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INSTRUCTION MANUAL  
FOR  
TELEGRAPH SIGNAL ANALYZER  
SERIES CDA-770  
MODELS 770, 771, 780

**CD** CIRCUIT DATA  
CORPORATION

SYOSSET, NEW YORK 11791

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CIRCUIT DATA CORPORATION

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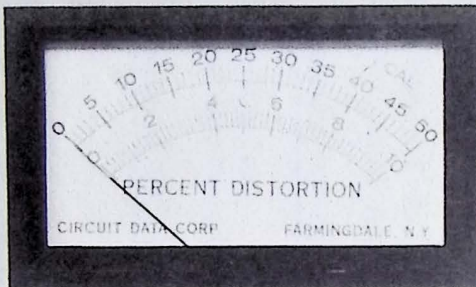
MODEL CDA-770

# TELEGRAPHIC DISTORTION ANALYZER

**CD** **CIRCUIT DATA CORP.**  
FARMINGDALE, N. Y., U. S. A.

3 4 5 6 7 8 9  
2 1  
ALL  
TRANSITION SELECT

ADJ  
ON  
OFF  
CAL



ADJUST

6 7 8  
5  
SYNC  
CODE LEVEL

RESET  
AUTO  
OFF  
MAN

74.2 75 110 150 300  
61.12 600  
56.8 1200  
37.5 2400  
EXT 4800  
SPEED (BAUDS)

MARK

AVERAGE END TOTAL EARLY PEAK  
BIAS LATE  
DISTORTION

SPACE

20/30P 60N 20N  
POLAR +M -M NEUTRAL  
INPUT SELECT

METER RANGE  
-5

+15	SIG
-15	SYNC
GRD	CLOCK

FILTER  
IN OUT

POLARITY SIGNAL EXT CLOCK

ON/OFF

1/2 AMP  
FUSE

BRIDGING INPUT  
LO HI

SERIES INPUT  
1/10 AMP LOOP  
FUSE

DOT CYCLE  
INPUT OUTPUT

POWER

1/10 AMP LOOP

INPUT

OUTPUT

-111-

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## SECTION I

### 1.0 INTRODUCTION

#### 1.1 Scope

This manual describes the theory, operation, installation and adjustment and maintenance techniques for the Telegraph Distortion Analyzers in the Circuit Data Corporation Series:

CDA-770	Portable 4800 baud
-771	Portable 9600 baud
-780	Rack mounted 4800 baud

#### 1.2 Use

The CDA-770 Series Distortion Analyzers are used to measure all types of telegraph and other digital data signal distortion. These are rugged, light weight, portable units for use in communication centers, the field and laboratory.

#### 1.3 Special Features

Models 770, 771 and 780 incorporate:

- A. 0-10% distortion scale in addition to the usual 50% scale.
- B. Dot cycle output for equipment and line testing.

#### 1.4 Characteristics

All the CDA-700 series use digital circuits and techniques for all measurement purposes. This makes it possible to operate immediately without warm up time and to obtain accurate unambiguous observations with minimum operator knowledge.

#### 1.5 Input Signals

The CDA-700 accepts and measures signals of the following characteristics:

- A. Current---Series (a) 20 ma neutral (200 ohm)  
(b) 60 ma neutral (67 ohm)  
(c) 20/30 ma polar (200 ohm)  
Polarity selected by front panel switch.

- B. Voltage--Bridge to ground

Polar Positive or negative marking.  
Sense switch selected.



- (a) High level  $\pm 2$  to  $\pm 130$  volts  
Input Impedance  $50K$  ohms.
- (b) Low Level  $\pm 0.5$  to  $\pm 12$  volts.  
Input Impedance  $20K$  ohms.

Neutral

Positive or negative marking.  
Sense switch selected.

- (a) High Level  $\pm 5$  to  $\pm 130$  volts.  
Input Impedance  $50K$  ohms.
- (b) Low Level  $\pm 1$  to  $\pm 12$  volts.  
Input Impedance  $20K$  ohms.

- C. Codes Start Stop 5 to 8 level inclusive.  
(7 to 10 unit intervals).  
Synchronous, all speeds on internal clock from  
37.5 to 4800 baud.  
Model 771 to 9600 baud. With external clock  
lower and higher speeds may be accommodated.  
For internal synchronization the applied signal  
speed must be within 0.1% of the analyzer for  
correct synchronization.
- D. Speeds 37.5; 45.5; 50; 56.8; 61.12; 74.2; 75; 110; 150;  
300; 600; 1200; 2400; 4800 bits/sec.  
internally, and one externally derived.  
Switch selected.  
Accuracy of internal generator .01%.
- E. Conditioning For speeds up to 75 bauds a switchable  
low frequency filter removes transients  
of 1/2 ms or less.
- F. Compatibility The circuits are fully compatible with  
EIA STD RS-232, low level Fielddata and  
high and low level MIL STD 188B logic  
signals.

1.6 Measurements

- A. The CDA-700 Series measure directly:
  - Mark and space bias distortion
  - Mark and space end distortion
  - Total peak distortion
  - Early peak distortion
  - Late peak distortion
- B. Accuracy
  - $\pm 1/2\%$  on 10% distortion scale
  - $\pm 2\%$  at F.S.D. on 50% distortion scale

## 1.7 Indicators

<u>Indicator</u>	<u>Function</u>
Signal Indicator Lamp	Input signal marking
Mark Distortion Lamp	Indicate measurement being made
Space Distortion Lamp	Indicate measurement being made

## 1.8 Meter Functions

- A. With appropriate switch settings the meter is used to perform:

Mark Average Bias and End measurements  
Space Average Bias and End measurements  
Total Peak Distortion measurements  
Early Peak Distortion measurements  
Late Peak Distortion measurements

These measurements may be selected for individual transitions in a code group or the average of the group.

- B. Peak Measurement In the manual mode, the meter retain the highest peak reading until reset manually. In the automatic mode, the peak readings are sampled at 4 ±1 second intervals.

## 1.9 Physical Characteristics

Input Power 115V ±10%, 47 to 63 C/S  
30 watts nominal

Operating Temperature Range 0 to 50°C

Dimensions Model 770 and 771 - 11"w x 8"l x 14"d.  
17 lbs. net wt.  
Model 780 - 19"w x 7"l x 10"d.  
17 lbs. net wt.

## SECTION II

### 2.0 INSTALLATION AND OPERATION

The CDA-700 Series equipments are self-contained and need only input and output connections.

#### 2.1 Connections

Power required is 115V AC, 47-63 Hz from a 3 wire grounded supply receptacle.

Signal jack is 2 circuit MIL JJ-089 and requires MIL PJ-055B plug or equivalent. It is used for series loop tests. The sleeve is insulated from chassis.

Bridging input uses Grayhill series 29 twin plugs and jacks, or equivalent. These operate "LO" to ground or "HI" to ground according to signal level.

External Clock uses BNC connections and requires a pulse of 10V negative going amplitude; PRF 200 times line operating speed, e.g., 75 baud requires 15.05K Hz +0.1%. Rise time less than 1 microsecond. Pulse length between 40% and 60% of pulse period.

Dot Cycle output, via JJ-089 jack, provides a continuous "Space Mark" switch operation at the baud rate selected. Jack is insulated from ground.

Test Points monitor the internal operating conditions and require a multimeter with pin plug leads or oscilloscope.

"+15", "-15", "GND" are used to measure the DC voltages on the bus lines with a multimeter.

"SIG" is provided to monitor the conditioned incoming signal, prior to its application to its application to the counters and measuring circuits.

"SYNC" provides a rectangular synchronizing pulse of -15 volts to ground at a recurrence frequency equal to the baud speed divided by the code level.

"CLOCK" monitors the seven master crystal oscillator outputs at the 200X bit rate.

#### 2.2 Calibration

Before using CDA-700 series equipment, check the meter calibration as follows:

1. Switch equipment on.
2. Set and hold "Reset" switch to "manual".
3. Check meter for zero setting and adjust to zero if necessary with the screwdriver adjustment "adjust" under the meter.
4. Release "Reset" and set "Cal" to "on". The meter should read "40" on the 50% scale. Adjust with "ADJ" control to "40" if necessary.

### 2.3 Operation

1. Determine the type of circuit to be measured.
2. Connect the circuit to "Bridging" or "Series" input according to the measurement desired.
3. Set "Polarity switch", "Input Select", "Speed" and "Code Level" switches to the characteristics of the circuit under test. "Polarity" operates only in series input signals.
4. Determine the type of measurement to be made.
5. Set "Distortion" and "Transition Select" to coincide with the measurement desired.

#### NOTE:

"Reset" should be "off" except when peak measurements are being made.

"Filter" should be "out" initially for speeds up to 75 bauds. It is switched out automatically at speeds above 75 baud.

"Distortion" set to:

"Average Bias" selects Space to Mark transitions. J

"Average End" selects Mark to Space transitions. 7

"Peak Total" selects peak distortion from all transitions, Mark-Space and Space-Mark.

"Peak Early" selects all transitions occurring early in a character.

"Peak Late" selects all transitions occurring late in a character.

"Transition Select" set to:

"1" selects the first transition of the code group (character) of the type selected previously by "Distortion".

"2" selects the second transition, etc.

"all" averages the code group as an entity.

"Reset" is used for peak measurements.

In "manual" the analyzer reads the highest peak value of distortion as it occurs and holds it indefinitely, until reset by selecting "OFF".

In "auto" the circuits sample the peak distortion every 4 seconds +1 second and display the value on the meter.

It should be noted that the number of transitions available cannot exceed one more than the code level number of the signal.

The meter will now indicate the distortion present for the conditions selected above. If it reads less than 10%, the meter scale may be changed to "-5" for increased reading accuracy by the pushbutton momentary switch.

### 2.3.1 Auxiliary Indications

#### "Mark" and "Space" Lamps

These light automatically to show which transitions are being measured. When distortion is very low they may alternate.

#### Polarity

#### "Polarity" Switch

For neutral signals the correct setting is that which causes the "signal indicator" lamp to flash.

For polar signals both switch positions cause the lamps to flash.

### 2.4 Notes on Use of Distortion Analyzer

The four basic types of distortion are illustrated in Figure 3.

Each type may be selected by the function switch of the analyzer and measured as an average or peak value of the signal under observation.

By use of the transition select switch various conclusions concerning the measurement may be drawn.

(1) If early bias distortion increases as the transition switch setting is increased from 1 to the maximum for the code level, it is probable that the signal operating speed is faster than the analyzer speed and vice-versa.

(2) Similarly, late bias distortion increasing with transition setting implies slower signal speed and vice-versa.

(3) Similar conclusions apply for end distortion.

(4) If the observed distortion varies cyclically with time, then lack of synchronization with the signal transmitter is indicated. This may be due to the machine, or probably the transmission system path if it includes single side band voice multiplex equipment which is not synchronized to the pilot carrier.

Random varying distortion would indicate noise or an intermittent circuit in the system, but a check of the loop current should be made to see if it is adequate, but not excessive for the system in the series operating mode.

#### Early and Late Peak Measurements

If the readings obtained in the TOTAL PEAK position of DISTORTION switch are steady, early and late peak measurements are made to determine the type of distortion and amount of each.

- a. Set DISTORTION switch to EARLY. The meter will read the distortion occurring on both M/S and S/M transition that is a result of early transition. Note the reading on the meter.
- b. Set DISTORTION switch to LATE position. The meter will read the peak distortion occurring on the M/S and S/M transitions that is a result of late transition. Note the reading on the meter.

Comparison of a and b will indicate where the major element of distortion lies. This should then be compared with average readings for correlation and analysis.

#### Bias and End Distortion Measurements

Early peak distortion is indicative of early transitions. Early transitions may be the result of mark bias or space end distortion, depending upon whether it is the M/S transition or the S/M transition that is affected. Late transitions are the result of space bias or mark end distortion. Assume a late peak reading.

- a. Set DISTORTION switch to BIAS position. If the distortion is bias distortion, the meter will read the average amount of distortion and the SPACING lamp will indicate it is spacing bias distortion.
- b. Set DISTORTION switch to END position. If the distortion is end distortion, the meter will read the amount of distortion and the MARK lamp will indicate if it is marking end distortion.
- c. Late peak distortion may be the result of both space bias and mark end distortion, then a reading will be obtained in both cases.
- d. Assume an early peak reading. Set the DISTORTION switch to BIAS position. If the distortion is bias distortion, the meter will indicate the amount and the MARK lamp will indicate it as marking bias distortion.

- e. Set DISTORTION switch to END position. If the distortion is space end distortion, the meter will indicate the amount and the SPACE lamp will light.
- f. Early peak distortion may be the result of both space end and mark bias distortion, then a reading will be obtained in both cases.

#### Analyzing an Unknown Signal

Analyzing an unknown signal requires that the following characteristics be determined.

- a. Type of signal (neutral or polar)
- b. Polarity of signal
- c. Current level (20 or 60 ma.) of a neutral signal
- d. Speed of signal
- e. Total peak distortion
- f. Amount of bias and end distortion
- g. Amount of fortuitous distortion
- h. Presence of shaping signals

These characteristics can be determined as indicated earlier and by the additional information in the following.

1. A meter may be used to check currents of SERIES input signals. A 20 ma. signal will not produce measurements on the analyzer when the INPUT SELECT switch is in the 60N position. A 60 ma. signal will produce readings on 20, 20/30, and 60 positions of the INPUT SELECT switch.
2. The POLARITY switch is used to determine correct polarity of SERIES input signals: on neutral signals only the correct position of this switch will cause SIG IND lamp to flash. On polar signals (negative marking) the polarity switch should be set to -, while for positive marking it should be set to +. Both positions will cause the SIG IND lamp to flash, but on 7.42 or 7.5 unit code input signals, the distortion will be high if the wrong polarity is chosen. On 7.0 or 8.0 unit code no such indication will occur and the result is to cause the mark and space sensing to be reversed in the analyzer. Marking bias will show as spacing bias and vice-versa.
3. A large difference in speed between the incoming signal and the analyzer will cause erratic behavior of meter when measuring end distortion.
4. When analyzing a signal of unknown speed, proceed through each position of the SPEED control. If the signal is one which the analyzer will measure, a reasonably steady meter indication will result.

5. On SERIES input signals, an indication of signal shaping may be obtained for neutral 60 milliampere current signal by using the INPUT SELECT control. In the 20N position, transitions are measured at 10 ma. level, in the 60N position they are made at 30 ma. If the distortion is the same for both positions, no shaping is present on the input signal. If, however, the readings differ, some shaping is present.

## 2.5 Maintenance

Very little maintenance is required for the CDA-700 series analyzers.

### DC Voltage

[An occasional check of the +15, -15 volt DC supplies may be made by connecting a multimeter between "GND" and "+15" and "-15" respectively.]

Fuses - The fuses provided to protect the equipment are:

<u>Circuit</u>	<u>Fuse</u>	<u>Location</u>
(1) 115V line	1/2 amp. 3AG	Front panel (left)
(2) Signal Series loop	1/10 amp. (3AG)	Front panel (right)
(3) -20V line	1.6 amp. 3AG	Power Supply Board

## 2.6 Input Circuit Adjustment

- a. Four adjustments in the unit are used in alignment of the Series Input circuits. [All adjustments except filter adjust are located on DC115 and are accessible through a slot in the left side of the chassis when the unit cover is removed. These controls are factory adjusted and need only be checked on an annual basis or when XK1 is changed. The filter adjustment pot is located on PC111.]

- b. 60 MA Neutral Threshold Adjust PC115-R16 (60N)

The rheostat designated R15 on PC113 is used to adjust the threshold point of the Series input circuits to operate when the input current of a 60 ma. neutral loop exceeds 30 ma.

Set the Input Select switch to 60N and adjust the steady mark current in the loop for 30 ma. Key the loop and adjust the 60N rheostat until the SIG IND light on the front panel passes from an off condition to the point where it begins to flash. This sets the input circuits to threshold at 30 ma.



c. 20 MA Neutral Threshold Adjust PC115-R14 (20N)

The rheostat designated R14 on PC115 is used to adjust the threshold point of the series input circuits to operate when the input current on a 20 ma. neutral loop exceeds 10 ma.

Set the INPUT SELECT switch to 20N and adjust the steady mark current in the loop to 10 ma. Key the loop and adjust the 20N rheostat until the SIG IND light on the front panel passes from an off condition to the point where it begins to flash.

d. 20/30 MA Polar Threshold Adjust PC115-R15 (20/30P)

The rheostat designated 20/30P is used to adjust the threshold point of the series input circuits to operate when the current on a polar loop is passing through zero.

This adjust may be made without the need for an input signal. Set the INPUT SELECT switch to 20/30P and adjust the 20/30P control PC115-R15 to the point where the SIG IND lamp can be turned on and off by rotating the control backwards and forwards. Leave the control set so that the lamp remains ON.

e. Filter Adjust PC111-R29 (FIL)

The potentiometer designated R29 on PC111 is used to adjust the input circuits so that no distortion is introduced by the addition of the internal filter. This adjustment may be made with either the Series or the Bridging input.

A steady source of signal having no variation in distortion (though it may have a fixed amount) must be available for this adjustment.

The technique used for adjusting the filter circuit is to adjust the FIL rheostat so that the Analyzer gives the same readings whether the filter is IN or OUT of the circuit.

NOTE: The filter circuits are interlocked with the Speed control so that they cannot be inserted at speeds above 75 bauds.

## 2.7 Power Supply Adjustment

There are three regulated dc voltages used in the unit, +15, -15 volts and -5 volts referred to ground.

The +15 volts and -5 volts are shunt regulated by zener diodes and may be short circuited without resulting in damage to unit.

The -15 volts supply is a series regulated type fused for current overloads, and adjustable by means of variable resistor PC115-R6. The -15 volt adjustment is accessible through a hole in the chassis on the left side of the unit when the cover is removed. Test points are provided on the front panel for use with a voltmeter. The zener diode provides a reference voltage to offset the output voltage, as derived at R6, and thus provide a differential signal which is applied through Q2 and Q3 to control the voltage drop across Q1.

## SECTION III

### 3.0 THEORY OF OPERATION

#### 3.1 Basic Principles

The initial transition of the start pulse of a character group is defined as the origin for time of occurrence and length of mark period from which the subsequent bits (marks, spaces) are measured. The analyzer equipment generates a set of marks and spaces that are precisely timed from the transition of the start pulse. These are compared with the incoming signal and the transition time differences measured and displayed as distortion. The comparison is performed by opening a gate during the interval between the signal and its corresponding standard transition. The opened gate permits a pulse train, operating at 100 times the baud rate to enter a counter/register. The register output is proportional to the time difference, and is converted to its analog current for display on the meter as percentage distortion.

#### 3.2 Functional Description, Fig. I (Signal Flow Diagram) & Fig. 10

The material that follows describes the functions of the circuits in relation to the data flow in the equipment. Detailed circuit operation is covered in Section IV.

##### Signal Processing

##### Bridging Input (Voltage)

Bridging input signals are reduced to a fixed amplitude, and inverted as necessary by the setting of the Input Selector switch. Thus conditioned, they may be observed at Test Point T.P.1-PC111 as a series of positive going 2V pulses and are applied to the threshold detector which accepts "Bridging" or "Series" inputs.

##### Series Input (Current)

The operation of the current telegraph loop is observed by inserting a fixed resistor in the loop and measuring the resulting voltage across the resistor. The Input Selector switch selects the appropriate resistor for 20/30, 30 or 60 ma. loop operation and the Polarity switch sets the polarity as required by the isolators that follow.

The isolator output provides a fixed 2V output (T.P.2-PC111) which is applied to the threshold detector.

##### Threshold Detector and Signal Repeater TP1-PC110

The threshold detector output serves to drive the Schmitt trigger which is the signal repeater. The result is a

series of pulses precisely timed to and corresponding with the incoming signal transitions. The filter is used to remove transients of 1/2 ms or less from lines operating at 75 bauds or less.

### Sample Pulse Generator

The sample pulse generator is a flip-flop which is used to generate pulses for transferring the decade counter outputs to the shift register. It is set by the data signal repeater and reset by the 100X bit data binary counter, thereby generating one 1/100 bit pulse at each signal transition of the type selected by the Distortion Switch.

### Speed Selection

Operating speed selection is accomplished by selecting one of seven oscillators and dividing the output in a simple binary countdown chain to arrive at 200X bit rate. TP1-PC102, TP2-PC102.

At this point, synchronizing circuits are inserted for adding or subtracting pulses to ensure coincidence of the internally generated bits with the data signal repeater transitions in the "Synchronous" speed mode only. TP1-PC103, TP2-PC103. After synchronization, the pulses are again divided by 2, TP1-PC104, preparatory to driving the 2 decade counters that feed the register and also generate the bit rate pulse stream. TP1-PC106, TP1-PC107. The bit rate stream is further divided in a 5-stage binary bit counter. The code level switch selects the count of this divider chain and automatically provides for the availability of transition gate signals which are selected subsequently by the Transition Select switch.

The 2 decade counter accepts and counts the 100X bits and is reset to zero by the character reset signal derived from the decade counter. In its turn, the bit counter is set to count the 1X bit rate output of the decade counter and is reset by the code level switch for the appropriate number of transitions in the character. In the absence of controls, the 7 element decade register would continuously follow the count of the 2 decade counter. The transfer gates act to hold the register at the count corresponding to the distortion observed. In the hold condition, the current outputs of the 7 element register are added in the precision resistor network, e.g., R2, 8, 32 and 40, on PC108 and applied in the distortion indicator meter to be read as percent distortion. In practice, the early count is obtained by subtracting from 100 count (50% distortion) by using the 1's complement of the register. The late count is obtained by counting up from 0.

The transfer gate inputs control the decade registers so that they will only operate on the selected transition. Five conditions must be met for the transfer of the sampling pulses to take place.

1. Q1 will permit only early transfers. Fig. 14  
Q2 will permit only late transfers.
2. No transfer for start M/S transition, as determined by output of the bit counter.
3. Transfer only when permitted by transition selection period.
4. Early peak switch selection inhibits late transfer pulses, similarly late peak inhibits early pulses.
5. "Peak" mode selection inhibits all transfers except one representing larger distortion than the one stored in the register.

#### Peak Logic -Figures 18,19

The peak logic circuits consist of 2 groups of 2 input diode "and" gates, each with a common output. One group controls the early peak gate, the other the late peak gate. The peak gate in turn controls a flip-flop, which in its turn controls the transfer gates (item 5 above) and permits the count to continue. The inputs of each "and" gate are obtained from a decade counter flip-flop output and its corresponding register flip-flop output. The inputs are chosen so that the register outputs normally control the group output. When the counter outputs to the early peak logic group equals the 1's complement of the register output, the early peak gate operates and triggers the peak flip-flop. Similarly the late peak group operates when the counter outputs exceed the 1's count of the register. This permits the count to continue to the end of the transition.

#### Automatic Peak Operation

Peak distortion in the manual mode is recorded continuously by the meter. In the automatic mode, a multi-vibrator operating at 4 second recurrence value resets the registers to zero for a new peak observation.

#### Mark-Space Indication

The mark and space indicator lights are operated by a binary flip-flop driven from 1X bit rate counter output, and controlled by the early and late transfer gates when distortion is present.



## SECTION IV

### 4.0 TROUBLE SHOOTING

#### 4.1 General

##### a. Component Replacement

Printed circuit boards require caution in the replacement of defective components. They are easily damaged by excessive heat during soldering. Use a small iron, designed for PC boards, and apply the hot tip to the lead of the component to be removed. DO NOT APPLY IRON TO FOIL. As soon as the solder melts remove the iron and brush excess solder away. Straighten leads and if necessary, reheat and pull the lead out. Do not force or twist the leads to remove them as this may result in damage to the foil.

Cutting out the component and then removing the remaining portion of the leads is the preferred method of component removal.

Before inserting the new component clear all holes of solder, by briefly heating the area of the hole and when the solder is melted, tap the board. Mount the component on the PC board by gently pushing the leads through the holes. Bend the leads close to the foil and clip them to about 1/8" in length. Solder with a resin covered solder. Remove the iron as soon as the solder flows into the joint and clean the joint of excess flux with alcohol.

##### b. Repair of Printed Circuit Conductor

If the foil conductor is damaged it must be replaced with a physical wire conductor. Remove the defective portion of the conductor. Drill two holes one at each end of the break alongside the foil. Insert either buss wire or insulated wire from the side of the board opposite that of the broken conductor, and bend the ends of the wire across the foil. Apply flux and solder. Check with an ohmmeter for continuity.

##### Test Equipment Required:

The following test equipment is required for maintenance and trouble shooting of the CDC 770 Analyzer.

Oscilloscope - Tektronix Model 535A or equivalent  
Frequency Counter - Hewlett Packard Model 523B or equivalent.

Multimeter

Telegraph Signal Generator - capable of generating a telegraph signal with controlled amounts of distortion at speeds up to 4800 bits/sec.

d. Assembly Locations:

CDC 700 is made up of fifteen assemblies. See Figure 2 for a view showing their location within the units.

