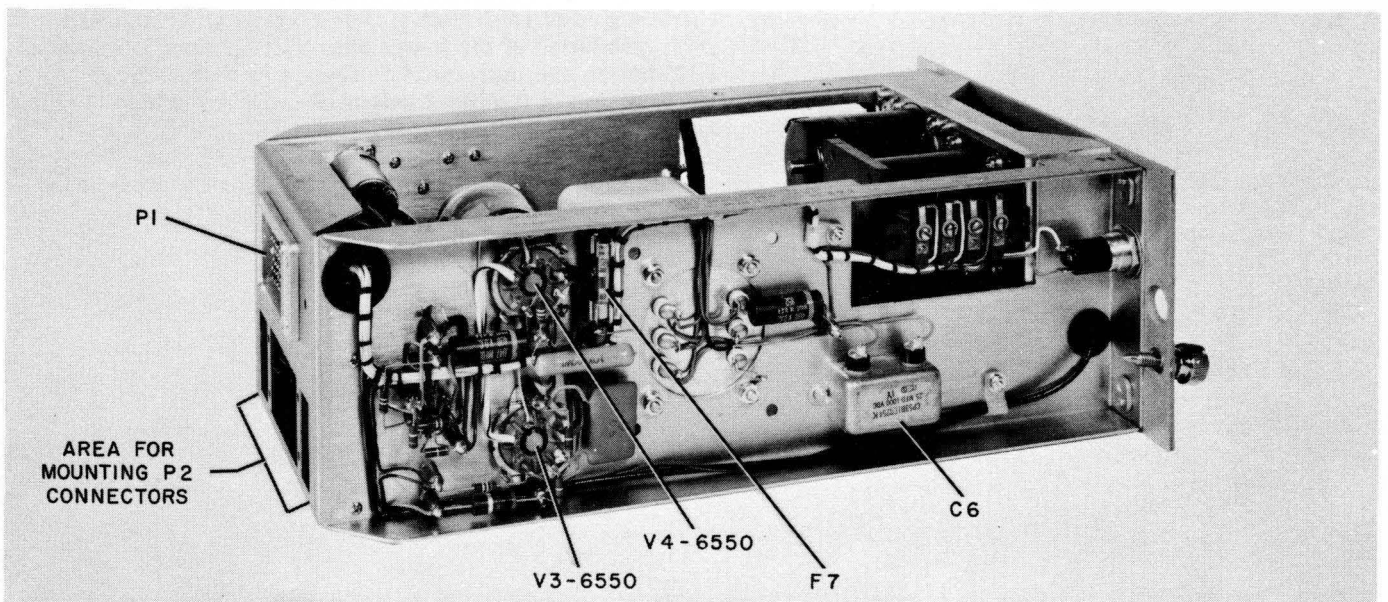


Figure 17. Servo Mechanical Multiplier 7.083 (26-7M), Three-Quarter Rear View

2. MULTIPLYING POTENTIOMETER CONFIGURATIONS

7.083 (26-7M) Multiplier

| <u>Model Number</u> | <u>Potentiometer Description</u>                                  |
|---------------------|---|
| 7.083-0 (26-7M-20)  | *6 linear cups, 30K, 17 taps                                      |
| 7.083-1 (26-7M-11)  | *6 linear cups, 30K, center tapped                                |
| 7.083-2 (26-7M-12)  | 4 linear cups, 30K, 17 taps<br>*2 linear cups, 30K, center tapped |
| 7.083-3 (26-7M-13)  | *4 linear cups, 30K, center tapped<br>2 linear cups, 30K, 17 taps |
| 7.083-5 (26-7M-15)  | *4 linear cups, 30K, center tapped                                |
| 7.083-6 (26-7M-16)  | *1 linear cup, 30K, center tapped<br>5 linear cups, 30K, 17 taps  |
| 7.083-7 (26-7M-17)  | *4 linear cups, 30K, 17 taps                                      |

3. CONTROLS AND INDICATORS

The following indicators and controls are provided on the front panel of the multiplier unit for operational convenience.

|                             |  |
|-----------------------------|--|
| ELECTRICAL STOP switch      | This switch is normally ON except when computational use necessitates disconnection of the electrical stops.   |
| GAIN Control                | Controls servo amplifier gain.   |
| DAMPING Control             | Controls degree of damping of servo feedback system.   |
| Indicator Dial              | Indicates input voltage. The graduations are based on a $\pm 100$ reference (2,000 divisions). Each half revolution of the lower dial (100 divisions) is indicated as one increment on the upper dial. The green portion of the dials indicates negative voltage and red indicates positive. |
| External OVERLOAD Indicator | A neon lamp that provides a visual indication of servo overload.   |

4. TECHNICAL DATA, PHYSICAL

Front Panel

|              |              |
|--------------|--------------|
| Height ..... | 5 inches     |
| Width .....  | 9-1/2 inches |

---

\*Configuration of feedback cup.

Chassis

|              |              |
|--------------|--------------|
| Height ..... | 4-3/4 inches |
| Width .....  | 8 inches     |
| Depth .....  | 15 inches    |
| Weight ..... | 20 pounds    |

Tube Complement

- Type 12AT7 - 1 each
- Type 12AX7 - 1 each
- Type 6550 - 2 each

5. TECHNICAL DATA, ELECTRICAL

Power Input

| <u>Quiescent</u>          | <u>Slewing</u>            |
|---------------------------|---------------------------|
| +300V DC ..... 8 ma       | +300V DC ..... 15 ma      |
| +390V DC ..... 90 ma      | +390V DC ..... 130 ma     |
| -300V DC ..... 4 ma       | -300V DC ..... 4 ma       |
| 115V AC, 60~ ..... 375 ma | 115V AC, 60~ ..... 375 ma |
| 6.3V AC ..... 3.95 A      | 6.3V AC ..... 3.95 A      |

Reference Voltage

It is recommended that the external reference voltage be within the range of plus and minus 25 to 100 volts. The load on the reference source varies in accordance with the circuit connections.

Electrical Stop Voltage

A voltage equal to three times reference voltage is recommended for the electrical stop. (The load on this circuit is 62,000 ohms for the 30,000 ohm cups.)

6. TECHNICAL DATA, OPERATIONAL

*Potentiometer Characteristics (Wirewound)*

Linear Potentiometers:

|                             |   |
|-----------------------------|---|
| Resistance .....            | 30,000 ohms $\pm 5\%$ between taps CW and CCW |
| Independent Linearity ..... | 0.025%  |

|                               |   |
|-------------------------------|---|
| Electrical Rotation .....     | 3600° +1°, -0°  |
| Electrical Overtravel .....   | 90° nominal, 88° minimum  |
| End Taps .....                | Feedback cup has end taps<br>A and B at approximately<br>90° past the CW and CCW<br>terminals |
| Center Tap Tolerance .....    | 0.025%  |
| Resolution .....              | 0.0066%   |
| Temperature Coefficient ..... | 20 PPM  |

## Linear Tapped Potentiometers:

|   |                 |
|---|-----------------|
| Resistance .....  | 30,000 ohms ±5% |
| Independent Linearity .....   | 0.025%          |
| Electrical Rotation .....   | 3600°, +1°, -0° |
| Number of taps equally spaced counting C. T. but not overtravel taps<br>A and B (if used) ..... | 17              |
| Tolerance of all tap locations .....  | 0.025% *        |
| Resolution .....  | 0.0066%         |
| Temperature Coefficient .....   | 20 PPM          |

*Servo Static Nulling Error:*

|   |       |
|---|-------|
| Error between input and feedback signal as percentage of Full<br>Scale (200V) ..... | 0.01% |
|---|-------|

*Acceleration:*

|  |                          |
|--|--------------------------|
| The acceleration limit based on 200V across feedback<br>potentiometer is ..... | 10,000V/sec <sup>2</sup> |
|--|--------------------------|

*Velocity:*

|  |          |
|--|----------|
| The velocity limit based on 200V across feedback potentiometer is .... | 210V/sec |
|--|----------|

---

\*The tolerance on the deviation between the actual and ideal tap voltages. The tolerance is expressed as a percentage of the total reference voltage, a nominal 200 volts.



*Dynamic Error:*

The overall dynamic errors of the servo system are shown as frequency versus input curves in Figure 18.

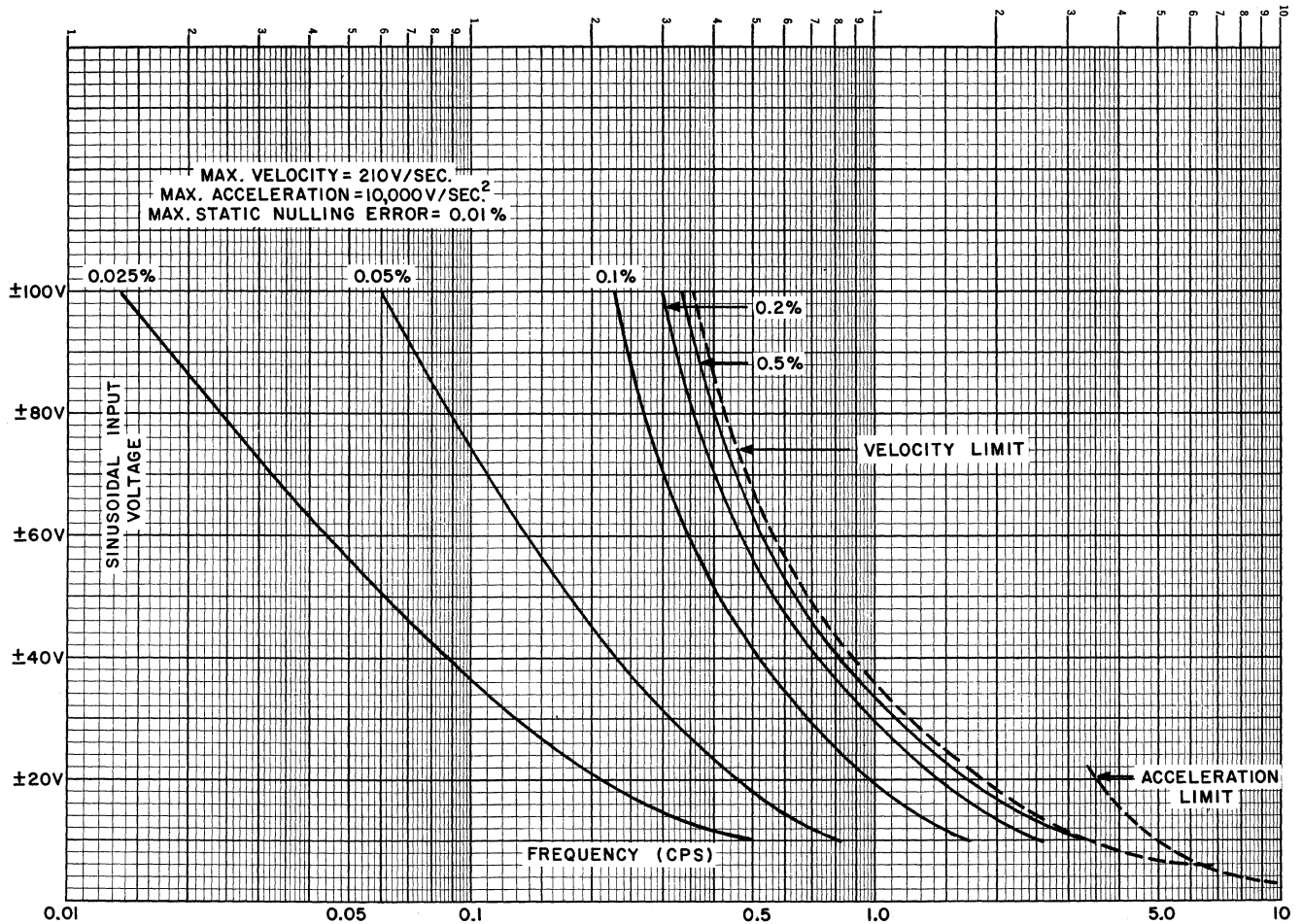


Figure 18. Dynamic Error Curves, 7,083 (26-7M) Multiplier

*Loading Error:*

The output channel termination should operate into a load of between 1 megohm and infinity. A resistor equal in value to the load on the multiplying channels should be included in the feedback circuit in order to cancel out the error due to external loading. This resistor,  $R_L$ , (Figures 4 through 8, Section I) should be connected from the feedback cup terminal 12 to ground, as shown in the applicable schematics.

## 7. INPUT AND OUTPUT TERMINATIONS

All connections to the multiplier are made through connectors located at the rear of the chassis. On models utilizing tapped cups for function generation, connector P1 and as many P2 connectors as required, are furnished. Connector P1 provides for power inputs, and potentiometer end tap, wiper arm and center tap connections. Connectors P2A through P2E (as required) provide the additional connections required by multi-tapped potentiometers. Each multi-tap cup of the potentiometer is provided with a separate connector for termination of the tapped cup during function generation. An internal connector (J6) is provided to facilitate potentiometer removal.

## 8. INSTALLATION AND ADJUSTMENTS

### a. Installation

The 7.083 Series of multipliers is completely interchangeable with other EAI multipliers such as the 7.017 (16-7S) and the 7.084 (26-7N) Series when used in PACE Computers and associated expansion racks.

CAUTION

*Compare schematic diagrams of units being interchanged, to prevent damage to the potentiometers.*

Use of the overload indicator circuitry requires connection of Terminal 6 (J1) to the input of an overload alarm unit (such as EAI Models 16-13A and 13.001). If an overload alarm unit is not provided, connect terminal 6 of P1 to terminal 3. Overload can then be observed at the OVERLOAD INDICATOR located on the front panel.

Multipliers supplied with multi-tapped cups require a cable from the appropriate P2 connector to a pot padder, or a jumper plug (provided with the unit) to connect the end tap, center tap, and wiper arm connections of the multi-tapped cups back to P1 and to the pre-patch panel area of the computer.

Reference voltages in the range of  $\pm 25$  to  $\pm 100$  volts may be used on the feedback cup (F). Reference voltages applied should never exceed  $\pm 100$  volts; that is, the total voltage applied across the cup between pins 8 and 10 of connector P1 (+F and -F on the computer pre-patch panel) should never be over 200 volts. With a known reference applied to the feedback cup, the indicator dial displays an approximate indication of servo input. More accurate measurement can be made using the VTVM or DVM provided in the computer.

### b. Adjustments

The GAIN and DAMPING controls are adjusted after installation and thereafter at the discretion of the operator. These controls interact to some degree so that the adjustment steps should be repeated until satisfactory response is obtained.

(1) *Gain Adjustment.* Apply a step function to the servo system and adjust the GAIN control just below the point where servo oscillations occur.

(2) *Damping Adjustment.* The DAMPING control is adjusted so that with a step function, one overshoot occurs before the servo nulls. No overshoot indicates over-damping. Re-adjust the GAIN control if required.

## 9. THEORY OF OPERATION

### a. General

The multiplier circuitry consists of a servo amplifier (with input network and modulator), servo motor, gear train and a multiplying potentiometer. The servo amplifier provides positioning power to the servo motor from two sources: (1) a common variable signal coupled to the signal input; and (2) the feedback voltage (FB). The signal input represents the magnitude of the common variable by which the other variables are to be multiplied. The feedback voltage is derived from the wiper arm of the feedback cup of the multiplying potentiometer (see Figure 19). Coupling of the servo motor to the multiplying potentiometer is provided by a gear train with a ratio of 5.5:1 (motor to potentiometer) as shown in Figure 20.

### b. Input Network and Chopper

The signal input and feedback voltages are applied to opposite sides of the input network R1, R2, R3, R4 (DAMPING control) and C1. The voltage across this network is equal to the difference between the two inputs. The output of the network, taken across R2, is a "proportional-plus-derivative" representation of the servo loop error. The voltage divider provides the proportional error voltage and capacitor C1 provides the derivative error voltage (an error signal proportional to the rate of change). This method of control functions to provide a large error voltage when the servo is displaced from null, and an effective "braking" force when the servo approaches the new null.

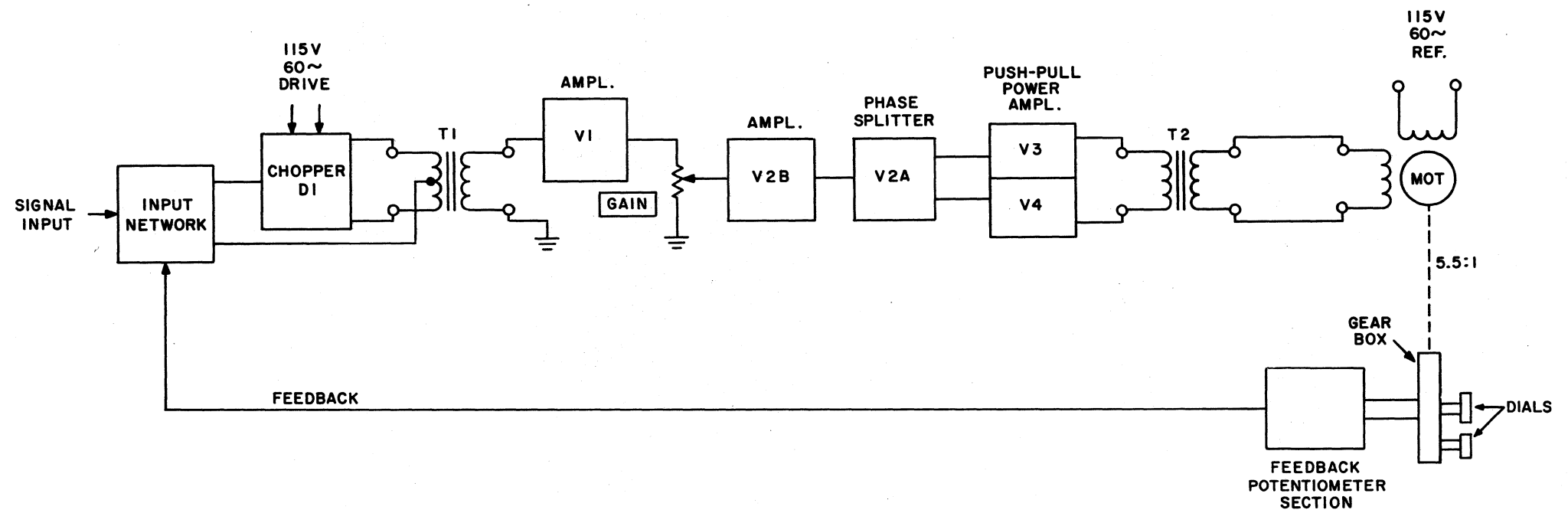


Figure 19.

Multiplier 7.083, Simplified Schematic

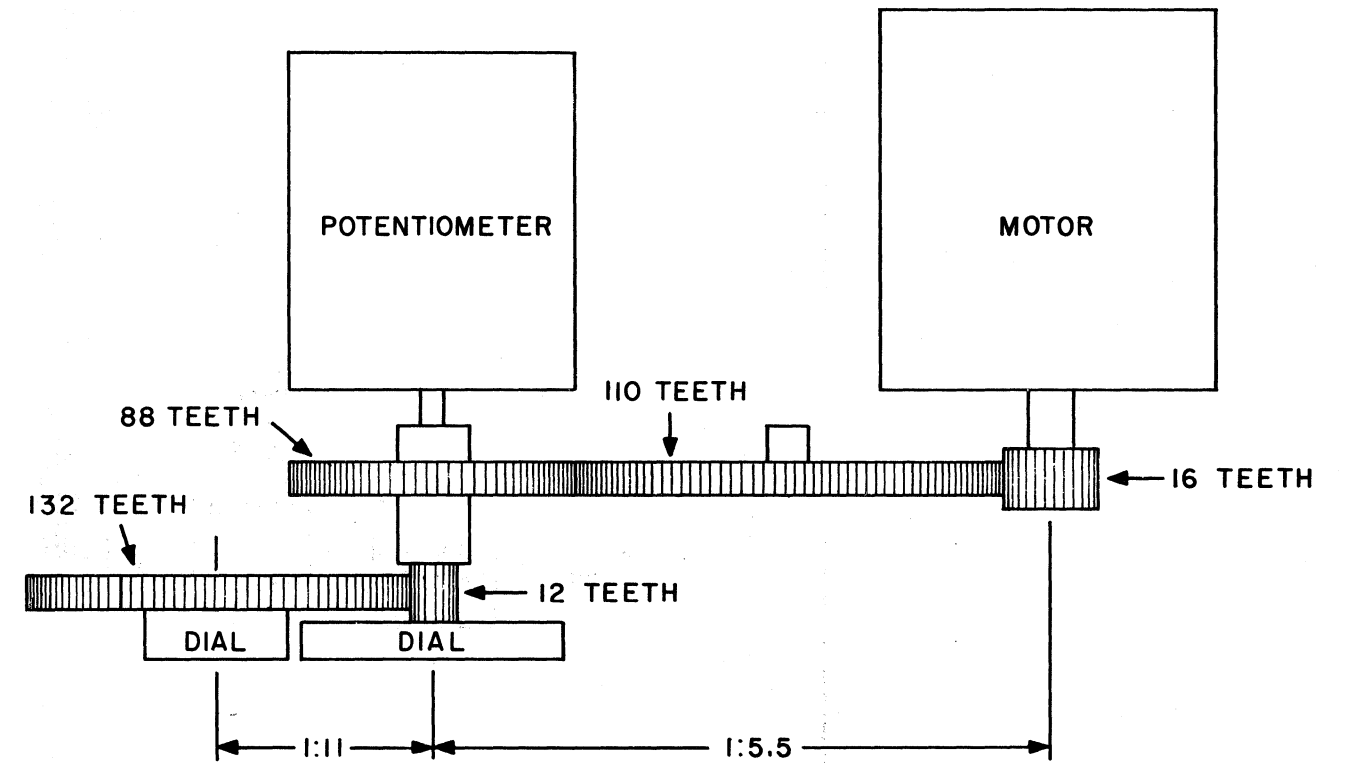


Figure 20. 7.083 Gear Train Schematic

The d-c error voltage appearing across R2 is modulated at a 60 cycle rate by chopper D1 (electro-mechanical vibrator). The vibrating reed of the chopper alternately connects the high and the low end of the primary winding of transformer T1 to one side of the error voltage. The other side of the error voltage source is connected to the center tap of the primary winding. This places the error signal alternately across one or the other half of the winding. The resultant action of current (proportional to the error) flowing for one half cycle in one direction and for the other half cycle in the opposite direction, induces a 60 cycle square wave across the secondary of T1. The amplitude of this voltage is proportional to the error, and the phase is determined by the error voltage polarity.

#### c. Amplifier Circuitry

The amplifier section consists of cascaded voltage amplifier stages V1, and V2b, a phase inverter V2a, and a push-pull power output stage, V3 and V4. V1 is driven by the 60-cycle voltage across the secondary of T1. The output of this stage is R-C coupled to the grid of V2a.

The signal voltage at the plate of V1a appears across the GAIN control potentiometer R9 and is applied to the grid of V2b (left-hand section). The output of this stage is directly coupled to the grid of the V2a which is connected as a split-load phase inverter. Equal load resistors (R13 and R14) are connected in the plate and cathode circuits to provide two equal signals 180 degrees out of phase to drive the output tubes.

The power output stage consists of V3 and V4 connected in conventional push-pull configuration with the tubes coupled to the control phase of the servo motor through transformer T2. The output tubes are protected by a quarter-ampere fuse (F7) in series with the common cathode resistor. Capacitor C6 is connected across the output transformer primary, to reduce harmonic distortion and add stability to the amplifier.

A panel-mounted neon lamp is provided as an amplifier OVERLOAD INDICATOR. This lamp is terminated at Pin 6 on the chassis connector and may be connected to an external overload alarm system if available or to ground if no external indicator is used.

The gain of the amplifier is controlled by a potentiometer in the grid circuit of V1 (Pin 7). Inverse feedback is obtained from the secondary of the output transformer and is applied to V2b through R18. Inverse feedback improves the linearity of the amplifier and consequently allows high loop gain in the servo system.

#### d. Electrical Stop

An electrical stop is incorporated in this multiplier to prevent overtravel of the servo when signal voltages equal in amplitude to the reference voltages are applied. The electrical stop requires a voltage equal to three times the reference potential to provide the proper voltage gradient between the electrical end taps of the feedback cup (FB) and the physical end of the winding. With the reference voltage on the electrical end taps of the feedback cup, the cup wipers approach the electrical end taps and stop when reference voltage is placed on the servo input or when one end is worked at ground and zero volts is applied. Further uncontrolled movement into the end area is prevented due to the high voltage slope generated in this area.

The ELECTRICAL STOP switch (S1) connected in the end-stop voltage leads, permits removal of the electrical stop from the feedback cup circuit during computations involving division where such voltage is undesirable. Mechanical end stops are provided in the gear train for such cases. Where a voltage equivalent to three times reference is not available and another value is utilized, the value of the two resistors R25 and R26 must be adjusted in proportion. Care must be exercised to maintain a voltage slope in the end area winding no greater than 50% to 90% of the slope in the reference wound area; otherwise current will be forced back into the reference supply.

## 10. POTENTIOMETER MAINTENANCE

A method for checking the accuracy of the potentiometers in this multiplier is outlined in Section II, Paragraph 10.

The subsequent information applies to maintenance of the potentiometers utilized in this unit.

To dismount the potentiometers, first remove the gear box assembly from the multiplier. To do this, remove the pilot light socket from its mounting and unplug the wiring connected to the potentiometers. If the follow-up

potentiometer is to be removed, first remove the smaller dial by loosening the two setscrews in its hub. To free the potentiometer, take out the screws holding the potentiometer flange to the gear box and lift straight out.

**CAUTION**

*Do not remove the gears from the potentiometer shafts. The holes in the shafts and the gears are drilled together and are not interchangeable. If the gear is removed, it may not be possible to replace it in the same position.*

To remove the case from the potentiometer, take out the two screws on the terminal block(s) nearest the gear end of the potentiometer shaft. Next remove the three small screws at the base of the cover. Raise the terminal strip slightly to clear the cover, being extremely careful to avoid exerting more than slight tension upon the small wires connected to the terminal strip, since there is often very little slack in these leads.

Remove the cover by sliding it carefully straight back. The case may be used as a convenient stand by inverting it with the open end down and placing the potentiometer on it with the gear down, so that the small hole at the rear of the case accommodates the shaft.

In cleaning the resistance element, certain precautions must be observed. Do not lift the tension spring on the slider since it is very delicate and may easily be distorted or broken. Clean the element by the application of a solvent (such as Walsco Contactene) using a spray or a very soft sable brush. It is not advisable to attempt disassembly of the potentiometer beyond the extent indicated above. Be extremely cautious in handling the unit in order that the brushes at the end of the shaft are not bent out of shape. If they do not center on the slip rings in the case, they may be carefully bent until they are in the proper position.

If any of the parts are damaged, the potentiometer must be returned to EAI for repairs. Before reassembling the potentiometer, a lubricant may be applied to the resistance element by dabbing spots of the material at 1/2-inch intervals on the element and distributing it by means of oscillating motions of the slider, until it is completely dispersed. The lubricant should be of a light solid type such as LubeRex supplied by the General Cement Company.

In replacing the potentiometer, mount it so that the terminal strip(s) are in such a position that they will afford the maximum amount of slack for wires leading to the potentiometer. If only one of the potentiometers has been removed, set all remaining units to the center-tap position and insert the potentiometer with its shaft set similarly. Insert two of the mounting screws and check the gear action by rotating the motor shaft.

**CAUTION**

*When performing the following tests the ohmmeter must not draw more than 5.0 milliamperes through the potentiometer winding in order to avoid overloading it. Use a range of the ohmmeter which will not exceed this value.*

Connect the centertaps of all the potentiometers under test with a jumper. Next connect the ohmmeter between the potentiometer wipers of the feedback cup and the next potentiometer. Now adjust the second potentiometer until the minimum resistance is attained.

Repeat the procedure for the third potentiometer, as in the preceding step. The potentiometers will now be closely aligned, if the procedure is carefully executed.

If the gears seem to bind or to mesh too loosely, loosen the potentiometer mounting screws, readjust the gear mesh, and tighten the screws. Then insert the remaining screws. If all the potentiometers have been removed, or the feedback potentiometer has been removed, see the instructions below. If a potentiometer is found to have its two cups misaligned, it will have to be replaced.

If all the potentiometers have been removed, replace the feedback potentiometer first and check the gear mesh before tightening the mounting screws. Replace the other units, checking the gear mesh and alignment of each one before replacing the next one, each time setting the potentiometer to its center tap position. When all the units have been mounted, set the large dial so that the zero index is up and attach the small dial to the followup shaft so that the zero index coincides with that of the large dial. When this has been accomplished, tighten the set screws on the small dial. For fine adjustments after the gear box has been replaced in the multiplier, refer to Paragraph 10, Section II.

## APPENDIX III-1

### REPLACEABLE PARTS LISTS

This appendix lists all replaceable parts in the Multiplier 7.083 (26-7M). In each case a brief description of the part and a manufacturer's number are listed. Where applicable, a reference symbol (schematic designation) is included. To enable a particular sheet to be readily located, an index precedes the individual spare parts lists.

The category column in the parts list is intended to indicate the availability of each listed part so that a replacement part can be obtained as quickly as possible. The components in category-A are standard electronic items that are usually available from any commercial electronic supplier. In order to expedite obtaining items of this nature, it is suggested that they be purchased from a local source whenever possible. If necessary, these parts may be ordered from EAI.

The components in category-B are items that can be obtained from EAI or any of the listed manufacturers. However, in most cases EAI is in a position to offer the most rapid service on items in this category.

The parts in category-C are custom-made components and proprietary items that are available only from EAI. When ordering items of this type, please specify the type number and serial number of the basic unit in which the part is located, as well as the part identification.

Where possible, sufficient information is given for category-C items to permit an *electrically-similar* replacement part to be obtained locally. Thus, if desired, a temporary repair may be made while the *exact* replacement is being obtained from EAI. *Note, however, that EAI does not guarantee that the affected unit will operate within specifications when the specified category-C part is not used.*

PLEASE NOTE THAT EAI RESERVES THE RIGHT TO MAKE PART SUBSTITUTIONS WHEN REQUIRED. IN ALL CASES EAI GUARANTEES THAT THESE SUBSTITUTIONS ARE ELECTRICALLY AND PHYSICALLY COMPATIBLE WITH THE ORIGINAL COMPONENT.

### PARTS LIST INDEX

#### MULTIPLIER 7.083 (26-7M)

|    | <u>Model<br/>Number</u> | <u>Component</u>              | <u>Page</u> |
|----|-------------------------|-------------------------------|-------------|
| 1. | 7.083 (26-7M)           | Multiplier .....              | AIII-1-2    |
| 2. | 7.093 (16-7MB-4)        | Servo Amplifier Chassis ..... | AIII-1-3    |
| 3. | 16-7MA                  | Multiplier Gear Box .....     | AIII-1-2    |

| ITEM   | REF. DESIG.      | DESCRIPTION  | EAI NO.                                 | *CAT.     |            |            |
|--|------------------|--|---|-----------|------------|------------|
| 1  | I2               | Lamp, Glow: Neon; NE51 Type  | 578 004 0                               | A         |            |            |
| 2  | R4               | Resistor, Variable, Composition: 250K Ohms<br>± 10%, 2W; Allen-Bradley JA1L040S254UC | 642 018 0                               | B         |            |            |
| 3  | R9               | Resistor, Variable, Composition: 1 Megohm<br>± 20%, 2W; Allen-Bradley JA1L040S105MC  | 642 020 0                               | B         |            |            |
| 4  | S1               | Switch, Toggle: DPDT; Cutler-Hammer 7565K5   | 664 011 0                               | A         |            |            |
| 5  |                  | Multiplier Gear Box  | See Table                               | C         |            |            |
|  |                  | UNIT NO.   | GEAR BOX                                |           |            |            |
|  |                  | 7.083  | 16-7MA-10                               |           |            |            |
|  |                  | 7.083-1  | 16-7MA-1                                |           |            |            |
|  |                  | 7.083-2  | 16-7MA-2                                |           |            |            |
|  |                  | 7.083-3  | 16-7MA-3                                |           |            |            |
|  |                  | 7.083-5  | 16-7MA-5                                |           |            |            |
|  |                  | 7.083-6  | 16-7MA-6                                |           |            |            |
|  |                  | 7.083-7  | 16-7MA-7                                |           |            |            |
|  |                  | <u>16-7MA MULTIPLIER GEAR BOX</u>  |   |           |            |            |
| 1  | R22,23,29,<br>34 | Resistor, Variable, Wirewound  | See Table                               | C         |            |            |
| 2  |                  | Motor, Servo: Diehl FPE 25-79-1  | 594 019 0                               | B         |            |            |
|  |                  | UNIT NO.   | R22                                     | R23       | R29        | R34        |
|  |                  | 16-7MA-10  | B16M7MA14                               | -----     | B16M7MA14  | B16M7MA14  |
|  |                  | 16-7MA-1   | B642 277 0                              | -----     | B642 277 0 | B642 277 0 |
|  |                  | 16-7MA-2   | B642 277 0                              | -----     | B16M7MA14  | B16M7MA14  |
|  |                  | 16-7MA-3   | B642 277 0                              | -----     | B642 277 0 | B16M7MA14  |
|  |                  | 16-7MA-5   | B642 277 0                              | -----     | B642 277 0 | -----      |
|  |                  | 16-7MA-6   | B642 489 0                              | -----     | B16M7MA14  | B16M7MA14  |
|  |                  | 16-7MA-7   | B16M7MA14                               | B16M7MA14 | -----      | -----      |
| <p>*NOTE: THE CATEGORY COLUMN IS DESIGNED TO INDICATE AVAILABILITY OF PARTS.<br/> A - INDICATES PARTS THAT SHOULD BE PURCHASED LOCALLY.<br/> B - INDICATES PARTS THAT CAN BE PURCHASED LOCALLY OR FROM EAI.<br/> C - INDICATES PARTS THAT SHOULD BE PURCHASED FROM EAI.<br/> THE PROPER EAI PART SHOULD BE INSTALLED FOR CATEGORY C ITEMS. A COMPLETE DESCRIPTION IS GIVEN TO PROVIDE FOR TEMPORARY REPAIRS; HOWEVER, EAI WILL NOT BE RESPONSIBLE IF UNIT IS NOT WITHIN SPECIFICATIONS UNDER THESE CONDITIONS.</p> |                  |  | <b>UNIT TITLE</b><br>MULTIPLIER (26-7M) |           |            |            |
|  |                  |  | <b>MODEL NO.</b><br>7.083               |           |            |            |



| ITEM | REF. DESIG. | DESCRIPTION   | EAI NO.   | *CAT. |
|------|-------------|---|-----------|-------|
| 1    | C1          | Capacitor, Fixed, Paper: .75 UF $\pm$ 10%, 600V; Aerovox 630D                       | 520 066 0 | A     |
| 2    | C2          | Capacitor, Fixed, Plastic: .047 UF $\pm$ 20%, 600V; Cornell-Dubilier PM6S47         | 521 015 0 | A     |
| 3    | C3          | Capacitor, Fixed, Mica: 10,000 UUF $\pm$ 10%, 500V; Elmenco CM35B103K               | 519 051 0 | A     |
| 4    | C4,7        | Capacitor, Fixed, Paper: .047 UF $\pm$ 20%, 400V; Aerovox P88N                      | 520 053 0 | A     |
| 5    | C5          | Capacitor, Fixed, Ceramic: .05 UF GMV, 600V; Centralab DF-503                       | 515 003 0 | A     |
| 6    | C6          | Capacitor, Fixed, Paper: .25 UF $\pm$ 10%, 1000V; Sangamo Electric Co. CP53B1FG254K | 520 008 0 | B     |
| 7    | D1          | Chopper: Coil: 6.3V, 60 cps. Contacts: SPDT, BBM; Airpax A-175                      | 530 003 0 | B     |
| 8    | F1 Thru F6  | Fuse, Cartridge, Fast Acting Type: 1/32 Amp, 250V; Buss AGX                         | 570 004 0 | A     |
| 9    | F7          | Fuse, Cartridge, Slow Acting Type: 15/100 Amp, 125V; Littelfuse 313.150             | 570 098 0 | A     |
| 10   | I1          | Lamp, Incandescent: 47 Type   | 578 003 0 | A     |
| 11   | J6          | Connector, Receptacle: 50 Contacts; Cannon Electric DD50S                           | 542 103 0 | A     |
| 12   | P1          | Connector, Plug: 45 Contacts; Cannon Electric DPD-45-34P-1L                         | 542 120 0 | A     |
| 13   | R1,5        | Resistor, Fixed, Composition: 10K ohms $\pm$ 10%, 1/2W; Allen-Bradley EB            | 626 103 1 | A     |
| 14   | R2          | Resistor, Fixed, Composition: 2.2K ohms $\pm$ 10%, 1/2W; Allen-Bradley EB           | 626 222 1 | A     |
| 15   | R3          | Resistor, Fixed, Composition: 68K ohms $\pm$ 10%, 1/2W; Allen-Bradley EB            | 626 683 1 | A     |
| 16   | R6,15,17    | Resistor, Fixed, Composition: 270K ohms $\pm$ 10%, 1/2W; Allen-Bradley EB           | 626 274 1 | A     |
| 17   | R7          | Resistor, Fixed, Composition: 1K ohms $\pm$ 10%, 1/2W; Allen-Bradley EB             | 626 102 1 | A     |

\*NOTE: THE CATEGORY COLUMN IS DESIGNED TO INDICATE AVAILABILITY OF PARTS.  
A - INDICATES PARTS THAT SHOULD BE PURCHASED LOCALLY.  
B - INDICATES PARTS THAT CAN BE PURCHASED LOCALLY OR FROM EAI.  
C - INDICATES PARTS THAT SHOULD BE PURCHASED FROM EAI.  
THE PROPER EAI PART SHOULD BE INSTALLED FOR CATEGORY C ITEMS. A COMPLETE DESCRIPTION IS GIVEN TO PROVIDE FOR TEMPORARY REPAIRS; HOWEVER, EAI WILL NOT BE RESPONSIBLE IF UNIT IS NOT WITHIN SPECIFICATIONS UNDER THESE CONDITIONS.

UNIT TITLE

SERVO AMPLIFIER CHASSIS

MODEL NO.

7.093

Sheet 1 of 2

| ITEM | REF. DESIG. | DESCRIPTION   | EAI NO.    | *CAT. |
|------|-------------|---|------------|-------|
| 18   | R8          | Resistor, Fixed, Composition: 47K ohms $\pm$ 10%, 1W; Allen-Bradley GB      | 627 473 1  | A     |
| 19   | R10         | Resistor, Fixed, Composition: 3.3 Megohms $\pm$ 10%, 1/2W; Allen-Bradley EB | 626 335 1  | A     |
| 20   | R11,16      | Resistor, Fixed, Composition: 1 Megohm $\pm$ 10%, 1/2W; Allen-Bradley EB    | 626 105 1  | A     |
| 21   | R12         | Resistor, Fixed, Composition: 2.7K ohms $\pm$ 10%, 1/2W; Allen-Bradley EB   | 626 272 1  | A     |
| 22   | R13,14      | Resistor, Fixed, Composition: 100K ohms $\pm$ 10%, 1/2W; Allen-Bradley EB   | 626 104 1  | A     |
| 23   | R18         | Resistor, Fixed, Composition: 820K ohms $\pm$ 10%, 1/2W; Allen-Bradley EB   | 626 824 1  | A     |
| 24   | R19         | Resistor, Fixed, Wirewound: 300 ohms $\pm$ 5%, 10W; Ward Leonard 10X300WL   | 636 070 0  | A     |
| 25   | R20         | Resistor, Fixed, Composition: 100 ohms $\pm$ 10%, 1/2W; Allen-Bradley EB    | 626 101 1  | A     |
| 26   | R21         | Resistor, Fixed, Composition: 1K ohms $\pm$ 10%, 2W; Allen-Bradley HB       | 628 102 1  | A     |
| 27   | R25,26      | Resistor, Fixed, Composition: 47K ohms $\pm$ 5%, 2W; Allen-Bradley HB       | 628 473 0  | A     |
| 28   | T1          | Transformer, Audio Frequency: Leeds and Northrup STD-21178-39               | B684 015 0 | B     |
| 29   | T2          | <b>Transformer, Audio</b> Frequency: Sterling Transformer ST26281           | B684 159 0 | C     |
| 30   | V1          | Electron Tube: RCA 12AT7 Type   | 562 033 0  | A     |
| 31   | V2          | Electron Tube: 12AX7 Type   | 562 035 0  | A     |
| 32   | V3,4        | Electron Tube: Tung-Sol 6550 Type   | 562 074 0  | A     |

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UNIT TITLE

SERVO AMPLIFIER CHASSIS

MODEL NO.

7.093

Sheet 2 of 2

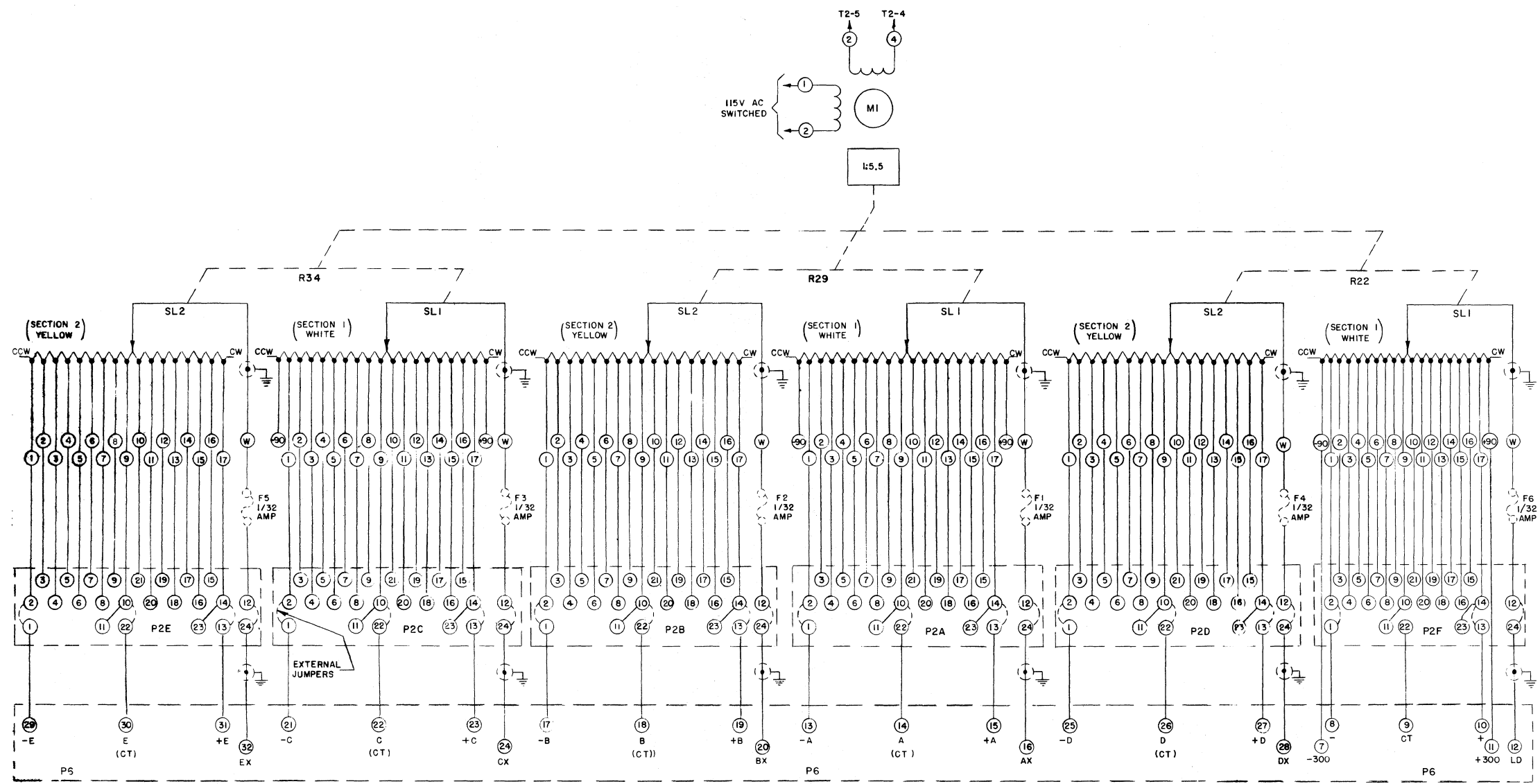
APPENDIX III-2

DRAWINGS

This appendix contains all of the schematic and wiring diagrams necessary for maintenance of the Multiplier 7.083 (26-7M).

| <u>Drawing<br/>Number</u>                          | <u>Title</u>                        |
|--|-------------------------------------|
| D007 083 OS  | 7.083 (26-7M) Multiplier, Schematic |
| B007 083 OW (Sheets 2, 7, 9, 14,<br>17, 19 and 24) | 7.083 (26-7M) Multiplier, Wiring    |
| D007 093 OS  | Servo Amplifier Chassis, Schematic  |
| D007 093 OW (Sheet 1)                              | Servo Amplifier Chassis, Wiring     |

NOTE:  
1. SEE DWG. "D007 093 05 FOR SCHEMATIC OF SERVO AMPLIFIER.



| UNIT NO. | DWG. NO.  | SCHEMATIC NUMBER | PARTS LIST & NEXT ASSY. | DESCRIPTION       | PARTS LIST USED ON. | PROJECT NUMBER |
|----------|-----------|------------------|-------------------------|-------------------|---------------------|----------------|
| 7.083-8  |           |                  |                         | NO DWGS AVAILABLE |                     |                |
| 7.083-8  |           |                  |                         | NO DWGS AVAILABLE |                     |                |
| 7.083-7  | C265M7-17 | 007 083 7        | 007 083 7P              | AS SHOWN SHT 7    |                     | 429            |
| 7.083-6  | C265M7-16 | 007 083 6S       | 007 083 6P              | AS SHOWN SHT 6    |                     | 7345           |
| 7.083-5  | C265M7-15 | 007 083 5S       | 007 083 5P              | AS SHOWN SHT 5    |                     | 429            |
| 7.083-4  |           |                  |                         | NO DWGS AVAILABLE |                     |                |
| 7.083-3  | C265M7-13 | 007 083 3S       | 007 083 3P              | AS SHOWN SHT 4    |                     | 429            |
| 7.083-2  | C265M7-12 | 007 083 2S       | 007 083 2P              | AS SHOWN SHT 3    |                     | 429            |
| 7.083-1  | C265M7-11 | 007 083 1S       | 007 083 1P              | AS SHOWN SHT 2    |                     | 429            |
| 7.083    | C265M7-20 | 007 083 0S       | 007 083 0P              | AS SHOWN SHT 1    |                     | 1393           |

TABLE OF UNIT NUMBERS

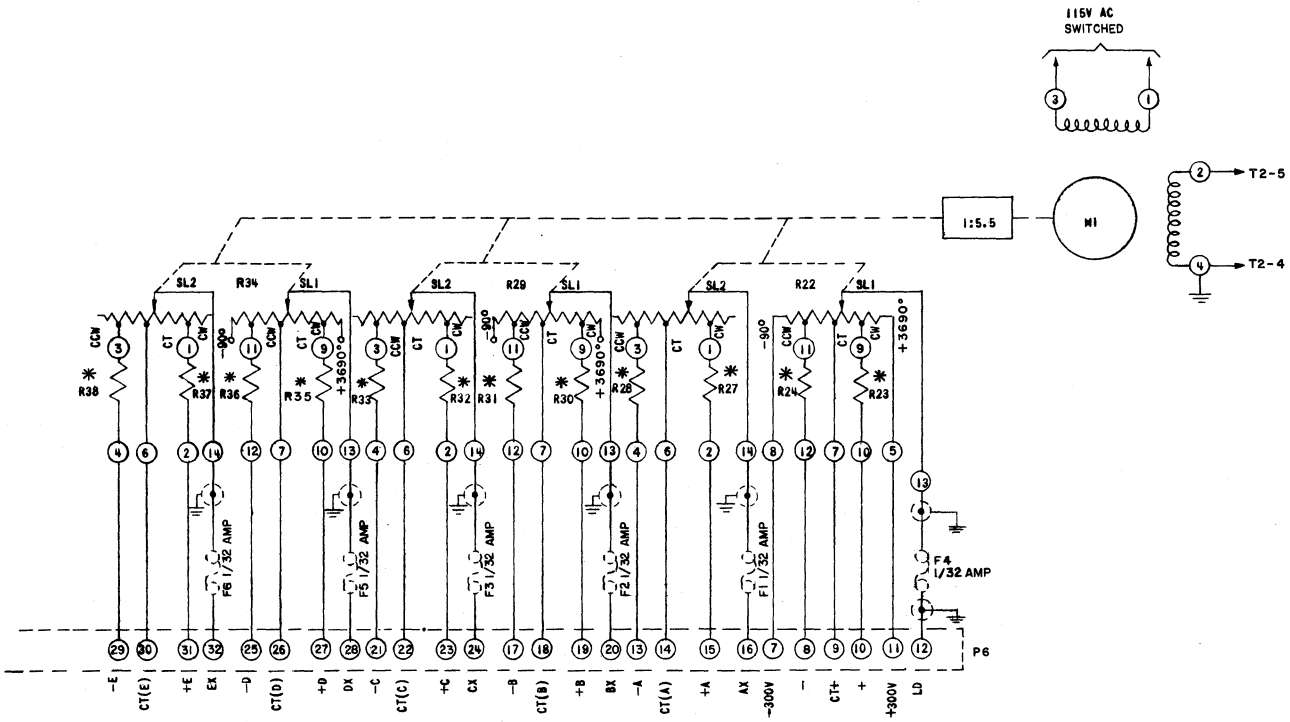
ELECTRONIC ASSOCIATES, INC.  
LONG BRANCH, NEW JERSEY

**SCHEMATIC MULTIPLIER**

|          |                  |   |   |   |   |   |  |  |  |  |
|----------|------------------|---|---|---|---|---|--|--|--|--|
| SHT. NO. | 2                | 3 | 4 | 5 | 6 | 7 |  |  |  |  |
| SIZE     | C                | C | C | C | C | C |  |  |  |  |
| REV. NO. | 1                | 1 | 1 | 1 | 1 | 1 |  |  |  |  |
| PROJECT  | 1393 D007 083 05 |   |   |   |   |   |  |  |  |  |
| SHEET    | 1                | 1 | 1 | 1 | 1 | 1 |  |  |  |  |

NOTE:

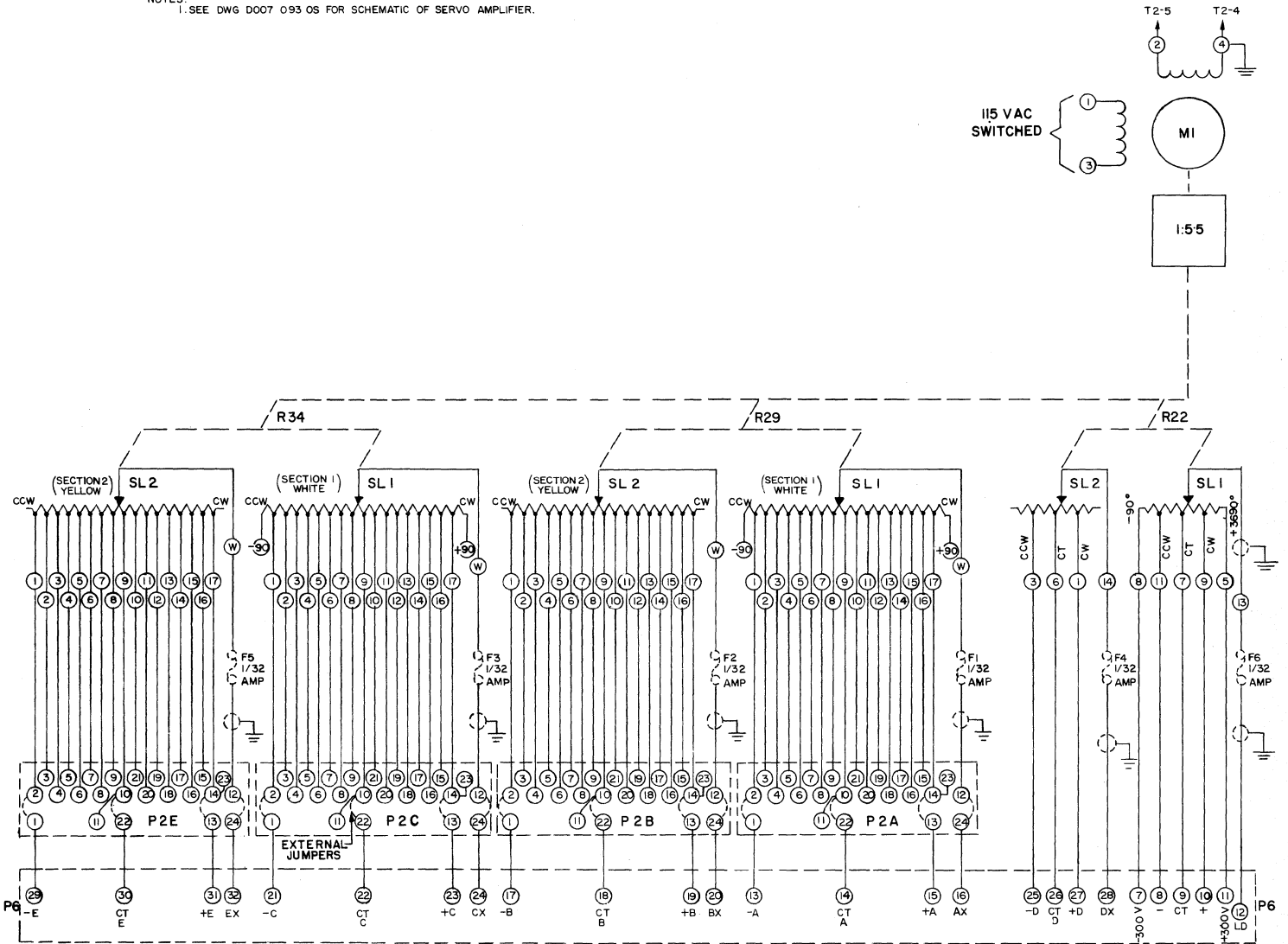
1. \*VALUE OF PAD RESISTORS ON R22, R29, & R34 TO BE DETERMINED AT TIME OF MFR.
2. SEE DWG D007 093 05 FOR SCHEMATIC OF SERVO AMPLIFIER.



007 083 IS

|                             |             |
|-----------------------------|-------------|
| ELECTRONIC ASSOCIATES, INC. |             |
| LONG BRANCH, NEW JERSEY     |             |
| SCHEMATIC DIAGRAM           |             |
| MULTIPLIER                  |             |
| SHY NO                      |             |
| SIZE                        |             |
| PROJECT                     | C007 083 05 |
| SHEET 2 OF 4                |             |

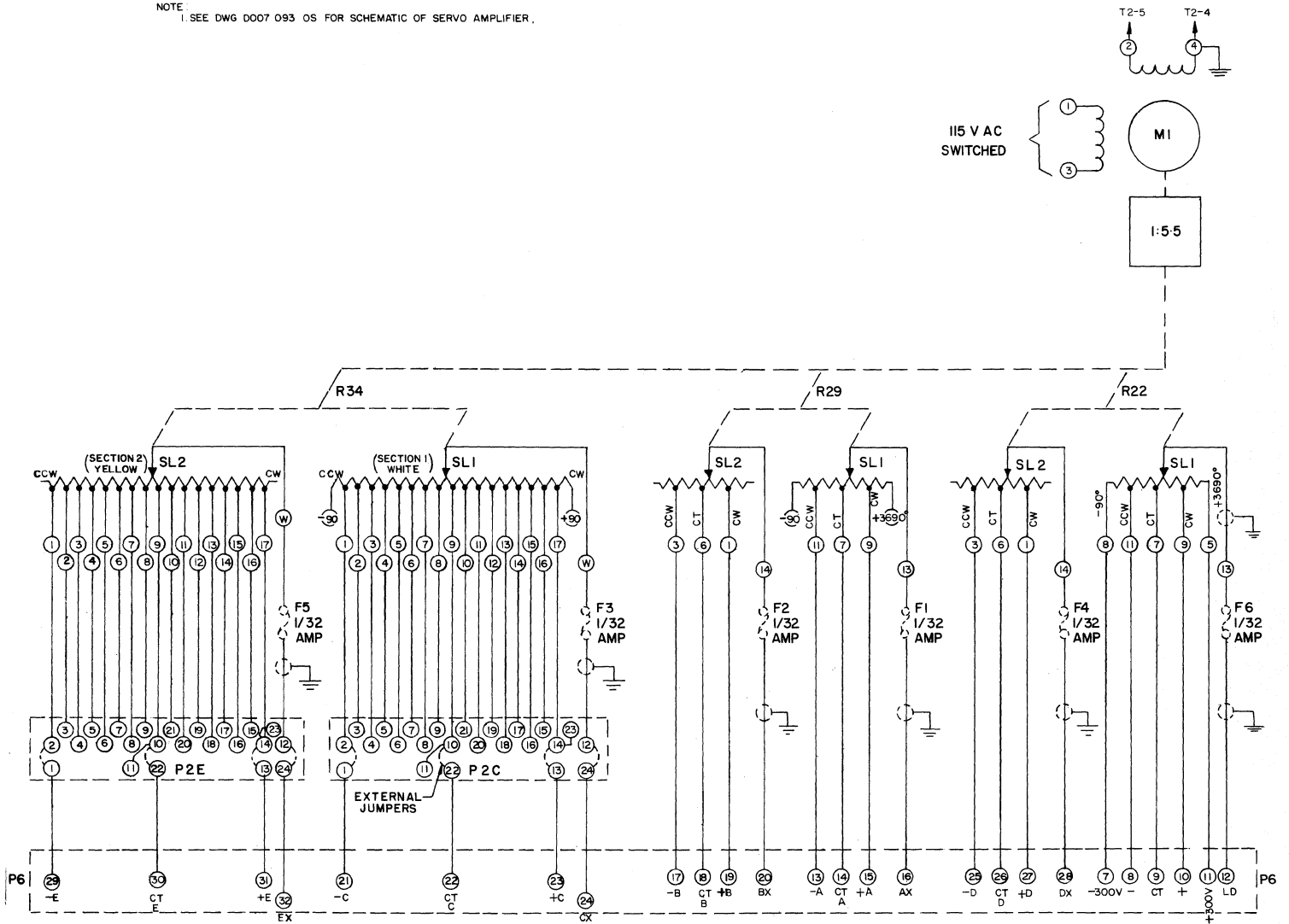
NOTES:  
 1. SEE DWG D007 093 OS FOR SCHEMATIC OF SERVO AMPLIFIER.