4.2 Trouble Shooting Procedures

Use of Extender Card

The test points indicated in the trouble shooting table of procedure are accessible without removing the PC cards. When the malfunction is isolated to a card, the card may be removed and the card extender inserted between card and socket. The individual components will now be exposed and may be tested with power on in accordance with the troubleshooting procedures outlined for individual elements, e.g., binary flip-flop.

Procedure

Table 1 sets out a logical plan to isolate PC board assemblies as sources of trouble. Reference to the PC board descriptions and the characteristics of functional elements will enable the fault to be further isolated to individual components.



TROUBLE SHOOTING PROGRAM

<u>ACTION</u>	<u>OBSERVATION</u>	<u>CONCLUSION/CORRECTIVE ACTION</u>	<u>PARTS AFFECTED</u>
1. Check Power Plug and switch "on".	1. Indicator light "off".	1. Fuse, lamp, or -15V power supply faulty.	PC115
2. Set "Cal" switch to "on".	(a) Meter reads 40 (approx). Indicator light off. (b) No meter reading. Indicator light off.	Fuse and -15V supply good. Lamp and/or +15V supply faulty. Proceed to 2.1. Fuse faulty - replace.	PC115
2.1 Replace lamp.	Light "off".	+15V supply faulty. Proceed Test 3.	
3. Apply voltmeter "+15" "gnd" and "-15" "gnd".	+15V +15V	Confirm +15V supply good) if faulty Confirm -15V supply good) proceed Test 5	
4. Set "speed" to 4800 baud. Connect oscilloscope as in Fig. 4. 10V cm sensitivity.	(a) Dot cycle output 15V P/P 208 us pulse train. (b) Incorrect output.	4800 baud oscillator/divider chain good. Proceed to Test 5. Oscillator or divider faulty. Proceed to Test 5, and correct.	PC101 PC102
5. Repeat 4 at all other speed settings. See Table 2 corresponding. Oscilloscope display pulse lengths.	(a) Incorrect output at one or more of 110, 74.2, 61.12, 56.8, 45.5, speeds. (b) Incorrect output at all speeds.	Corresponding oscillator faulty. Analyze using PC101 description. Divider chain faulty. Analyze using PC102 description, and correct. Proceed to Test 6.	PC101 PC102
6. Connect dot cycle output to "bridging" input - circuit Fig. 5. Speed "75" baud. Input selector to "+M neutral" Filter "out".	(a) No output from "Sig". (b) 8 V P/P replica of dot cycle signal.	Signal conditioning faulty. Proceed to Test 6.1. Bridging circuit good, proceed to Test 6.2.	PC111 part of PC110

TROUBLE SHOOTING PROGRAM  
(continued)

<u>ACTION</u>	<u>OBSERVATION</u>	<u>CONCLUSION/CORRECTIVE ACTION</u>	<u>AFFECTED</u>
6.1 Set selector to "+M neutral" and change plug from +15V to -15V.	(a) No output	Signal conditioning faulty, proceed to test 7.0.	PC112
	(b) 8 V P/P dot cycle replica.	Signal circuit good except for "+M neutral" component.	
6.2 Set Filter "In".	(a) 8 V P/P dot cycle	Filter good. Proceed to Test 7.	
	(b) Incorrect or no output.	Filter faulty. Analyze PC111.	
7.0 Connect "dot cycle" output to "Series" jack, Fig. 6. "Series Input" switch to "20/30 P". Speed to "7,5" baud, filter "out".	(a) No output from "Sig".	Signal conditioning faulty. Analyze PC112., and correct.	PC112
	(b) 8 V P/P replica of dot cycle signal.	20/30 P series signal condition is good.	
8.0 Connect "dot cycle" input to bridging input (Fig. 7) speed to "75 baud", input selector to "+M neutral" Filter "out", transition select to "all" code level to "sync". Distortion to "average bias".	(a) Meter reads "0" distortion.	Analyzer, good, proceed to test 9.0.	
	(b) Meter reads other than "0".	Counter circuits faulty. Proceed to Test 10.	

	<u>ACTION</u>	<u>OBSERVATION</u>	<u>CONCLUSION/CORRECTIVE ACTION</u>	<u>AFFECTED</u>
9.0	Connect calibrated signal from distortion test generator to bridge input, see makers instructions; or set up calibration circuit of Fig. 8. Set speed to 4800 baud input selector to "M" neutral, filter "out". Transition select to "all" code level "sync" distortion to (1) average then (2) peak.	At 4800 bauds, meter should read bias distortion. Exact value of distortion to be calibrated from scope time base readings - or Test generator calibration in both average and peak switch positions.	Analyzer within calibration.	
10.0	Connect dot cycle output to bridging input Fig. 7, code level - "sync", speed 37.5 baud.	Confirm 200X bit rate TP2 on PC102 with scope.		
10.1	Transfer scope to TP1-PC103.	200X bit rate absent or faulty.	Gates Q13 or Q14 or Q15,16; multi faulty. Repair and proceed to 10.2.	PC103 (part)
10.2	Transfer scope to TP1-PC104.	100X bit rate absent or faulty.	Gate Q7 or flip-flop Q5,6; faulty. Repair and proceed to 11.	PC104 (part)
11.0	Probe to TP1-PC106.	10X bit rate absent or faulty (erratic).	Decade counter PC106 faulty, repair and proceed to 11.1.	PC106
11.1	Probe to TP1-104. Set scope for 10 pulses. Transfer probe to TP1-106.	One pulse in same time as 10 pulses at TP1-104. False count	Counter satisfactory, proceed to 12. PC 106 circuitry incorrect check feed back loops.	PC106

TROUBLE SHOOTING PROGRAM  
(continued)

<u>ACTION</u>	<u>OBSERVATION</u>	<u>CONCLUSION/CORRECTIVE ACTION</u>	<u>PARTS AFFECTED</u>
12. Probe to TP1-PC106.	1X bit rate absent or faulty.	Decade counter PC107 faulty. Repair and proceed to 12.1.	PC107 (Part)
12.1 Transfer probe to TP1-PC105. Set scope for 10 pulses. Transfer probe to TP1-106.	One pulse in same time at 10 at TP1-PC105. False count (regular)	Counter satisfactory, proceed to 13. Counter faulty - check feedback loops, correct, proceed to 13.	
13. Transfer scope sync to TP1-PC107. Probe to TP4 (Sync) front panel.	1.6 bit (8 x 1, 8 x 0) absent or faulty.	Bit counter PC105 faulty. Repair and proceed to 14.	PC105
14. Connect dot cycle output to bridge input - Fig. 7. Speed - 75baud, select "+M neutral. Transition "all". Code level - "sync". Distortion - "Average Bias".	(a) Meter shows steady reading other than 0. (b) Meter shows fluctuating reading.	Register flip/flop faulty. Analyze PC108, 109 and correct. Early or late gates register faulty, analyze and correct.	PC108 PC109 PC110 PC104
14.1 Distortion to "Peak Early" Distortion to "Peak Late"	(a) Meter fluctuates. (b) Meter fluctuates.	Early gate and register peak gate faulty, analyze and correct. Late gate and register or peak gate faulty, analyze and correct.	
14.2 Distortion to "Average End"	(a) and (b) occur.	Register or peak gate faulty, analyze and correct.	

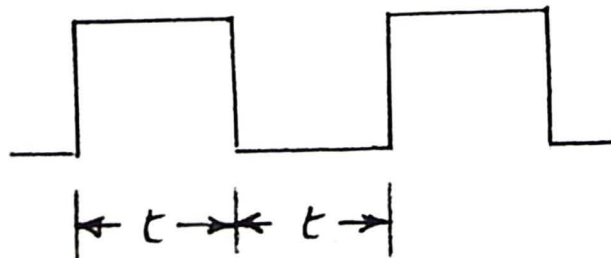
TROUBLE SHOOTING PROGRAM  
(continued)

<u>ACTION</u>	<u>OBSERVATION</u>	<u>CONCLUSION/CORRECTIVE ACTION</u>	<u>PARTS AFFECTED</u>
15.1 Voltmeter between ground fuse	15 - 20V (depending on load)	Transformer/rectifier good	
15.2 Voltmeter between ground and output TP.	(a) 15V, varies with setting of R6 (b) Low voltage	Supply good  Proceed to 15.3	
15.3 Bypass Q1 with elip lead from fuse to output	6.8V between center point R5 and ground	R5, zener diode good. Proceed to 15.4	
15.4 Remove slip lead, check voltages on electrodes Q2 and Q3.	Out of tolerance	Transistors faulty, replace. Proceed to 5.0.	

TABLE 2

DOT CYCLE OSCILLOSCOPE PRESENTATION

<u>SPEED</u>	<u>TIME (<math>t</math>)</u>
4800	208us
2400	416us
1200	833us
600	1.66ms
300	3.33ms
150	6.66ms
110	9.0ms
75	13.3ms
74.2	13.5ms
61.12	16.4ms
56.8	17.6ms
50	20ms
45.5	22ms
37.5	26.6ms



### 4.3 Printed Circuit Board Descriptions

#### Oscillator-PC101 Fig. 11

The oscillator board contains 7 modified Hartley crystal oscillators to provide the clock drive for the analyzer. The waveforms may be observed at TP1 on PC102 Fig. 26. If there is any doubt about the frequency, it should be checked with a frequency counter having an accuracy of 1 part in  $10^6$  or better. The trimming capacitor should be set to trim the frequencies to those shown in PC101 functional schematic drawing Fig. 11.

#### Bit and Dot Cycle Generator-PC102 Fig. 12

The oscillator input is applied at Es to a buffer Q1, and then to both divider chains. IC1 and IC2 divide by 256 and provide outputs for use in the counter and gating circuits. IC's 3, 4, and 5, divide by 400 and provide drive to the Dot cycle switch Q3, Q4. This switch will accept a 60 ma. current through J1-T and J1-R. TP2 shows a 5V P/P waveform at 200X baud rate selected. TP3 shows 5V at the Dot cycle rate. (Table 2)

#### Synchronizer-PC103 Fig. 13

Figure 10 Logic Diagram and Figure 38 for waveforms.

The synchronizer consists of three monostable multivibrators Q5, 6; Q7, 8; and Q15, 16, four binaries Q1, 2; Q3, 4; Q9, 10; and two gates Q13 and Q14.

The 200X bit rate timing signal from the divider passes through gates Q13, Q14 and monostable Q15, 16; for both, start-stop and synchronous operation and is the basic timing for the analyzer. To lock the internal timing signal of the analyzer to the phase and frequency of the incoming synchronous signal, timing pulses are either added to or subtracted from the 200X bit rate timing signal. The synchronizer tracks only the S/M transitions of the incoming signal. Whenever the S/M transition is not in phase with the bit rate interval timing, a correction is made to the 200X bit rate timing signal. If the transition is early, a pulse is subtracted by Q9; 10; to delay the internal timing; and if the transition is late, a pulse is added by Q5,6. Thus the internal timing of the analyzer is adjusted to that of the incoming signal. However, the baud rate of the internal baud rate of the analyzer to pull in properly.

#### Adding A Pulse - (line 5 through 12 of Figure 38)

A replica of the input signal, which has an inverted polarity to gnd on Space is connected to a voltage divider made up of R25 and R26. Capacitor C12 provides equalization. The output of the voltage divider is used to trigger binaries Q1,2; and Q9,10; which

of these two binaries will be triggered by the M/S transition of the incoming signal depends on the condition of the Early and Late bit rate bit rate timing signals at the time of the M/S trigger. The Late timing signal, positive during the first half of a bit, is connected to the trigger resistors of Binary Q1,2. When the internal timing is late, the incoming M/S transition causes Q1,2; to change state.

Every second change of Q1,2; triggers binary Q3,4; to produce a positive output. This positive output triggers the oscillator timing 200X bit rate signal from Q13 to trigger monostable Q5,6. The trigger occurs 180° out of phase from the timing signal, from Q14 which triggers monostable Q15,16; the Q6 output of monostable Q5,6; triggers the second input to monostable Q15,16; thereby adding a pulse to the 200X timing signal between the normal pulses. The Q5 output of monostable Q5,6 resets 3,4; to prepare it for the next ADD command from binary Q1,2.

This process of adding pulses is continued until the internal timing is no longer occurring late with respect to the M/S transition.

Subtracting a Pulse Lines 13 through 17 Fig. 38

The subtract circuitry consists of binaries Q9, 10; and Q11,12; and gate on PC105.

When the internal timing is early with respect to the M/S transition of the data signal, Binary Q9,10; is triggered. Every second change in state of Q9,10; produces a trigger for binary Q11,12; causing Q12 to go negative. This negative signal is connected to one input of stop gate on PC105 and prevents timing signals from passing through the gate. This lasts for one count only, since the Q15 output of Q15,16; resets binary Q11,12; to eliminate the negative signal at Q12. This reset occurs as shown in Figure 38 and results in the deletion of one and pulse from the 200X bit rate timing signal for each positive excursion of binary Q11,12.

The maximum correction rate is 1/400 bit per bit and requires a complete dot cycle.

Transfer Gates Fig. 39 and 100X Bit Generator-PC104 Fig. 14

The sample pulse is AC coupled to gates Q1 and Q3. The passage of sampling pulses through these gates is then controlled by five input elements:

1. Q1,Q3 will pass only transfers occurring EARLY } as determined by X1 bit rate output of decade counter  
Q3,Q4 will pass only transfers occurring LATE }



2. No transfer will pass for the Start transition (first M/S in a character) - the inhibiting signal comes from bit counter output.
3. The TRANSITION SELECT diode gates CR1 through CR4 restrict passage of transfers to the selected time interval.
4. For EARLY PEAK operation no late transfer pulses will pass through Q1.  
For LATE PEAK operation no early transfer pulses will pass through Q3.
5. For all peak operation the output peak Flip-Flop PC110 will prevent transfers from passing through Q1 or Q3, unless they represent a distortion higher than that already stored in the Register.

The surviving Transfer pulses are those selected for measurement. They are passed through the inverter driver gates Q2 and Q4 before triggering the Register.

The transition select gate, CR1 through CR4 is selected by the switch to produce a positive enabling signal of one bit duration, starting 1/2 bit before and ending 1/2 bit after the proper transition time for the selected transition. This allows gates Q1 and Q2 to pass sampling pulses only during the selected transition interval.

#### 100X Bit Generator

The binary Q5,6; divides the output of the gate Q7 by two. Gate Q7 is controlled by a stop pulse generated by the bit counter and the input signal in Start/Stop operation. In synchronous operation, the subtracting output from the synchronizer is operative to remove pulses from the stream.

#### Bit Counter and Timing Control-PC105 Fig. 15, Fig. 40

The bit counter consists of 5 binaries Q1,2; Q3,4; Q5,6; Q7,8; Q9,10; and 3 gates Q11, Q12, A13.

The zero output of the X1 bit counter is applied through D to drive the bit counter through a sequence set by the transition select switch. It creates a 1/2 bit offset at the beginning of each character. The decoded output is a pulse 1 bit wide equally spaced about the selected transition. The counter output stages are connected through the Code Level switch to gate Q11 to generate a negative stop pulse. This is inverted in Q12 to drive Q13 and provide reset to the decade counter. Q13 is also controlled by the data signal repeater so that when it changes to start

(M/S transition) the bit counter is reset. In synchronous operation diodes CR15, 16, 17, serve to inhibit the timing signal and also allow subtract pulses from the synchronizer to eliminate excess bits.

High Speed Decade Counter-PC106 Fig. 16 Fig. 39

High Speed Decade Counter-PC107 Fig. 17 Fig. 39

These counters are basically identical synchronous binary decade counters cascaded to divide by X100. PC107 provides the final bit rate output to the bit counter and elsewhere. The input is X100 bit pulse stream from PC104 bit generator. The outputs of each binary are applied to the corresponding register binaries, and are reset by the character reset pulse generated in the bit counter gates.

Distortion Indicator Register-PC108 Fig. 18 Fig. 41

Distortion Indicator Register-PC109 Fig. 19 Fig. 41

These two boards correspond binary for binary to the high speed decade counters and register both the decade counter count and its complement. The first seven elements supply current for the digital to analog summing network to the distortion meter. The eighth controls (X1 bit rate) the mark and space indicator lights. The register readout to the summing network is controlled by the early and late transfer gates which transfer the counter binary states to be held by the corresponding register binaries. Late transfer transfers the count and Early transfer transfers the complement. This automatically ensures that the meter current corresponds to the distortion D and not (50-D) regardless of whether bias or end distortion is being observed. A pulse from the astable 4 second multivibrator on PC110 provides reset to 0 for reading peak distortion automatically.

Peak Transfer Control-PC110 Fig. 20 Fig. 39

This board contains 3 separate circuits.

Automatic Reset Multivibrator Q5;6;

This provides a pulse every 4 seconds for resetting registers to zero when automatically sampling peak distortion.

Data Signal Repeater Q1,2; and Sample Pulse Generator Q3,4;

The data signal repeater is a Schmitt trigger binary which provides a fast rise time replica of the data signal to be analyzed. This ensures accurate transitions even though the signal may have low frequency components that create a slow rise time.

The sample pulse generator provides short pulses corresponding to the mark and space transitions generated by the signal repeater. These pulses operate the gates to the counting circuits.

#### Peak Transfer Control

This consists of two gates Q7, Q10, driving a binary Q8,9. Q7 gate is controlled by early transfer, Q10 by late transfer. Each has an input derived from a peak logic summing network in the register. Each network consists of a group of 7 gates each consisting of two diodes and one 16K ohm resistor, with common output, e.g., (PC109-D-R18,19,31 and PC108-N-R15,19,47,48). These function as "AND" gates. The 2 inputs to each gate come from the counter and register respectively. When the counter exceeds the register, the sum opens the gate and the flip-flop generates pulses which are fed to the transfer gates until the register has caught up to the new peak count, which is then held by the register for readout on the meter.

#### Bridging Input Circuit-PC111 Fig. 21 Fig. 40

Bridging input signals are reduced to a common P/P amplitude at the junction of R2 and R4. Depending on whether polar or neutral signals are present, bias to amplifier Q1 is added to compensate. The signal is switch selected at the inverter gate outputs Q2, Q3 for positive or negative marking sense, and applied to Q4 to provide a positive going signal for subsequent conditioning.

Q5,6 is a threshold detector which accepts bridging or series signals and provides fast transitions at mark or space. Its output passes to the digital filter Q7,8 which removes transients of less than 0.5 ms and is only in circuit for signals operating at 75 baud or lower speeds. The filter is adjusted by R29 so that at 75 bauds the same waveshape is observed at Y regardless of whether the filter is in or out of circuit. The filter output passes to the data signal repeater or PC110.

#### Power Supply Fig. 22

There are three regulated dc voltages used in the unit, +15, -15 volts and -5 volts referred to ground.

The +15 volts and -5 volts are shunt regulated by zener diodes and may be short circuited without resulting in damage to unit.

The -15 volts supply is a series regulated type fused for current overloads, and adjustable by means of variable resistor PC115-R6.

#### 4.4 Functional Elements Fig. 50 through 53

The following material indicates tests and methods for isolating faulty components. The figures show typical circuit configurations.

##### Binaries (flip-flop) Fig. 50

If the flip-flop circuit is dc stable, grounding the bases of Q1 and Q2 alternately will cause the circuit to flip back and forth between its two stable states. A second check involves the ac trigger circuits each consisting of a capacitor, resistor, diode combination. There is at least one trigger circuit connected to each transistor base. Apply a signal to each input in turn to check the collectors of Q1 and Q2 to determine which one is at ground and does not turn off. The trigger circuit associated with that transistor is suspect. The most probable cause of trouble is a defective diode. A volt-ohm meter in the circuit will show the forward resistance of a good diode to be under 20 ohms, while the reverse resistance will normally be in the range 200K to 400K ohms.

##### PNP Gates Figure 51

If a gate is found to be not operating check the base waveform on the oscilloscope. For the transistor to saturate the base must be negative about -0.2 volts with respect to the emitter and to be cut-off the gate must be positive (and about 1 volt). If either one of these conditions exists steadily then the gate collector will stay at the appropriate voltage without changing and the inputs to the gate should be checked. A base voltage more negative than -0.2 volts with respect to its emitter indicates an open circuit.

To determine whether a transistor which is saturated is defective, short the base to the emitter; this should cut the transistor off, producing a negative voltage at the collector.

If the defect keeps the gate always cut-off, check the forward resistance of transistor base to emitter and base to collector junctions for an open circuit.

##### Monostable Multivibrator Fig. 52

A monostable multivibrator is similar to a Binary except that it has only one stable state. The stable condition is Q1 conducting and Q2 "off". To determine whether the circuit is dc stable, ground the base lead of Q1 to turn it off. The collector of Q1 should go negative and the collector of Q2 should go to ground. If Q1 does not turn off, (1) it may have an internal

collector to emitter short, or (2) the collector is grounded externally. If Q2 does not turn on, going to ground, it may have a base to emitter open or a base to collector open. Open circuits between collector of Q1 to base of Q2 are another possible cause. The dc check, therefore, will locate faulty transistors, resistors or connections within the monostable circuit.

The other source of trouble can be the ac triggering circuit made up of a capacitor, resistor, and diode. At least one such combination is connected to the base of Q1. The most probable trouble is a defective diode.

#### Schmitt Triggers Fig. 53

Since a trigger has two stable states controlled by the input signal level, the first check outlined for the binary is applicable.

## SECTION V

### WARRANTY

Circuit Data Corporation, hereinafter referred to as Circuit Data, warrants the equipment (except tubes, semi-conductors, fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. Circuit Data further warrants that the equipment will perform in a manner thereto accompanying the formal equipment offer.

Circuit Data will replace or repair any such defective items, F.O.B. factory, which may fall within the stated warranty period, PROVIDED:

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2. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by Circuit Data, if required, indicates the validity of such claim to Circuit Data's satisfaction.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by Circuit Data, or otherwise.
4. That any equipment or accessories furnished but not manufactured by Circuit Data, or not of Circuit Data design, shall be subject only to such adjustments as Circuit Data may obtain from the supplier thereof.

Electron tubes or semiconductors furnished by Circuit Data, but manufactured by others, bear only the warranty given by such other manufacturers.

Circuit Data's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At Circuit Data's option any defective part or equipment which falls within the warranty period shall be returned to the factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to Circuit Data unless a return authorization is issued by Circuit Data.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by Circuit Data and the foregoing warranty shall constitute the Buyer's sole right and remedy. In no event does Circuit Data assume any liability for consequential damages, or for loss, damage or expense directly arising from the use of Circuit Data Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

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When ordering a replacement part or spares, please specify (1) Circuit Data or other part number, as appropriate, (2) its complete name as indicated in the "Table of Replacement Parts". Since the characteristics of any given component may have been altered in subsequent production changes, take this information from the Operating and Service Manual originally received with the instrument. An order for a part without the stock number, must include the instrument model and serial number, a complete description of the part and its location within the instrument.

#### REPAIR SERVICE

Circuit Data will repair any defective instrument which may be within warranty. Transportation costs will be paid by the user. Instruments that have exceeded the warranty period will be repaired at the customer's expense.

#### NEW EQUIPMENT

Please specify the catalog model number, and the name of the instrument. To prevent misunderstanding, include significant parameters and modifications to the standard specifications. Whenever special options or features, such as color, non-standard power line voltage, etc., are required, include specific details.