007 083 2S

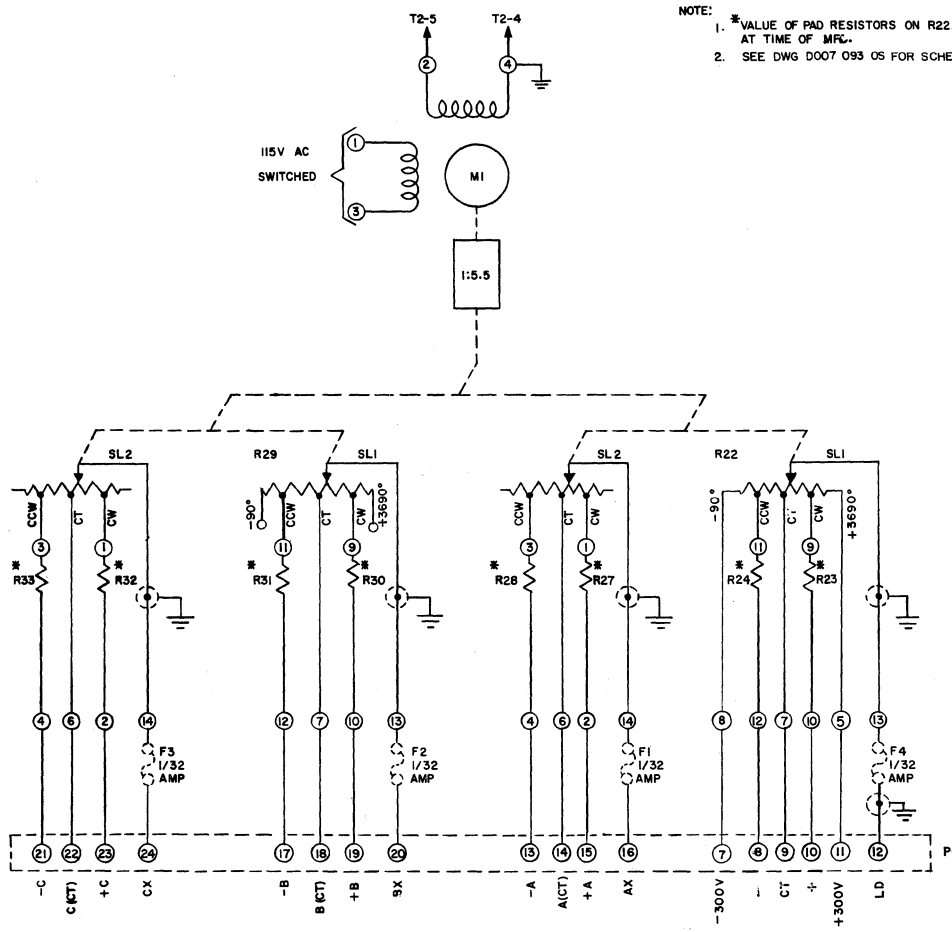
|  |             |
|--|-------------|
| ELECTRONIC ASSOCIATES, INC.<br>LONG BRANCH, NEW JERSEY |             |
| SCHEMATIC DIAGRAM<br>MULTIPLIER                        |             |
| ☒ BHT NO   |             |
| SIZE   |             |
| PROJECT<br>1393  | C007 083 OS |
| SHEET 2 OF SHEETS                                      |             |

NOTE  
1. SEE DWG D007 093 OS FOR SCHEMATIC OF SERVO AMPLIFIER.



007 083 3S

|  |             |
|--|-------------|
| ELECTRONIC ASSOCIATES, INC.<br>LONG BRANCH, NEW JERSEY |             |
| SCHEMATIC DIAGRAM<br>MULTIPLIER                        |             |
| X  | SHT NO      |
| E  | SIZE        |
| PROJECT<br>1393  | CO07 083 OS |
| SHEET 4 OF SHEETS                                      |             |



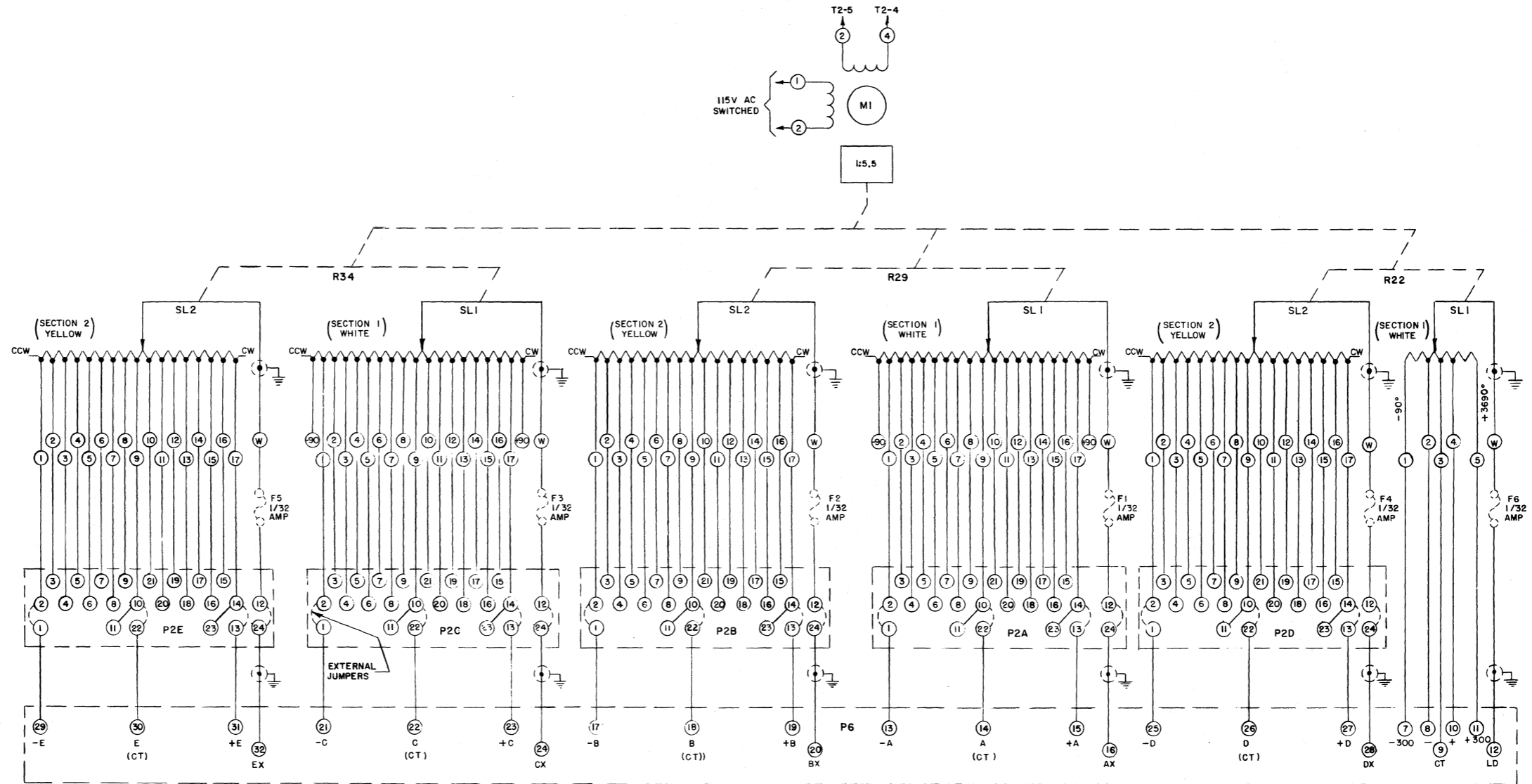
NOTE:  
 1. \* VALUE OF PAD RESISTORS ON R22, & R29 TO BE DETERMINED AT TIME OF MFG.  
 2. SEE DWG D007 093 05 FOR SCHEMATIC OF SERVO AMPLIFIER.

007 083 5S

|  |                  |  |  |  |  |  |  |  |  |  |  |
|--|------------------|--|--|--|--|--|--|--|--|--|--|
| ELECTRONIC ASSOCIATES, INC.<br>LONG BRANCH, NEW JERSEY |                  |  |  |  |  |  |  |  |  |  |  |
| <b>SCHEMATIC DIAGRAM<br/>MULTIPLIER</b>                |                  |  |  |  |  |  |  |  |  |  |  |
| SHT. NO.   |                  |  |  |  |  |  |  |  |  |  |  |
| SIZE   |                  |  |  |  |  |  |  |  |  |  |  |
| REV. NO.   |                  |  |  |  |  |  |  |  |  |  |  |
| PROJECT  | 1393 C007 083 05 |  |  |  |  |  |  |  |  |  |  |
| SHEET 5 OF SHEETS                                      |                  |  |  |  |  |  |  |  |  |  |  |



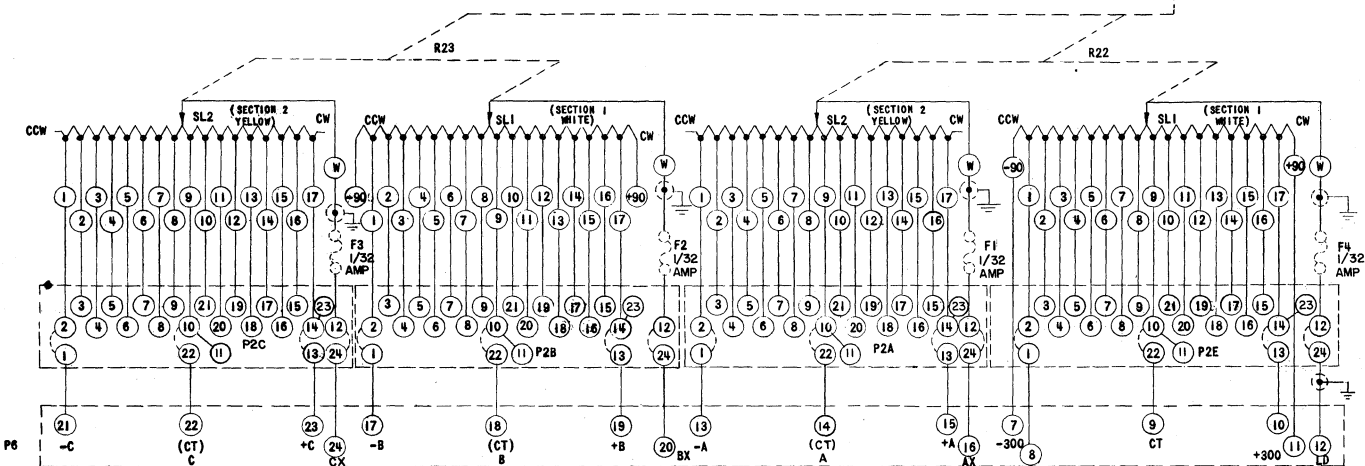
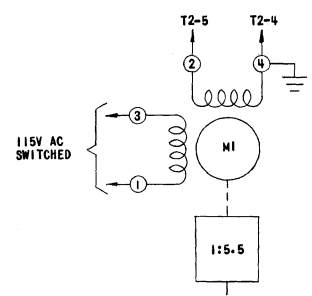
NOTES:  
1. SEE DWG D007 093 05 FOR SCHEMATIC OF SERVO AMPLIFIER.



007 083 75

|  |             |
|--|-------------|
| ELECTRONIC ASSOCIATES, INC.<br>LONG BRANCH, NEW JERSEY |             |
| SCHEMATIC<br>MULTIPLIER                                |             |
| SHT. NO.   |             |
| SIZE   |             |
| REV. NO.   |             |
| PROJECT<br>1393  | D007 083 05 |
| SHEET 5 OF 5 SHEETS                                    |             |

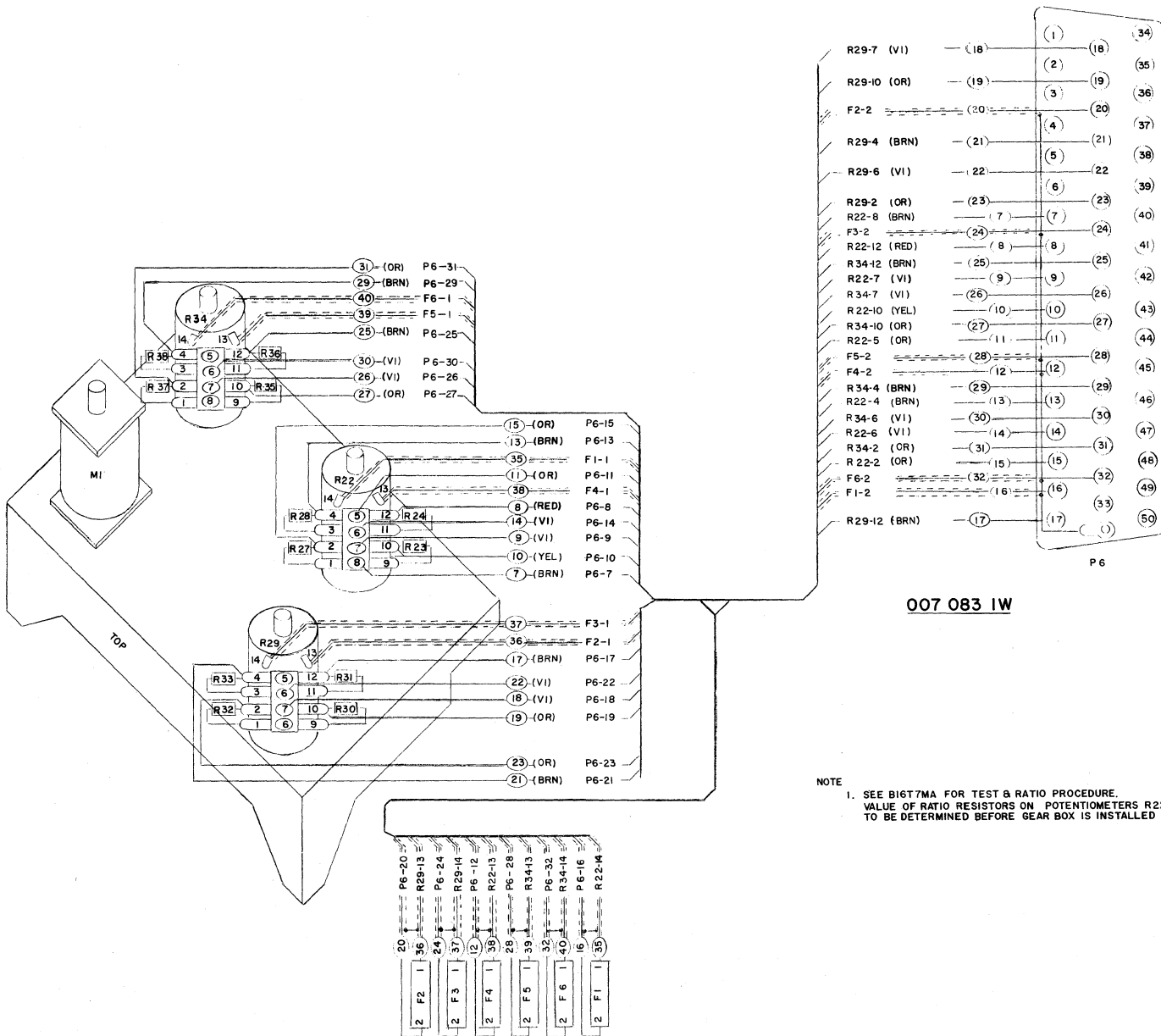
NOTES:  
 1 SEE DWG D007 093 OS FOR SCHEMATIC OF SERVO AMPLIFIER.



007 083 7S

|                             |                  |
|-----------------------------|------------------|
| ELECTRONIC ASSOCIATES, INC. |                  |
| LONG BRANCH, NEW JERSEY     |                  |
| SCHEMATIC DIAGRAM           |                  |
| MULTIPLIER                  |                  |
| DRG(SHT NO)                 |                  |
| E SIZE                      |                  |
| PROJECT                     | 1393 C007 083 OS |
| SHEET 7 OF 7 SHEETS         |                  |



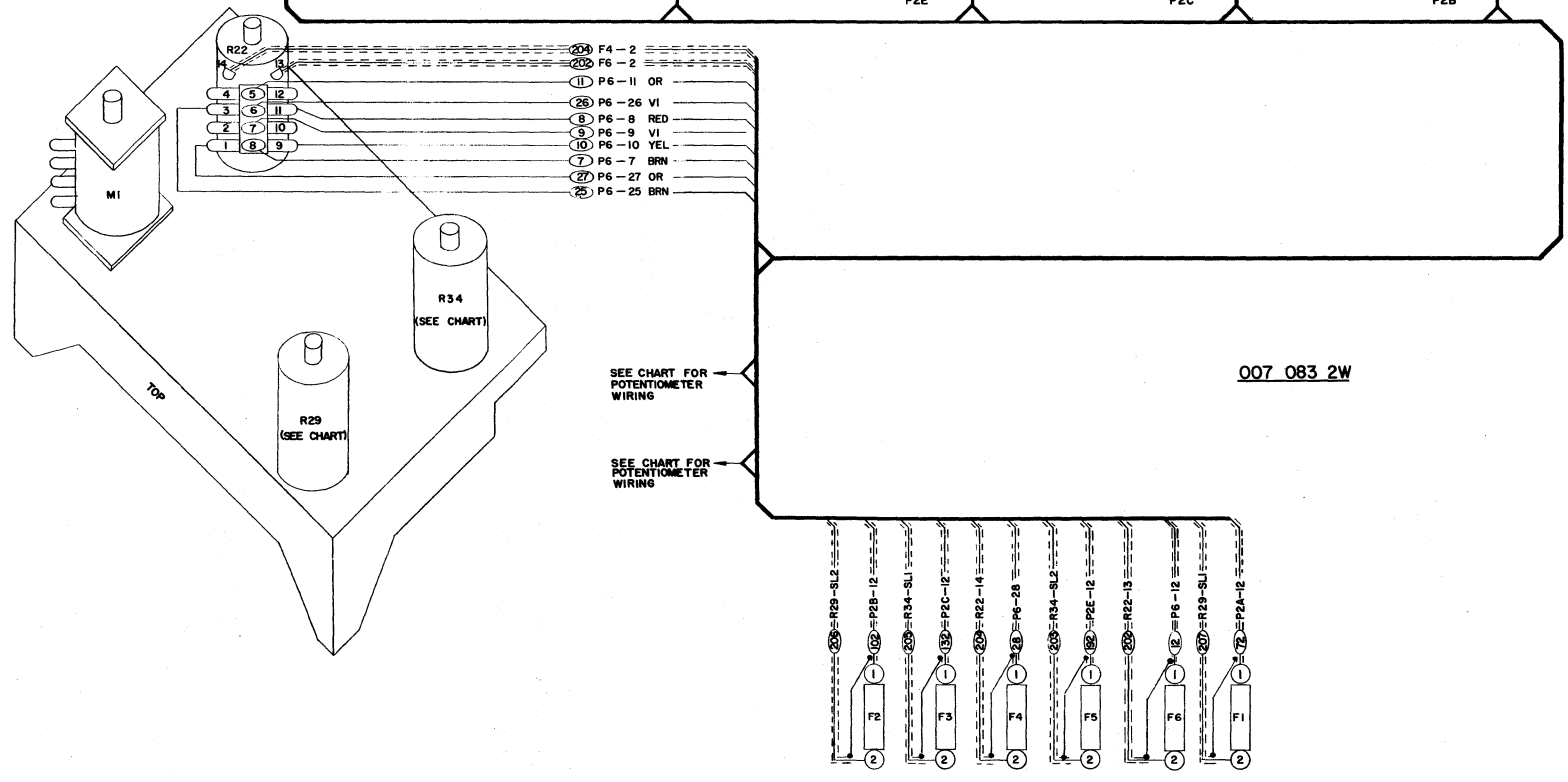
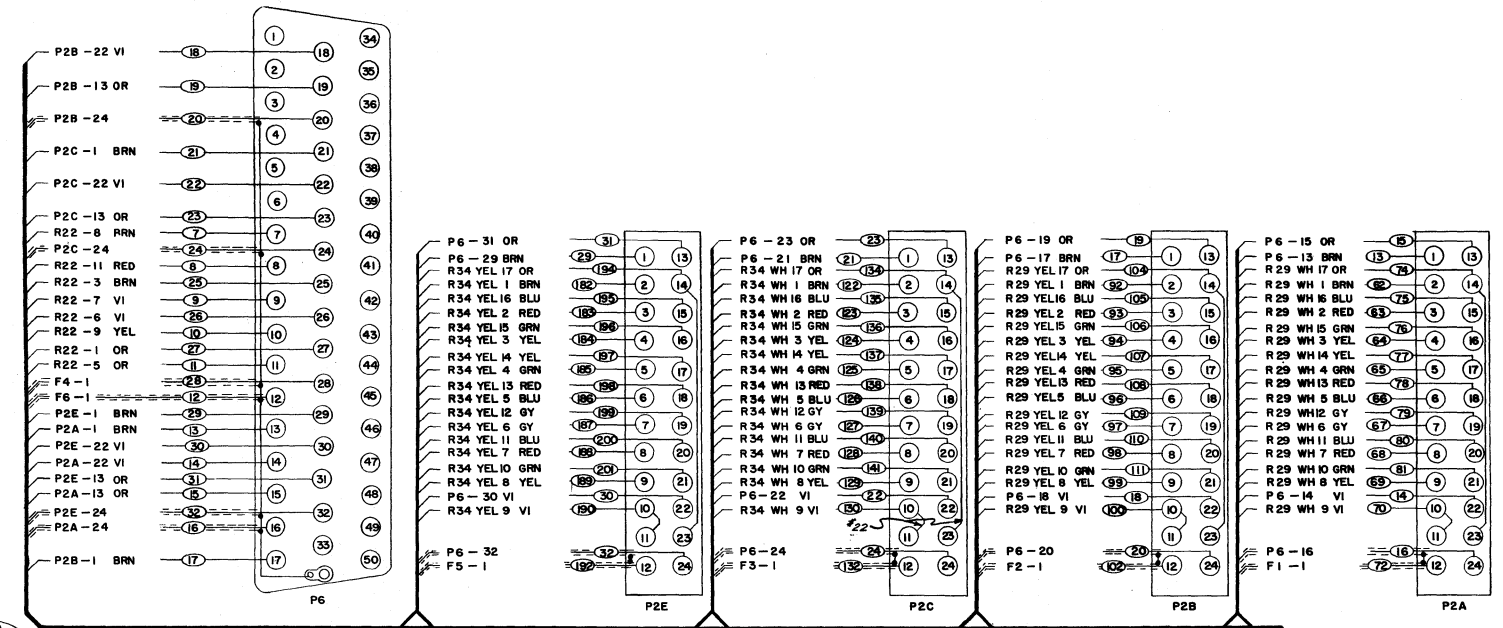


007 083 1W

NOTE  
 1. SEE BIG7MA FOR TEST & RATIO PROCEDURE.  
 VALUE OF RATIO RESISTORS ON POTENTIOMETERS R22 & R29  
 TO BE DETERMINED BEFORE GEAR BOX IS INSTALLED OR WIRED.

|  |              |
|--|--------------|
| ELECTRONIC ASSOCIATES, INC.<br>LONG BRANCH, NEW JERSEY |              |
| WIRING DIAGRAM<br>MULTIPLIER                           |              |
| SHT. NO.   |              |
| SIZE   |              |
| REV. NO.   |              |
| PROJECT<br>1393  | C 007 083 0W |
| SHEET 7 OF SHEETS                                      |              |

| POTENTIOMETER WIRING AND TERMINAL DESTINATIONS |                 |          |      |     |
|--|-----------------|----------|------|-----|
| MANUFACTURERS CODE NO.                         |                 | WIRE NO. |      |     |
| COLOR  | TERM. LETTERING | R29      | R34  |     |
| SECTION 1 WHITE                                | CCW - 90        | NONE     | NONE |     |
|  | 1               | 62       | 122  |     |
|  | 2               | 63       | 123  |     |
|  | 3               | 64       | 124  |     |
|  | 4               | 65       | 125  |     |
|  | 5               | 66       | 126  |     |
|  | 6               | 67       | 127  |     |
|  | 7               | 68       | 128  |     |
|  | 8               | 69       | 129  |     |
|  | 9               | 70       | 130  |     |
|  | 10              | 81       | 141  |     |
|  | 11              | 80       | 140  |     |
|  | 12              | 79       | 139  |     |
|  | 13              | 78       | 138  |     |
|  | 14              | 77       | 137  |     |
|  | 15              | 76       | 136  |     |
|  | 16              | 75       | 135  |     |
| 17   | 74              | 134      |      |     |
|  | CW + 90         | NONE     | NONE |     |
| SECTION 2 YELLOW                               | CCW             |          |      |     |
|  | 1               | 92       | 182  |     |
|  | 2               | 93       | 183  |     |
|  | 3               | 94       | 184  |     |
|  | 4               | 95       | 185  |     |
|  | 5               | 96       | 186  |     |
|  | 6               | 97       | 187  |     |
|  | 7               | 98       | 188  |     |
|  | 8               | 99       | 189  |     |
|  | 9               | 100      | 190  |     |
|  | 10              | 111      | 201  |     |
|  | 11              | 110      | 200  |     |
|  | 12              | 109      | 199  |     |
|  | 13              | 108      | 198  |     |
|  | 14              | 107      | 197  |     |
|  | 15              | 106      | 196  |     |
|  | 16              | 105      | 195  |     |
|  | 17              | 104      | 194  |     |
|  |                 | SLI      | 207  | 205 |
|  |                 | SL2      | 206  | 203 |