#### PRICE AND DELIVERY INFORMATION

Please consult Circuit Data sales office for prices and current delivery information. Circuit Data reserves the right to



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Orders should be addressed to Circuit Data Corporation  
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Syosset, New York 11791

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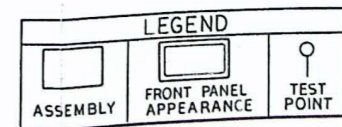
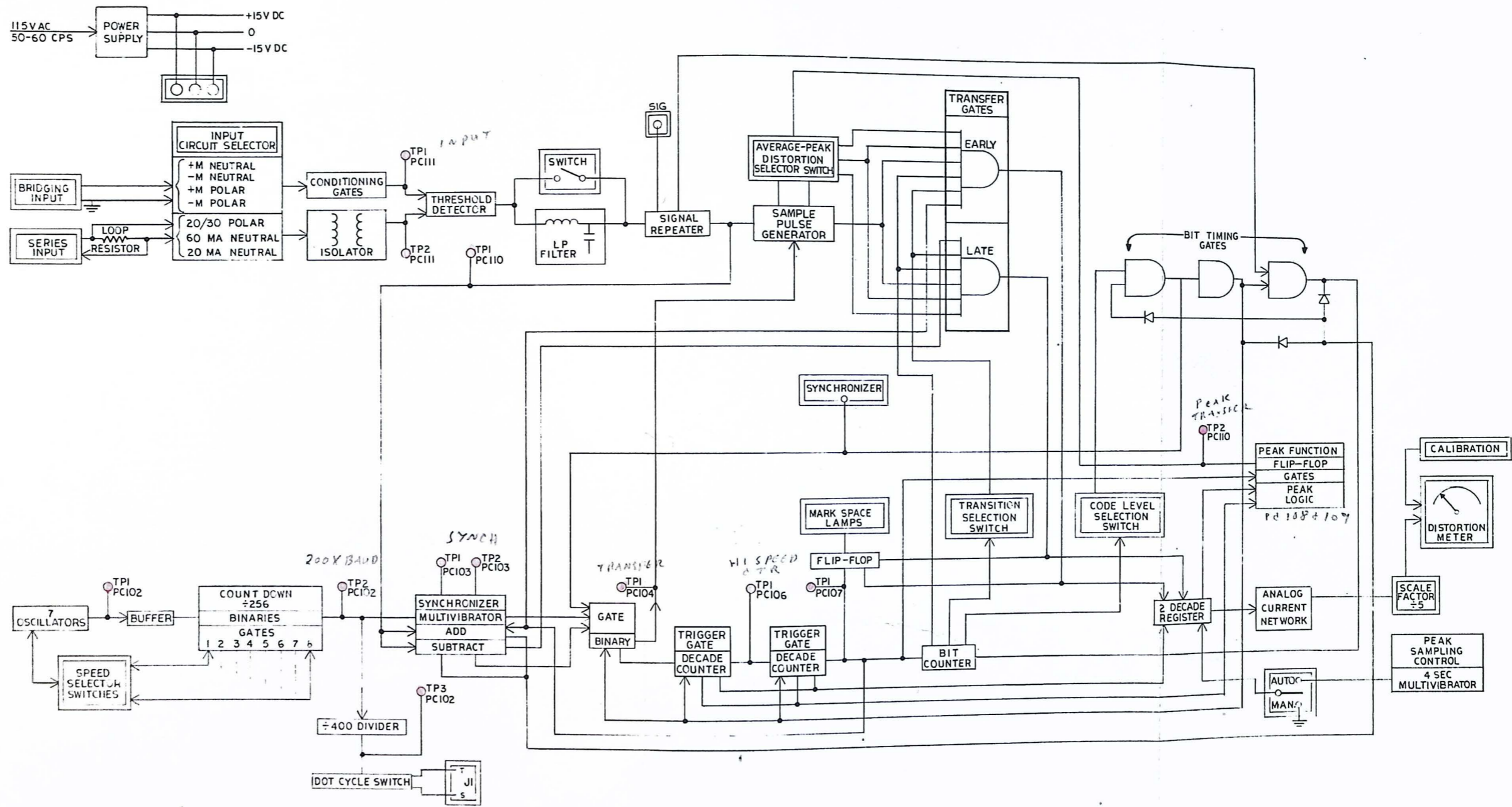
Terms are F.O.B., Syosset, New York in non-returnable shipping containers. MIL and wood crate packaging is available at additional cost. Instruments will be shipped in accordance with our acceptance of the order. Circuit Data will expedite delivery to meet requirements wherever possible.

#### PAYMENT

Terms of payment in the U.S.A. are net 10 days. Unless credit has already been established, shipments will be made C.O.D., or on receipt of cash in advance. Shipments will be invoiced at prices in effect at date of acceptance of order unless otherwise agreed to in writing.

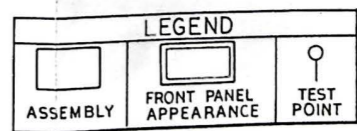
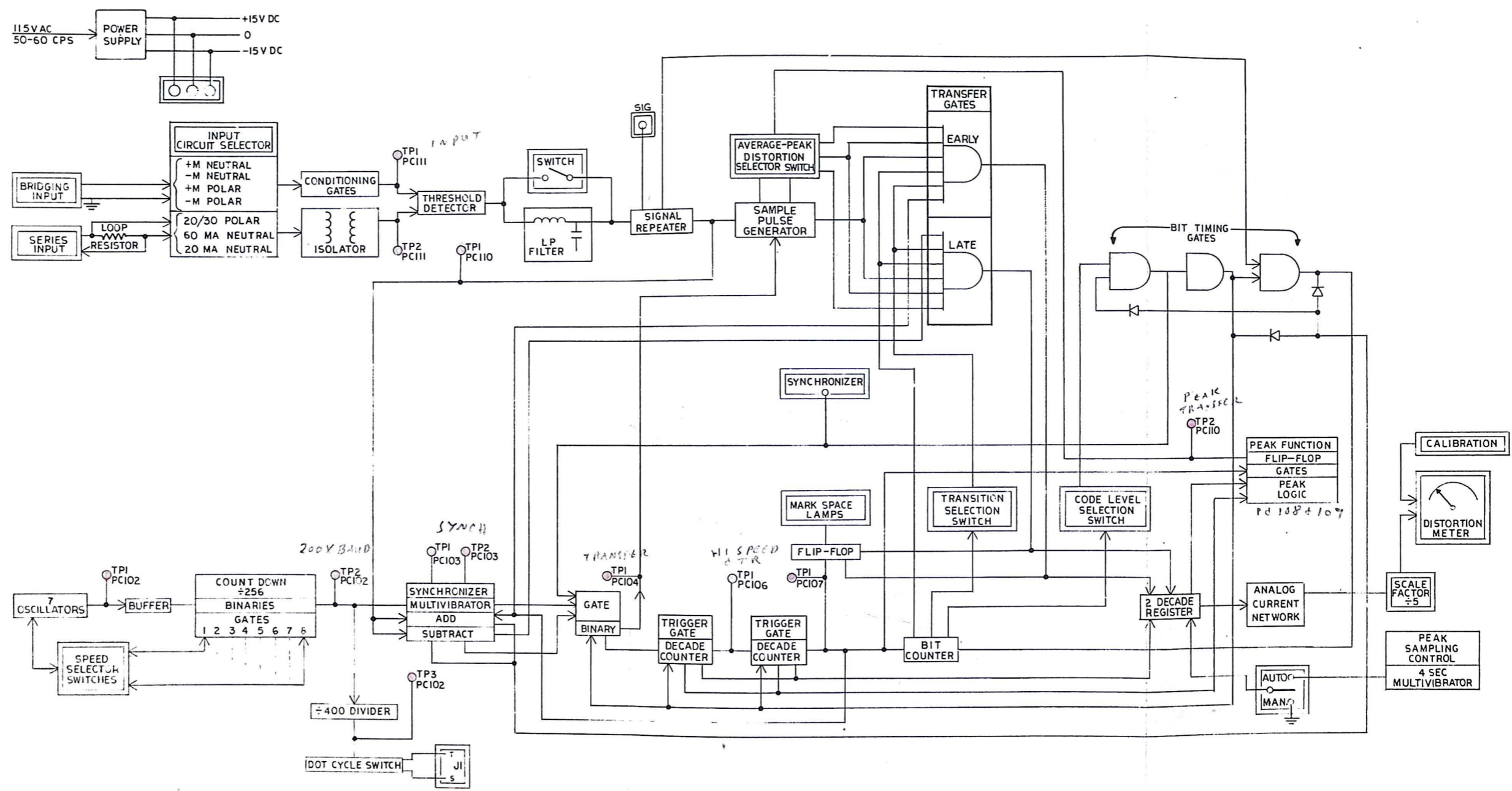
#### TERMS FOR INTERNATIONAL SALES

An irrevocable letter of credit confirmed by a New York City bank is required, payable against shipping documents. Shipping is F.O.B., Syosset, New York. The buyer agrees to pay all shipping charges and any additional costs such as insurance, duties, taxes or fees incurred in connection with export from the U.S.A. or import into a foreign country. An import certificate should be sent with purchase order in order to expedite our obtaining an export license when necessary.



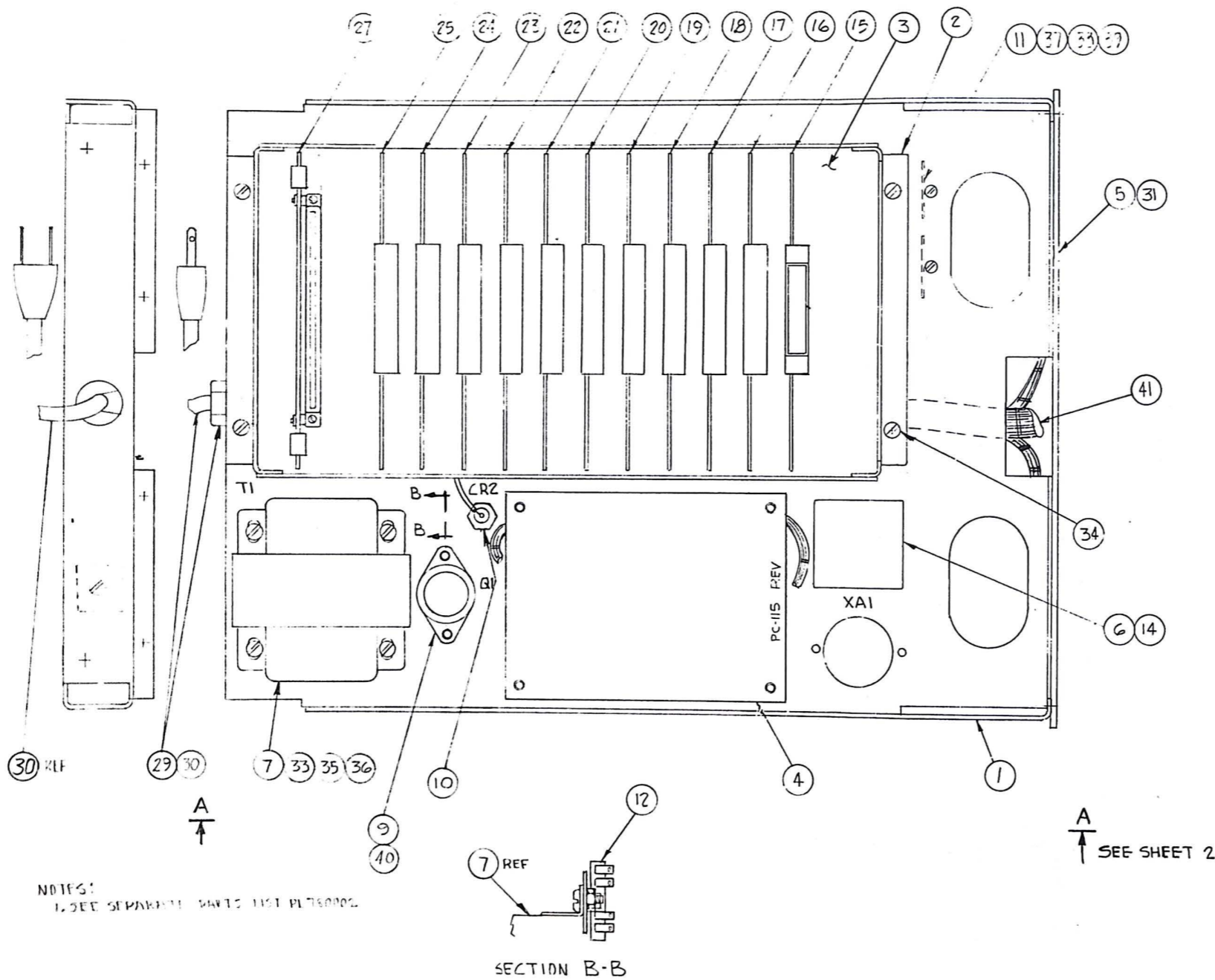
SIGNAL FLOW  
DIAGRAM

FIGURE 1



SIGNAL FLOW  
DIAGRAM

FIGURE 1



ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	770004		CHASSIS		1	
2	770014		CAGE ASSEMBLY		1	
3	PC790014		BD, PRINTED CIRCUIT WIR. ASSY		1	
4	PC790015		POWER SUPPLY BD. ASSEMBLY		1	
5	780001		PANEL, FRONT ASSEMBLY		1	
6	8AM	YA1	SOCKET, 8 PIN		1	CINCH MFG.
7	770001	T1	TRANSFORMER, POWER		1	
8	SCA105	CR1	RECTIFIER		1	
9	TI 3027	Q1	TRANSISTOR, PWR, PNP		1	MOTOROLA
10	1N1595	CR2	DIODE		1	
11	332-21-03-048		TERM. STRIP (3 PT)		2	CINCH MFG.
12	332-31-05-048		TERM. STRIP (5 PT)		1	CINCH MFG.
13	780003		CHASSIS, WELDMENT ASS'Y.		1	
14	780012	XA1	SERIES INPUT MODULE ASS'Y.		1	
15	PC790001	PC101	P. C. CARD ASSEMBLY		1	
16	PC790002	PC102	P. C. CARD ASSEMBLY		1	
17	PC790003	PC103	P. C. CARD ASSEMBLY		1	
18	PC790004	PC104	P. C. CARD ASSEMBLY		1	
19	PC790005	PC105	P. C. CARD ASSEMBLY		1	
20	PC790006	PC106	P. C. CARD ASSEMBLY		1	
21	PC790007	PC107	P. C. CARD ASSEMBLY		1	
22	PC790008	PC108	P. C. CARD ASSEMBLY		1	
23	PC790009	PC109	P. C. CARD ASSEMBLY		1	
24	PC790010	PC110	P. C. CARD ASSEMBLY		1	
25	PC790011	PC111	P. C. CARD ASSEMBLY		1	
26						
27	PC790016	PC116	P. C. CARD ASSEMBLY		1	
28	CH/C/10037/3		CARD PULLER (REF)		13	VERO
29	#SR-6L		BUSHING, SNAP (NYLON)		1	HAYCO
30			CORD, A. C.		1	6 Ft. Lg.
31	No. 6-32 x 1/2 Lg.		SCREW, PH. HD.		4	
32	No. 6-32 x 3/8 Lg.		SCREW, FLAT HD		1	
33	No. 6-32 x 1/2 Lg.		SCREW, BD. HD.		4	
34	No. 6-32 x 5/16 Lg.		SCREW, BD. HD.		4	
35	No. 6		WASHER, LOCK		11	
36	No. 6		NUT, HEX		7	
37	No. 4-40 x 1/4 Lg.		SCREW, BD. HD.		4	
38	No. 4		WASHER, LOCK		4	
39	No. 4		NUT, HEX		4	
40	MK-15		POWER TRANSISTOR MOUNTING KIT		1	MOTOROLA
41	WH-780000		WIRING HARNESS ASSY		1	

FIGURE 2

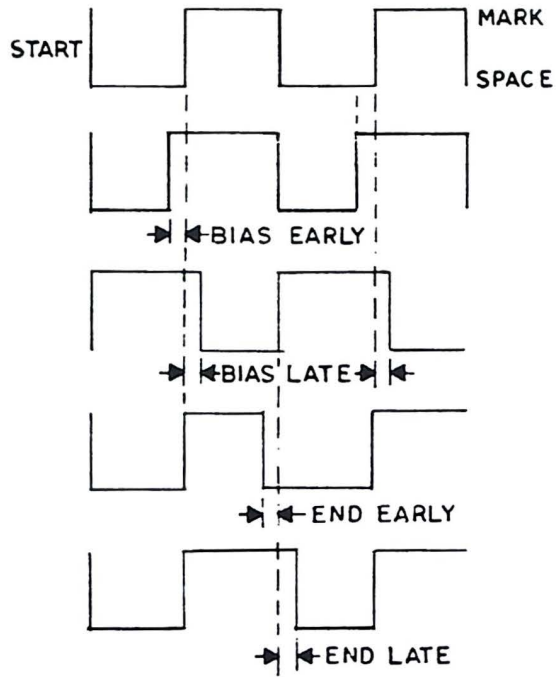


FIG #3 DISTORTION DIAGRAM

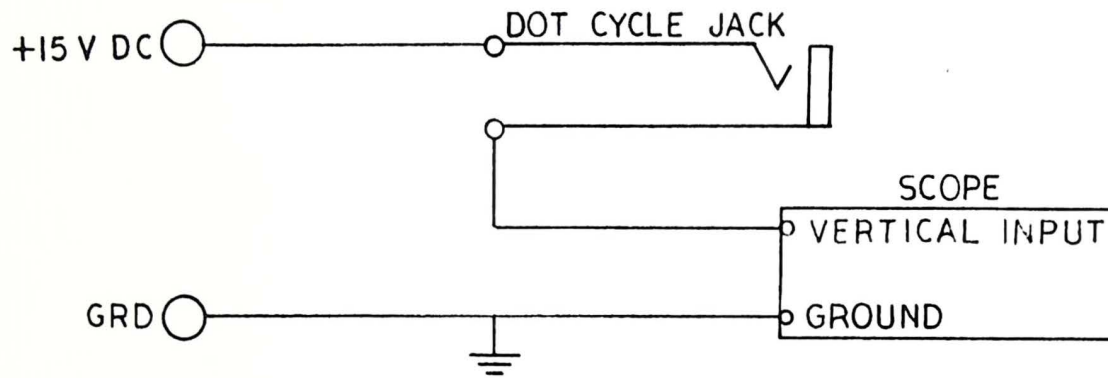
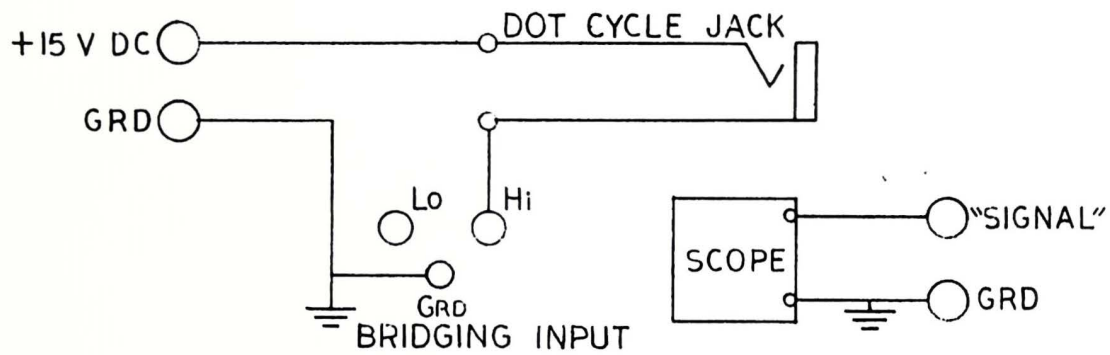


FIGURE 4



TEST CIRCUITS

FIGURE 5

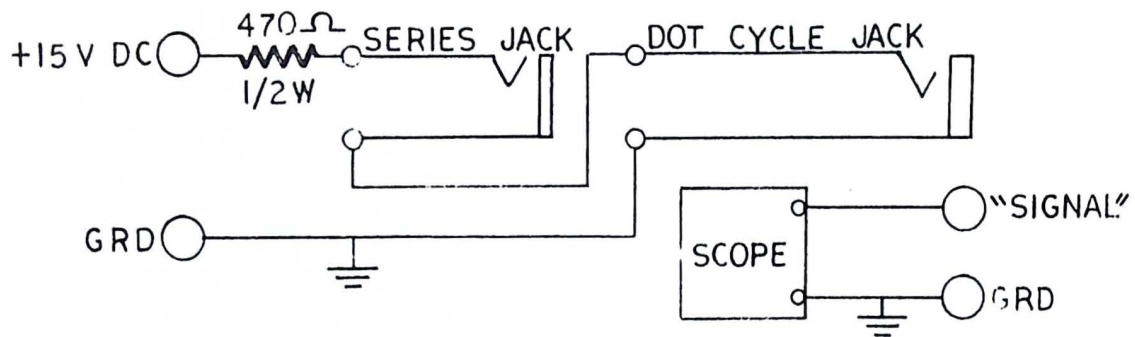
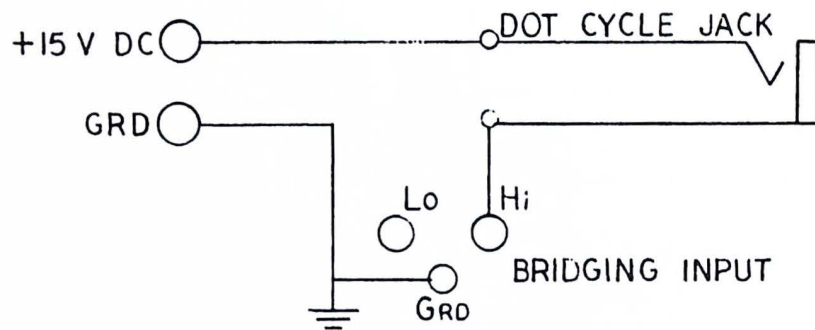
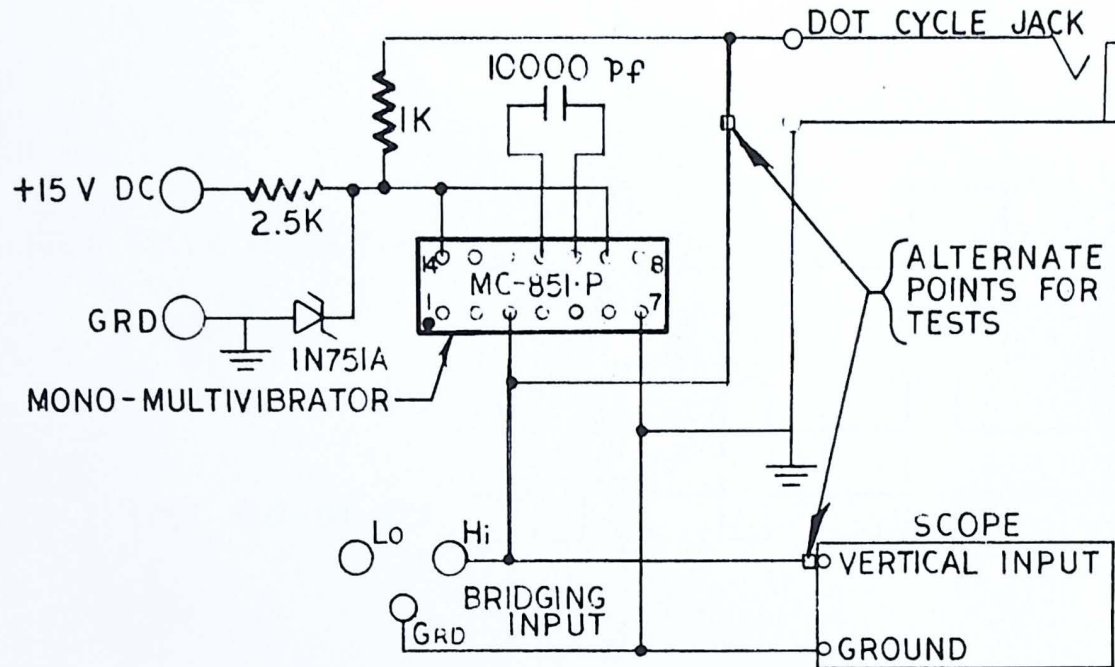


FIGURE 6



TEST CIRCUITS

FIGURE 7

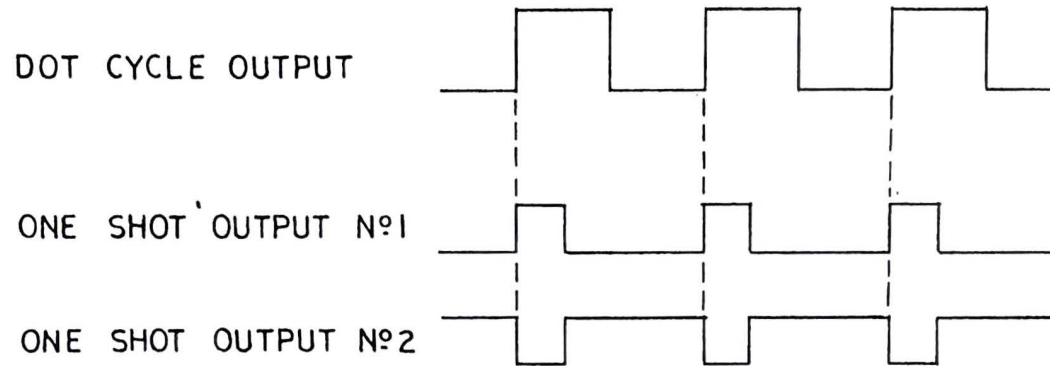


THIS CIRCUIT IS NOT OF HIGH ACCURACY, UNLESS CALIBRATED INDEPENDENTLY.  
IT SHOULD BE USED ONLY FOR FIELD CHECK.

## CALIBRATION CIRCUIT

FIGURE 8

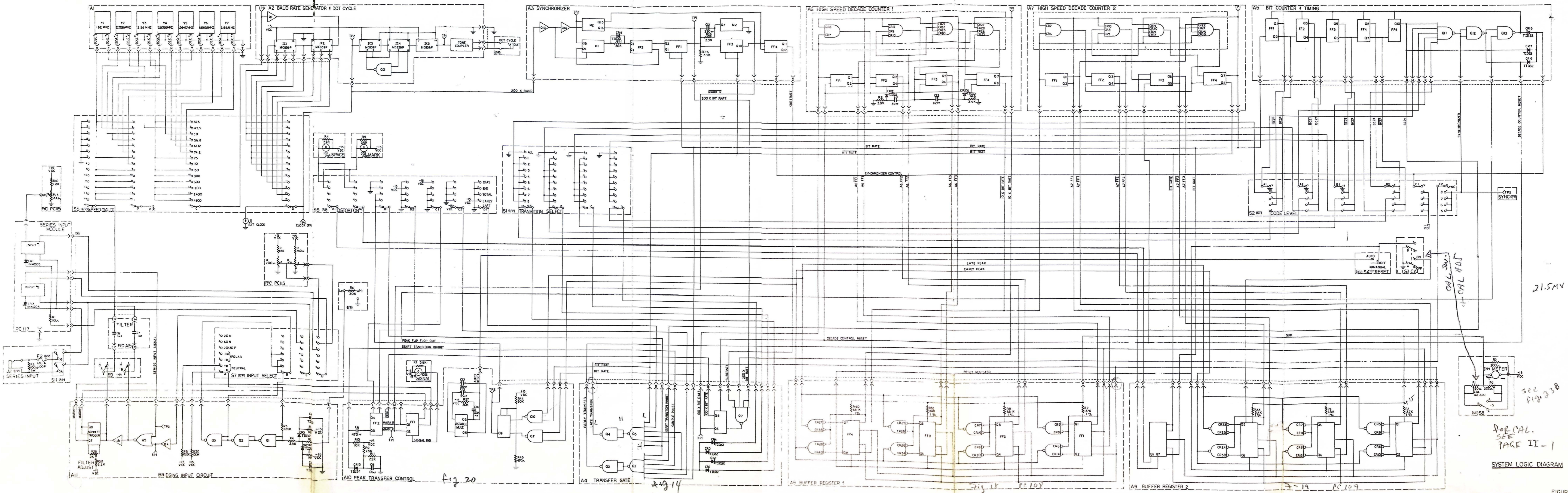




DISTORTION IS APPROXIMATELY 25 %, CALIBRATE AGAINST  
SCOPE TIME BASE AT BAUD SPEED " "

CALIBRATOR  
TIMING DIAGRAM

FIGURE 9



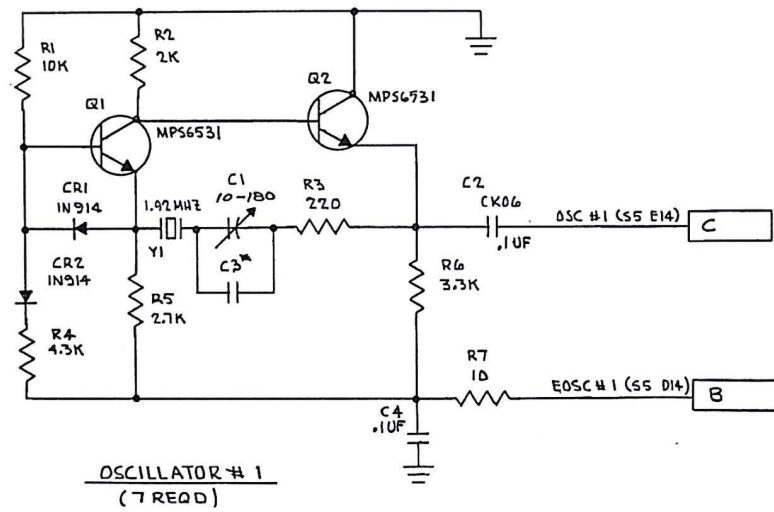
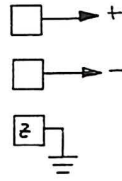
21.5MV = 10%

SEE FIG 23A

FOR CAL. SEE PAGE II-1

SYSTEM LOGIC DIAGRAM

FIGURE 10



NOTES: UNLESS OTHERWISE SPECIFIED,  
 1. ALL RESISTORS ARE IN OHMS, 1/4 W ± 5%  
 2. ALL CAPACITORS VALUES ARE IN PF  
 \* SELECT AT TEST

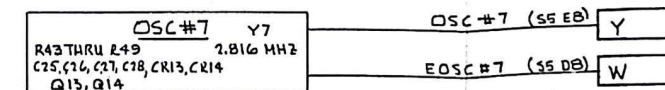
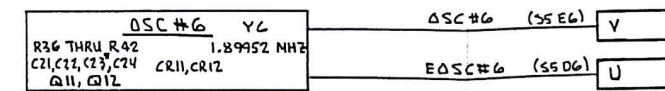
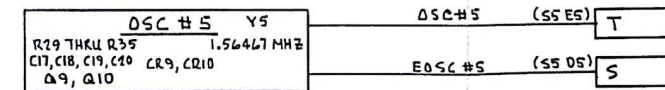
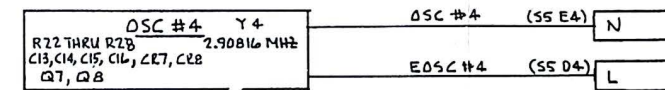
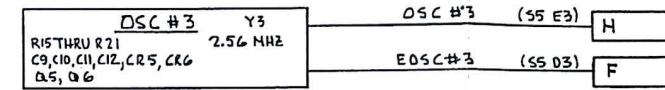
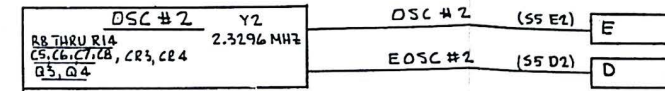
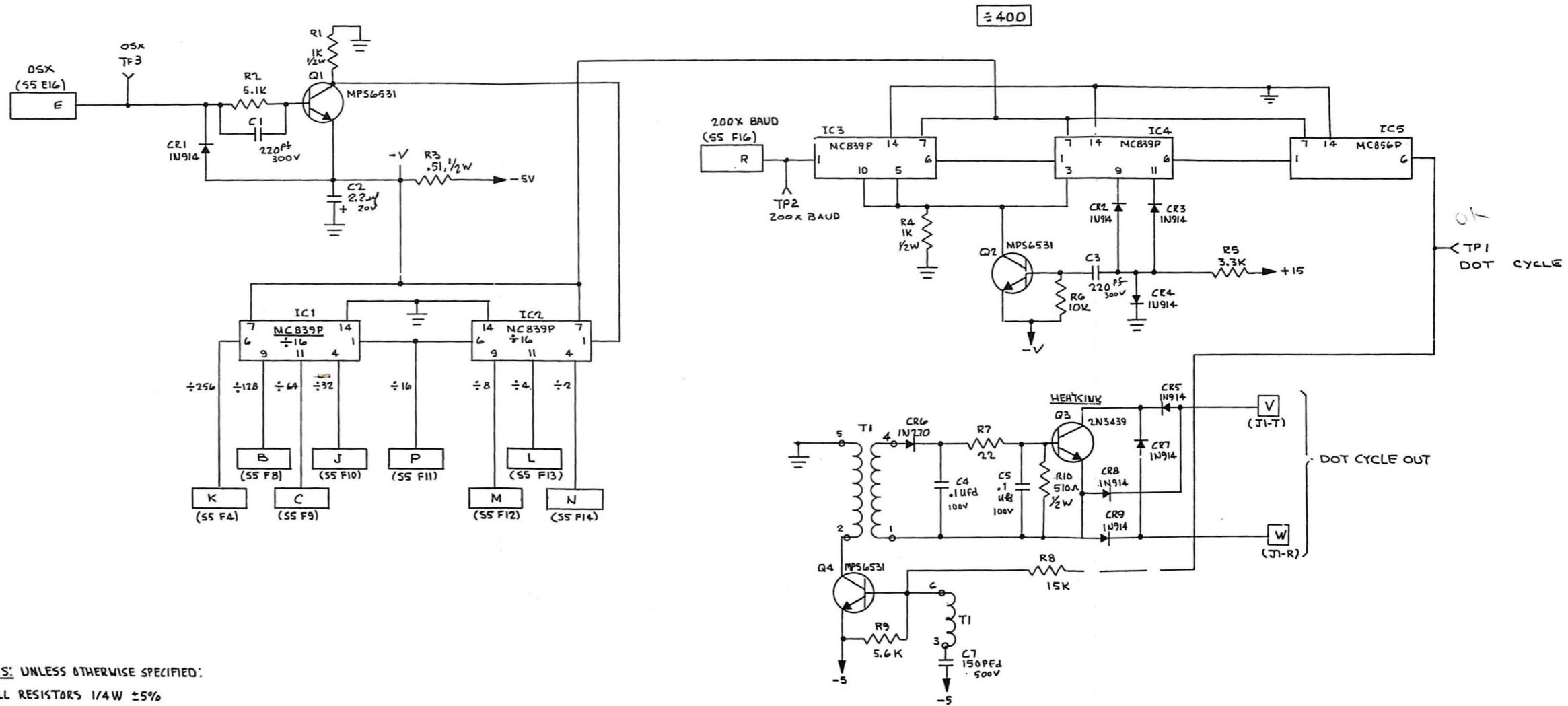
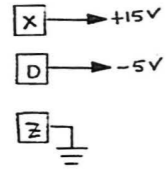


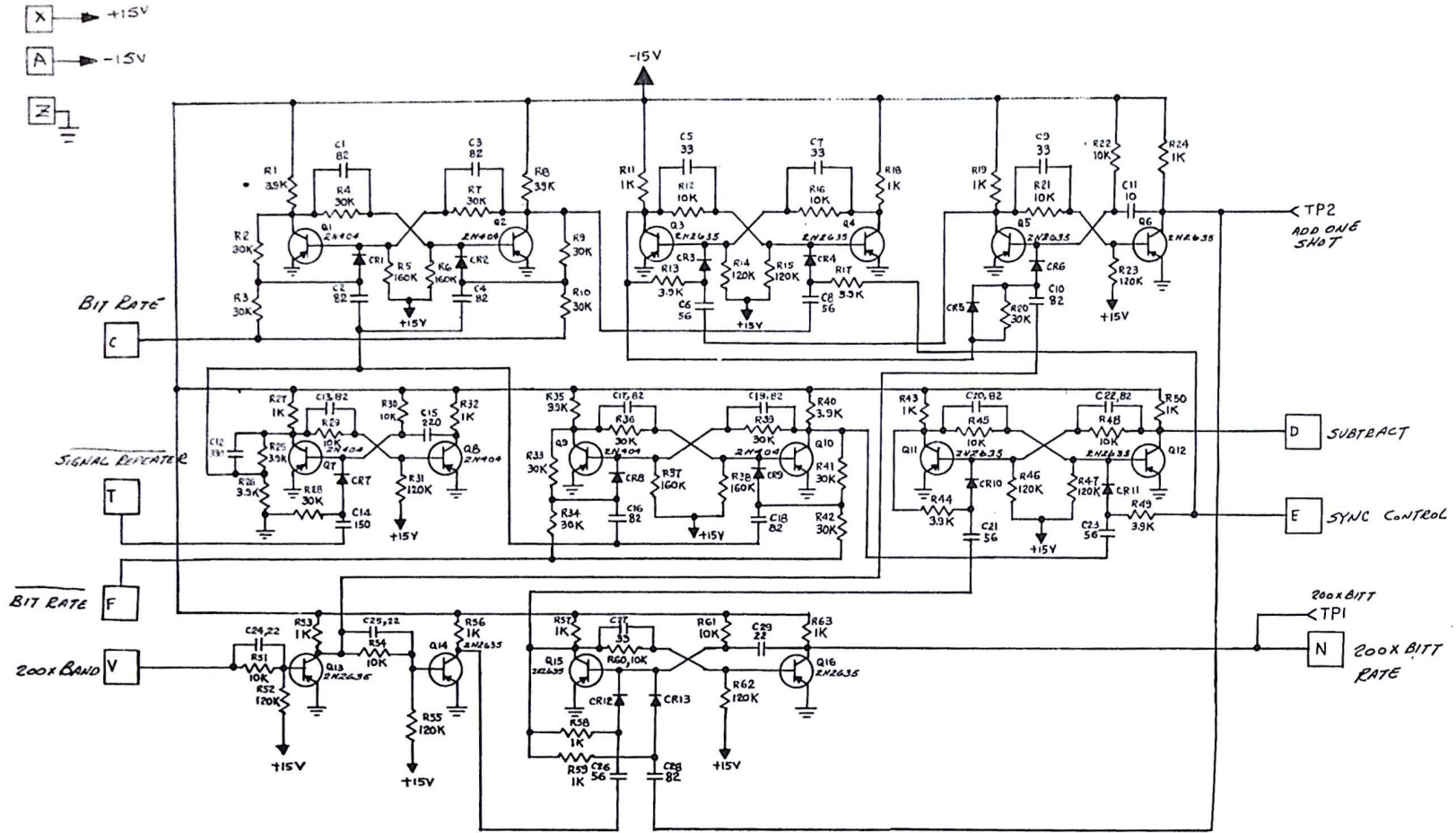
FIGURE 11



NOTES: UNLESS OTHERWISE SPECIFIED:  
 1. ALL RESISTORS 1/4W ±5%

COMPONENTS NOT USED  
 CG

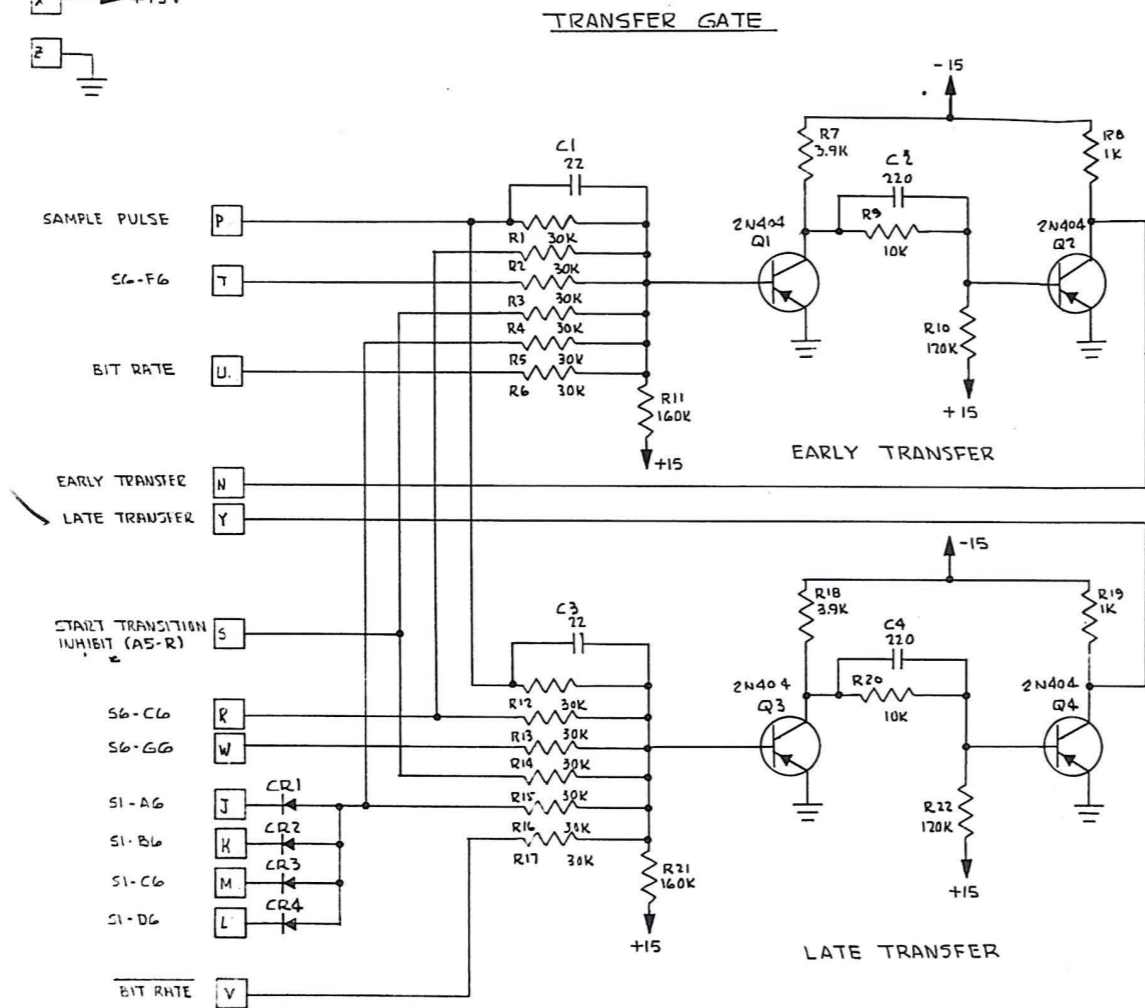
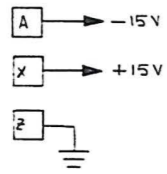
FIGURE 12



**NOTES**

1. UNLESS OTHERWISE SPECIFIED: 1. ALL RESISTORS 1K & BELOW ARE  $\frac{1}{2} W, \pm 5\% \text{ TOL. (OHMS)}$  AND ALL OTHERS ARE  $\frac{1}{4} W, \pm 5\% \text{ TOL. (OHMS)}$  +
2. ALL CAPACITOR VALUES IN PF
3. ALL DIODES ARE 71D32
4. PIN A-1  $\rightarrow$  -15V
5. PIN X-20  $\rightarrow$  +15V
6. PIN Z-22  $\rightarrow$  GROUNDED
7. NUMBERS INSIDE SQUARE ARE PIN NOS.

FIGURE 13



**NOTES: UNLESS OTHERWISE SPECIFIED:**

1. ALL RESISTORS 1K & BELOW ARE 1/2W ±5%, AND ALL OTHERS ARE 1/4W ±5%.
2. ALL CAPACITOR VALUES IN P4
3. ALL DIODES ARE 71032
4. NUMBERS INSIDE SQUARE ARE PIN #

pc-104

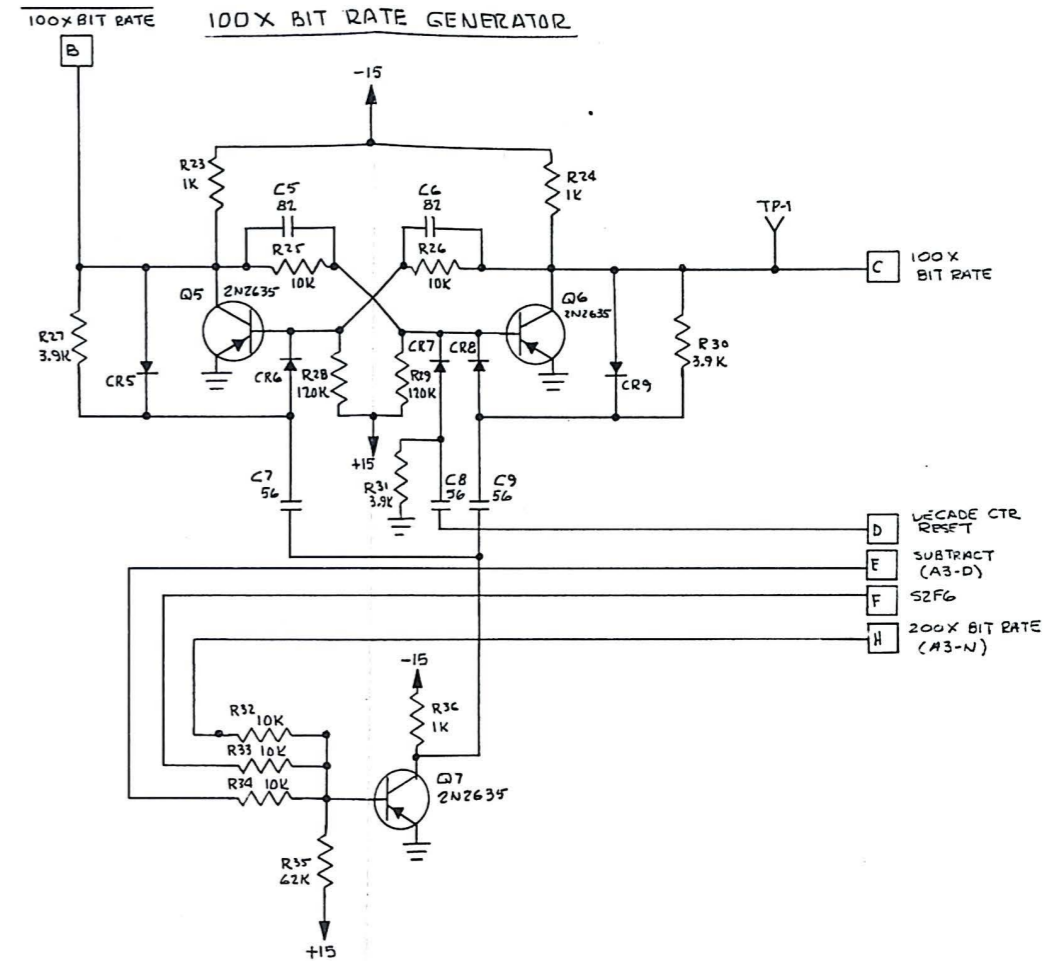
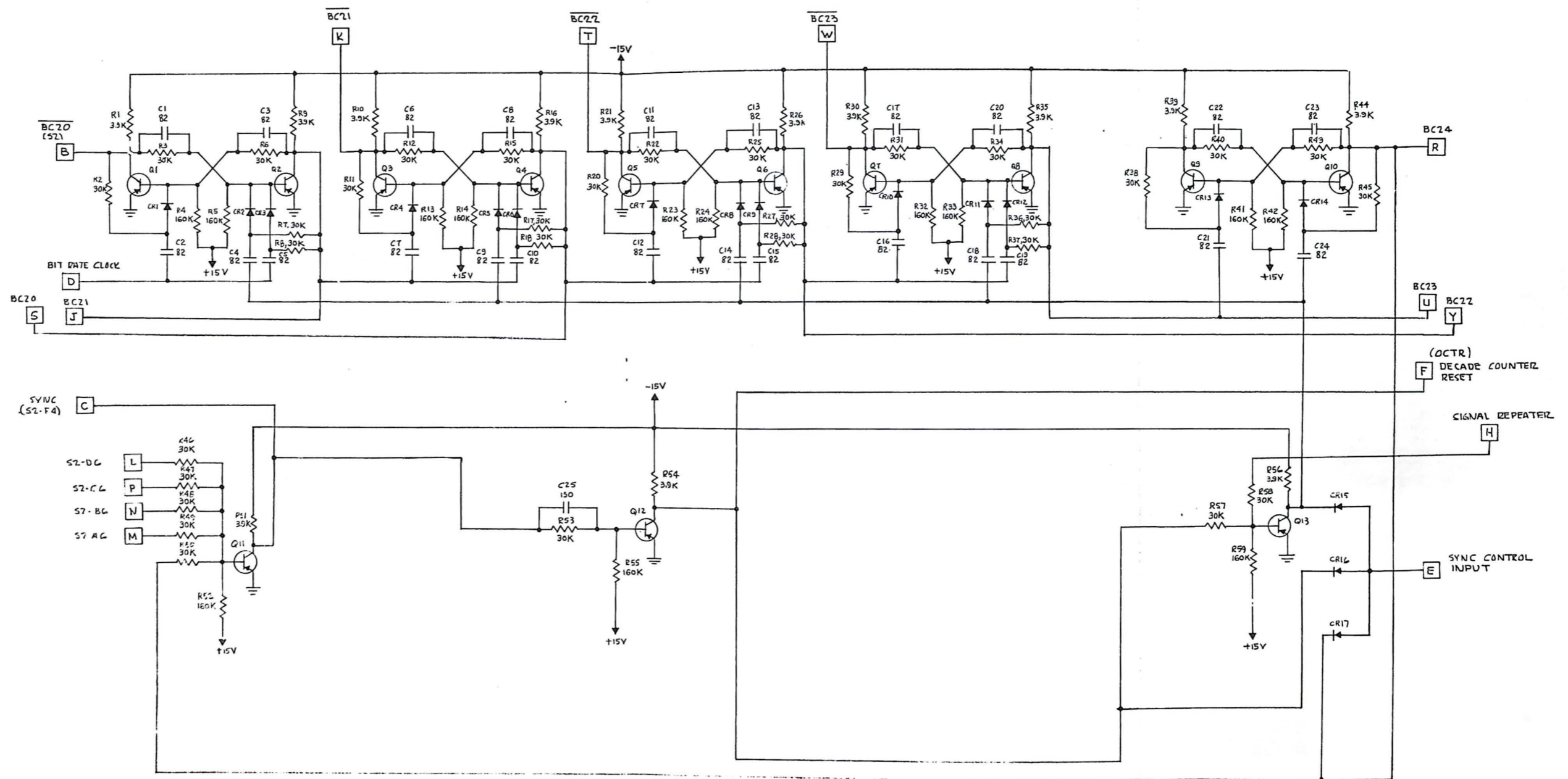