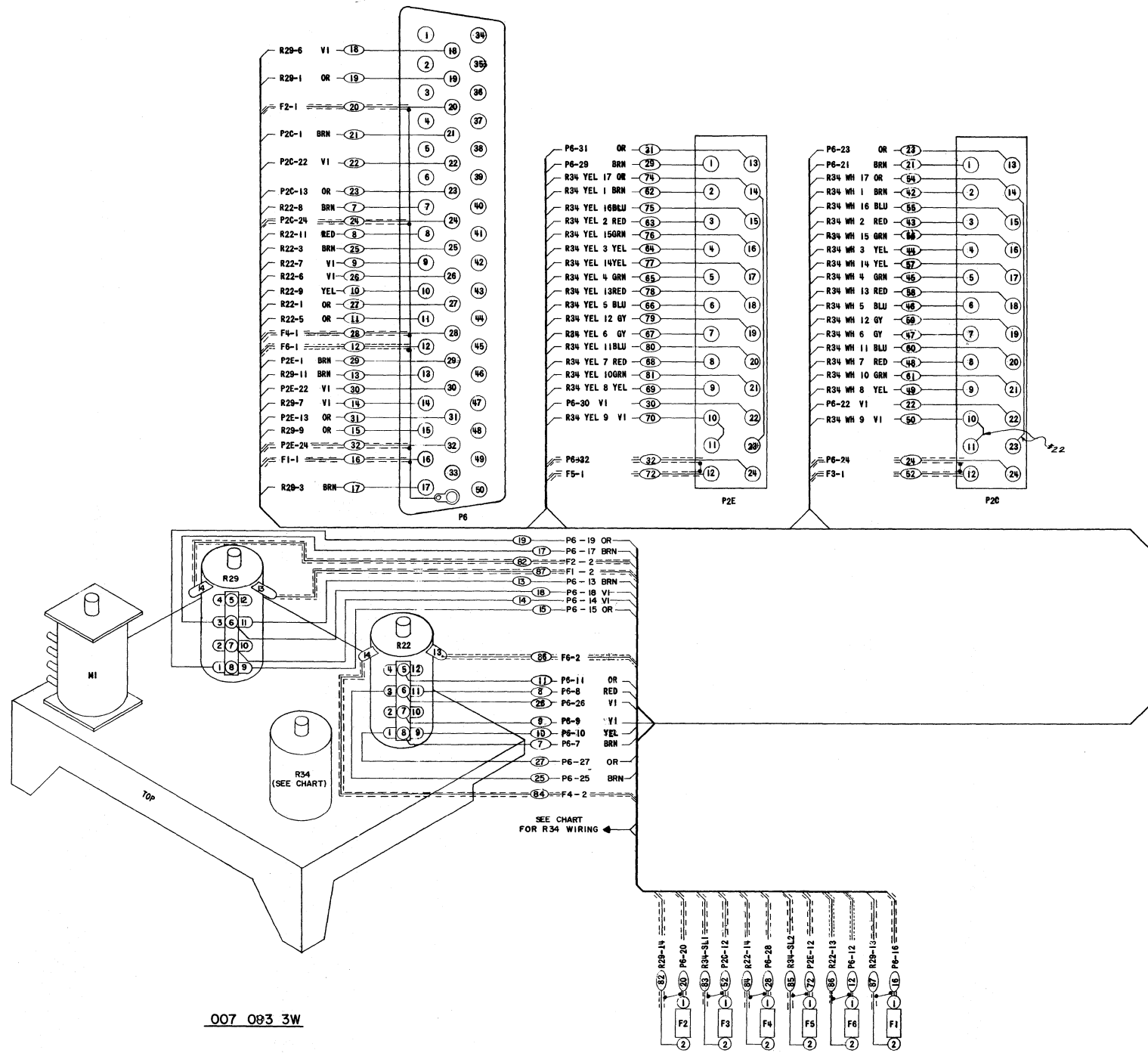
007 083 2W

ELECTRONIC ASSOCIATES, Inc.  
LONG BRANCH, NEW JERSEY

**WIRING DIAGRAM**  
**MULTIPLIER**

|                     |      |                  |  |  |  |  |  |  |  |
|---------------------|------|------------------|--|--|--|--|--|--|--|
| SHT NO              |      |                  |  |  |  |  |  |  |  |
| E                   | SIZE |                  |  |  |  |  |  |  |  |
| PROJECT             |      | 4393 D007 083 OW |  |  |  |  |  |  |  |
| SHEET 9 OF 9 SHEETS |      |                  |  |  |  |  |  |  |  |

| R34 WIRING AND TERMINAL DESTINATIONS |                 |          |
|--------------------------------------|-----------------|----------|
| MANUFACTURER CODE NO.                |                 | WIRE NO. |
| COLOR                                | TERM. LETTERING |          |
| SECTION 1 WHITE                      | CCW -90         | NONE     |
|                                      | CCW             | 42       |
|                                      | 1               | 43       |
|                                      | 2               | 44       |
|                                      | 3               | 45       |
|                                      | 4               | 46       |
|                                      | 5               | 47       |
|                                      | 6               | 48       |
|                                      | 7               | 49       |
|                                      | 8               | 50       |
|                                      | 9               | 51       |
|                                      | 10              | 52       |
|                                      | 11              | 53       |
|                                      | 12              | 54       |
|                                      | 13              | 55       |
|                                      | 14              | 56       |
|                                      | 15              | 57       |
| 16                                   | 58              |          |
| 17                                   | 59              |          |
| SECTION 2 YELLOW                     | CW +90          | NONE     |
|                                      | CCW             | 62       |
|                                      | 1               | 63       |
|                                      | 2               | 64       |
|                                      | 3               | 65       |
|                                      | 4               | 66       |
|                                      | 5               | 67       |
|                                      | 6               | 68       |
|                                      | 7               | 69       |
|                                      | 8               | 70       |
|                                      | 9               | 71       |
|                                      | 10              | 72       |
|                                      | 11              | 73       |
|                                      | 12              | 74       |
|                                      | 13              | 75       |
|                                      | 14              | 76       |
|                                      | 15              | 77       |
| 16                                   | 78              |          |
| 17                                   | 79              |          |
| SL1                                  | 80              |          |
| SL2                                  | 81              |          |

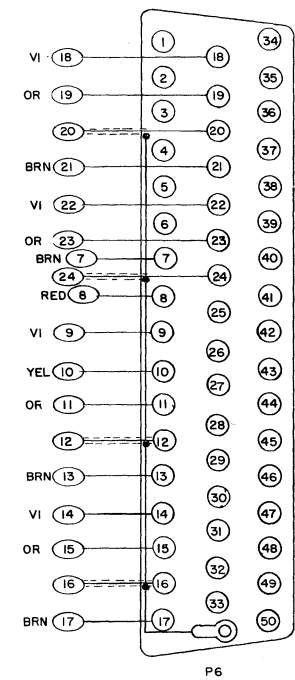
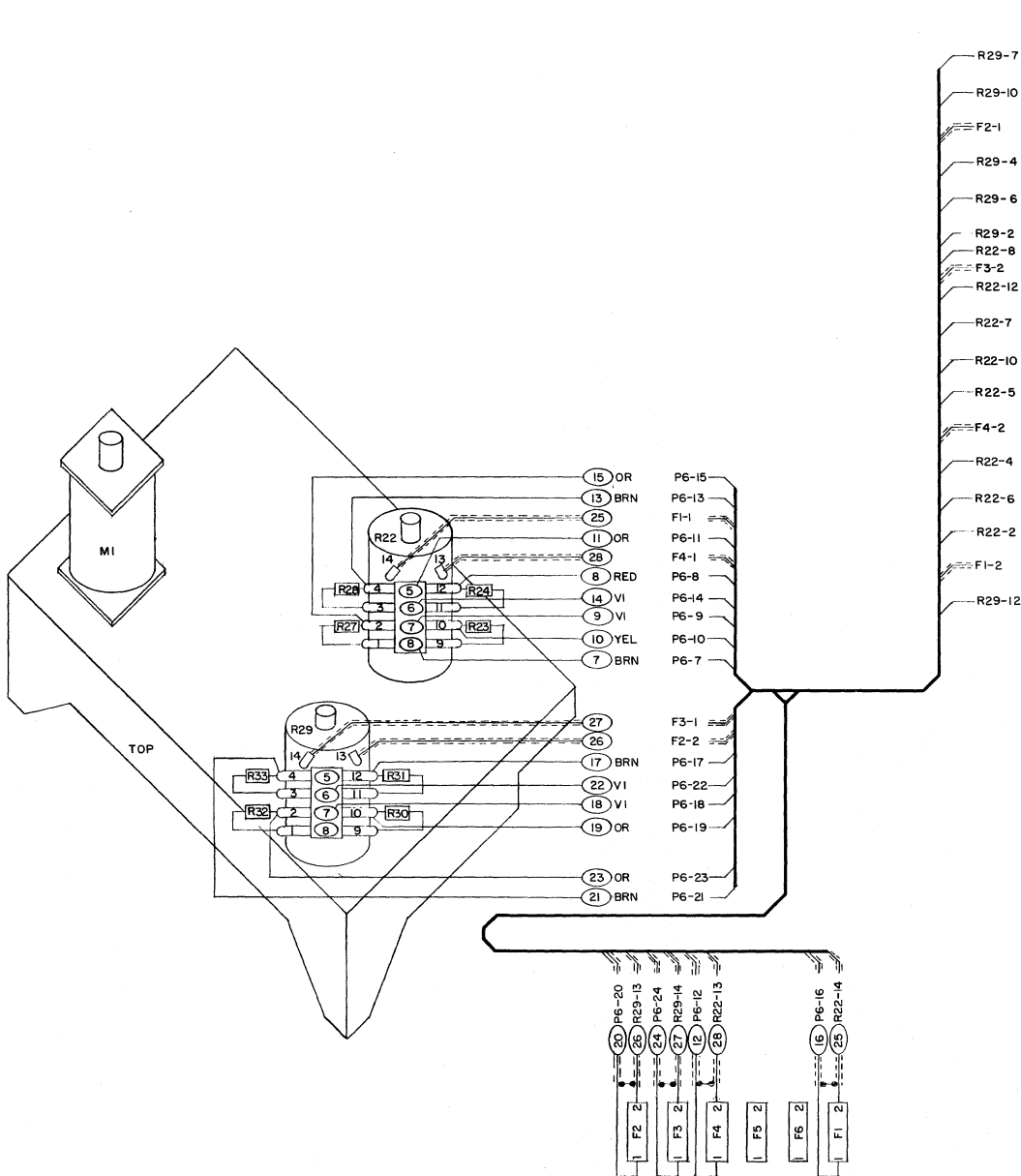


007 083 3W

ELECTRONIC ASSOCIATES, Inc.  
LONG BRANCH, NEW JERSEY

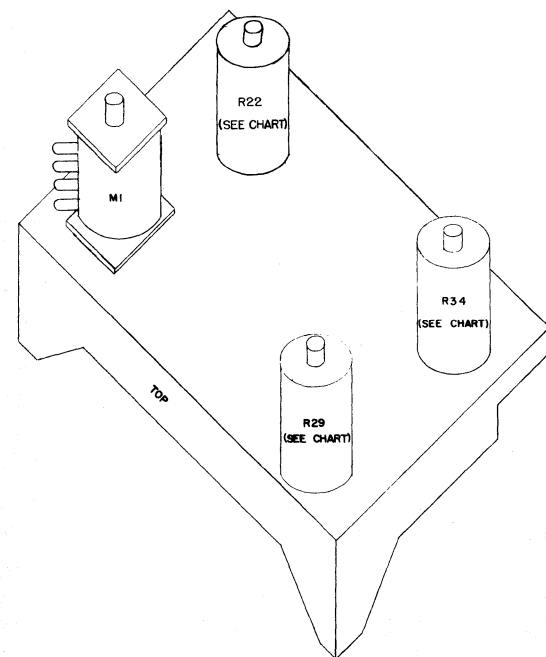
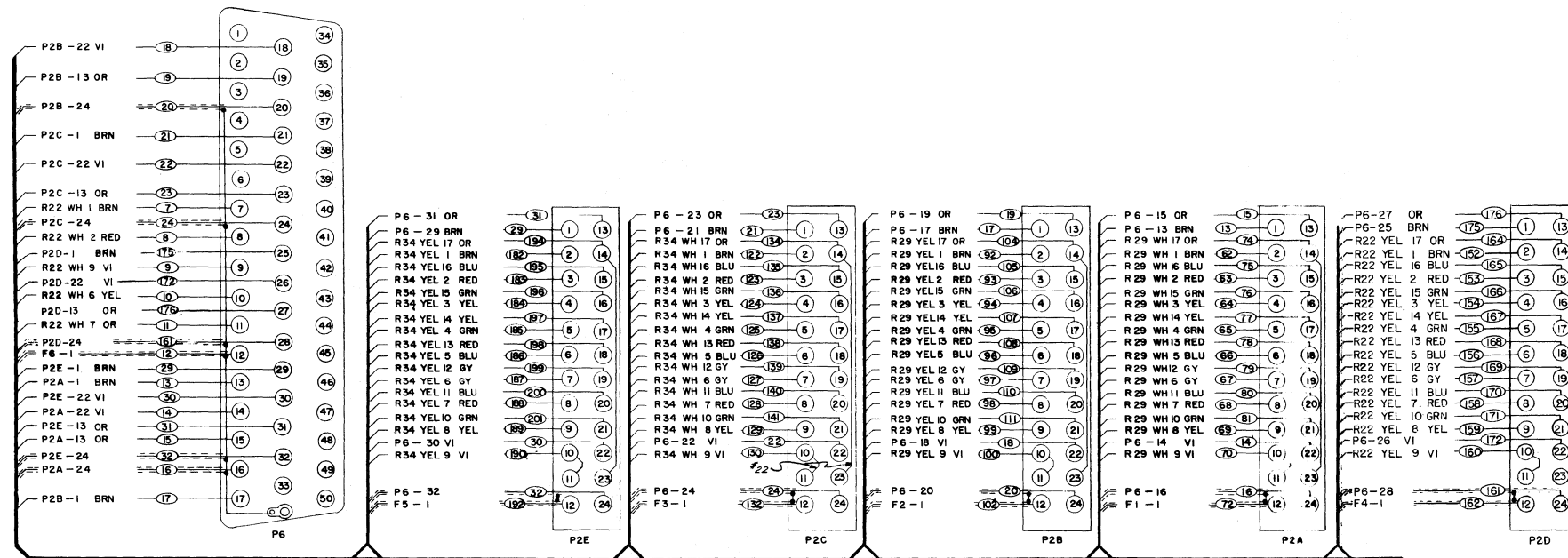
**WIRING DIAGRAM  
MULTIPLIER**

|         |        |                |  |  |  |  |  |  |  |
|---------|--------|----------------|--|--|--|--|--|--|--|
| REV     | SHT NO |                |  |  |  |  |  |  |  |
| E       | SIZE   |                |  |  |  |  |  |  |  |
| PROJECT |        | D007 083 0W    |  |  |  |  |  |  |  |
| 1393    |        | SHEET 14 OF 18 |  |  |  |  |  |  |  |



007 083 5W

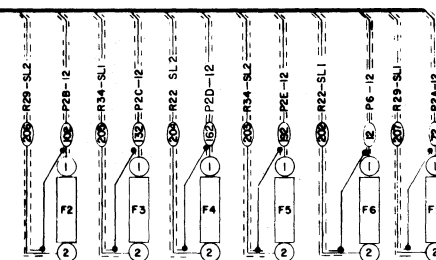
|  |                    |
|--|--------------------|
| ELECTRONIC ASSOCIATES, INC.<br>LONG BRANCH, NEW JERSEY |                    |
| <b>WIRING DIAGRAM<br/>MULTIPLIER</b>                   |                    |
| SHT. NO.   |                    |
| SIZE   |                    |
| REV. NO.   |                    |
| PROJECT<br><b>429</b>                                  | <b>C007 083 0W</b> |
| SHEET 17 OF SHEETS                                     |                    |



SEE CHART FOR  
POTENTIOMETER  
WIRING

\* TERMINALS 1 & 5 ARE END POINTS ON  
R22 ONLY.

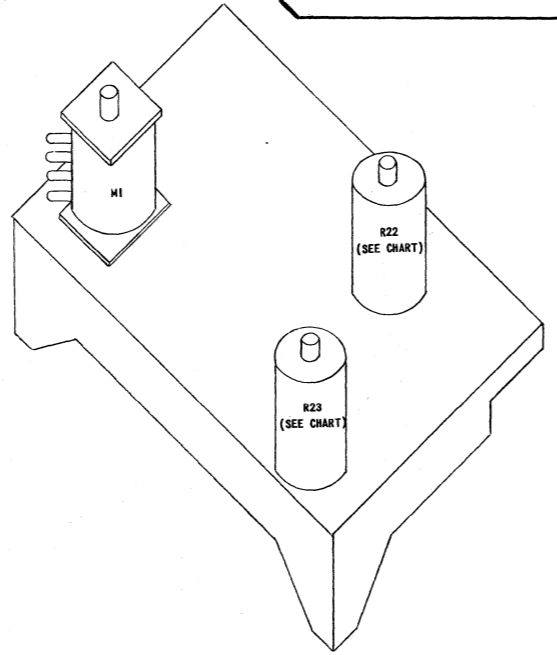
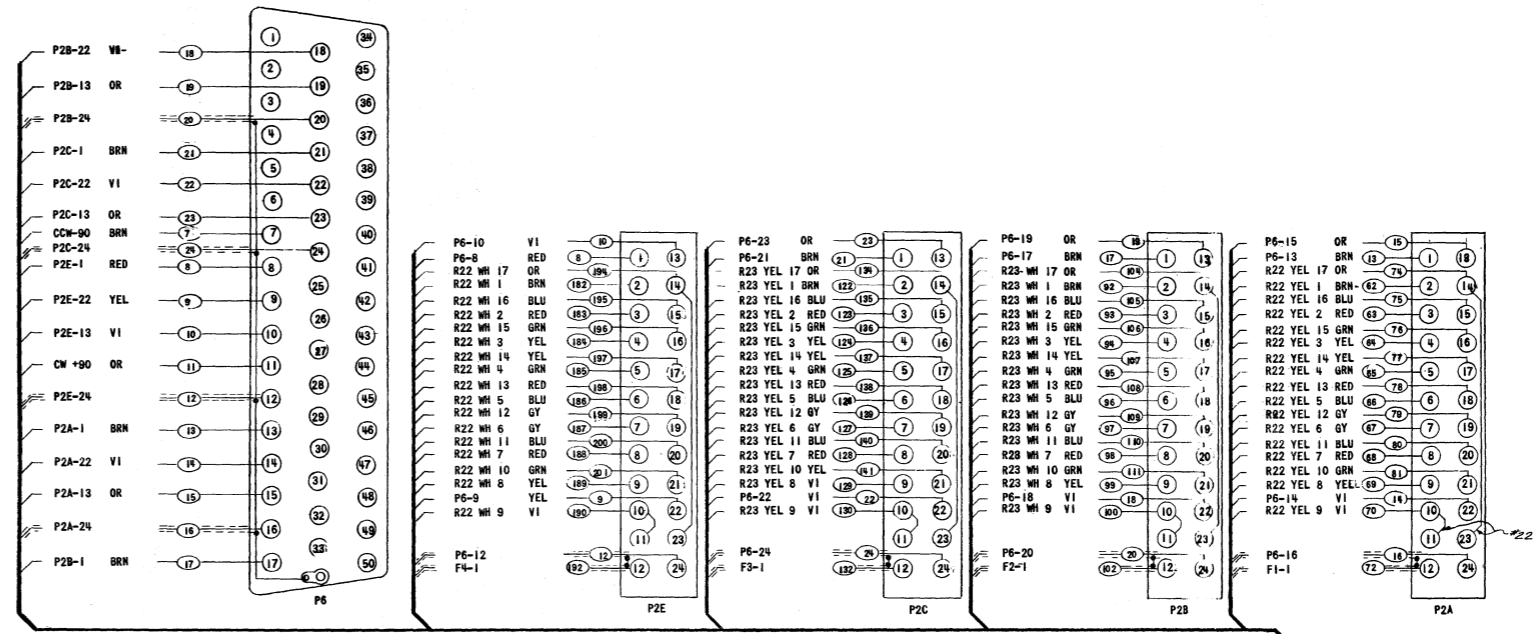
007 083 6W



| POTENTIOMETER WIRING AND TERMINAL DESTINATIONS |                 |          |      |      |
|--|-----------------|----------|------|------|
| MANUFACTURERS CODE NO.                         |                 | WIRE NO. |      |      |
| COLOR  | TERM. LETTERING | R22      | R29  | R34  |
| SECTION 1 WHITE                                | CCW - 90        | NONE     | NONE | NONE |
|  | * (L-90)        | 7        | 82   | 122  |
|  | 2               | 8        | 63   | 123  |
|  | 3               | 9        | 64   | 124  |
|  | 4               | 10       | 65   | 125  |
|  | * (3690)        | 11       | 66   | 126  |
|  | 6               | NONE     | 67   | 127  |
|  | 7               | NONE     | 68   | 128  |
|  | 8               | NONE     | 69   | 129  |
|  | 9               | NONE     | 70   | 130  |
|  | 10              | NONE     | 71   | 131  |
|  | 11              | NONE     | 72   | 132  |
|  | 12              | NONE     | 73   | 133  |
|  | 13              | NONE     | 74   | 134  |
|  | 14              | NONE     | 75   | 135  |
|  | 15              | NONE     | 76   | 136  |
|  | 16              | NONE     | 77   | 137  |
| 17   | NONE            | 78       | 138  |      |
| CW + 90  | NONE            | NONE     | NONE |      |
| SECTION 2 YELLOW                               | CCW             |          |      |      |
|  | 1               | 152      | 82   | 182  |
|  | 2               | 153      | 83   | 183  |
|  | 3               | 154      | 84   | 184  |
|  | 4               | 155      | 85   | 185  |
|  | 5               | 156      | 86   | 186  |
|  | 6               | 157      | 87   | 187  |
|  | 7               | 158      | 88   | 188  |
|  | 8               | 159      | 89   | 189  |
|  | 9               | 160      | 90   | 190  |
|  | 10              | 171      | 111  | 201  |
|  | 11              | 170      | 110  | 200  |
|  | 12              | 169      | 109  | 199  |
|  | 13              | 168      | 108  | 198  |
|  | 14              | 167      | 107  | 197  |
|  | 15              | 166      | 106  | 196  |
|  | 16              | 165      | 105  | 195  |
| 17   | 164             | 104      | 194  |      |
| SL1  | 202             | 207      | 205  |      |
| SL2  | 204             | 206      | 203  |      |

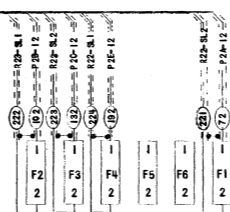


| POTENTIOMETER WIRING AND TERMINAL DESTINATIONS |                 |          |     |     |      |
|--|-----------------|----------|-----|-----|------|
| MANUFACTURERS CODE NO.                         |                 | WIRE NO. |     |     |      |
| COLOR  | TERM. LETTERING | R22      | R23 |     |      |
| SECTION 1 WHITE                                | CCW -90<br>CCW  | 1        | 182 | 92  | NONE |
|  |                 | 2        | 183 | 93  |      |
|  |                 | 3        | 184 | 94  |      |
|  |                 | 4        | 185 | 95  |      |
|  |                 | 5        | 186 | 96  |      |
|  |                 | 6        | 187 | 97  |      |
|  |                 | 7        | 188 | 98  |      |
|  |                 | 8        | 189 | 99  |      |
|  |                 | 9        | 190 | 100 |      |
|  |                 | 10       | 201 | 111 |      |
|  |                 | 11       | 200 | 110 |      |
|  |                 | 12       | 199 | 109 |      |
|  |                 | 13       | 198 | 108 |      |
|  |                 | 14       | 197 | 107 |      |
|  |                 | 15       | 196 | 106 |      |
|  |                 | 16       | 195 | 105 |      |
|  |                 | 17       | 194 | 104 |      |
| SECTION 2 YELLOW                               | CCW +90<br>CCW  | 1        | 62  | 122 |      |
|  |                 | 2        | 63  | 123 |      |
|  |                 | 3        | 64  | 124 |      |
|  |                 | 4        | 65  | 125 |      |
|  |                 | 5        | 66  | 126 |      |
|  |                 | 6        | 67  | 127 |      |
|  |                 | 7        | 68  | 128 |      |
|  |                 | 8        | 69  | 129 |      |
|  |                 | 9        | 70  | 130 |      |
|  |                 | 10       | 81  | 141 |      |
|  |                 | 11       | 80  | 140 |      |
|  |                 | 12       | 79  | 139 |      |
|  |                 | 13       | 78  | 138 |      |
|  |                 | 14       | 77  | 137 |      |
|  |                 | 15       | 76  | 136 |      |
|  |                 | 16       | 75  | 135 |      |
|  |                 | 17       | 74  | 134 |      |
|  | SL1             | 224      | 222 |     |      |
|  | SL2             | 221      | 223 |     |      |



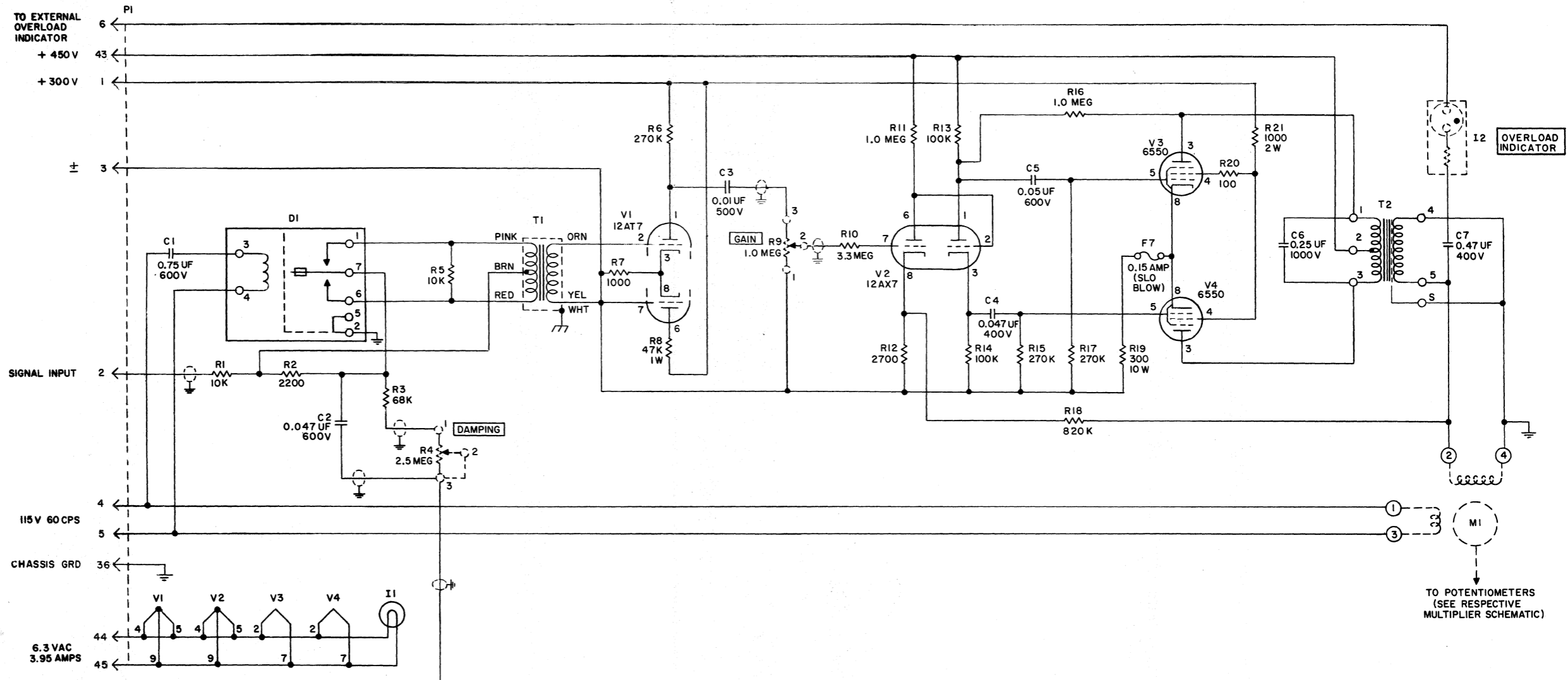
SEE CHART FOR POTENTIOMETER WIRING

SEE CHART FOR POTENTIOMETER WIRING



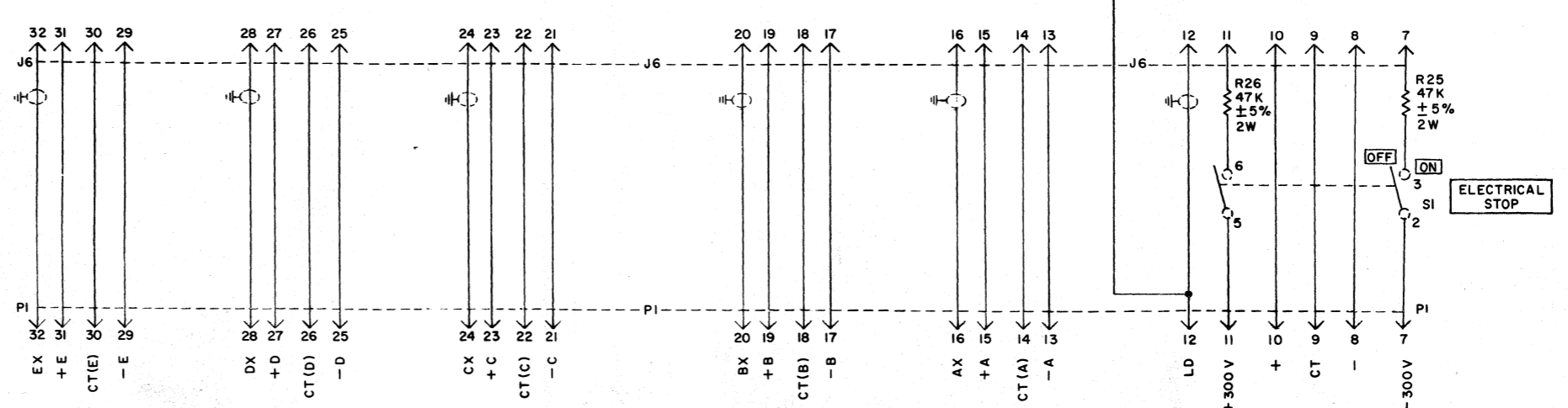
007 083 7W

|                              |             |
|------------------------------|-------------|
| ELECTRONIC ASSOCIATES, Inc.  |             |
| LONG BRANCH, NEW JERSEY      |             |
| WIRING DIAGRAM<br>MULTIPLIER |             |
| SHT NO                       |             |
| SIZE                         |             |
| PROJECT                      | D007 083 OW |
| SHEET 24 OF SHEETS           |             |



**NOTES:**  
 1— ALL RESISTORS TO BE 1/2 WATT & ±10% TOLERANCE UNLESS OTHERWISE SPECIFIED.  
 2— COMPONENTS S1, I2, R4, R9 & M1 ARE INSTALLED AT FINAL ASSEMBLY.

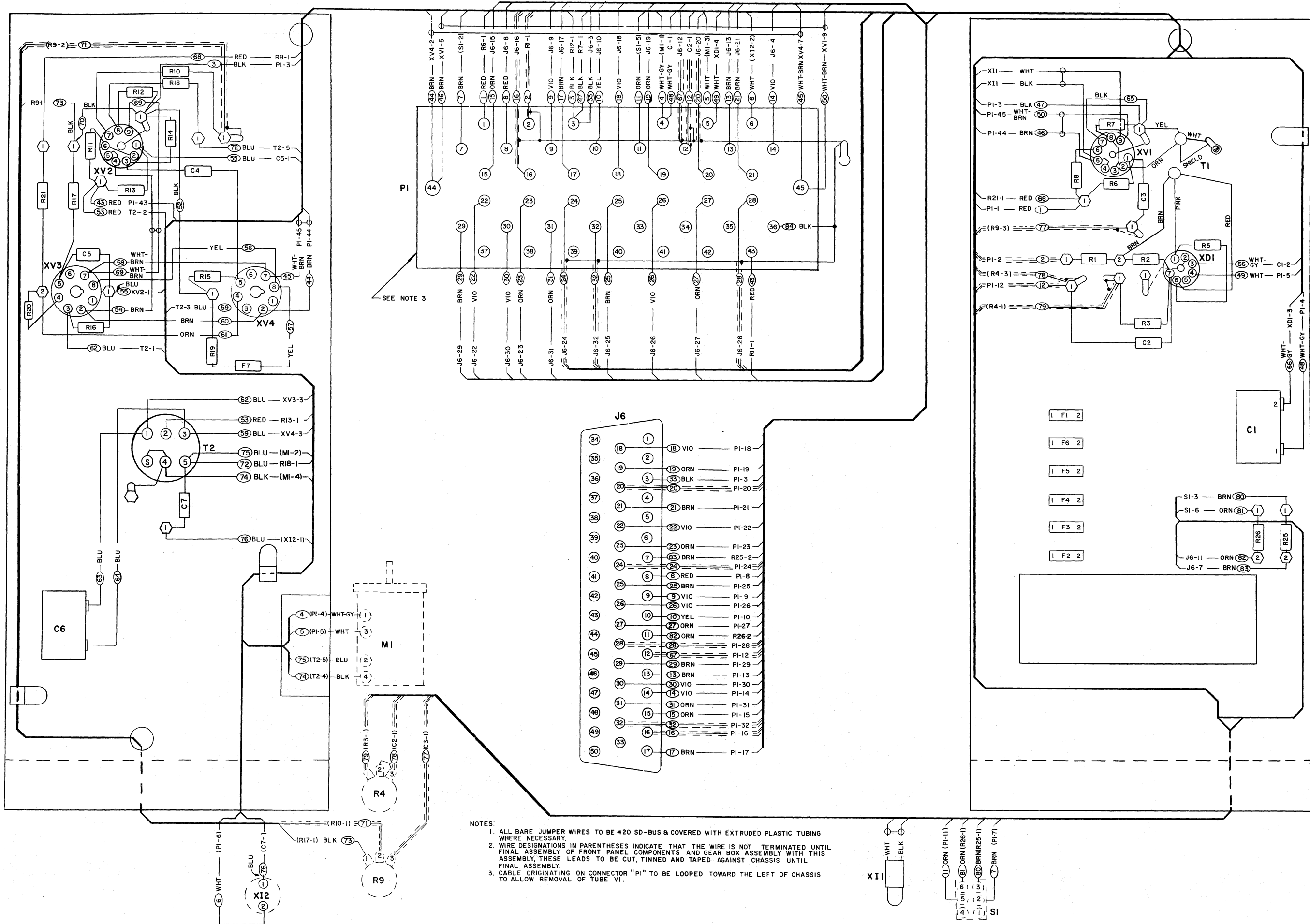
**DESIGN NOTE:**  
 TERMINALS \*33 & \*34 ON CONNECTOR P1 ARE RESERVED FOR ±100V REF ON FUTURE DESIGNS.



ELECTRONIC ASSOCIATES, INC.  
 LONG BRANCH, NEW JERSEY

**SCHEMATIC  
 SERVO AMPLIFIER  
 CHASSIS**

|          |     |      |     |        |  |
|----------|-----|------|-----|--------|--|
| SHT. NO. |     |      |     |        |  |
| SIZE     |     |      |     |        |  |
| REV. NO. |     |      |     |        |  |
| PROJECT  | 429 | D007 | 093 | OS     |  |
| SHEET    |     | OF   |     | SHEETS |  |



- NOTES:
- ALL BARE JUMPER WIRES TO BE #20 SD-BUS & COVERED WITH EXTRUDED PLASTIC TUBING WHERE NECESSARY.
  - WIRE DESIGNATIONS IN PARENTHESES INDICATE THAT THE WIRE IS NOT TERMINATED UNTIL FINAL ASSEMBLY OF FRONT PANEL COMPONENTS AND GEAR BOX ASSEMBLY WITH THIS ASSEMBLY, THESE LEADS TO BE CUT, TINNED AND TAPED AGAINST CHASSIS UNTIL FINAL ASSEMBLY.
  - CABLE ORIGINATING ON CONNECTOR "PI" TO BE LOOPED TOWARD THE LEFT OF CHASSIS TO ALLOW REMOVAL OF TUBE VI.

## SECTION IV

### SERVO MECHANICAL MULTIPLIER 7.084 (26-7N)

#### 1. GENERAL

Servo Multiplier, Type 7.084, (Figures 21 and 22) is a single-turn multiplier utilizing a 60 cps servo system for high speed and good accuracy. This multiplier is identical with the 26-7N Multiplier.

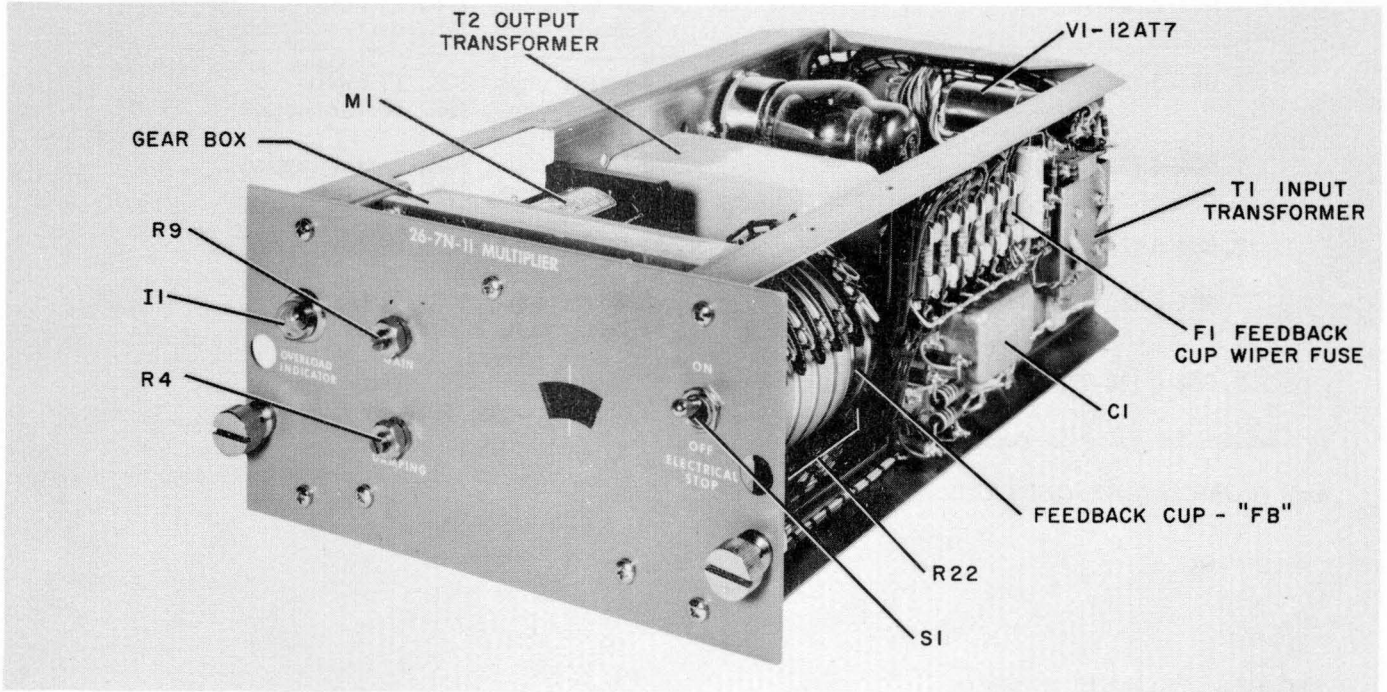


Figure 21. Servo Mechanical Multiplier 7.084 (26-7N), Three-Quarter Front View

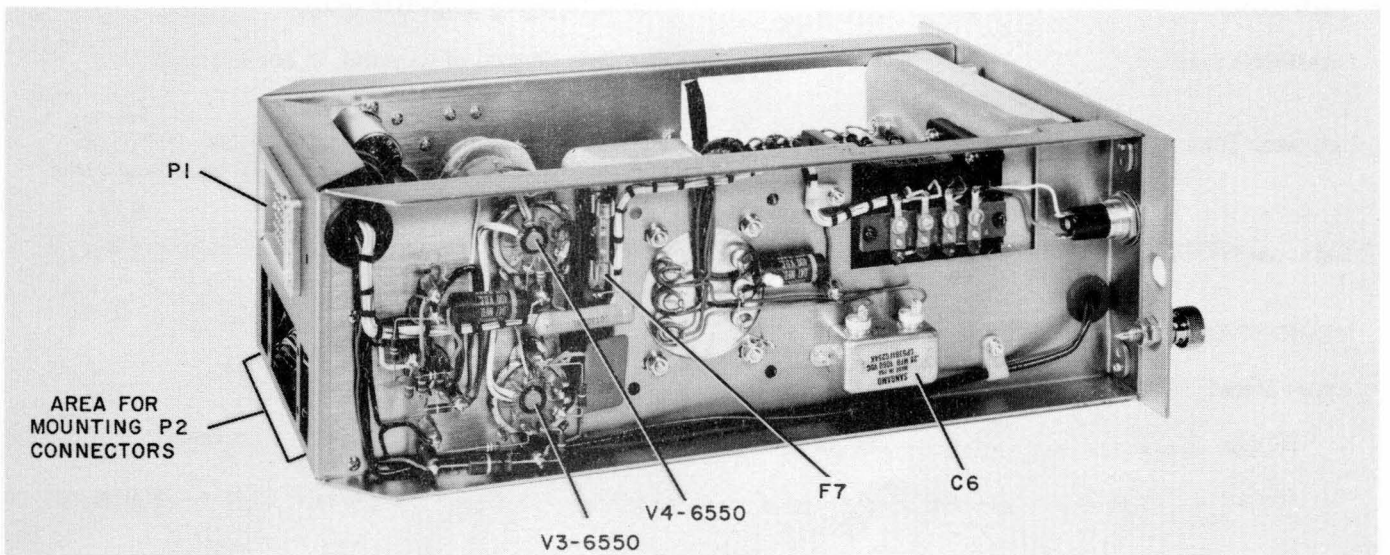


Figure 22. Servo Mechanical Multiplier 7.084 (26-7N), Three-Quarter Rear View

2. MULTIPLYING POTENTIOMETER CONFIGURATIONS

7.084 (26-7N) Multiplier

| <u>Model Number</u>  | <u>Potentiometer Description</u>                                      |
|--|---|
| 7.084-0 (26-7N-20)   | *6 linear cups, 30K, 17 taps  |
| 7.084-1 (26-7N-11)   | *6 linear cups, 30K, center tapped                                    |
| 7.084-2 (26-7N-12)   | 4 linear cups, 30K, 17 taps<br>*2 linear cups, 30K, center tapped     |
| 7.084-3 (26-7N-13)   | 2 linear cups, 30K, 17 taps<br>*4 linear cups, 30K, center tapped     |
| 7.084-4 (26-7N-14)   | 2 linear cups, 30K, center tapped<br>*4 linear cups, 30K, 17 taps     |
| 7.084-5 (26-7N-15)   | *4 linear cups, 30K, center tapped                                    |
| 7.084-6 (26-7N-16)   | 5 linear cups, 30K, 17 taps<br>*1 linear cup, 30K, center tapped      |
| 7.084-8 (26-7N-18) <i>(This multiplier variation is intended for polar-to-rectangular data conversion only (FORWARD RESOLUTION).</i> | *1 linear cup, 30K, center tapped<br>4 sin-cos cups, 20K per quadrant |

3. CONTROLS AND INDICATORS

The following indicators and controls are provided on the front panel of the multiplier unit for operational convenience.

|                             |  |
|-----------------------------|--|
| GAIN Control                | Controls servo amplifier gain.   |
| DAMPING Control             | Controls degree of damping in servo feedback system.   |
| Indicator Dial              | Front panel indicator dial, divided into 200 parts and calibrated from -100V to +100V to indicate the position of the servo. |
| External OVERLOAD Indicator | A neon lamp to provide a visual indication of servo overload.  |

4. TECHNICAL DATA, PHYSICAL

Front Panel

|              |              |
|--------------|--------------|
| Height ..... | 5 inches     |
| Width .....  | 9-1/2 inches |

---

\*Configuration of feedback cup.

Chassis

|              |              |
|--------------|--------------|
| Height ..... | 4-3/4 inches |
| Width .....  | 8 inches     |
| Depth .....  | 15 inches    |
| Weight ..... | 20 pounds    |

Tube Complement

- Type 12AT7 - 1 each
- Type 12AX7 - 1 each
- Type 6550 - 2 each

5. TECHNICAL DATA, ELECTRICAL

Power Input

| <u>Quiescent</u>          | <u>Slewing</u>            |
|---------------------------|---------------------------|
| +300V DC ..... 8 ma       | +300V DC ..... 15 ma      |
| +390V DC ..... 90 ma      | +390V DC ..... 130 ma     |
| -300V DC ..... 4 ma       | -300V DC ..... 4 ma       |
| 115V AC, 60~ ..... 375 ma | 115V AC, 60~ ..... 375 ma |
| 6.3V AC ..... 3.95 amp    | 6.3V AC ..... 3.95 amp    |

Reference Voltage

The external reference voltage should be within the range of plus and minus 25 to 100 volts. The load on the reference source varies in accordance with the circuit connections.

Electrical Stop Voltage

A voltage equal to three times the reference voltage is used for the electrical stop. The load on this circuit is 62,000 ohms for the 30,000 ohm cups.

6. TECHNICAL DATA, OPERATIONAL

*Potentiometer Characteristics (Wirewound)*

Linear Potentiometers:

|                             |   |
|-----------------------------|---|
| Resistance .....            | 30,000 ohms $\pm 5\%$ between taps CW and CCW   |
| Independent Linearity ..... | 0.12%   |
| Electrical Rotation .....   | 304° $\pm 1^\circ$  |
| Electrical Overtravel ..... | 27° nominal, 26° minimum  |
| End Taps .....              | Feedback cup has end taps A and B at approximately 27° past the CW and CCW terminals. |

|                               |        |
|-------------------------------|--------|
| Center Tap Tolerance .....    | 0.2%*  |
| Resolution .....              | 0.05%  |
| Temperature Coefficient ..... | 20 PPM |

Linear Tapped Potentiometers:

|   |                         |
|---|-------------------------|
| Resistance .....  | 30,000 ohms $\pm 5\%$   |
| Independent Linearity .....   | 0.12%                   |
| Electrical Rotation .....   | $304^\circ \pm 1^\circ$ |
| Number of taps equally spaced counting C. T. but not<br>overtravel taps A and B (if used) ..... | 17                      |
| Tolerance of all tap locations .....  | 0.2%*                   |
| Resolution .....  | 0.05%                   |
| Temperature Coefficient .....   | 20 PPM                  |

*Servo Static Nulling Error:*

|   |                 |
|---|-----------------|
| Error between input and feedback signal as percentage of<br>Full Scale (200V) ..... | less than 0.02% |
|---|-----------------|

*Acceleration:*

|  |                 |
|--|-----------------|
| The acceleration limit based on 200V across feedback<br>potentiometer is ..... | $56,000V/sec^2$ |
|--|-----------------|

*Velocity:*

The velocity limit based on 200V across feedback potentiometer is . 1400V/sec

*Dynamic Error:*

The overall dynamic errors of the servo system are shown as frequency versus input curves in Figure 23.

*Loading Error:*

The output channel terminations should operate into a load of between 1 megohm and infinity. A resistor equal in value to the load on the multiplying channels should be included in the feedback circuit in order to cancel out the error due to external loading. This resistor,  $R_L$ , (Figures 4 through 8, Section I) should be connected from the feedback cup terminal 12 to ground, as shown in the applicable schematics.

---

\*The tolerance on the deviation between the actual and ideal tap voltages. The tolerance is expressed as a percentage of the total reference voltage, a nominal 200 volts.

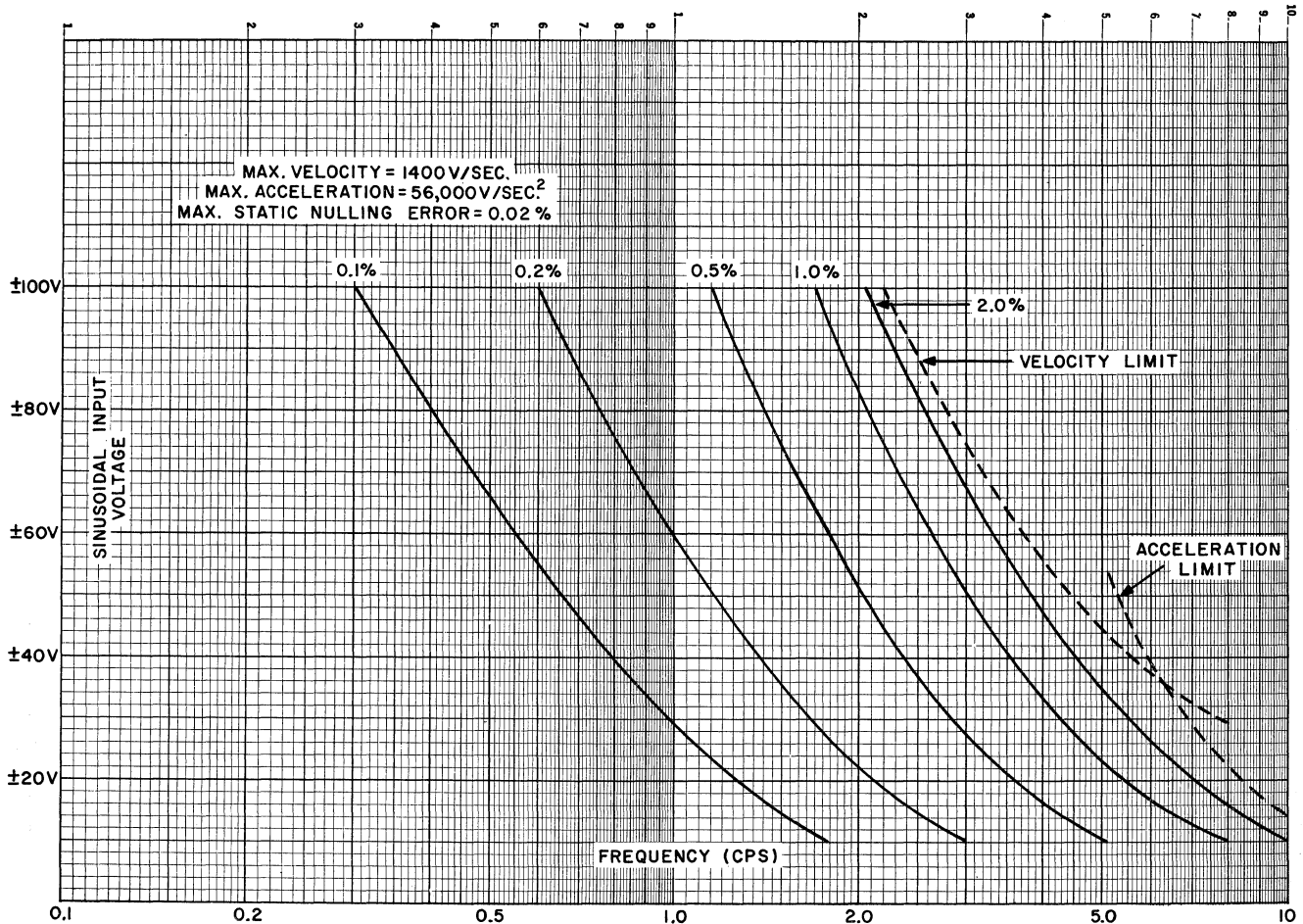


Figure 23. Dynamic Error Curves, 7.084 (26-7N) Multiplier

## 7. INPUT AND OUTPUT TERMINATIONS

All connections to the multiplier are made through connectors located at the rear of the chassis. On models utilizing tapped cups for function generation, connector P1 and as many P2 connectors as required are furnished. Connector P1 provides for power inputs, and potentiometer end-tap, wiper arm and center-tap connections. Connectors P2A through P2E (as required) provide the additional connections required by multi-tapped potentiometers. Each multi-tap cup of the potentiometer is provided with a separate connector to facilitate termination of the tapped cup during function generation. An internal connector (J6) is provided to facilitate potentiometer removal.

## 8. INSTALLATION AND ADJUSTMENTS

### a. Installation

The 7.084 Series of multipliers is completely interchangeable with other EAI multipliers such as the 7.083 (26-7M) and the 7.017 (16-7S) Series when used in PACE Computers and associated expansion racks.

### CAUTION

*Compare schematic diagrams of units being interchanged, to prevent damage to the potentiometers.*

Use of the overload indicator circuitry requires connection of terminal P1-6 to the input of an overload alarm unit such as EAI Models 16-13A and 13.001. If an overload alarm unit is not provided, connect terminal 6 of P1 to terminal 3. Overload can then be observed at the OVERLOAD INDICATOR located on the front panel.



Multipliers supplied with multi-tapped cups require a cable from the appropriate P2 connector to a pot padder or a jumper plug (provided with the unit) to connect the end-tap, center-tap, and wiper arm connections of the multi-tapped cups back to P1 and to the pre-patch panel area of the computer.

Reference voltages in the range of  $\pm 25$  to  $\pm 100$  volts may be used on the feedback cup (F). Reference voltages applied should never exceed  $\pm 100$  volts; that is, the total voltage applied across the cup between pins 8 and 10 of connector P1 (+F and -F on the computer pre-patch panel) should never be over 200 volts. The multiplier dial is graduated in 200 equal divisions, calibrated both in the positive and negative direction. With a known reference being applied to the feedback cup, the indicator dial then displays an approximate indication of servo input. More accurate measurement can be made using the VTVM or DVM provided in the computer.

#### b. Adjustments

The GAIN and DAMPING controls are adjusted after installation and thereafter at the discretion of the operator. These controls interact to some degree so that the adjustment procedure should be repeated until satisfactory response is obtained.

(1) *Gain Adjustment.* Apply a step function to the servo system and adjust the GAIN control just below the point where servo oscillations occur.

(2) *Damping Adjustment.* The DAMPING control is adjusted so that, in a step function, one overshoot occurs before the servo nulls. No overshoot indicates over-damping. Readjust the GAIN control if required.

### 9. THEORY OF OPERATION

#### a. General

The multiplier circuitry consists of a servo amplifier (with input network and modulator), servo motor, gear train and a multiplying potentiometer. The servo amplifier provides positioning power to the servo motor from two sources: (1), a common variable signal coupled to the signal input; and (2), the feedback voltage (FB). The signal input represents the magnitude of the common variable by which the other variables are to be multiplied. The feedback voltage is derived from the wiper arm of the feedback cup of the multiplying potentiometer (see Figure 24). Coupling of the servo motor to the multiplying potentiometer is provided by a gear train with a ratio of 9.9:1, motor to pot. (See Figure 25.)

#### b. Input Network and Chopper

The signal input and feedback voltage are applied to opposite ends of the input network R1, R2, R3, R4 (DAMPING control) and C1. The voltage across this network is equal to the difference between the two inputs. The output of the network, taken across R2, is a proportional-plus-derivative representation of the servo loop error. The function of the voltage divider is to provide the proportional error voltage, and capacitor C1 provides the derivative error voltage (an error signal proportional to the rate of change of the input). This method of control, functions to provide a large error voltage when the servo is displaced from null, and an effective "braking" force when the servo approaches the new null.

The d-c error voltage appearing across R2 is modulated at a 60 cycle rate by chopper D1 (electro-mechanical vibrator). The vibrating reed of the chopper alternately connects the high and the low end of the primary winding of transformer T1 to one side of the error voltage. The other side of the error voltage source is connected to the centertap of the primary winding. This applies the error signal alternately across one or the other half of the winding. The resultant action of current (proportional to the error) flowing for one half cycle in one direction and for the other half cycle in the opposite direction, induces a 60 cycle square wave in to the secondary of T1; the amplitude of this voltage is proportional to the error, and the phase is determined by the error voltage polarity.

#### c. Amplifier Circuitry

The amplifier section consists of cascaded voltage amplifier stages V1 and V2b, a phase inverter V2a, and a push pull power output stage V3 and V4. V1 is driven by the 60 cycle voltage across the secondary of T1. The output of this stage is R-C coupled to the grid of V2a.

The signal voltage at the plate of V1a appears across the GAIN control potentiometer R9 and is applied to the grid of V2b (left-hand section). The output of this stage is directly coupled to the grid of V2a which is connected as a split-load phase inverter. Equal load resistors (R13 and R14) are connected in the plate and cathode circuits to provide two equal signals 180 degrees out of phase to drive the output tubes.