FIGURE 14

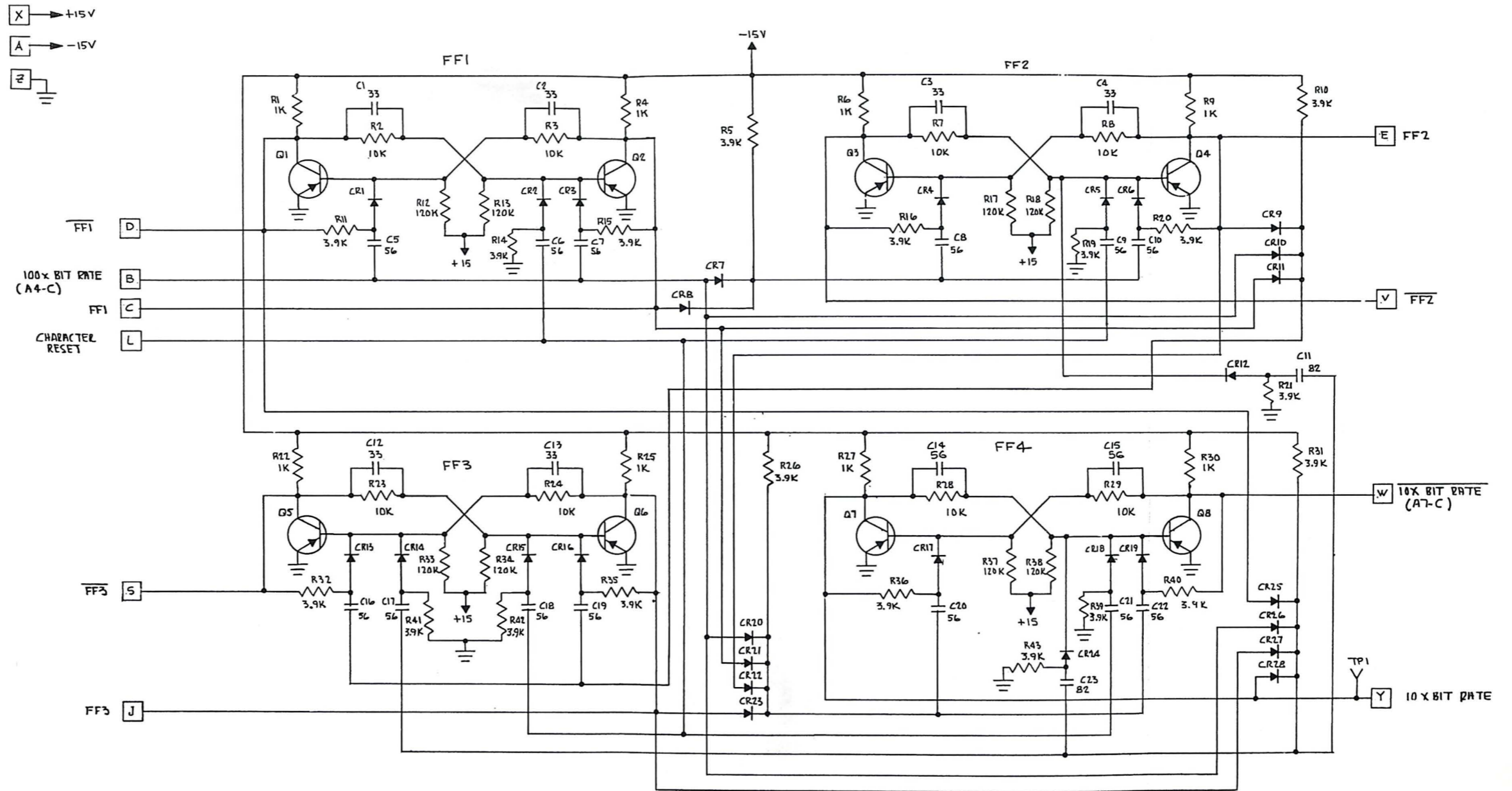


**NOTES**

1. UNLESS OTHERWISE SPECIFIED: 1. ALL RESISTORS 1K & BELOW ARE 1/2 W, ±5% TOL. (OHMS) AND ALL OTHERS ARE 1/4 W, ±5% TOL. (OHMS)
2. ALL CAPACITOR VALUES IN PF
3. ALL DIODES ARE 1N32
4. NUMBERS INSIDE SQUARE ARE PIN #
5. ALL TRANSISTORS ARE 2N404

R19 NOT USED

FIGURE 15

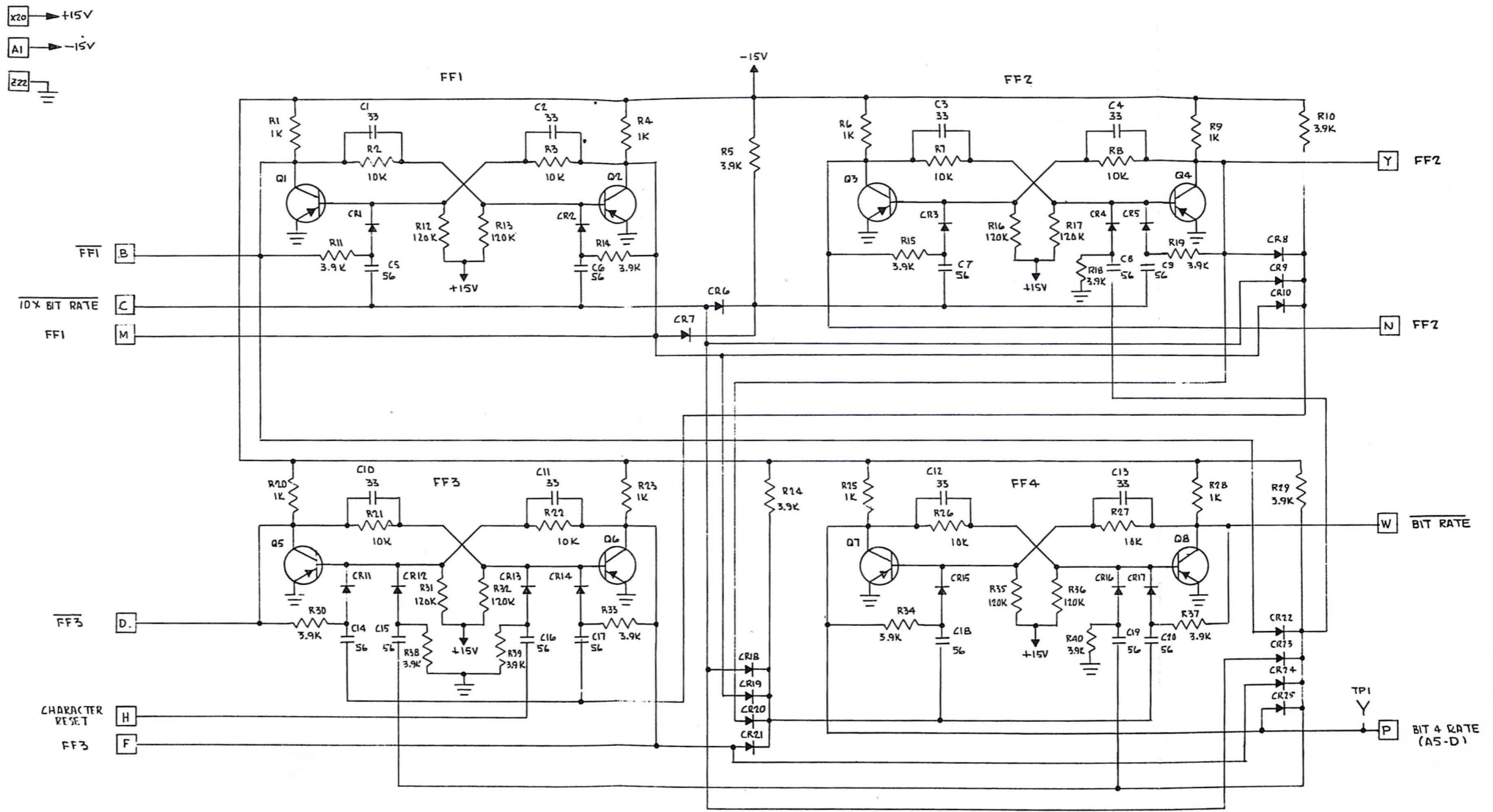


**NOTES: UNLESS OTHERWISE SPECIFIED:**

1. ALL RESISTORS ARE IN OHMS 1/4 W  $\pm 5\%$  (ALL RESISTOR 1K & BELOW ARE 1/2W  $\pm 5\%$ )
2. ALL CAPACITOR VALUES ARE IN PF  $\pm 5\%$ .
3. ALL DIODES ARE 71032
4. NUMBERS INSIDE SQUARE ARE PIN #
5. ALL TRANSISTORS ARE 2N1603

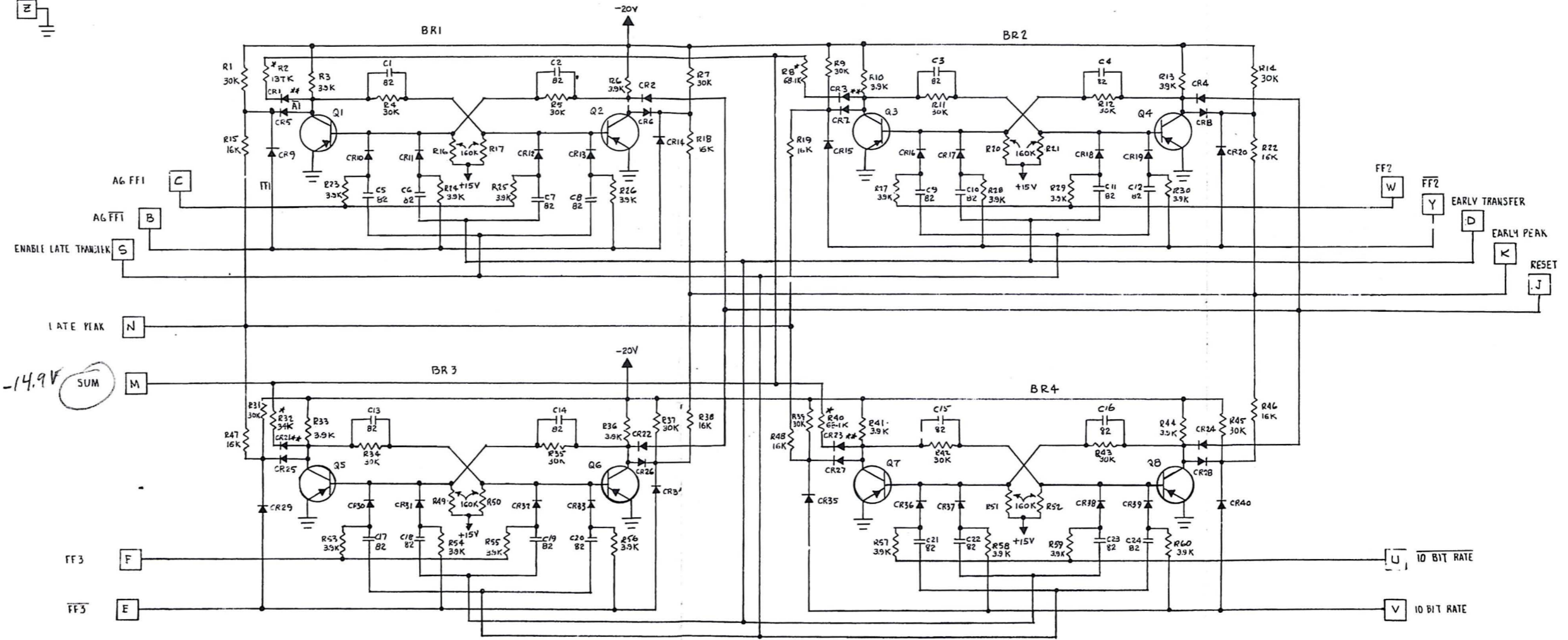
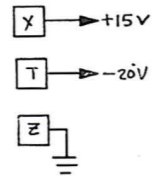
FIGURE 16





- NOTES: UNLESS OTHERWISE SPECIFIED,
1. ALL RESISTORS ARE IN OHMS 1/4W ±5% ALL RESISTORS 1K & BELOW ARE 1/2W ±5% TOL.
  2. ALL CAPACITOR VALUES ARE IN PF ±5%
  3. ALL DIODES ARE 71D32
  4. NUMBERS INSIDE SQUARE ARE PIN #
  5. ALL TRANSISTORS ARE 2N1683

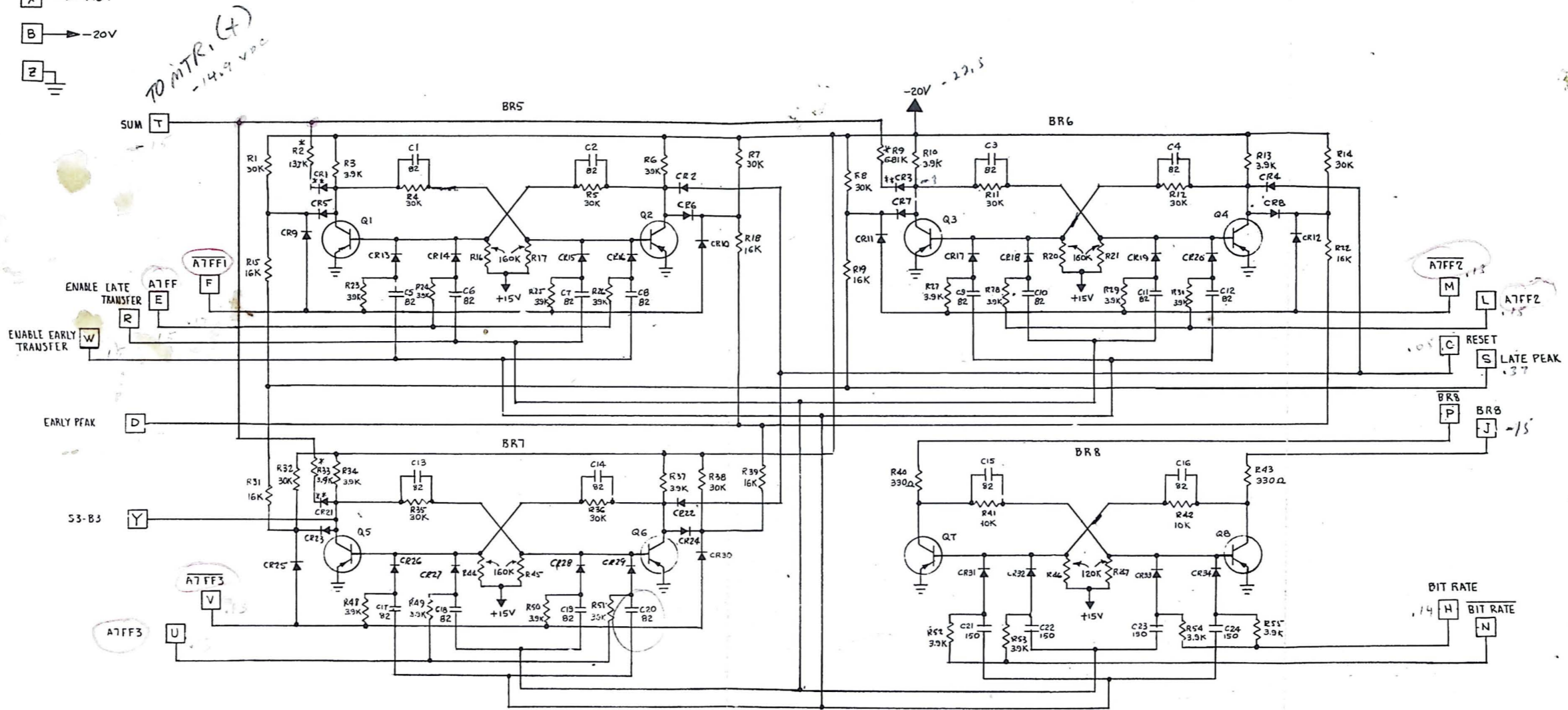
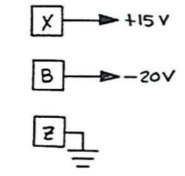
FIGURE 17



- NOTES
- UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE 1/4 W, ±5% AND ALL RESISTORS WITH ONE \* ARE FILM RESISTORS, ±1% TOL.
  2. ALL CAPACITOR VALUES IN PF, 5% TOL.
  3. ALL DIODES ARE 1N432 AND ALL DIODES WITH \*\* ARE 1N436
  4. NUMBERS INSIDE SQUARE ARE PIN #.
  5. ALL TRANSISTORS ARE 2N404

PC 108

FIGURE 18  
REG. DISTORTION IND +  
PEAK LOGIC



- NOTES
- UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/4 W, 15% AND ALL RESISTORS WITH ONE\* ARE FILM RESISTORS, 1% TOL.
  2. ALL CAPACITOR VALUES IN PF, 5% TOL.
  3. ALL DIODES ARE 1N432 AND ALL DIODES WITH DOUBLE\*\* ARE 1N456.
  4. NUMBERS INSIDE SQUARE ARE PIN #
  5. ALL TRANSISTORS ARE 2N404

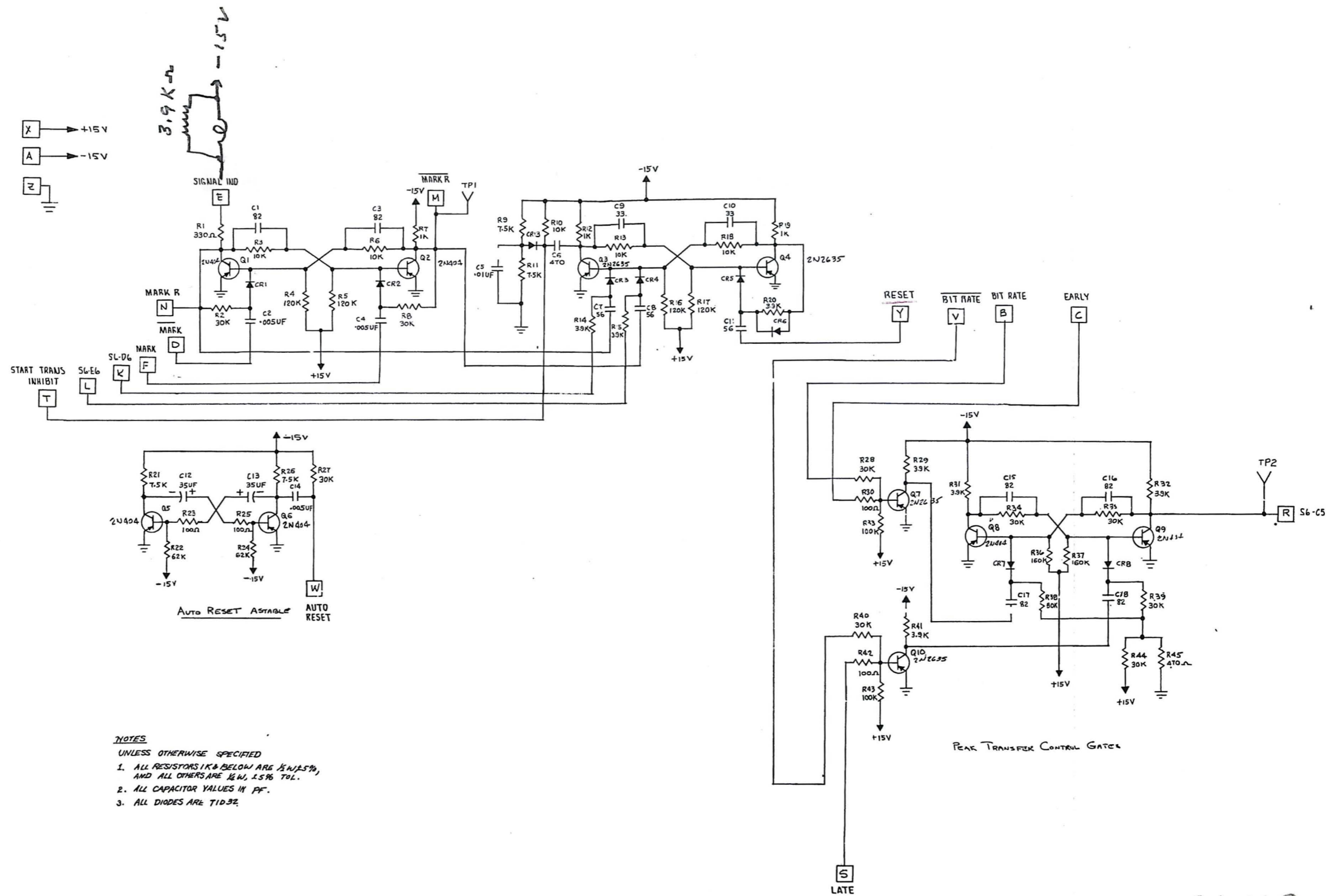
AB  
CD  
EF  
GH  
JK  
LM  
NP  
QR  
ST  
UV  
WX  
YZ

PARTS  
see fig 33

PC 109

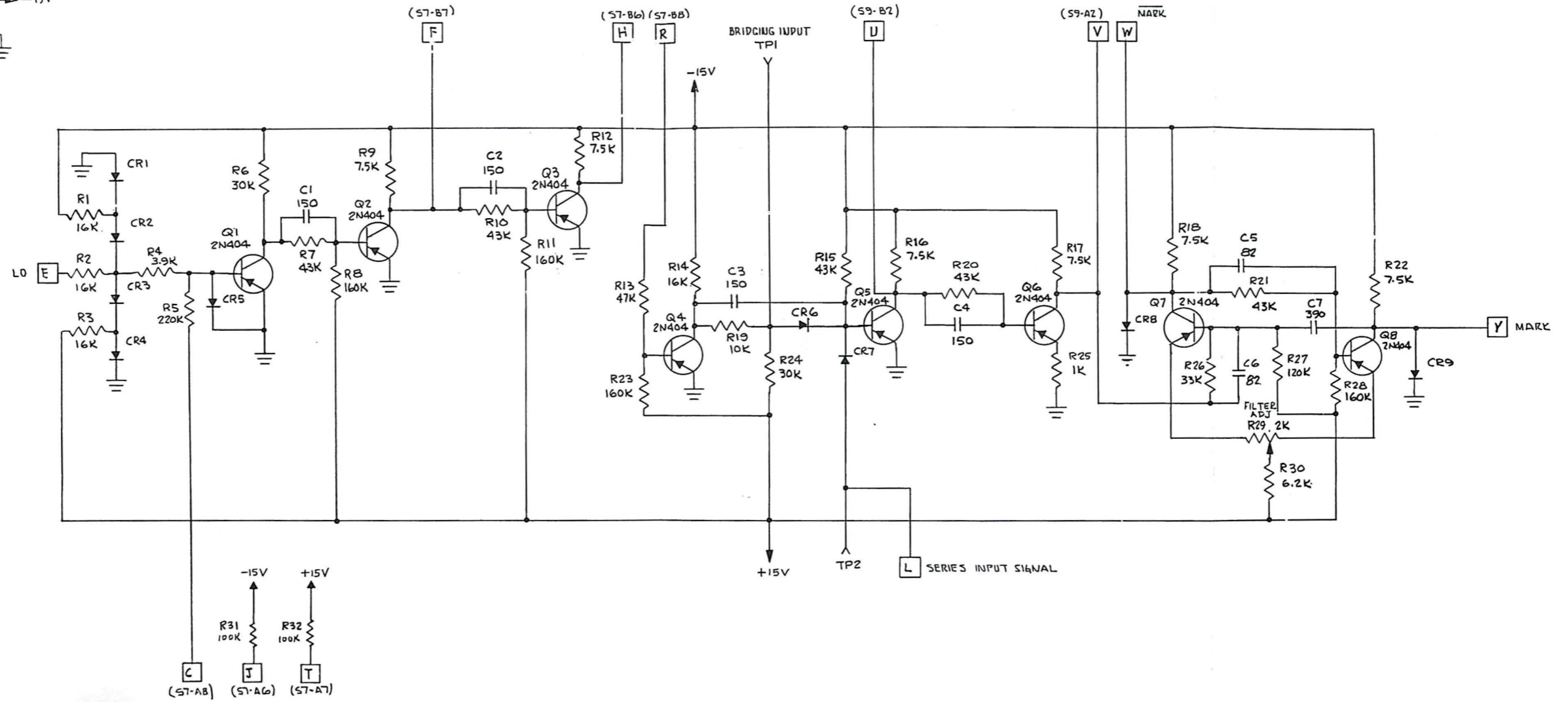
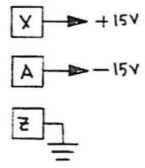
FIGURE 19

REG. DISTORTION INDICATOR  
& PEAK LOGIC



- NOTES**  
 UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS 1K & BELOW ARE 1/4W, 5%, AND ALL OTHERS ARE 1/4W, 1.5% TOL.
  2. ALL CAPACITOR VALUES IN PF.
  3. ALL DIODES ARE 1N32.

FIGURE 20

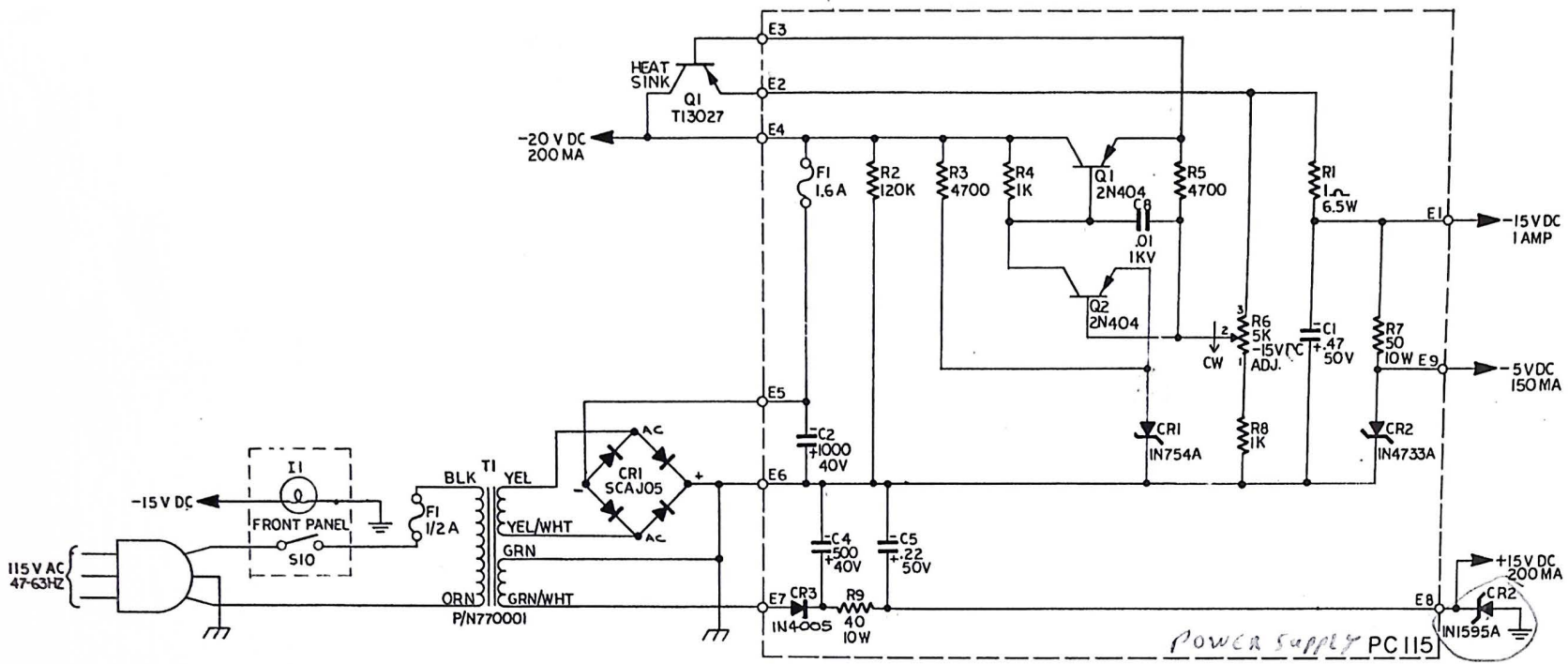


NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS 1K AND BELOW ARE 1/2 W ±5% ALL OTHERS ARE 1/4 W, ±5% TOL.
2. ALL CAPACITORS ARE IN PF ±5%
3. NUMBERS INSIDE SQUARE ARE PIN #.
4. ALL DIODES ARE T1D32.

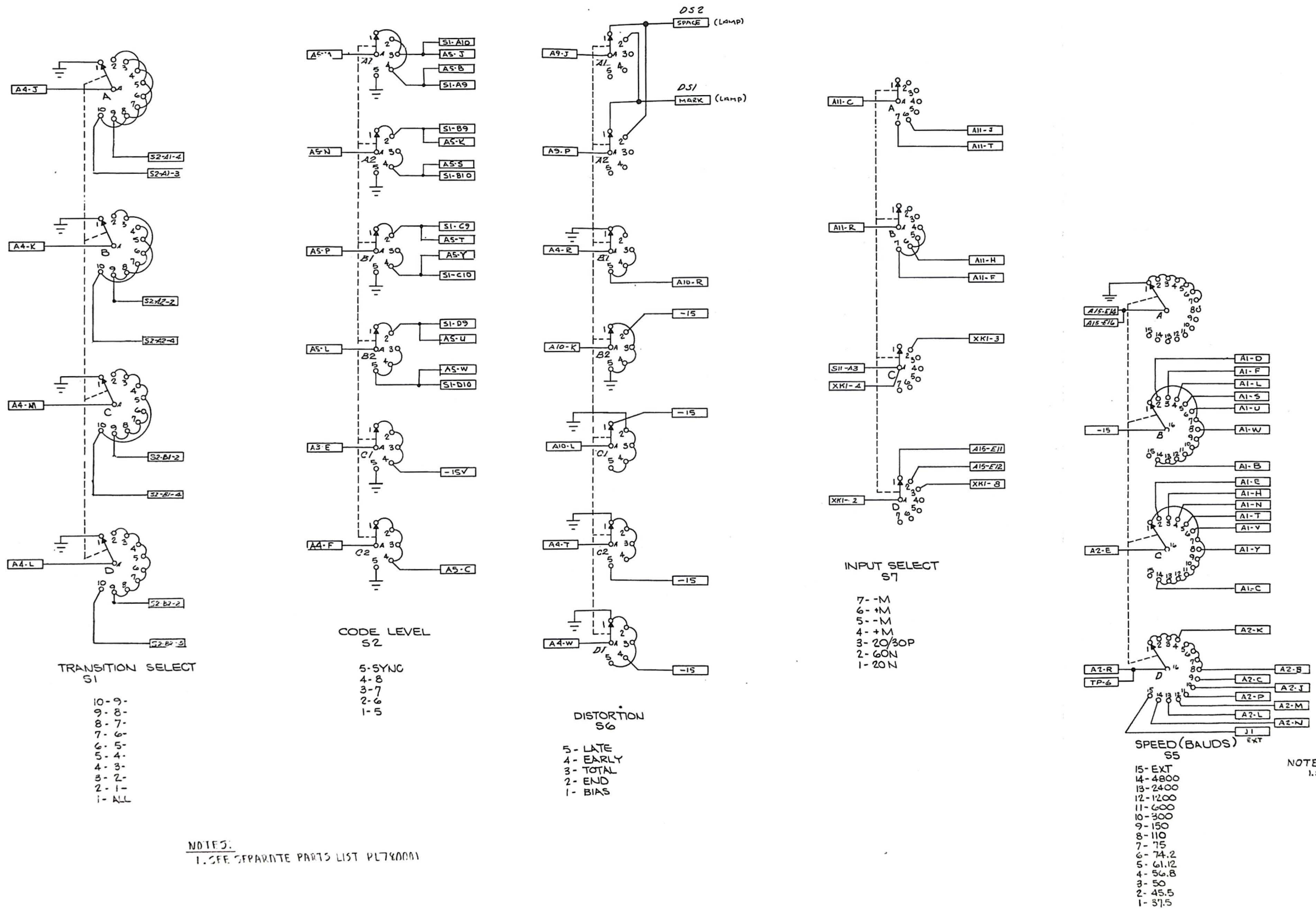
PC III  
INPUT CKT.

FIGURE 21



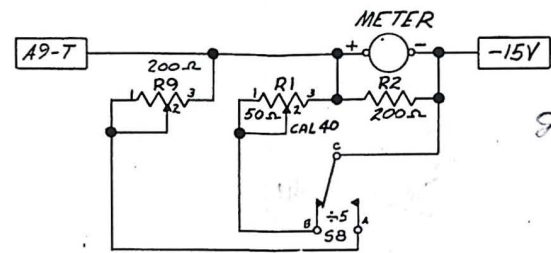
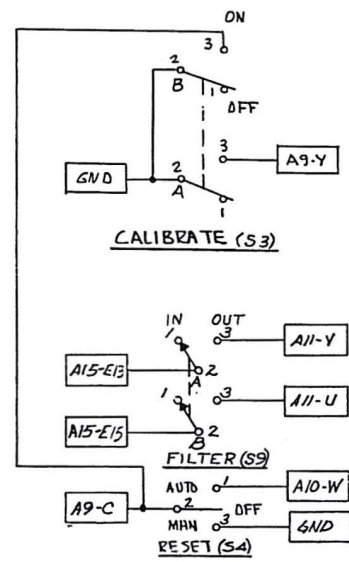
NOTES: UNLESS OTHERWISE SPECIFIED  
 1. ALL RESISTORS ARE IN OHMS, 1/4W, ±5%  
 2. ALL CAPACITORS ARE IN UF, ±5%

FIGURE 22

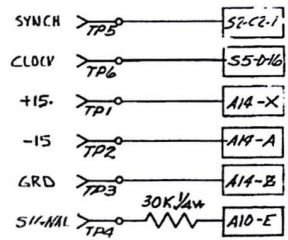
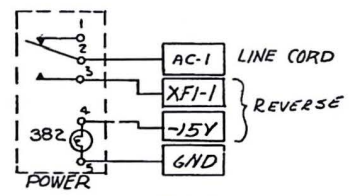
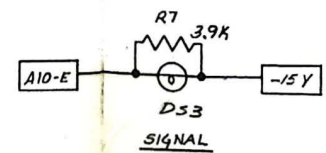
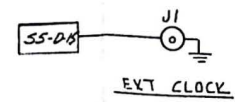
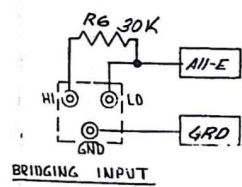
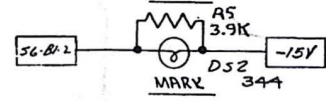
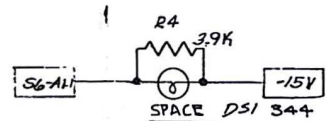
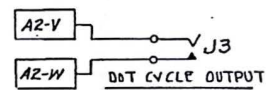
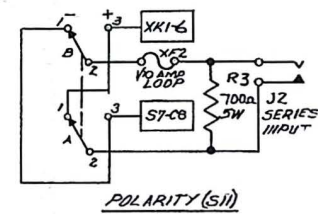


NOTES:  
1. SEE SHEET 2 FOR

FIGURE 23 A



See fig 10



**NOTES:**  
1. UNLESS OTHERWISE SPECIFIED:  
ALL RESISTORS ARE IN OHMS, 1/4W ±5%

FIGURE 23 B





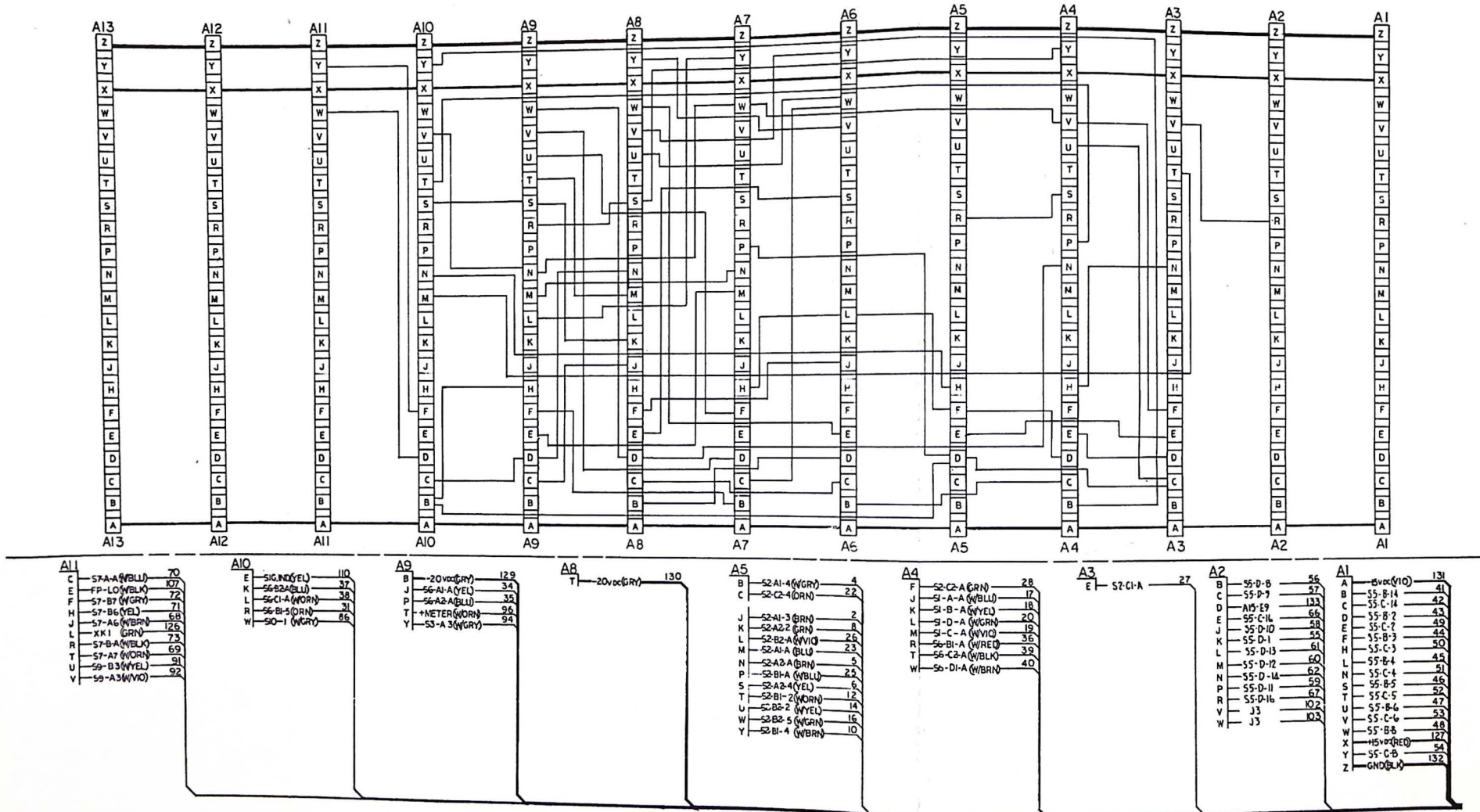
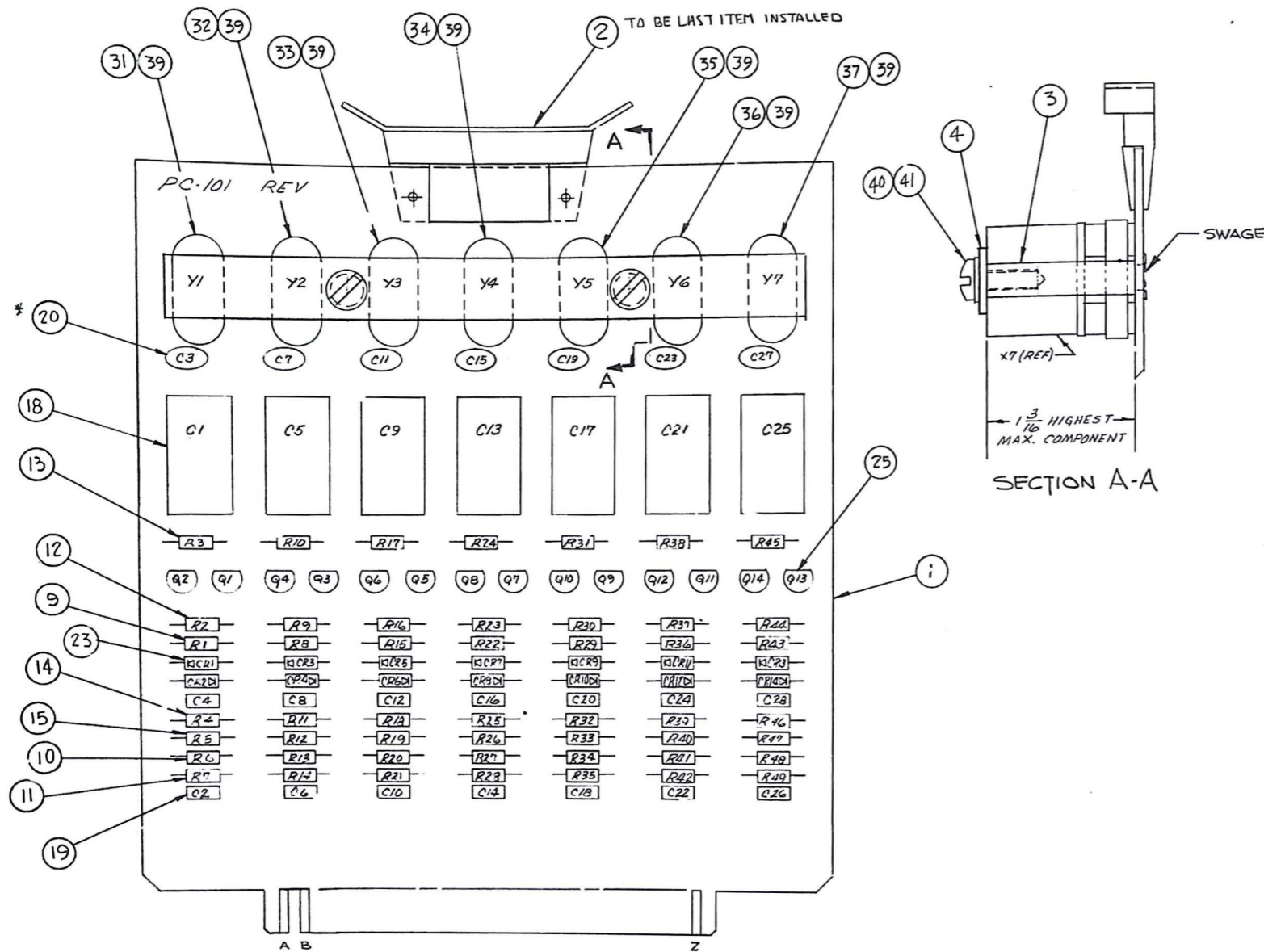


FIGURE 24

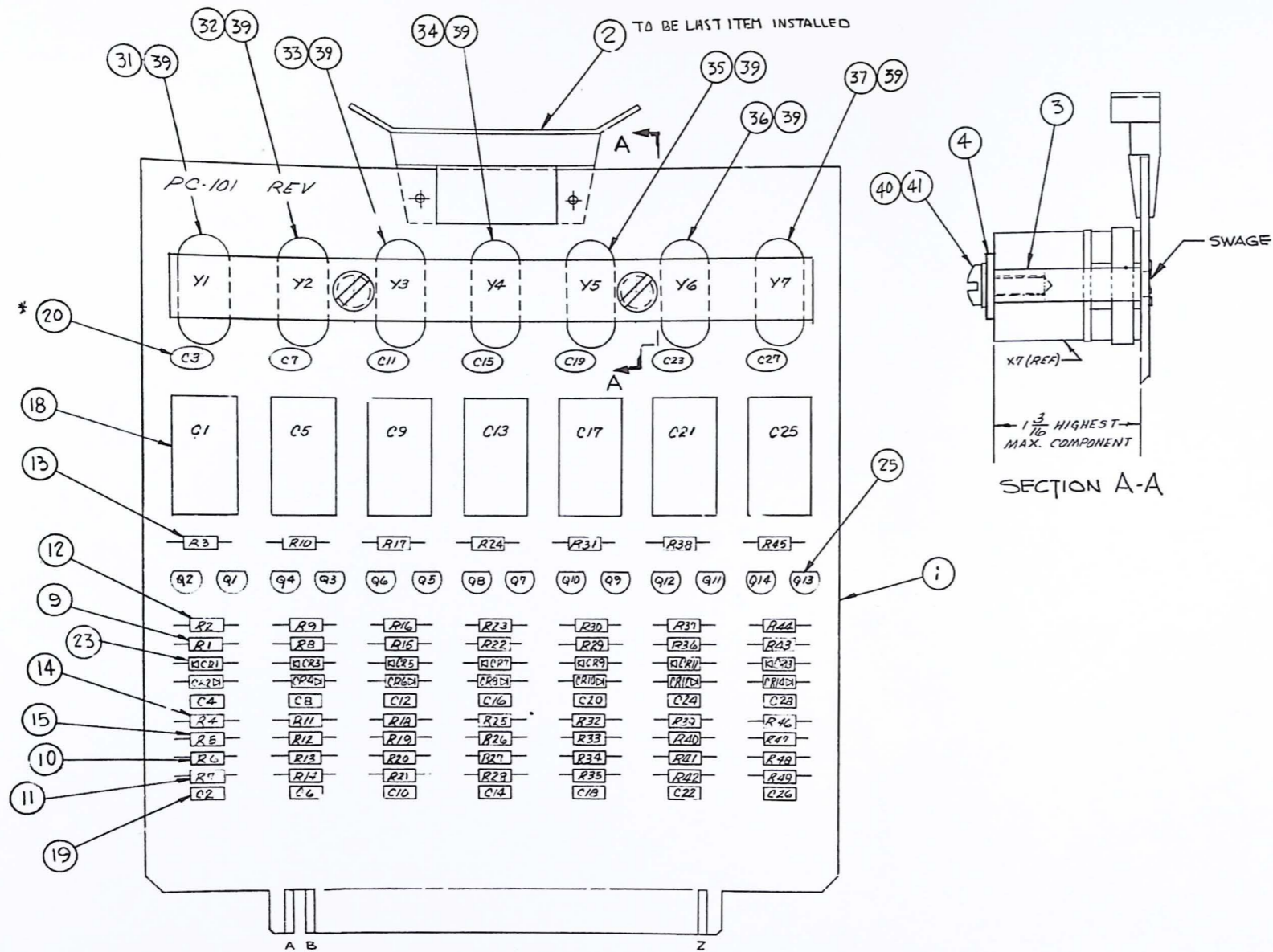


NOTES:

1. SEE SEPARATE PARTS LIST PL790001
  2. CONFORMAL COATING TO BE APPLIED AFTER ELECTRICAL INSPECTION
- COLUMBIA TECHNICAL CORP. NO. 1A20

ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780001	PC-101	PC Board		1	
2	CH/C/10037/3		Card Puller (blue)		1	Vero
3	SS-0532 0547B		Spacer 1-1/4 high		2	Amatom
4	710025		Strap/Support		1	
5						
6						
7						
8						
9	RC07	R1, 5, 13, 36, 43	Resistor, Fixed 10K, 1/4W ± 5%		7	
10	RC07	R6, 23, 34, 41, 34, 41, 34, 41	Resistor, Fixed 3.3K, 1/4W ± 5%		7	
11	RC07	R7, 14, 35, 42, 49	Resistor, Fixed 10ohm, 1/4W "		7	
12	RC07	R2, 9, 16, 23, 30, 37, 44	Resistor, Fixed 2K, 1/4W "		7	
13	RC07	R3, 10, 17, 24, 31, 38, 45	Resistor, Fixed 220 ohm, 1/4W "		7	
14	RC07	R4, 11, 18, 25, 32, 39, 46	Resistor, Fixed 4.3K, 1/4W "		7	
15	RC07	R5, 12, 19, 26, 33, 40, 47	Resistor, Fixed 2.7K, 1/4W "		7	
16						
17						
18	T52317-14	C1, 5, 9, 13, 17, 21, 25	Capacitor 10-180Pf		7	Electromotive
19	CK05HX104-K	C2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28	Capacitor, Inf, ± 10% 100V		14	
20	CD6CD330J03	C3, 7, 11, 15, 19, 27	Capacitor, Select at test		7	Cornell-Dubilier
21						
22						
23	1N914	CRI-CR14	Diode		14*	
24						
25	MPS6531	Q1-Q14	Transistor		14	Motorola
26						
27						
28						
29						
30						
31		Y1	Crystal 1.92 Mhz		1	Sherold Crystals
32		Y2	Crystal 2.3296 Mhz		1	Sherold Crystals
33		Y3	Crystal 2.55 Mhz		1	Sherold Crystals
34		Y4	Crystal 2.90816 Mhz		1	Sherold Crystals
35		Y5	Crystal 1.56467 Mhz		1	Sherold Crystals
36		Y6	Crystals 1.89952 Mhz		1	Sherold Crystals
37		Y7	Crystal 2.816 Mhz		1	Sherold Crystals
38						
39	1945		Socket, crystal		7	H. H. Smith
40	6-32 x 3/8 lg.		Screw, Phillips Pan Hd.		2	
41	No. 6		Wash. Int. Tooth		2	
42						
43						
44						
45	1A20		C-N Formal Coating (Humiseal)		A/R	Columbia Tech. Corp.
46	STR0001		SCHEMATIC DIAGRAM		REF	