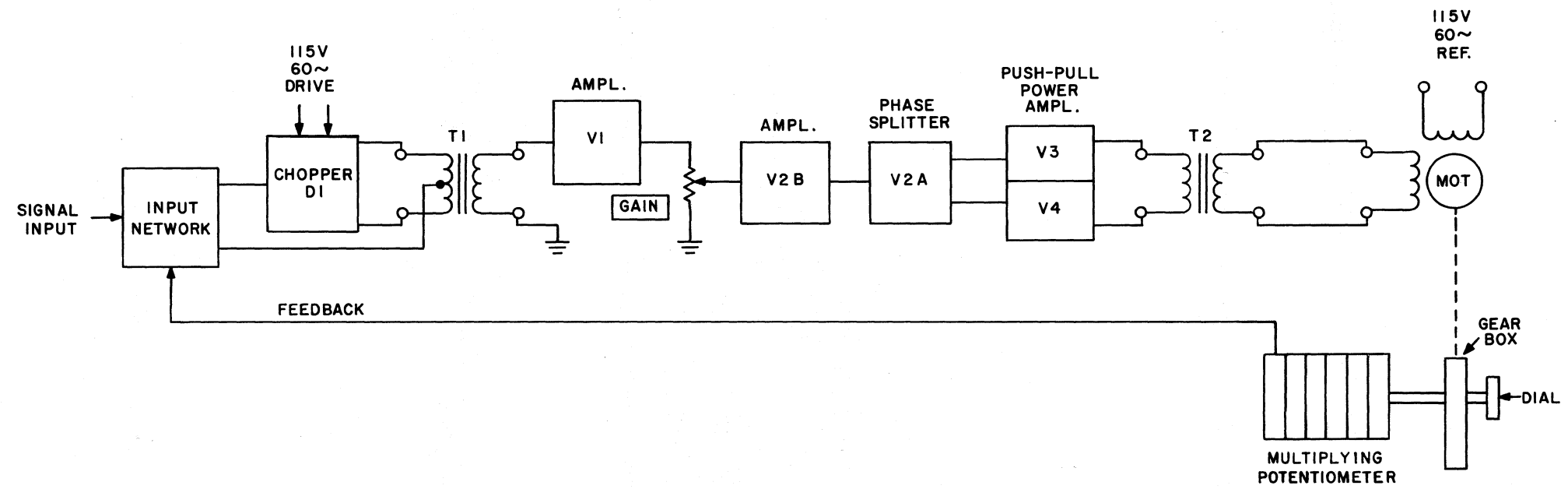


Figure 24.  
Multiplier 7.084, Simplified Schematic

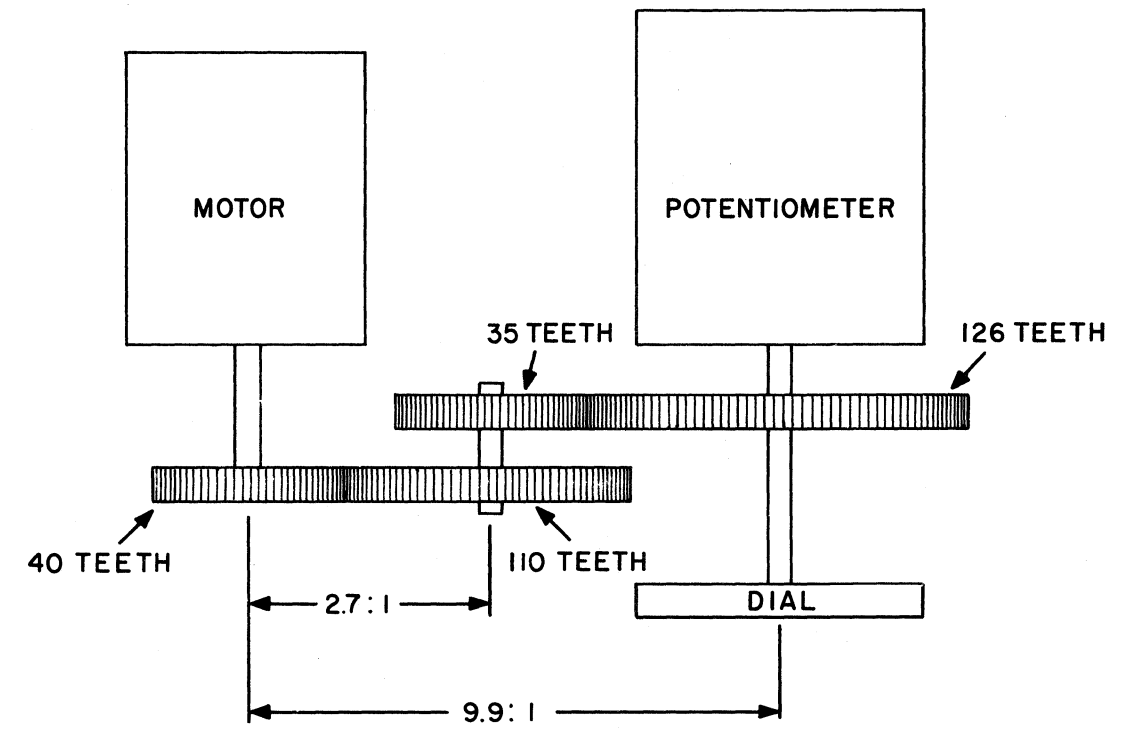


Figure 25. 7.084 Gear Train Schematic

The power output stage consists of V3 and V4 connected in conventional push-pull configuration, with the tubes coupled to the control phase of the servo motor through transformer T2. The output tubes are protected by a quarter-ampere fuse (F7) in series with the common cathode resistor. Capacitor C6 is connected across the output transformer primary to reduce harmonic distortion and add stability to the amplifier.

A panel-mounted neon lamp is provided as an amplifier OVERLOAD INDICATOR. This lamp is terminated at Pin 6 on the chassis connector and may be connected to an external overload alarm system if available or to ground if no external indicator is used.

The gain of the amplifier is controlled by a potentiometer in the grid circuit of V2b (Pin 7). Inverse feedback is obtained from the secondary of the output transformer and is applied to V2b through R18. Negative feedback improves the linearity of the amplifier and, consequently, allows high loop gain in the servo system.

#### d. Electrical Stop

An electrical stop is incorporated in the multiplier circuitry to prevent over-travel of the servo when signal voltages equal in amplitude to the reference voltages are applied. The electrical stop requires a voltage equal to three times the reference potential to provide the proper voltage gradient between the electrical end taps of the feedback cup (FB) and the physical end of the winding. With the reference voltage on the electrical end taps of the feedback cup, the cup wipers approach the electrical end taps and stop when reference voltage is applied to the servo input or when one end is worked at ground and zero volts is applied. Further uncontrolled movement into the end area is prevented due to the voltage slope generated in this area.

The ELECTRICAL STOP switch (S1) connected in the end-stop voltage leads permits removal of the electrical stop from the feedback cup circuit during computations involving division where such voltage is undesirable. Mechanical end stops are provided in the gear train for such cases. Where a voltage equivalent to three times reference is not available and another value is utilized, the value of the two resistors R25 and R26 must be adjusted in proportion. Care must be exercised to maintain a voltage slope in the end area winding no greater than 50% to 90% of the slope in the reference wound area, otherwise current will be forced back into the reference supply.

#### 10. POTENTIOMETER MAINTENANCE

The potentiometer utilized in the 7.084 Multiplier is physically similar to that used in the 7.017 Multiplier. Refer to Paragraph 10 of Section II for testing and maintenance procedures.

APPENDIX IV-1

REPLACEABLE PARTS LISTS

This appendix lists all replaceable parts in the Multiplier 7.084 (26-7N). In each case a brief description of the part and a manufacturer's number are listed. Where applicable, a reference symbol (schematic designation) is included. To enable a particular sheet to be readily located, an index precedes the individual spare parts lists.

The category column in the parts list is intended to indicate the availability of each listed part so that a replacement part can be obtained as quickly as possible. The components in category-A are standard electronic items that are usually available from any commercial electronic supplier. In order to expedite obtaining items of this nature, it is suggested that they be purchased from a local source whenever possible. If necessary, these parts may be ordered from EAI.

The components in category-B are items that can be obtained from EAI or any of the listed manufacturers. However, in most cases EAI is in a position to offer the most rapid service on items in this category.

The parts in category-C are custom-made components and proprietary items that are available only from EAI. When ordering items of this type, please specify the type number and serial number of the basic unit in which the part is located, as well as the part identification.

Where possible, sufficient information is given for category-C items to permit an *electrically-similar* replacement part to be obtained locally. Thus, if desired, a temporary repair may be made while the *exact* replacement is being obtained from EAI. *Note, however, that EAI does not guarantee that the affected unit will operate within specifications when the specified category-C part is not used.*

PLEASE NOTE THAT EAI RESERVES THE RIGHT TO MAKE PART SUBSTITUTIONS WHEN REQUIRED. IN ALL CASES EAI GUARANTEES THAT THESE SUBSTITUTIONS ARE ELECTRICALLY AND PHYSICALLY COMPATIBLE WITH THE ORIGINAL COMPONENT.

PARTS LIST INDEX

MULTIPLIER 7.084 (26-7N)

|    | <u>Model Number</u> | <u>Component</u>              | <u>Page</u> |
|----|---------------------|-------------------------------|-------------|
| 1. | 7.084 (26-7N)       | Multiplier .....              | AIV-1-2     |
| 2. | 7.093 (16-7MB-4)    | Servo Amplifier Chassis ..... | AIII-1-3    |
| 3. | 16-7H-3             | Multiplier Gear Box .....     | AIV-1-2     |

| ITEM   | REF. DESIG. | DESCRIPTION  | EAI NO.    | *CAT.              |
|--|-------------|--|------------|--------------------|
| 1  | I2          | Lamp, Glow: Neon; NE51 Type  | 578 004 0  | A                  |
| 2  | R4          | Resistor, Variable, Composition: 250K Ohms<br>± 10%, 2W; Allen-Bradley JA1L040S254UC | 642 018 0  | B                  |
| 3  | R9          | Resistor, Variable, Composition: 1 Megohm<br>± 20%, 2W; Allen-Bradley JA1L040S105MC  | 642 020 0  | B                  |
| 4  | R22         | Resistor, Variable, Wirewound  | See Table  | C                  |
| 5  | S1          | Switch, Toggle: DPDT; Cutler-Hammer 7565K5   | 664 011 0  | A                  |
|  |             | UNIT NO.   | R22        |                    |
|  |             | 7.084  | B642 462 0 |                    |
|  |             | 7.084-1  | B642 237 0 |                    |
|  |             | 7.084-2  | B642 243 0 |                    |
|  |             | 7.084-3  | B642 247 0 |                    |
|  |             | 7.084-4  | B642 252 0 |                    |
|  |             | 7.084-5  | B642 254 0 |                    |
|  |             | 7.084-6  | B642 256 0 |                    |
| 1  |             | <u>16-7H-3 MULTIPLIER GEAR BOX</u><br>Motor, Servo: Diehl FPE-25-79-1                | 594 019 0  | B                  |
| <p>*NOTE: THE CATEGORY COLUMN IS DESIGNED TO INDICATE AVAILABILITY OF PARTS.<br/> A - INDICATES PARTS THAT SHOULD BE PURCHASED LOCALLY.<br/> B - INDICATES PARTS THAT CAN BE PURCHASED LOCALLY OR FROM EAI.<br/> C - INDICATES PARTS THAT SHOULD BE PURCHASED FROM EAI.<br/> THE PROPER EAI PART SHOULD BE INSTALLED FOR CATEGORY C ITEMS. A COMPLETE DESCRIPTION IS GIVEN TO PROVIDE FOR TEMPORARY REPAIRS; HOWEVER, EAI WILL NOT BE RESPONSIBLE IF UNIT IS NOT WITHIN SPECIFICATIONS UNDER THESE CONDITIONS.</p> |             |  | UNIT TITLE | MULTIPLIER (26-7N) |
|  |             |  | MODEL NO.  | 7.084              |

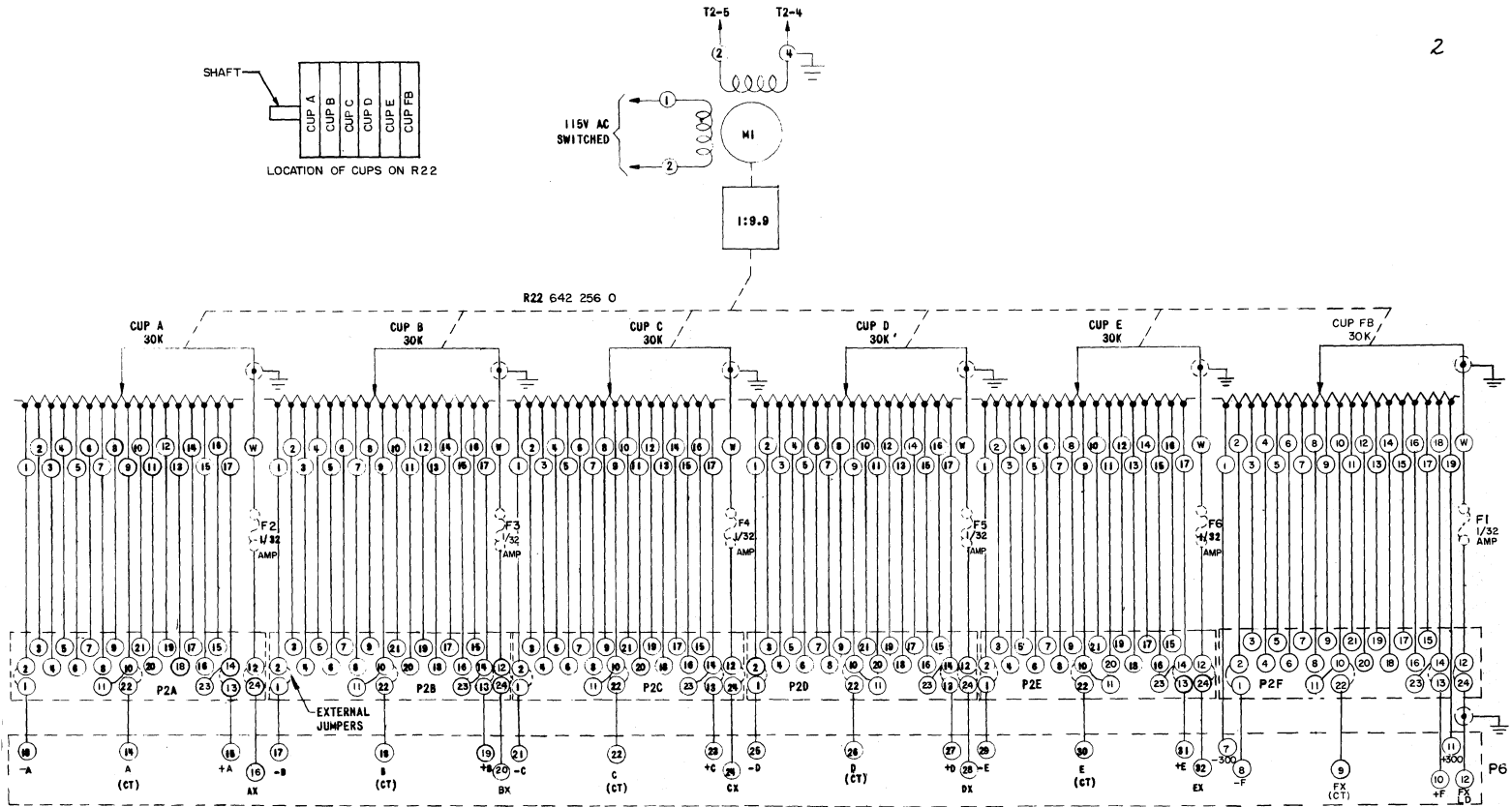
APPENDIX IV-2

DRAWINGS

This appendix contains all of the schematic and wiring diagrams necessary for maintenance of the Multiplier 7.084 (26-7N).

| <u>Drawing<br/>Number</u>                          | <u>Title</u>                        |
|--|-------------------------------------|
| C007 084 0S  | 7.084 (26-7N) Multiplier, Schematic |
| B007 084 0W (Sheets 2, 8, 9, 14,<br>18, 23 and 24) | 7.084 (26-7N) Multiplier, Wiring    |
| D007 093 0S  | Servo Amplifier Chassis, Schematic  |
| D007 093 0W (Sheet 1)                              | Servo Amplifier Chassis, Wiring     |

NOTE:  
1. SEE DWG # DO07 093 OS FOR SCHEMATIC OF SERVO AMPLIFIER.



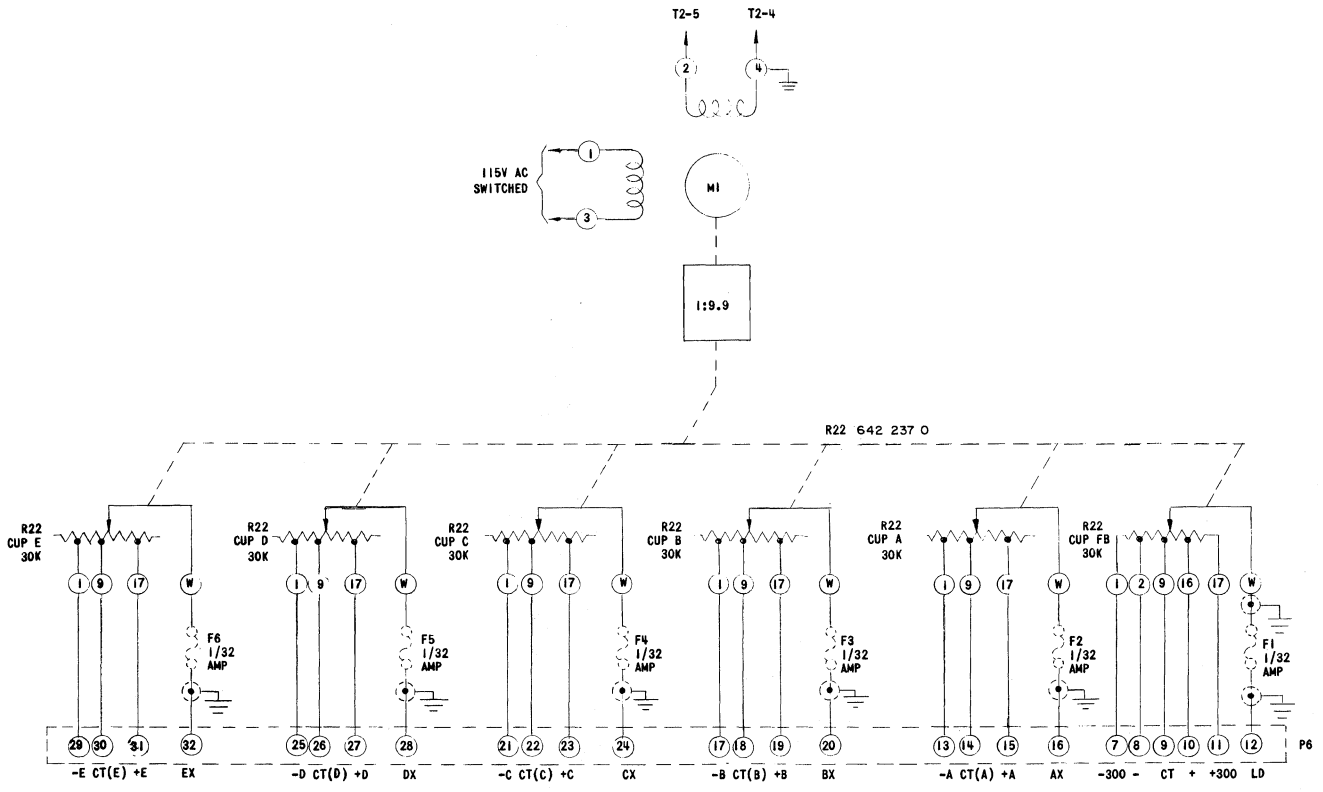
007 084 OS

| UNIT NUMBER           | DWG NO WAS | SCHEMATIC NUMBER | PARTS LIST & NEXT ASSY. | DESCRIPTION                    | PARTS LIST USED ON: | PROJECT NUMBER |
|-----------------------|------------|------------------|-------------------------|--------------------------------|---------------------|----------------|
| 7.084-9               |            | 007 084 9S       |                         | RESERVED NO. DWG. NO AVAILABLE |                     |                |
| 7.084-8               |            | 007 084 8S       |                         | " " " " " "                    |                     |                |
| 7.084-7               |            | 007 084 7S       |                         | " " " " " "                    |                     |                |
| 7.084-6               | C26S7N-16  | .007 084 6S      | 007 084 6P              | A3 SHOWN SHT 7                 |                     | 429            |
| 7.084-5               | C26S7N-15  | 007 084 5S       | 007 084 5P              | AS SHOWN SHT 6                 |                     | 429            |
| 7.084-4               | C26S7N-14  | 007 084 4S       | 007 084 4P              | AS SHOWN SHT 5                 |                     | 429            |
| 7.084-3               | C26S7N-13  | 007 084 3S       | 007 084 3P              | AS SHOWN SHT 4                 |                     | 429            |
| 7.084-2               | C26S7N-12  | 007 084 2S       | 007 084 2P              | AS SHOWN SHT 3                 |                     | 429            |
| 7.084-1               | C26S7N-11  | 007 084 1S       | 007 084 1P              | AS SHOWN SHT 2                 |                     | 429            |
| 7.084                 | C26S7N-20  | CO07 084 OS      | A007 084 OP             | AS SHOWN SHT 1                 |                     | 429            |
| TABLE OF UNIT NUMBERS |            |                  |                         |                                |                     |                |

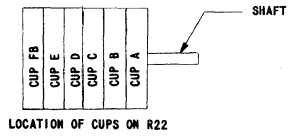
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| SCHEMATIC MULTIPLIER                                   |                 |   |   |   |   |   |   |   |    |
| REV  | 0               | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  |
| DRG NO   | 2               | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| SIZE   | C               | C | C | C | C | C | C | C | C  |
| PROJECT  | 429 CO07 084 OS |   |   |   |   |   |   |   |    |
| SHEET OF 7 SHEETS                                      |                 |   |   |   |   |   |   |   |    |



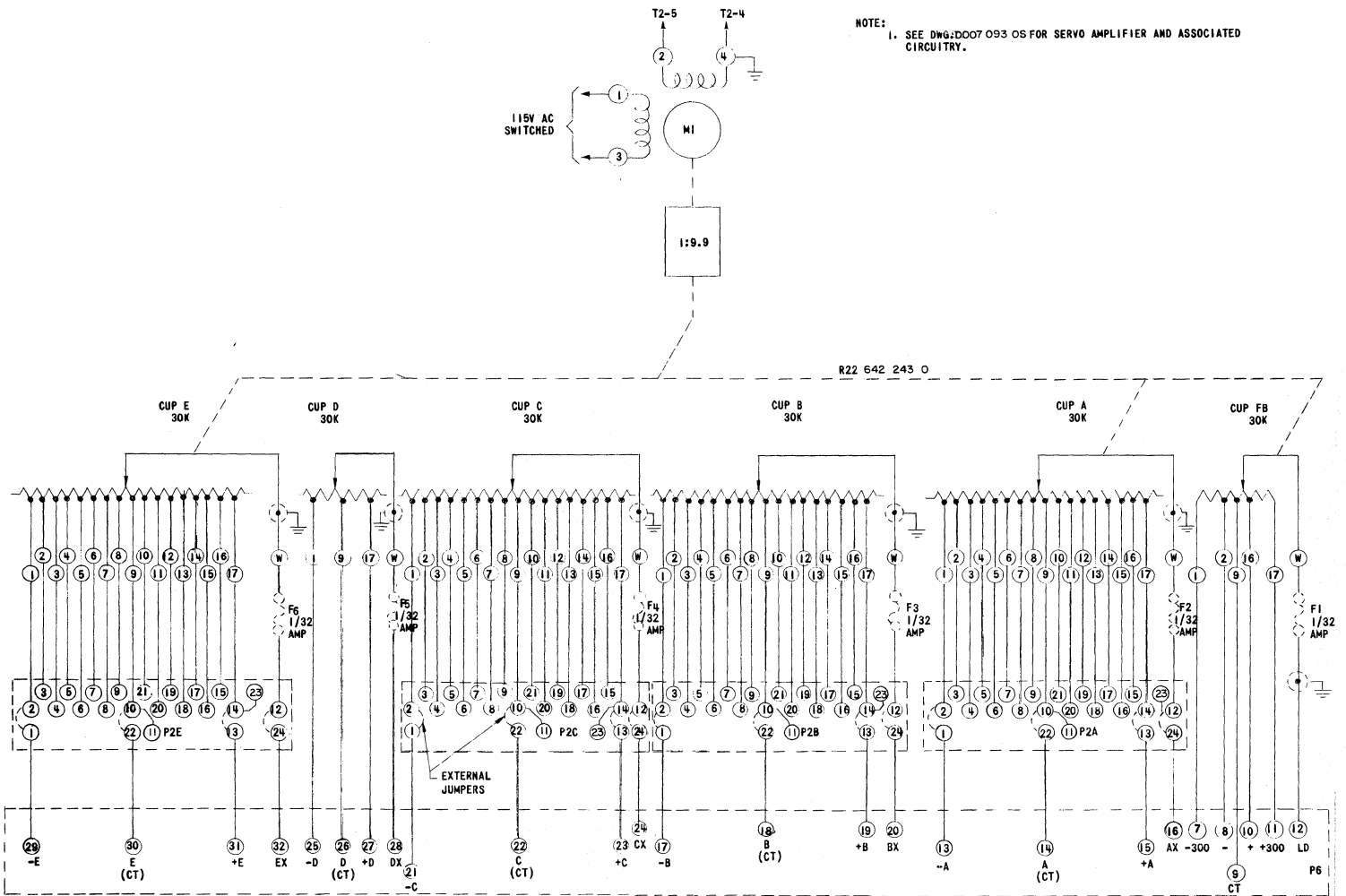
NOTE:  
1. SEE DWG D007 093 OS FOR SERVO AMPLIFIER.



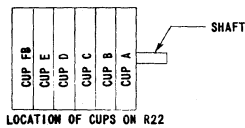
007 084 IS



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| DATE                            | SHT NO |             |  |
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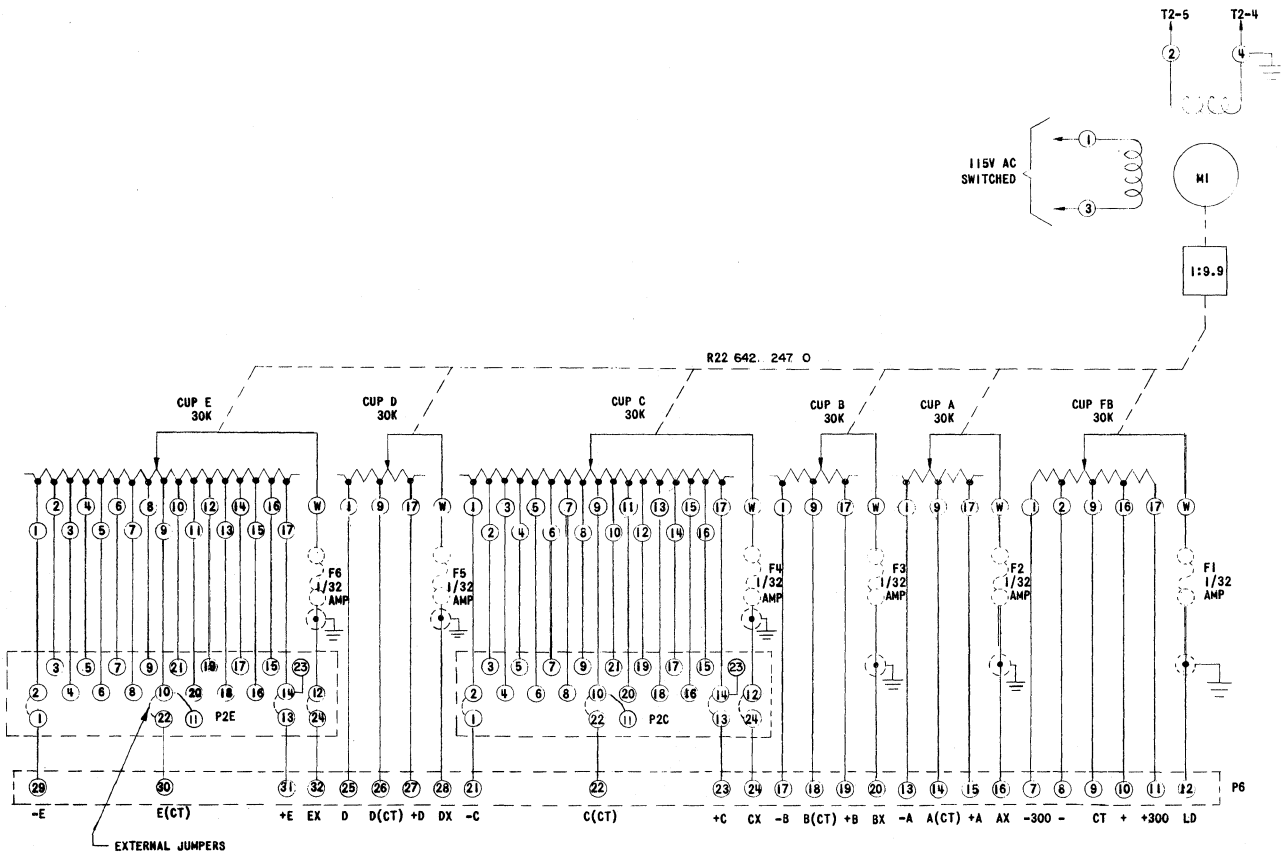