FIGURE 25

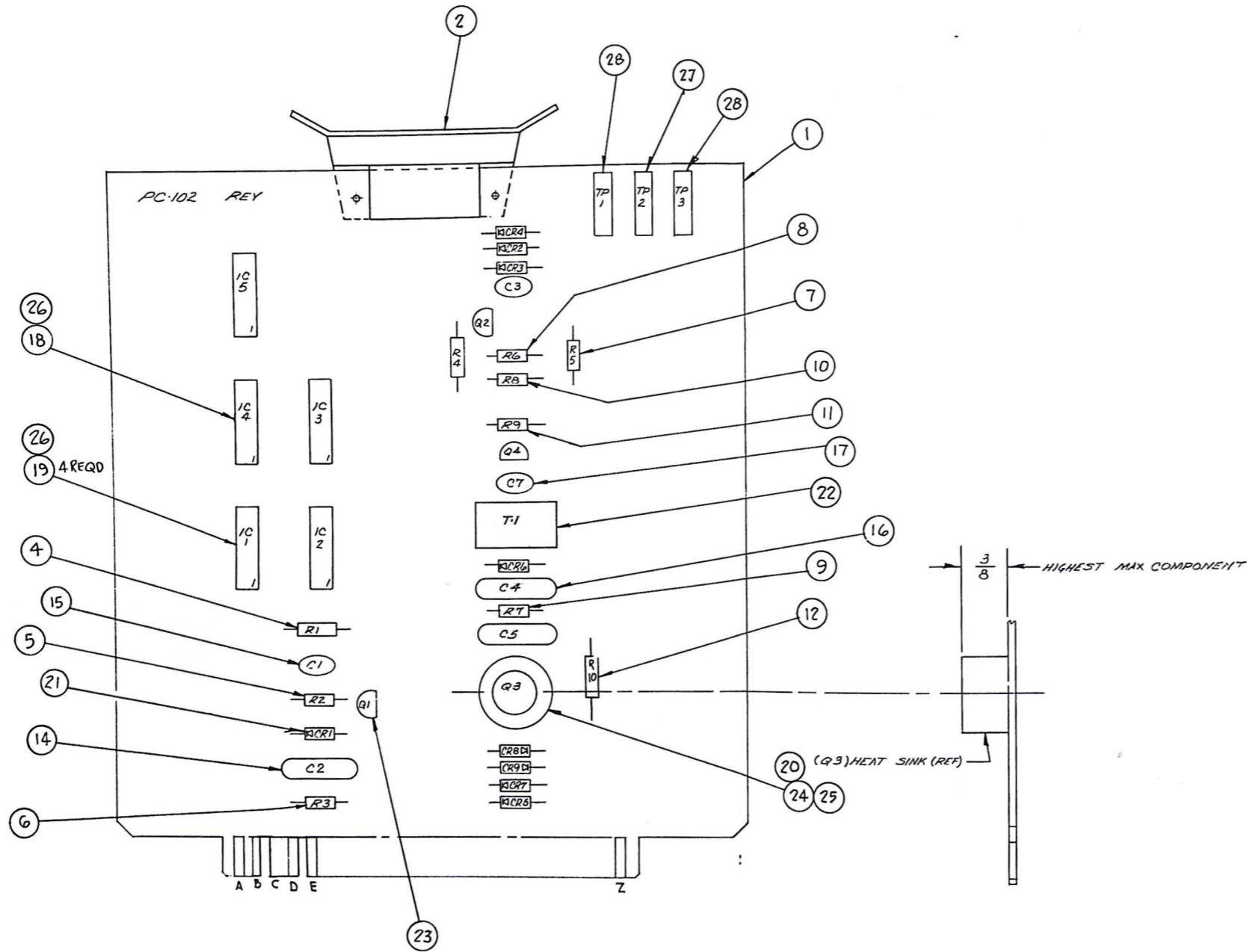


NOTES:

- 1. SEE SEPARATE PARTS LIST PL790001
- 2. CONFORMAL COATING TO BE APPLIED AFTER ELECTRICAL INSPECTION
- COLUMBIA TECHNICAL CORP. NO. 1A20

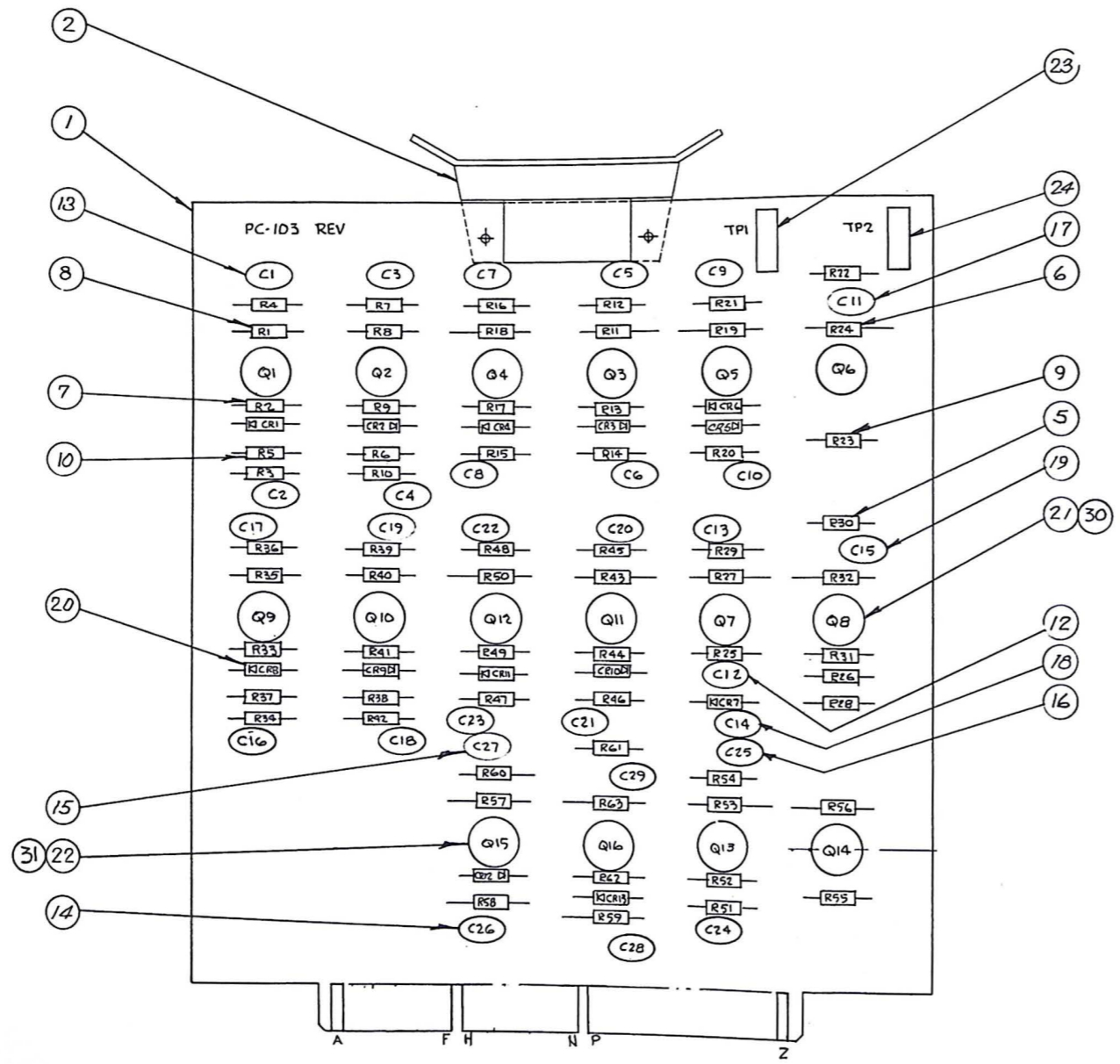
ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780001	PC-101	PC Board		1	
2	CH/C/10037/3		Card Puller (blue)		1	Vero
3	SS-0632 9547B		Spacer 1-1/4 high		2	Amatom
4	770025		Strap/Support		1	
5						
6						
7						
8						
9	RC07	R1, 9, 13, 38, 43	Resistor, Fixed 10K, 1/4W ± 5%		7	
10	RC07	R6, 13, 20, 27, 34, 41	Resistor, Fixed 3.3K, 1/4W ± 5%		7	
11	RC07	R7, 14, 31, 29, 35, 42, 49	Resistor, Fixed 10 ohm, 1/4W "		7	
12	RC07	R2, 9, 16, 23, 30, 37, 44	Resistor, Fixed, 2K, 1/4W "		7	
13	RC07	R3, 10, 17, 24, 31, 38, 45	Resistor, Fixed 220 ohm, 1/4W "		7	
14	RC07	R4, 11, 18, 25, 32, 39, 46	Resistor, Fixed 4.3K, 1/4W "		7	
15	RC07	R5, 12, 19, 26, 33, 40, 47	Resistor, Fixed 2.7K, 1/4W "		7	
16						
17						
18	T52317-14	C1, 5, 9, 13, 17, 21, 25	Capacitor 10-180Pf		7	Electromotive
19	CK06BX104-K	C2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28	Capacitor, luf, ± 10% 100V		14	
20	CD6CD330J03	C3, 7, 11, 15, 19, 27	Capacitor, Select at test		7	Cornell-Dubilier
21						
22						
23	1N914	CR1-CR4	Diode		14*	
24						
25	MPS6531	Q1-Q14	Transistor		14	Motorola
26						
27						
28						
29						
30						
31		Y1	Crystal 1.92 Mhz		1	Sherold Crystals
32		Y2	Crystal 2.3296 Mhz		1	Sherold Crystals
33		Y3	Crystal 2.53 Mhz		1	Sherold Crystals
34		Y4	Crystal 2.90816 Mhz		1	Sherold Crystals
35		Y5	Crystal 1.56467 Mhz		1	Sherold Crystals
36		Y6	Crystals 1.89952 Mhz		1	Sherold Crystals
37		Y7	Crystal 2.816 Mhz		1	Sherold Crystals
38						
39	1945		Socket, crystal		7	H. H. Smith
40	6-32 x 3/8 lg.		Screw, Phillips Pan Hd.		2	
41	No. 6		Wash. Int. Tooth		2	
42						
43						
44						
45	1A20		C-N Formal Coating (Humiseal)		A/R	Columbia Tech. Corp.
46	S780001		SCHEMATIC DIAGRAM		REF	

FIGURE 25



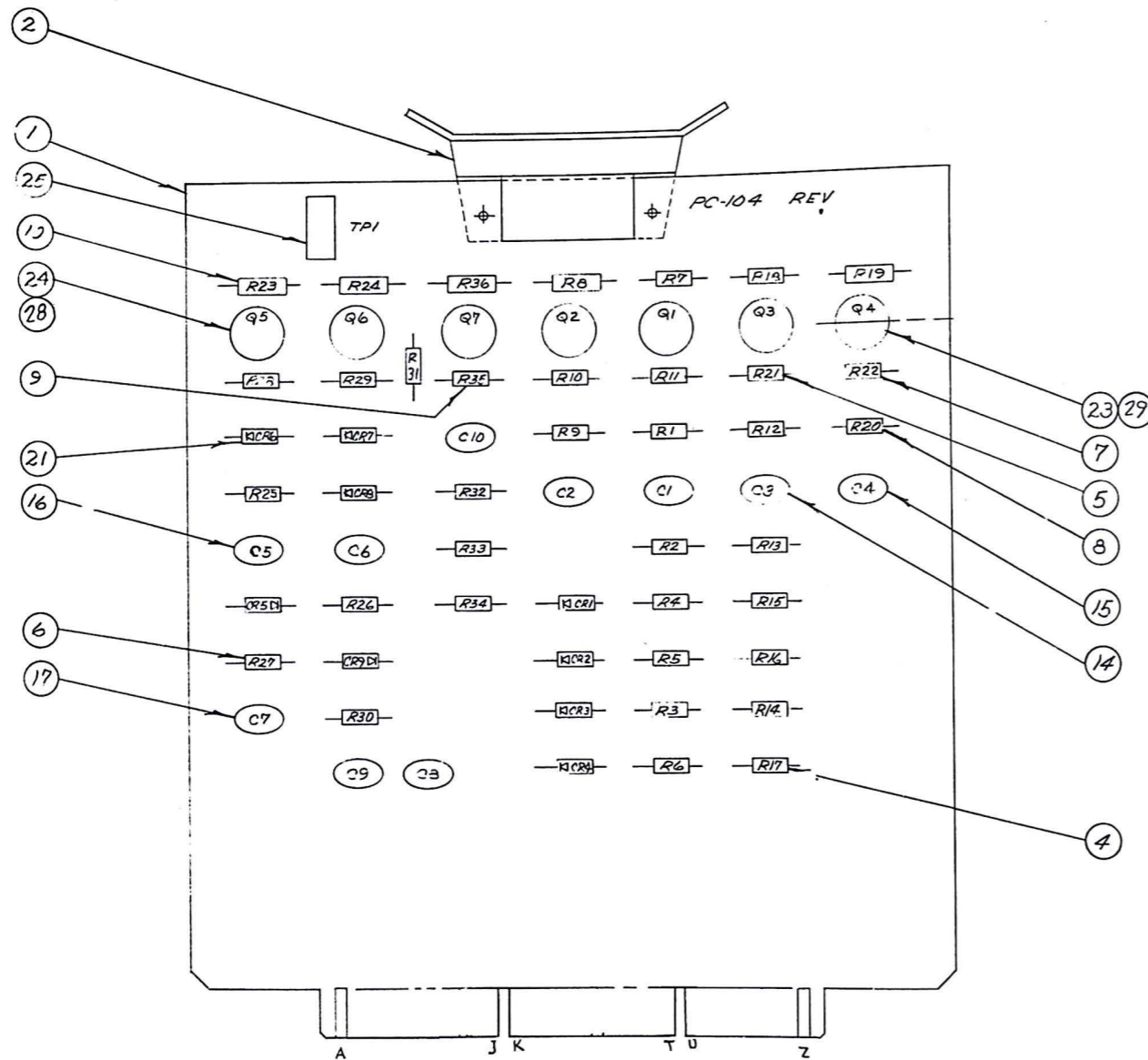
PARTS LIST FOR: 200X BAUD RATE GEN ASSEMBLY (CDA-770)						
ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780002	PC-102	PC Bd.		1	
2	CH/C/10037/3		Card Puller (Blue)		1	VERO
3						
4	RC07	R1,4	Resistor, Fixed 1K, 1/2W ± 5%		2	
5	RC07	R2	Resistor, Fixed 5.1K, 1/4W ± 5%		1	
6	RC20	R3	" " .51 ohm 1/2W "		1	
7	RC07	R5	" " 3.3K 1/4W "		1	
8	RC07	R6	" " 10K 1/4W "		1	
9	RC20	R7	" " 22 1/4W "		1	
10	RC07	R8	" " 15K 1/4W "		1	
11	RC07	R9	" " 5.6K 1/4W "		1	
12	RC20	R10	" " 510, 1/2W "		1	
13						
14	K2R2C 20K	C2	Capacitor, Polarized 2.2uf 20V		1	Kemet
15	CD7FC221 J03	C1, C3	Capacitor 220 Pf, ± 5%, 300V		2	Cornell Dubilier
16	10P2-104	C4, C5	Capacitor .1 uf., 100V		2	Elmenco
17	CD7FD151J03	C7	Capacitor 150pfd, ± 5%, 500V		1	Cornell Dubilier
18	MC856P	IC4	I.C.		1	Motorola
19	MC839P	IC1, 2, IC3, 5,	I.C.		4	Motorola
20	7717-22N	Q3	TRANSISTOR PAD		1	THERMALLOY
21	IN914	CR1-9	DIODES		8	
22	33FGC	T1	TRANSFORMER		1	Technitrol
23	MPS6531	Q1, 2, 4	TRANSISTORS		3	Motorola
24	2N3439	Q3	TRANSISTORS		1	
25	2211		HEATSINK		1	Termalloy
26	1-380859-4		SOCKET, I.C.		5	AMP
27	119437-H	TP2	P.C. Test Jacks (Yellow)		1	Cinch
28	119437-G	TP1, 3	P.C. Test Jack (Blue)		2	Cinch
29						
30	1A20		Conformal Coating (Humiseal)		A/R	Columbia Tech. Corp.
31						
32						
33	S780002		SCHEMATIC		REF.	
34						

FIGURE 26



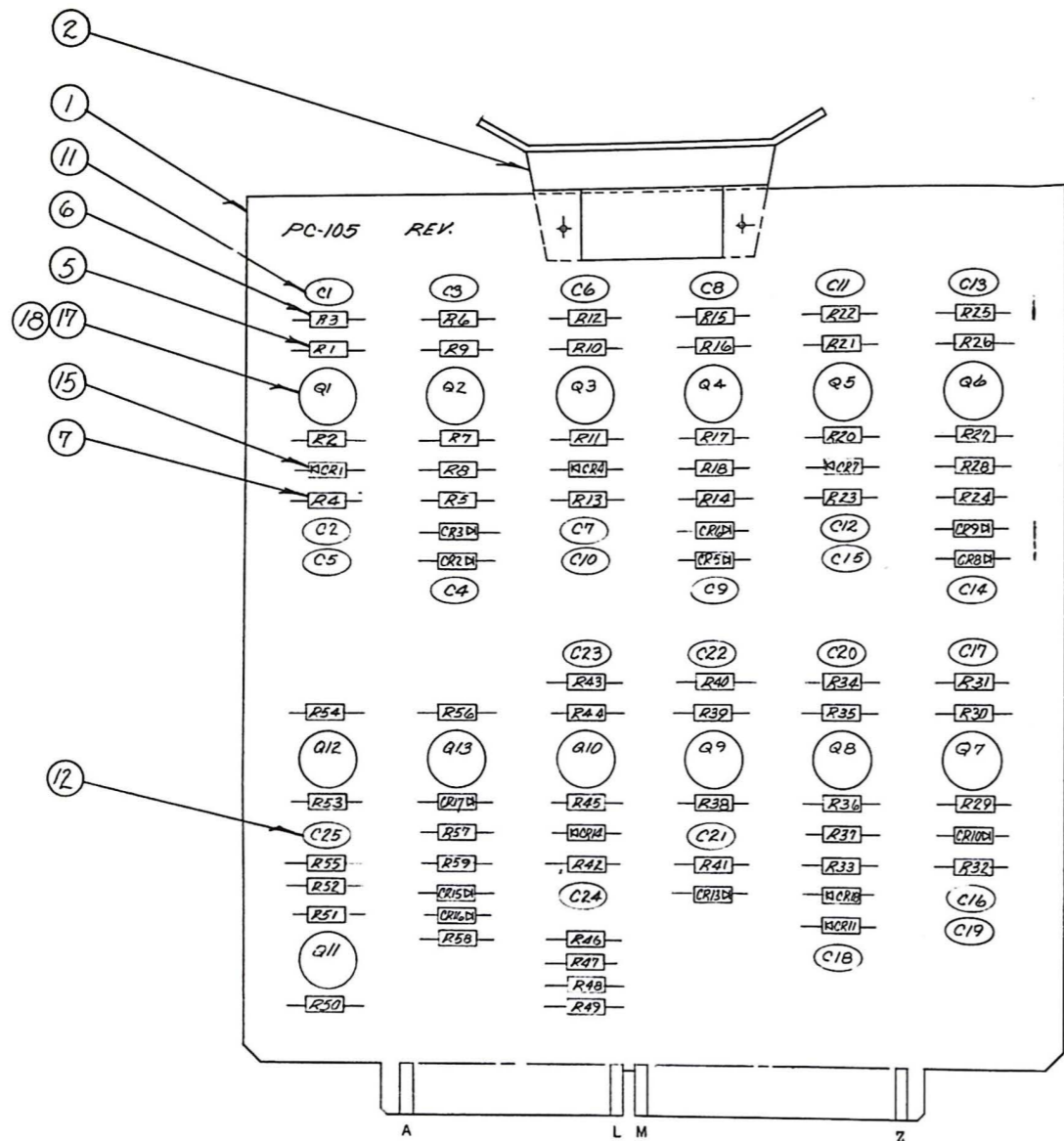
ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780003	PC-103	PC Bd.		1	
2	CH/C/10037/3		Card Puller (Blue)		1	VERO
3						
4						
5	RC07	R12, 16, 21, 22, 29, 30, 45, 48, 51, 54, 60, 61	Resistor, Fixed, 10K, 1/4W, ± 5%		12	
6	RC20	R11, 18, 19, 24, 27, 32, 43, 50, 53, 56, 63	Resistor, Fixed, 1K, 1/2W, ± 5%		14	
7	RC07	R2, 3, 4, 7, 9, 10, 20, 28, 33, 34, 36, 39, 41, 42	Resistor, Fixed, 30K, 1/4W, ± 5%		14	
8	RC07	R1, 8, 13, 17, 25, 26, 35, 40, 44, 49	Resistor, Fixed, 3.9K, 1/4W, ± 5%		10	
9	RC07	R14, 15, 23, 31, 46, 47, 52, 55, 62	Resistor, Fixed, 120K, 1/4W, ± 5%		9	
10	RC07	R5, 6, 37, 38	Resistor, Fixed, 160K, 1/4W, ± 5%		4	
11						
12	CD7FC331J03	C12	Capacitor, Fixed 330pf @ 300V		1	Cornell-Dubilier
13	CD6EC870J03	C1-C4, C10, 13, 16, 17, 18, 19, 20, 22, 28	Capacitor, Fixed 82pf. @ 300V		13	Cornell-Dubilier
14	CD6ED560J03	C6, 8, 21, 23, 26	Capacitor, Fixed, 56 pf. @ 500V		5	Cornell-Dubilier
15	CD6CD330J03	C5, 7, 9, 27	Capacitor, Fixed, 33 pf. @ 500V		4	Cornell-Dubilier
16	CD6CD220J03	C24, 25, 28	Capacitor, Fixed, 22 pf. @ 500V		3	Cornell-Dubilier
17	CD6CD100D03	C11	Capacitor, Fixed, 10pf., @ 500V		1	Cornell-Dubilier
18	CD7FD151J03	C14	Capacitor, Fixed, 150 pf. @ 500V		1	Cornell-Dubilier
19	CD7FC221J03	C15	Capacitor, Fixed, 220 pf. @ 300V		1	Cornell-Dubilier
20	T1D32	CRI-13	DIODES		13	Texas Instrument
21	2N404	Q1, 2, 7, 8, 9, 10	TRANSISTORS		6	
22	2N2635	Q3, 4, 5, 8, 11, 12, 13, 14, 15, 18	TRANSISTORS		10	
23	119437-H	TP1	P.C. Test Jacks (Yellow)		1	Cinch Mfg.
24	119437-G	TP2	P.C. Test Jack (Blue)		1	Cinch Mfg.
25						
26						
27						
28						
29						
30	7717-22N	XQ1, 2, 7, 8, 9, and 10.	TRANSISTOR PAD		6	
31	7717-44N	XQ3, 4, 5, 6, 11, 12, 13, 14, 15, 16.	TRANSISTOR PAD		10	
32	1A20		CONFORMAL COATING (Humiseal)		A/R	Columbia Tech. Corp.
33	S780003		SCHEMATIC DIAGRAM		REF	

FIGURE 27



ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780004	PC-104	P.C. Board		1	
2	CH/C/10037/3		Card Puller (Blue)		1	VERO
3						
4	RC07	R1-R6	Resistors, Fixed, 30K, 1/4W, ±5%		12	
5	RC07	R11, R21	Resistors, Fixed 160K 1/4W ± 5%		2	
6	RC07	R7, 18,	Resistors, Fixed 3.9K 1/4W ± 5%		5	
		27,30,31				
7	RC07	R10, 22	Resistors, Fixed 120K 1/4W ± 5%		4	
		28, 29				
8	RC07	R9, 20,	Resistors, Fixed 10K 1/4W ± 5%		7	
		25, 26,				
		32, 33, 34.				
9	RC07	R35	Resistor, Fixed 62K 1/4W, ± 5%			
10	RC20	R8, 19,	Resistors, Fixed 1K, 1/2W ± 5%		5	
		23,34,36				
11						
12						
13						
14	CD6CD220J03	C1,3,10	Capacitor, Fixed, 22 pf @ 500V		3	Cornell-Dubilier
15	CD6CD220J03	C2, C4	Capacitor, Fixed, 220 pf @ 500V		2	Cornell-Dubilier
16	CD6EC820J03	C5, C6	Capacitor, Fixed 82 pf @ 300V		2	Cornell-Dubilier
17	CD6ED560J03	C7,8,9	Capacitor, Fixed 56 pf @ 500V		3	Cornell-Dubilier
18						
19						
20						
21	T1D32	CRI-9	DIODES		9	Texas Instrument
22						
23	2N404	Q1-Q4	TRANSISTORS		4	
24	2N2635	Q5,6,7	TRANSISTORS		3	
25	119437-H	TP1	TEST JACK (YELLOW)		1	CINCH MFG.
26						
27						
28	7717-44N	XQ5,6,7	TRANSISTOR PAD		3	
29	7717-22N	XQL2,3,4	TRANSISTOR PAD		4	
30						
31	1A20		CONFORMAL COATING (humiseal)		A/R	Columbia Tech. Corp.
32	S780004		SCHEMATIC DIAGRAM		REF	