007 084 25

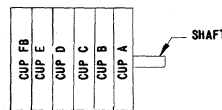


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NOTE:  
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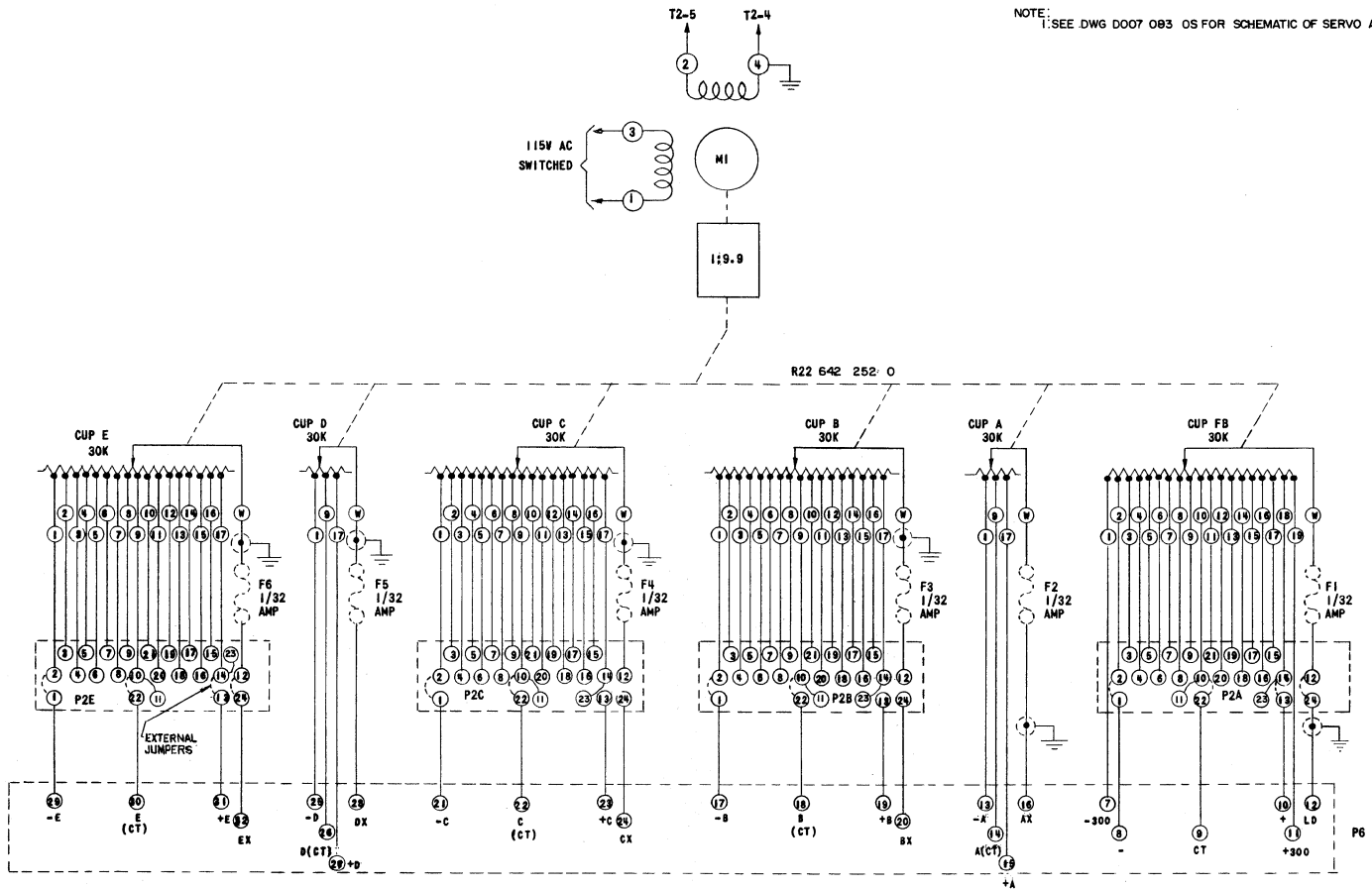
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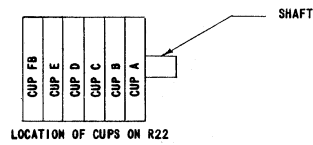
LOCATION OF CUPS ON R22

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| SCHEMATIC DIAGRAM                                      |                   |  |  |
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NOTE:  
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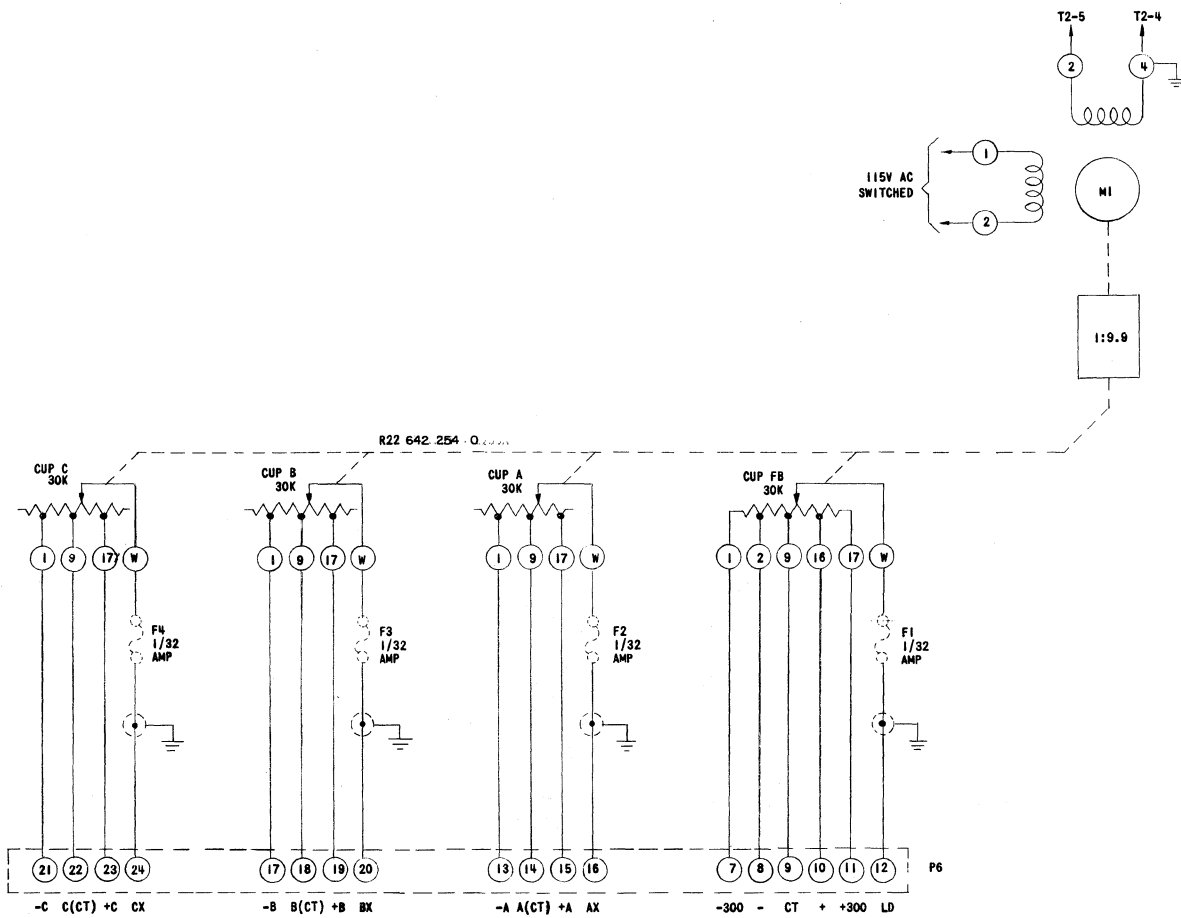


007 084 4S

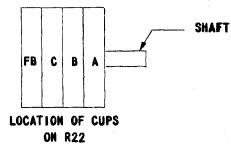


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| ELECTRONIC ASSOCIATES, INC. |        |                 |  |  |  |  |  |  |  |
| LONG BRANCH, NEW JERSEY     |        |                 |  |  |  |  |  |  |  |
| SCHEMATIC DIAGRAM           |        |                 |  |  |  |  |  |  |  |
| MULTIPLIER                  |        |                 |  |  |  |  |  |  |  |
| REV                         | SMT NO |                 |  |  |  |  |  |  |  |
| E                           | SIZE   |                 |  |  |  |  |  |  |  |
| PROJECT                     |        | 429 C007 084 0S |  |  |  |  |  |  |  |
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NOTE:  
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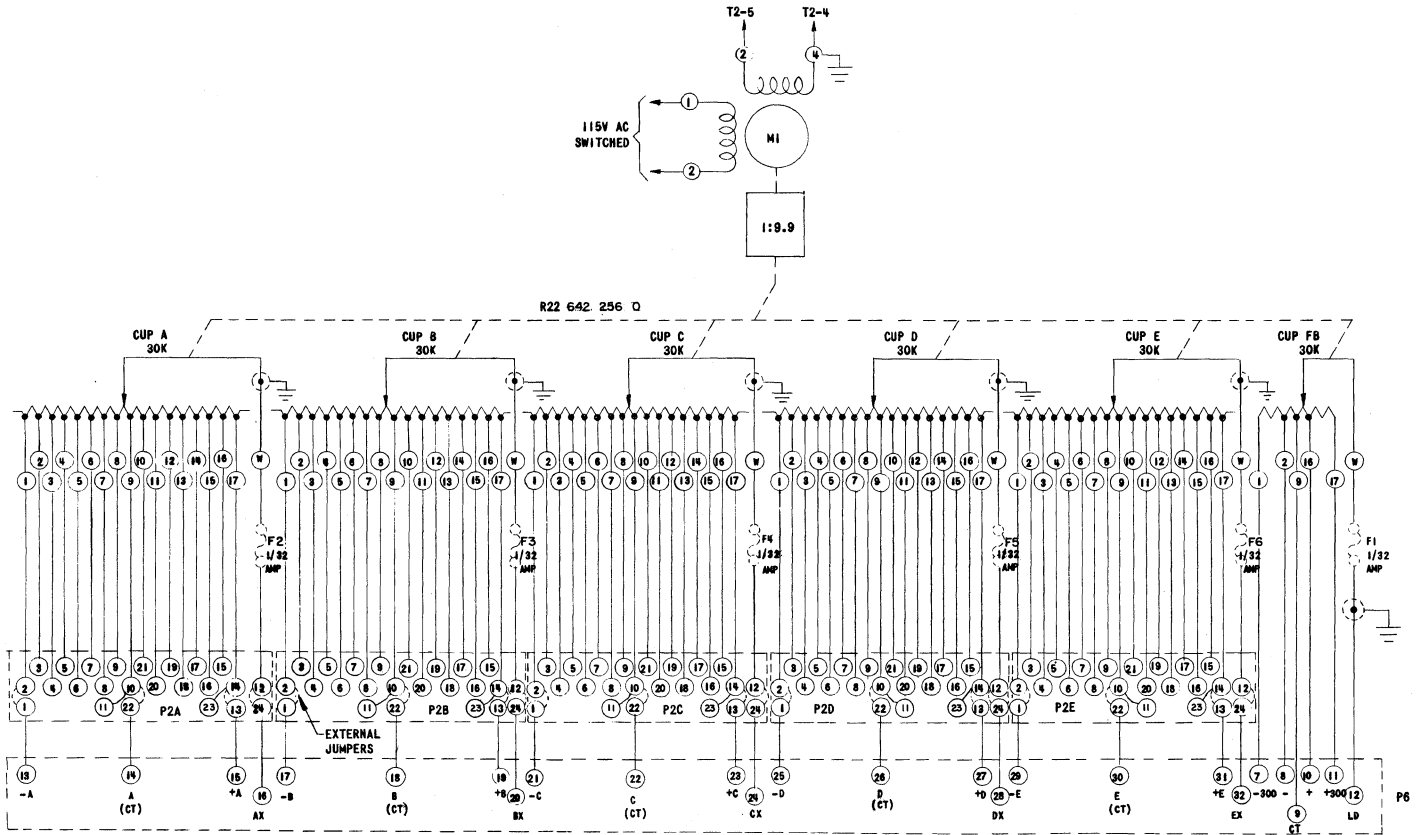


007 084 5S

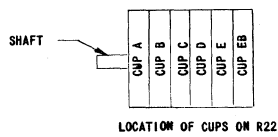


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| ELECTRONIC ASSOCIATES, INC. |                   |
| LONG BRANCH, NEW JERSEY     |                   |
| SCHEMATIC DIAGRAM           |                   |
| MULTIPLIER                  |                   |
| XX                          | SHT NO            |
| E                           | SIZE              |
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| 429                         | SHEET 6 OF SHEETS |

NOTE:  
1. SEE DWG DO07 093 OS FOR SCHEMATIC OF SERVO AMPLIFIER.

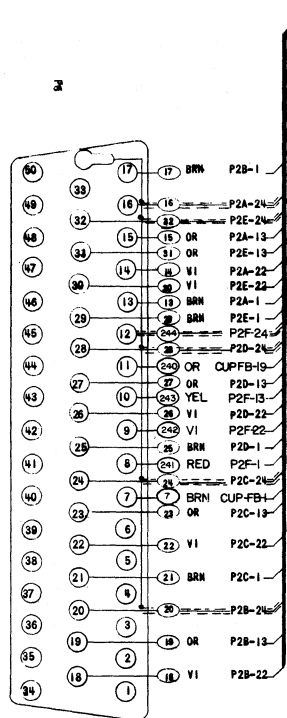


007 084 6S

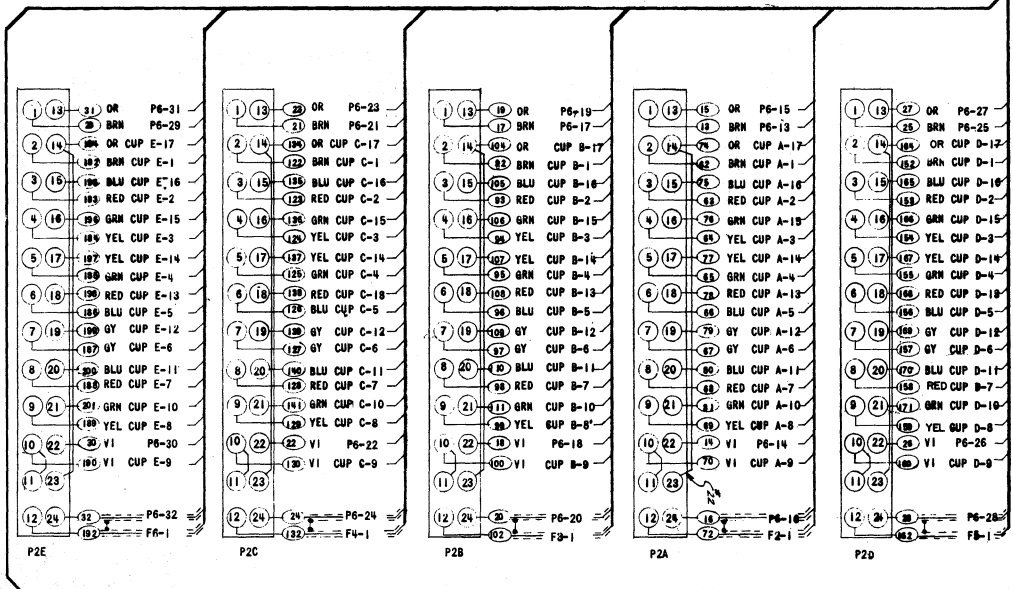
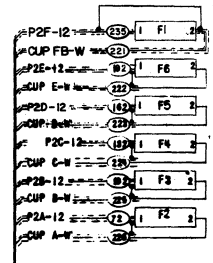
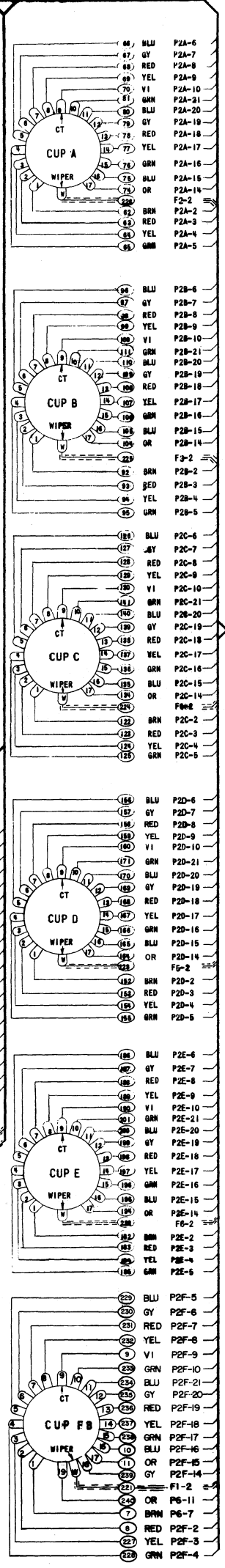


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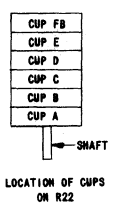
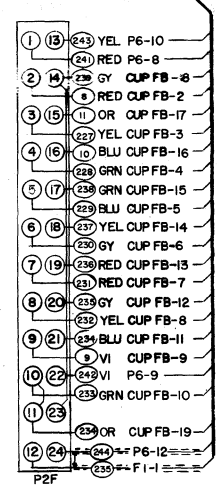
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| 7094-6      | 007 084 6W | AS SHOWN SHT 25   |                    | 429        | 028W7N-16 |     |
| 7094-5      | 007 084 5W | AS SHOWN SHT 24   |                    | 429        | 028W7N-15 |     |
| 7094-4      | 007 084 4W | AS SHOWN SHT 18   |                    | 429        | 028W7N-14 |     |
| 7094-3      | 007 084 3W | AS SHOWN SHT 14   |                    | 429        | 028W7N-13 |     |
| 7094-2      | 007 084 2W | AS SHOWN SHT 9    |                    | 429        | 028W7N-12 |     |
| 7094-1      | 007 084 1W | AS SHOWN THIS SHT |                    | 429        | 028W7N-11 |     |
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007 084 0W

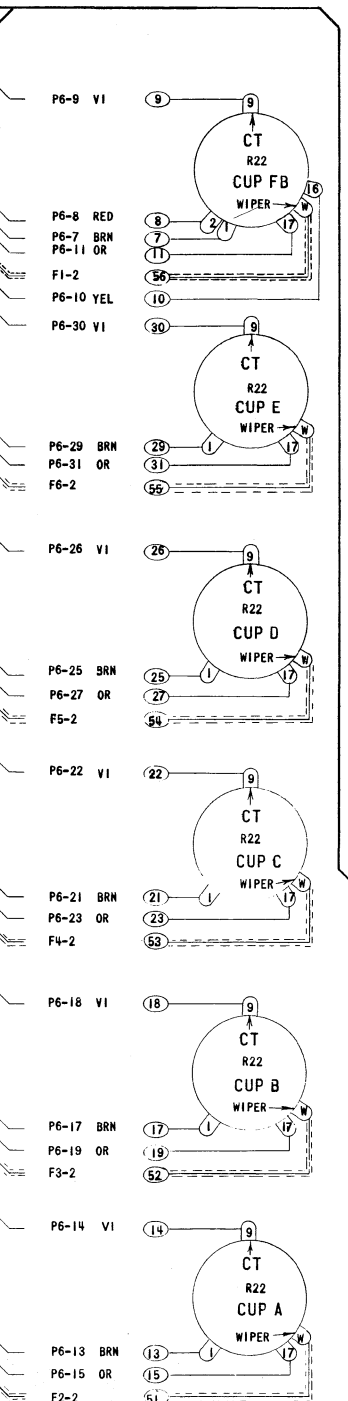
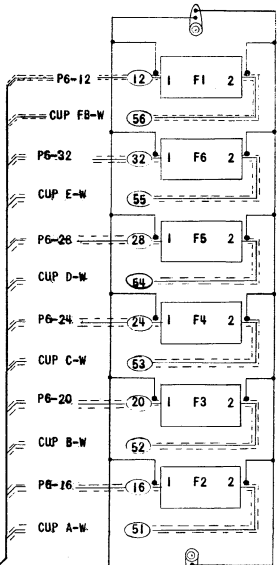
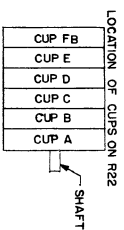


ALL CUPS SHOWN ARE REAR VIEW.

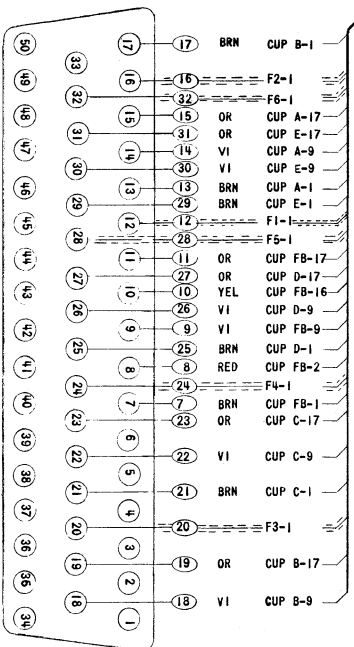


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| LONG BRANCH, NEW JERSEY     |            |
| WIRING DIAGRAM              |            |
| MULTIPLIER                  |            |
| REV                         |            |
| DATE                        |            |
| BY                          |            |
| PROJECT                     | 007 084 0W |
| PROJECT NO                  | 429        |
| PROJECT                     | 007 084 0W |
| PROJECT                     | 007 084 0W |
| PROJECT                     | 007 084 0W |

NOTES: ALL CUPS SHOWN ARE REAR VIEWS.



007 084 IW

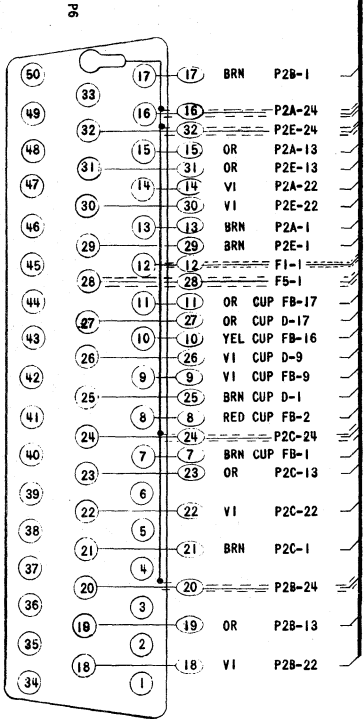


P6

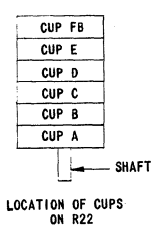
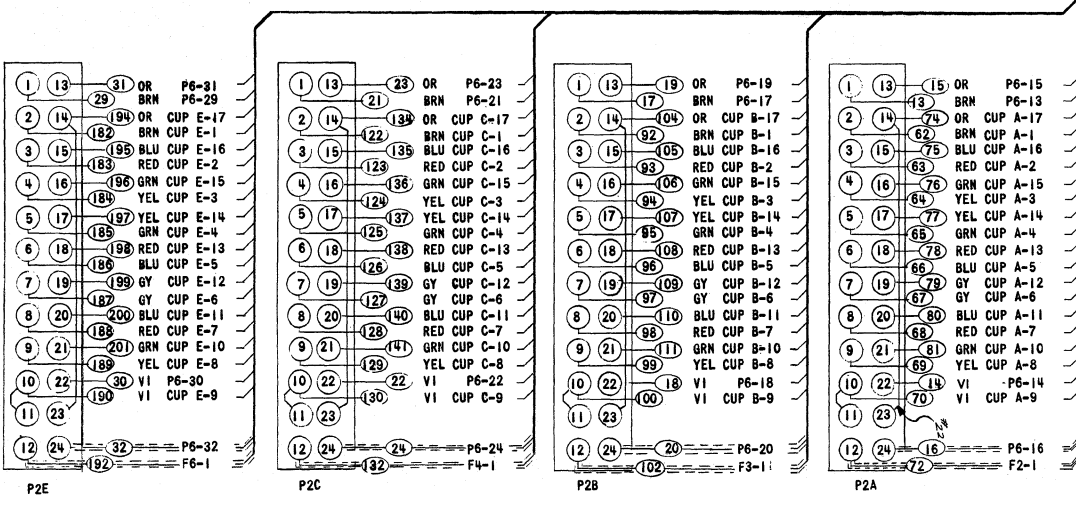
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|-------------|-------|-----|------|-------------|-------|-----|------|
| NO          | COLOR | AWG | TYPE | NO          | COLOR | AWG | TYPE |
| 30          | VIO   | 24  | PHU  | 30          | VIO   | 24  | PHU  |
| 29          | BRN   | 24  | PHU  | 29          | BRN   | 24  | PHU  |
| 28          |       | 20  | SHU  | 28          |       | 20  | SHU  |
| 27          | OR    | 24  | PHU  | 27          | OR    | 24  | PHU  |
| 26          | VIO   | 24  | PHU  | 26          | VIO   | 24  | PHU  |
| 25          | BRN   | 24  | PHU  | 25          | BRN   | 24  | PHU  |
| 24          | PHU   | 20  | SHU  | 24          | PHU   | 20  | SHU  |
| 23          | OR    | 24  | PHU  | 23          | OR    | 24  | PHU  |
| 22          | VIO   | 24  | PHU  | 22          | VIO   | 24  | PHU  |
| 21          | BRN   | 24  | PHU  | 21          | BRN   | 24  | PHU  |
| 20          | SHU   | 20  | SHU  | 20          | SHU   | 20  | SHU  |
| 19          | OR    | 24  | PHU  | 19          | OR    | 24  | PHU  |
| 18          | VIO   | 24  | PHU  | 18          | VIO   | 24  | PHU  |
| 17          | BRN   | 24  | PHU  | 17          | BRN   | 24  | PHU  |
| 16          |       | 20  | SHU  | 16          |       | 20  | SHU  |
| 15          | OR    | 24  | PHU  | 15          | OR    | 24  | PHU  |
| 14          | VIO   | 24  | PHU  | 14          | VIO   | 24  | PHU  |
| 13          | BRN   | 24  | PHU  | 13          | BRN   | 24  | PHU  |
| 12          |       | 20  | SHU  | 12          |       | 20  | SHU  |
| 11          | OR    | 24  | PHU  | 11          | OR    | 24  | PHU  |
| 10          | YEL   | 24  | PHU  | 10          | YEL   | 24  | PHU  |
| 9           | VIO   | 24  | PHU  | 9           | VIO   | 24  | PHU  |
| 8           | RED   | 24  | PHU  | 8           | RED   | 24  | PHU  |
| 7           | BRN   | 24  | PHU  | 7           | BRN   | 24  | PHU  |
| 6           |       | 2   |      | 6           |       | 2   |      |
| 5           |       | 4   |      | 5           |       | 4   |      |
| 4           |       | 4   |      | 4           |       | 4   |      |
| 3           |       | 3   |      | 3           |       | 3   |      |
| 2           |       | 2   |      | 2           |       | 2   |      |
| 1           |       | 1   |      | 1           |       | 1   |      |

|                             |     |                             |            |
|-----------------------------|-----|-----------------------------|------------|
| PROJECT                     | 429 | PROJECT                     | 007 084 OW |
| SHEET 8 OF                  |     | SHEET 8 OF                  |            |
| SIZE                        |     | SIZE                        |            |
| DATE                        |     | DATE                        |            |
| BY                          |     | BY                          |            |
| CHECKED                     |     | CHECKED                     |            |
| APPROVED                    |     | APPROVED                    |            |
| NEXT ASSY                   |     | NEXT ASSY                   |            |
| ELECTRONIC ASSOCIATES, INC. |     | ELECTRONIC ASSOCIATES, INC. |            |
| LONG BRANCH, NEW JERSEY     |     | LONG BRANCH, NEW JERSEY     |            |
| WIRING DIAGRAM              |     | WIRING DIAGRAM              |            |
| MULTIPLIER                  |     | MULTIPLIER                  |            |

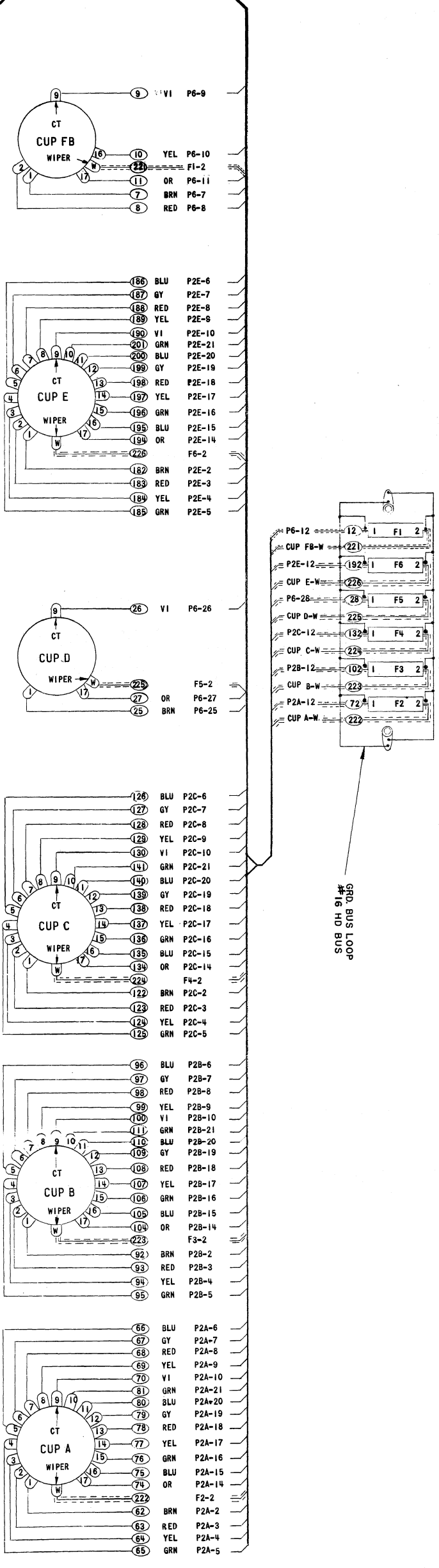




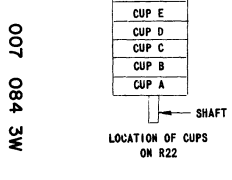
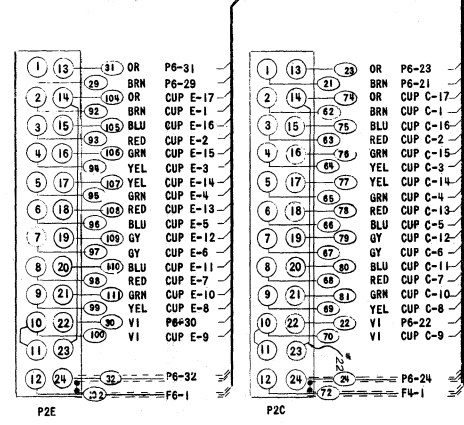
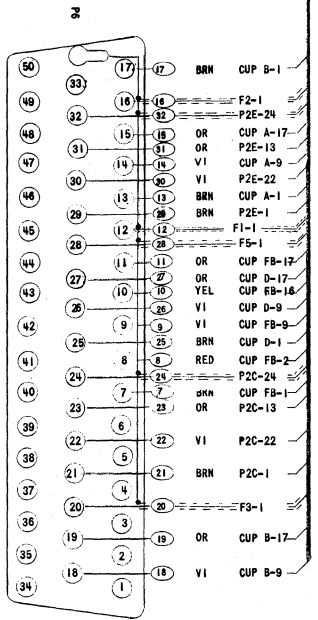
007 084 2W



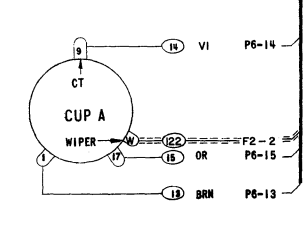
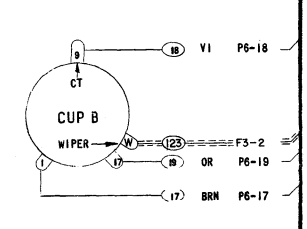
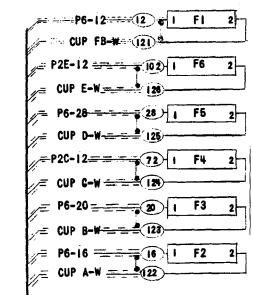
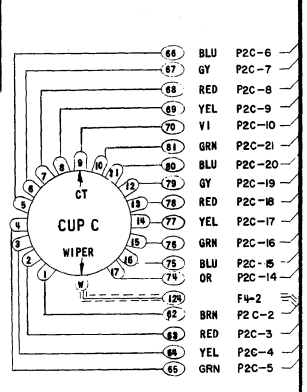
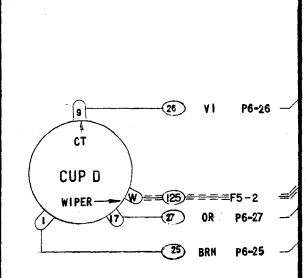
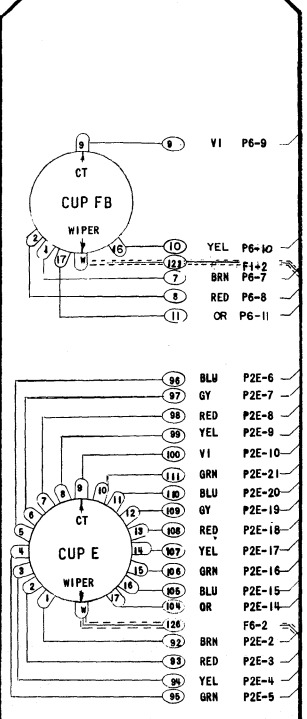
ALL CUPS SHOWN ARE REAR VIEWS.



|                             |             |
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| ELECTRONIC ASSOCIATES, INC. |             |
| LONG BRANCH, NEW JERSEY     |             |
| <b>WIRING MULTIPLIER</b>    |             |
| SHT NO                      |             |
| SIZE                        |             |
| REV                         |             |
| PROJECT                     | 0007 084 0W |
| 429                         |             |
| SHEET 9 OF 9 SHEETS         |             |

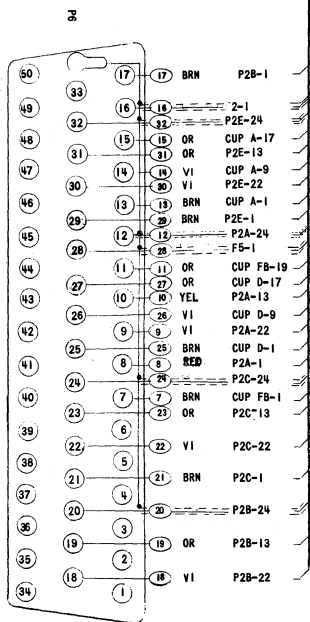


007 084 3W

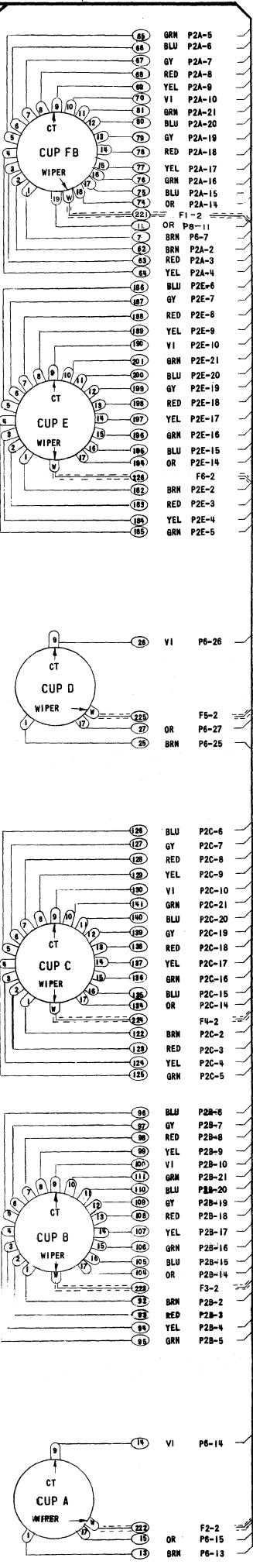
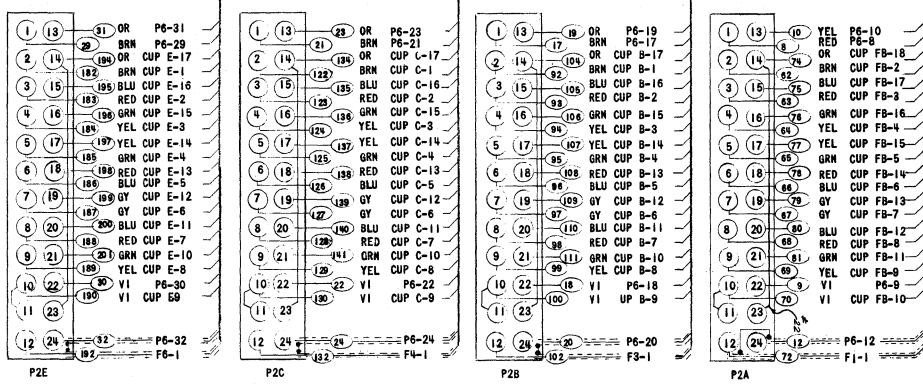


ALL CUPS SHOW ARE REAR VIEWS.

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| ELECTRONIC ASSOCIATES, INC. |             |
| LONG BRANCH NEW JERSEY      |             |
| WIRING DIAGRAM              |             |
| MULTIPLIER                  |             |
| SHEET NO.                   | 429         |
| PROJECT                     | DOO7 084 OW |
| DATE                        |             |
| BY                          |             |
| CHECKED                     |             |
| APPROVED                    |             |
| SHEET 14 OF 14 SHEETS       |             |



007 084 4W

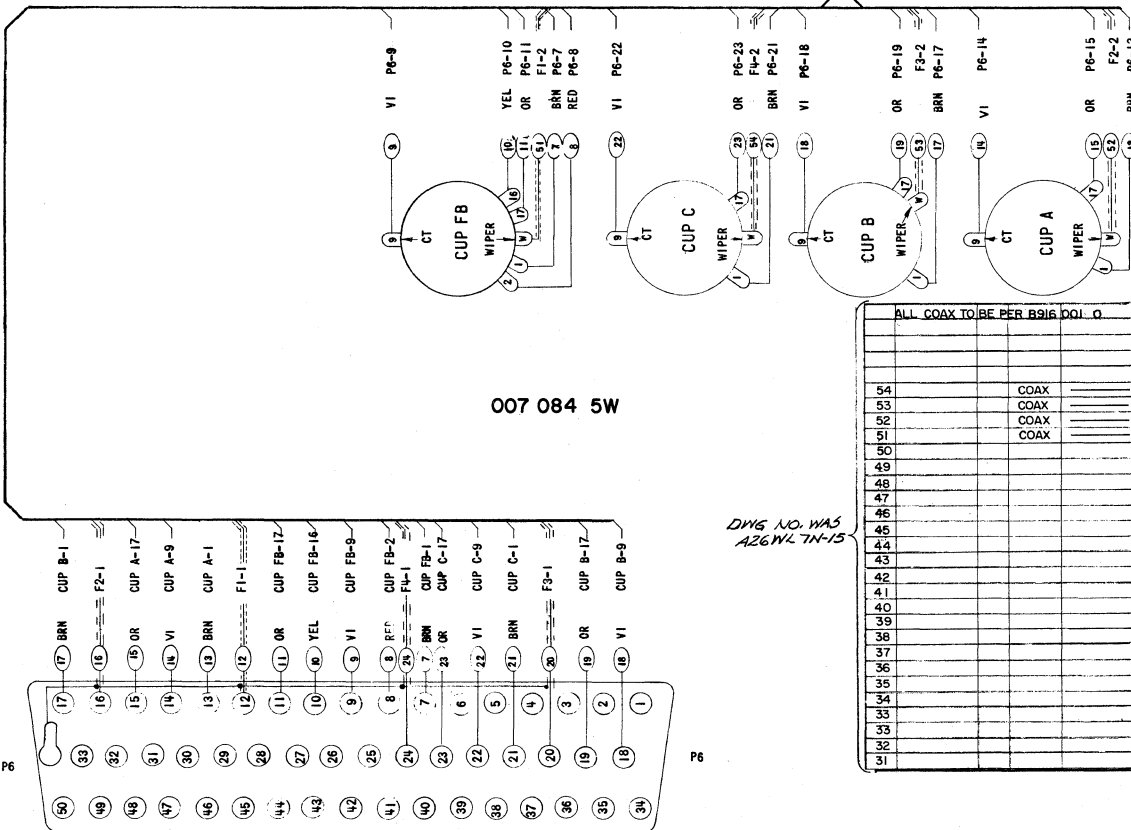
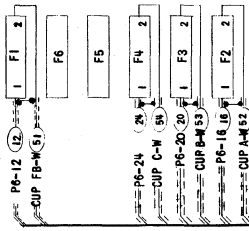
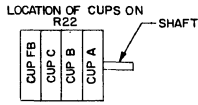


CUP FB  
 CUP E  
 CUP D  
 CUP C  
 CUP B  
 CUP A  
 ——— SHAFT  
 LOCATION OF CUPS  
 ON R22

ALL CUPS SHOWN ARE REAR VIEWS.

|                             |        |
|-----------------------------|--------|
| ELECTRONIC ASSOCIATES, INC. |        |
| LONG BRANCH, NEW JERSEY     |        |
| WIRING DIAGRAM              |        |
| MULTIPLIER                  |        |
| MM                          | SHT NO |
| E                           | SIZE   |
| PROJECT                     | 429    |
| DOOT 084 0W                 |        |
| SHEET 18 OF 20              |        |

NOTE:  
1. ALL CUPS SHOWN ARE REAR VIEWS.



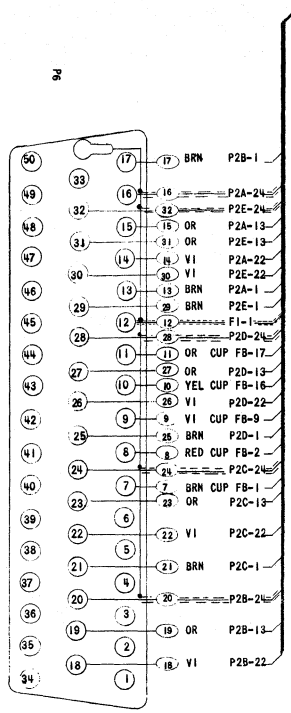
DWG NO. WAS  
A26WL 7N-15

| ALL COAX TO BE PER B916 DOL O |       |     |      |
|-------------------------------|-------|-----|------|
| NO                            | COLOR | AWG | TYPE |
| 30                            |       |     |      |
| 29                            |       |     |      |
| 28                            |       |     |      |
| 27                            |       |     |      |
| 26                            |       |     |      |
| 25                            |       |     |      |
| 24                            |       |     | COAX |
| 23                            | OR    | 24  | PHU  |
| 22                            | VI    | 24  | PHU  |
| 21                            | BRN   | 24  | PHU  |
| 20                            |       |     | COAX |
| 19                            | OR    | 24  | PH   |
| 18                            | VI    | 24  | PHU  |
| 17                            | BRN   | 24  | PHU  |
| 16                            |       |     | COAX |
| 15                            | OR    | 24  | PHU  |
| 14                            | VI    | 24  | PHU  |
| 13                            | BRN   | 24  | PHU  |
| 12                            |       |     | COAX |
| 11                            | OR    | 24  | PHU  |
| 10                            | YEL   | 24  | PHU  |
| 9                             | VI    | 24  | PHU  |
| 8                             | RED   | 24  | PHU  |
| 7                             | BRN   | 24  | PHU  |
| 6                             |       |     |      |
| 5                             |       |     |      |
| 4                             |       |     |      |
| 3                             |       |     |      |
| 2                             |       |     |      |
| 1                             |       |     |      |
| NO                            | COLOR | AWG | TYPE |
| WIRE LEGEND                   |       |     |      |

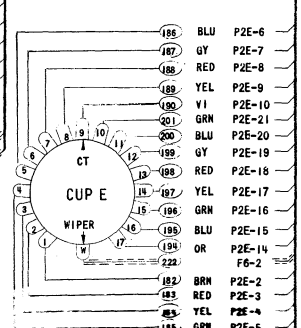
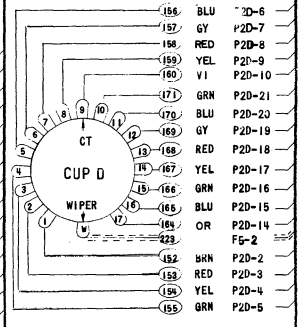
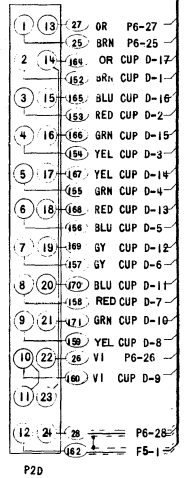
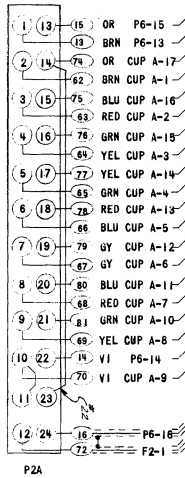
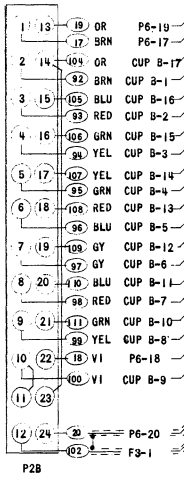
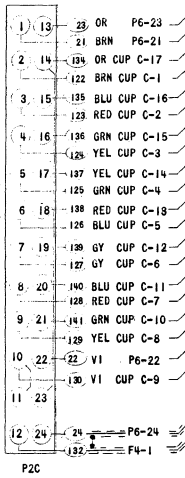
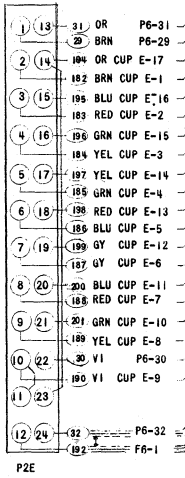
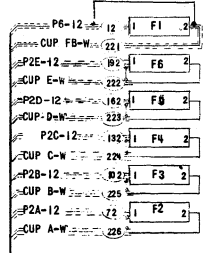
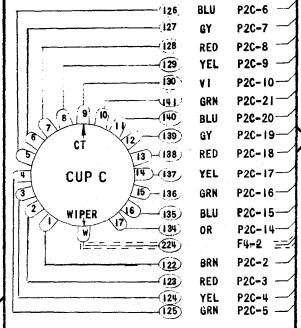
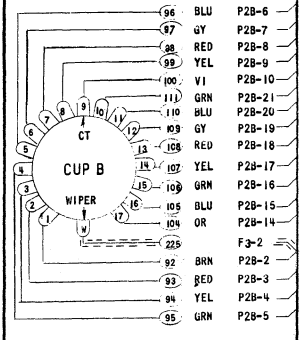
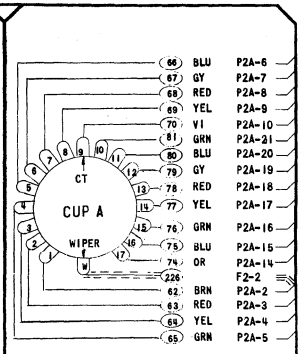
ELECTRONIC ASSOCIATES, INC.  
LONG BRANCH, NEW JERSEY

**WIRING DIAGRAM  
MULTIPLIER**

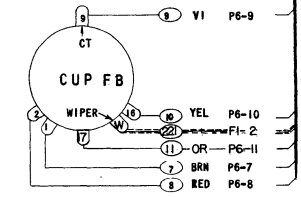
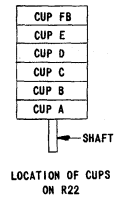
|                    |     |             |  |  |  |
|--------------------|-----|-------------|--|--|--|
| SHT NO             |     |             |  |  |  |
| SIZE               |     |             |  |  |  |
| PROJECT            | 429 | C007 084 OW |  |  |  |
| SHEET 23 OF SHEETS |     |             |  |  |  |



007 084 6W



ALL CUPS SHOWN ARE REAR VIEWS.



ELECTRONIC ASSOCIATES, INC.  
LONG BRANCH, NEW JERSEY

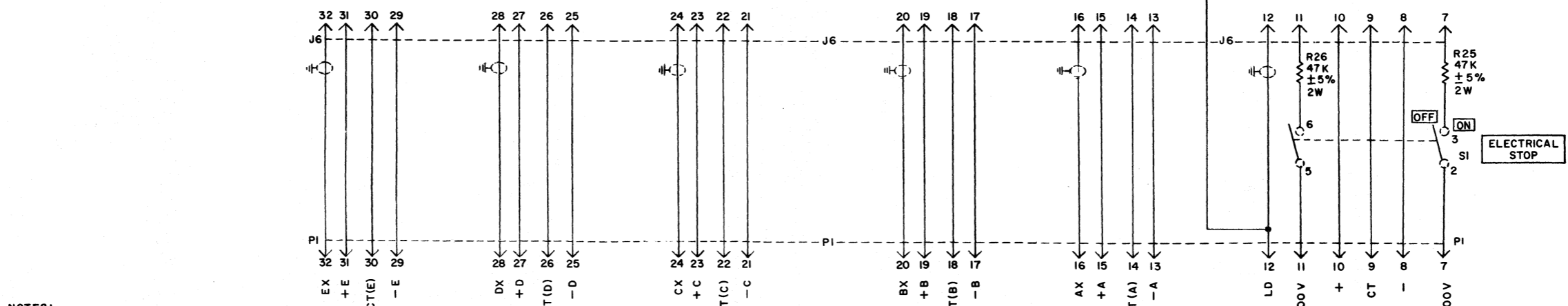
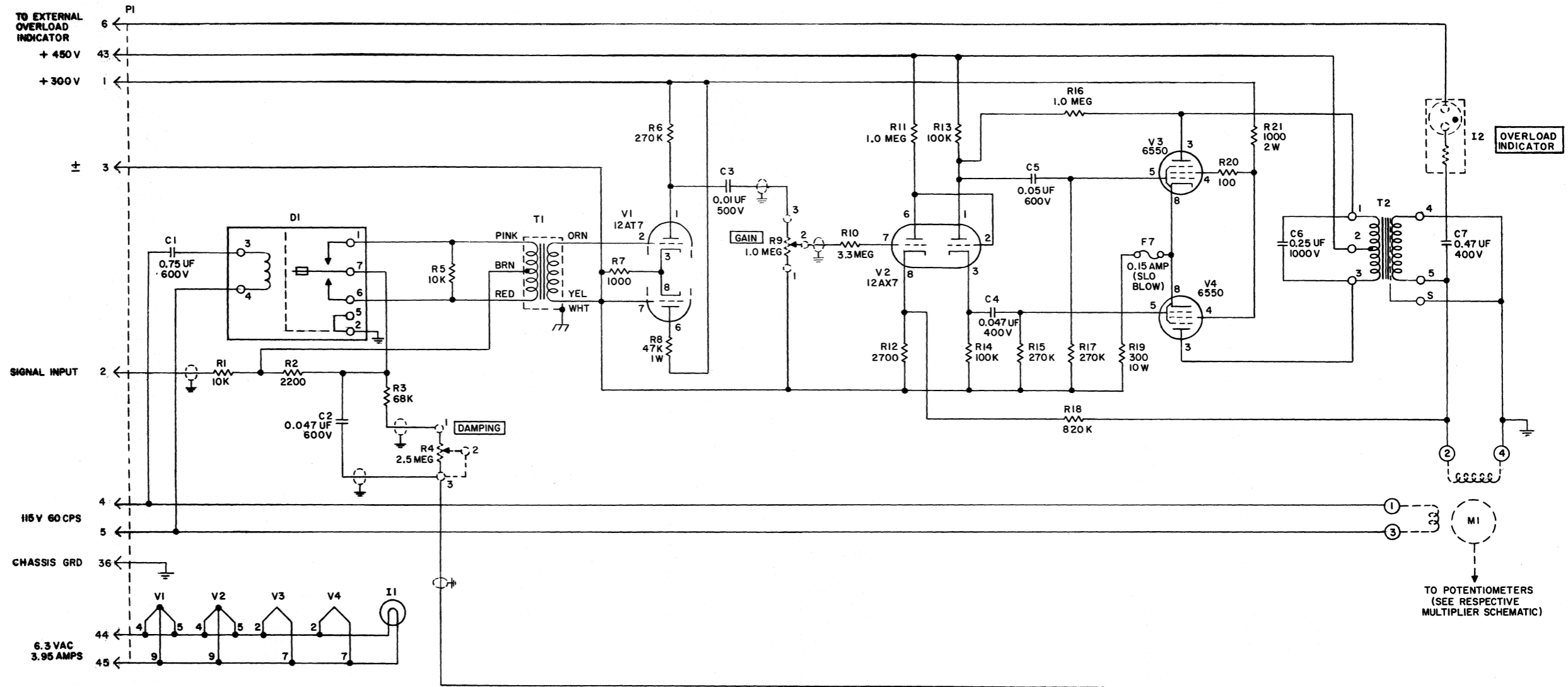
WIRING DIAGRAM  
MULTIPLIER

PROJECT: 429  
DRAWING NO: 0007 084 0 W

DATE: 2/28/67

BY: [Signature]

CHKD: [Signature]



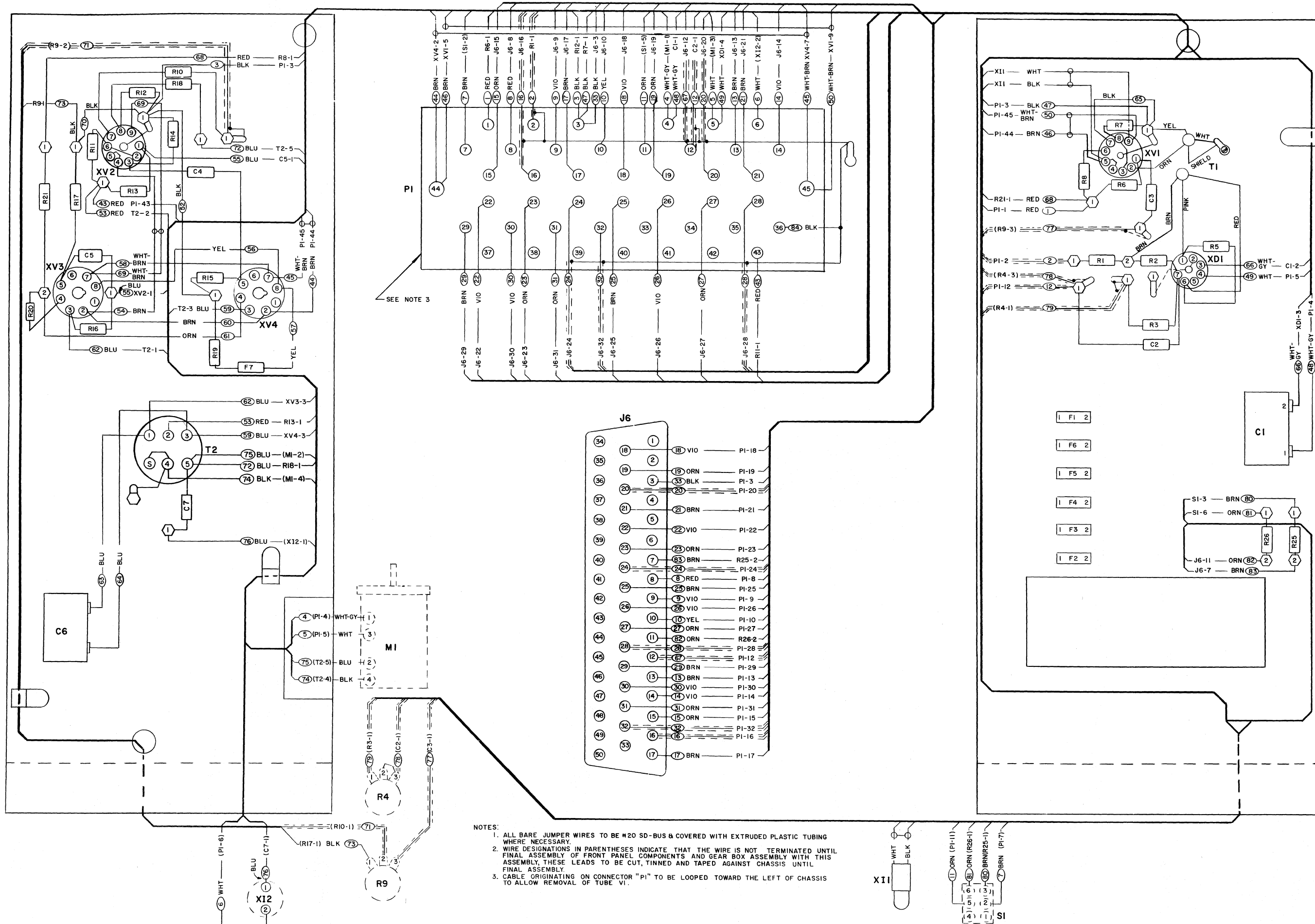
**NOTES:**  
 1—ALL RESISTORS TO BE 1/2 WATT & ±10% TOLERANCE UNLESS OTHERWISE SPECIFIED.  
 2—COMPONENTS SI, I2, R4, R9 & MI ARE INSTALLED AT FINAL ASSEMBLY.

**DESIGN NOTE:**  
 TERMINALS \*33 & \*34 ON CONNECTOR PI ARE RESERVED FOR ±100V REF ON FUTURE DESIGNS.

ELECTRONIC ASSOCIATES, INC.  
 LONG BRANCH, NEW JERSEY

**SCHEMATIC  
 SERVO AMPLIFIER  
 CHASSIS**

|          |             |
|----------|-------------|
| SHT. NO. |             |
| SIZE     |             |
| REV. NO. |             |
| PROJECT  | 429         |
|          | D007 093 OS |
| SHEET    | OF SHEETS   |



- NOTES:
1. ALL BARE JUMPER WIRES TO BE #20 SD-BUS & COVERED WITH EXTRUDED PLASTIC TUBING WHERE NECESSARY.
  2. WIRE DESIGNATIONS IN PARENTHESES INDICATE THAT THE WIRE IS NOT TERMINATED UNTIL FINAL ASSEMBLY OF FRONT PANEL COMPONENTS AND GEAR BOX ASSEMBLY WITH THIS ASSEMBLY, THESE LEADS TO BE CUT, TINNED AND TAPED AGAINST CHASSIS UNTIL FINAL ASSEMBLY.
  3. CABLE ORIGINATING ON CONNECTOR "PI" TO BE LOOPED TOWARD THE LEFT OF CHASSIS TO ALLOW REMOVAL OF TUBE VI.

9

|  |             |
|--|-------------|
| ELECTRONIC ASSOCIATES, INC.<br>LONG BRANCH, NEW JERSEY |             |
| <b>WIRING<br/>SERVO AMPLIFIER<br/>CHASSIS</b>          |             |
| SHT. NO.   | 2 3         |
| SIZE   | A A         |
| REV. NO.   | 1 2         |
| PROJECT  | 429         |
|  | D007 093 OW |
| SHEET 2 OF 3 SHEETS                                    |             |