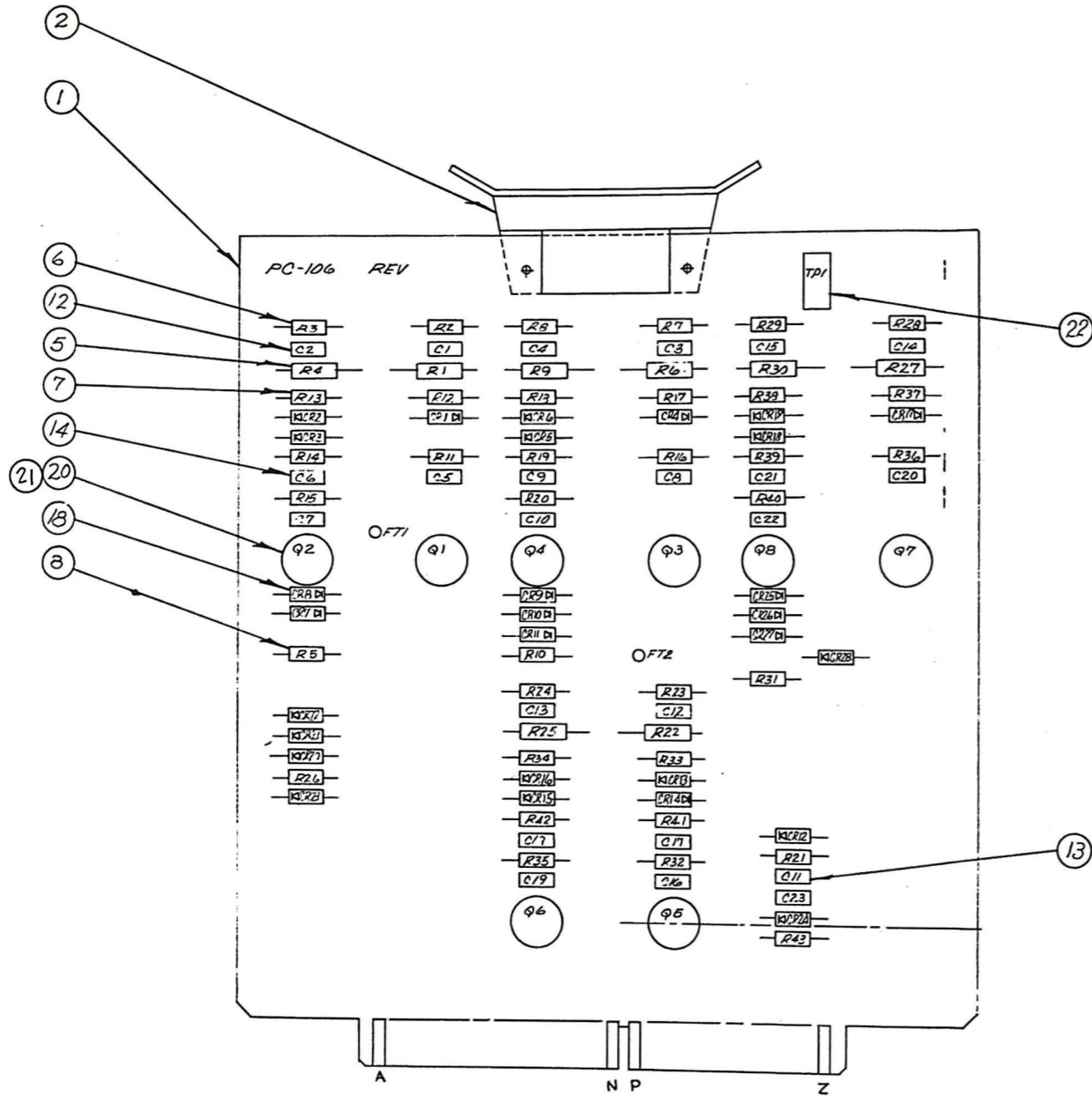
FIGURE 28



ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780005	PC-105	P. C. BOARD		1	
2	CH/C/10037/3		CARD PULLER (BLUE)		1	VERO
3						
4						
5	RC07	R1,9,10, 16,21,26, 30,35,36, 44,54,56	Resistor, Fixed - 3.9K, 1/4W ± 5%		12	
6	RC07	R2,3,6, 7,8,11, 12,15,17, 18,20,22, 25,27,28, 29,31,34, 37,38,40, 43,45,46, 47,48,49, 50,53,57, 58,51,36	Resistor, Fixed - 30K, 1/4W ± 5%		33	
7	RC07	R4,5,13, 14,19,23, 24,32,33, 41,42,52, 55,59	Resistor, Fixed - 160K, 1/4W ± 5%		14	
8						
9						
10						
11	CD6EC820J03	C1 thru C24	CAPACITORS, FIXED 82 pf @ 300V		24	Cornell-Dubilier
12	CD7FD151J03	C25	CAPACITOR, FIXED 150 pf @ 500V		1	Cornell-Dubilier
13						
14						
15	T1D02	CR1-17	DIODES		17	Texas Instrument
16						
17	2N404	Q1-Q3	TRANSISTORS		13	
18	7717-22N		TRANSISTOR PAD		13	Thermolloy
19						
20						
21	S780005		SCHEMATIC DIAGRAM		REF	
22	IA20		Conformal Coating (Humiseal)		A/R	Colombia Tech. Corp.

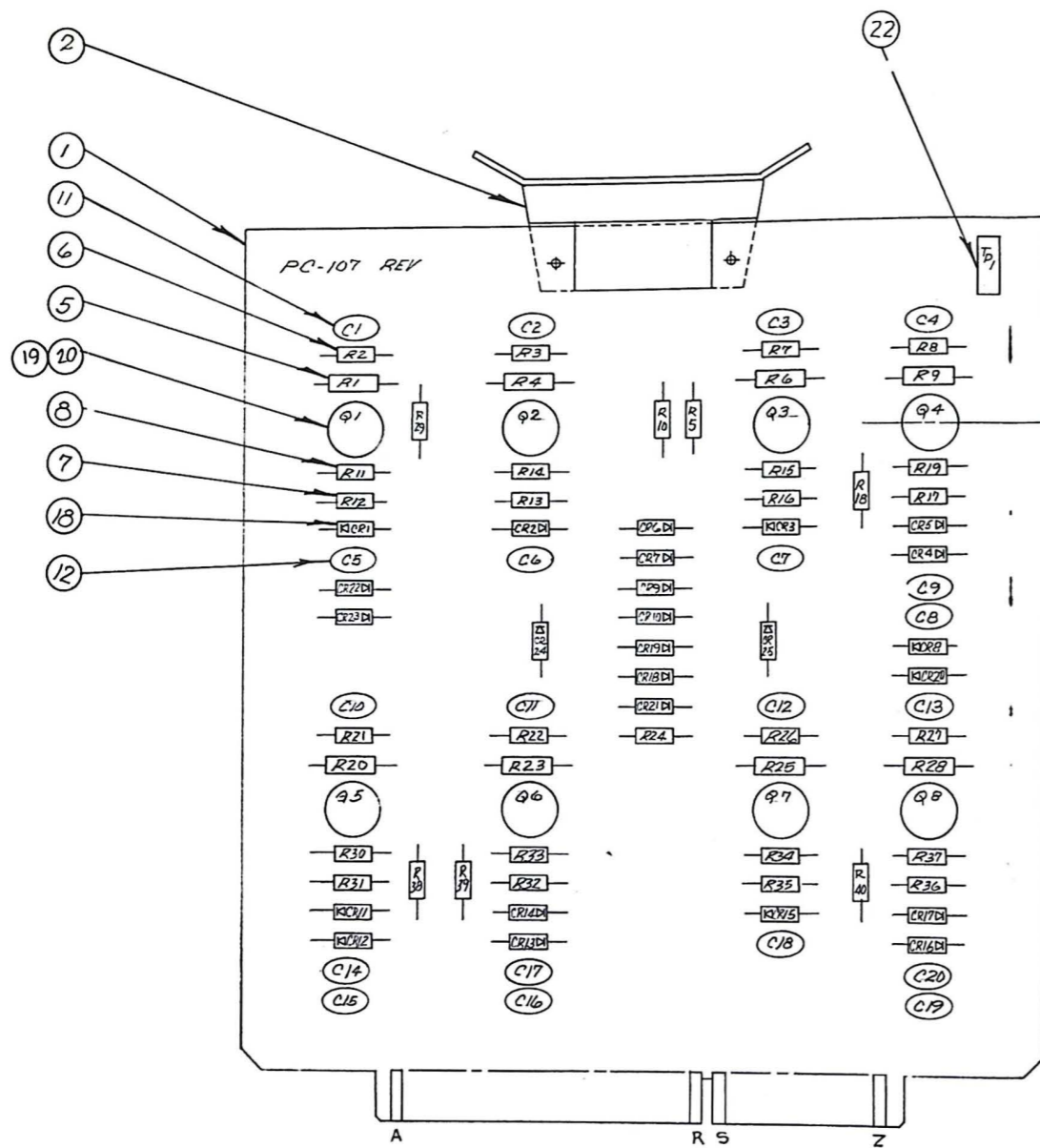
FIGURE 29





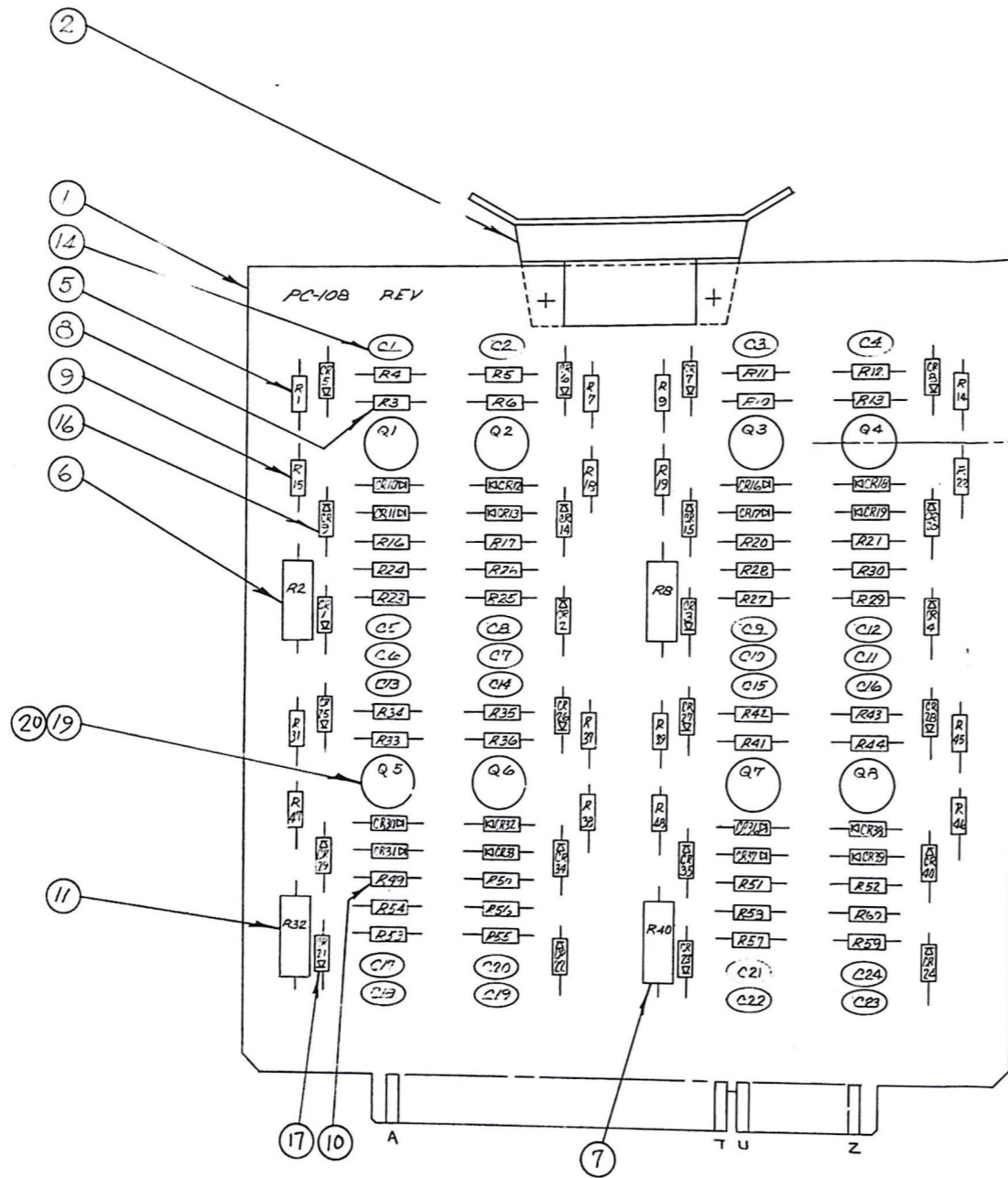
ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780005		P.C. BOARD		1	
2	CH/C/10637/3		CARD PULLER (BLUE)		1	VERO
3						
4						
5	RC20	R1,4,6, 9, 22, 24, 27,30,	RESISTOR, FIXED - 1K 1/2W±5%		8	
6	RC07	R2,3,7A, 23, 24, 28, 29	RESISTOR, FIXED 10K 1/4W ±5%		8	
7	RC07	R12, 13, 17,18,33, 34,37,38	RESISTOR, FIXED 120K1/4W±5%		8	
8	RC07	R5,10,11, 14,15,16, 19,20,21, 26,31,32, 35,36,39, 40, 43	RESISTOR, FIXED 3.8K 1/4W±5%		10	
9						
10						
11						
12	CD6CD330J03	C1,2,3, 4,12,13	CAPACITOR, FIXED-33pf±5%500V		6	Cornell-Dubilier
13	CD6EC820J03	C11, 23	Capacitor, Fixed - 82pf ±5% 300V		2	Cornell-Dubilier
14	CD6ED580J03	C5,6,7, 8,9,10, 16,17,18, 19,20,21, 22,14,15	Capacitor, Fixed-56pf ±5% 500V		15	Cornell-Dubilier
15						
16						
17						
18	TID32	CR1-28	DIODES		28	Texas Instrument
19						
20	2N2835	Q1-Q8	TRANSISTORS		8	
21	7717-44N	XQ1-8	TRANSISTOR PAD		8	Thermalloy
22	119437-H	TP1	TEST JACK (YELLOW)		1	CINCH MFG.
23	1A20		Conformal Coating (Humiseal)		A/R	Columbus Tech. Corp.
24	S780008		SCHEMATIC DIAGRAM		REF	

FIGURE 30



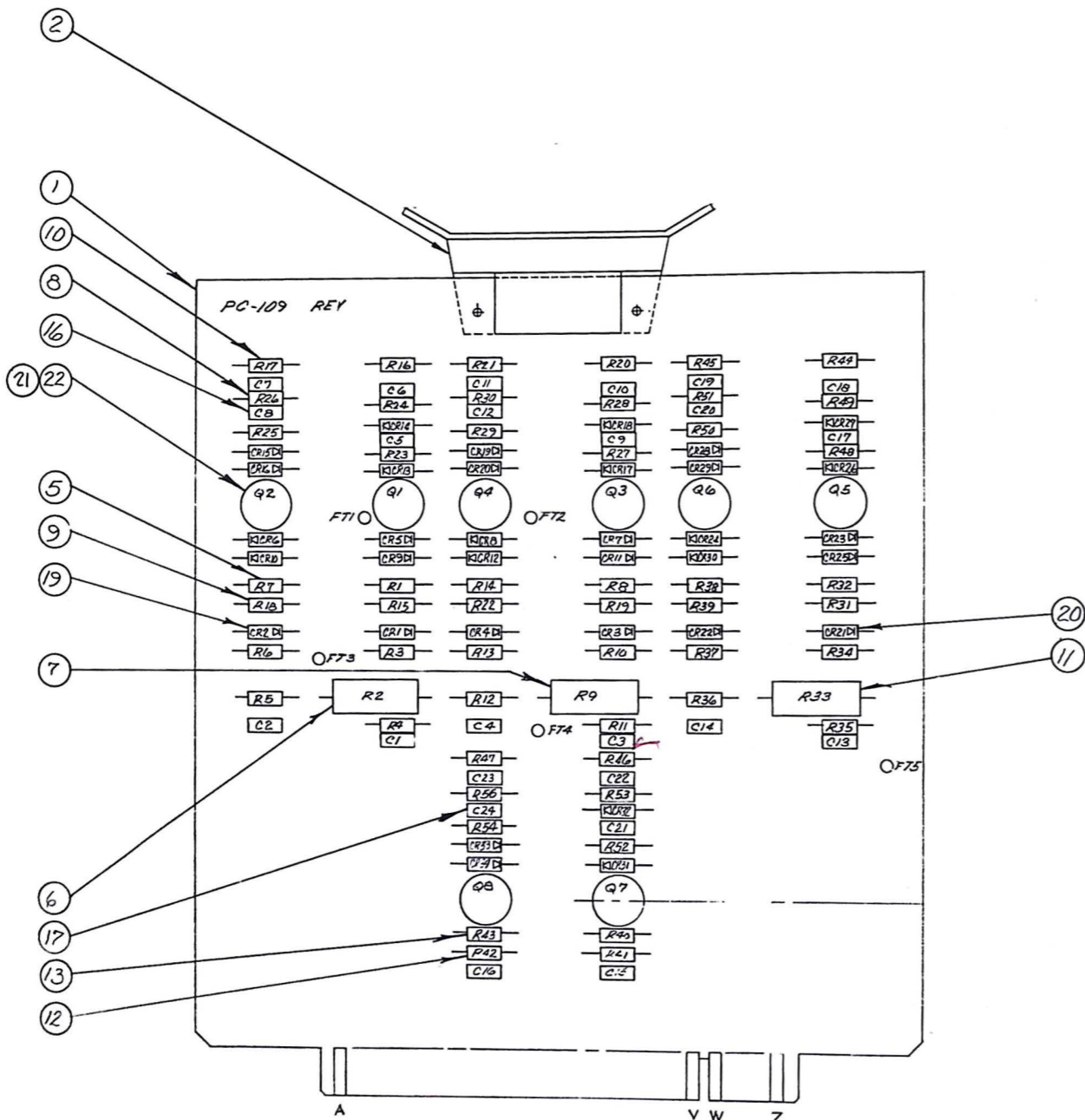
ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780007		P. C. BOARD		1	
2	CH/C/10037/3		CARD PULLER (BLUE)		1	VERBO
3						
4						
5	RC20	R1,4,6,9,20,23,25,28	RESISTORS, FIXED-1K 1/2W ±5%		8	
6	RC07	R2,3,7,8,21,22,26,27	RESISTORS, FIXED 10K 1/4W ±5%		8	
7	RC07	R12,13,16,17,31,32,35,36	RESISTORS, FIXED 120K 1/4W ±5%		8	
8	RC07	R10,11,14,15,18,19,24,29,30,33,34,37,38,39,40,5.	RESISTORS, FIXED 3.9K 1/4W ±5%		16	
9						
10						
11	CD6CD330J03	C1,2,3,4,10,11,12,13	CAPACITORS, Fixed-33pf ±5%500V		8	Cornell-Dubilier
12	CD6ED560J03	C5-9, C14-C20	CAPACITOR, Fixed -56pf, ±5%500V		12	Cornell-Dubilier
13						
14						
15						
16						
17						
18	T1D32	CR1 thru CR25	DIODES		25	Texas Instrument
19	2N2835	Q1-Q8	TRANSISTORS		8	
20	7717-44N	XQ1-8	TRANSISTOR PAD		8	Thermalloy
21						
22	119437-H	TP1	TEST JACK (YELLOW)		1	CINCH MFG.
23	1A20		Conformal Coating (Humiseal)		A/R	Columbia Tech. Corp.
24	S780007		SCHEMATIC DIAGRAM		REF	

FIGURE 31



ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780008	PC-108	P.C. BOARD		1	
2	CR(C/10037/3		CARD PULLER (BLUE)		1	VERO
3						
4						
5	RC07	R1,4,5, 7,9,11,12, 14,31,34, 35,37,39, 42,43,44	RESISTOR, FXED 30K1/4W ± 5%		16	
6	RN65C	R2	RESISTOR, FXED 137K 1/4W ± 1%		1	
7	RN65C	R8, R40	RESISTOR, FXED 68.1K 1/4W ± 1%		2	
8	RC07	R3,6,10, 13,23thr 30,33,36, 41, 44 53 thru 60.	RESISTOR, FXED 3.9K 1/4W ± 5%		24	
9	RC07	R15, 18, 19,22,38, 46, 47, 48	RESISTORS, FXED 16K 1/4W ± 5%		8	
10	RC07	R16, 17, R20, R21, R49, R50, R51, R52	RESISTORS, FXED 160K 1/4W ± 5%		8	
11	RN65C	R32	RESISTORS, FXED 34K 1/4W ± 1%		1	
12						
13						
14	CD6EC820103	C1-C24	CAPACITOR, FXED 82 pf @ 300V		24	Cornell-Dubilier
15	T1D32	CR2,	DIODES		35	Texas Instrument
16		4-20,22, 24-40.				
17	N456	CR1, 3, 21, 23	DIODES		4	
18						
19	2N404	Q1-Q8	TRANSISTORS		8	
20	7717-22N	XQ1-8	TRANSISTOR PAD		8	Thermalloy
21						
22	1A20		Conformal Coating (Humiseal)		A/R	Columbia Tech. Corp.
23	S780008		SCHEMATIC DIAGRAM		REF	

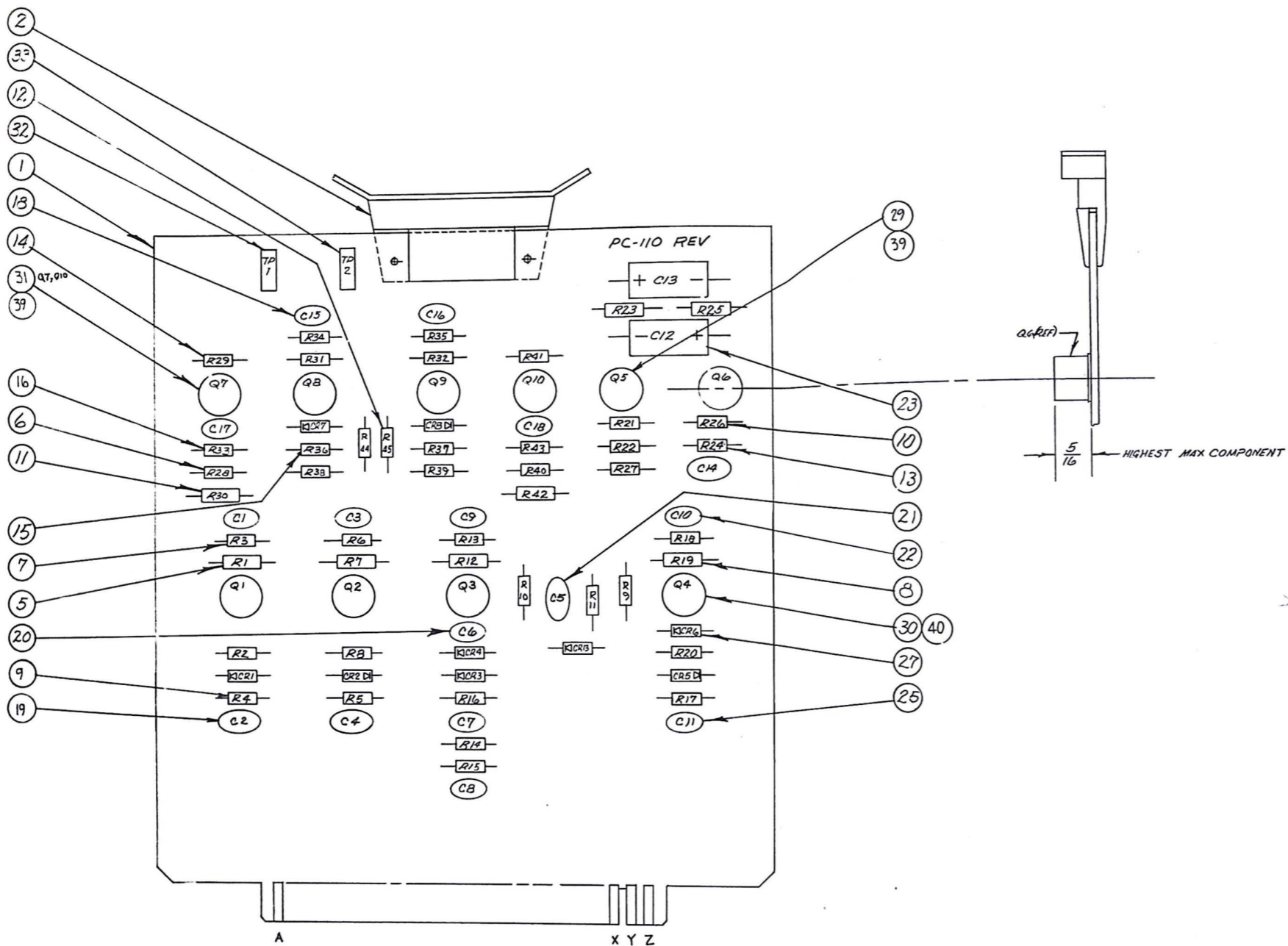
FIGURE 32



NOTES:  
 1. SEE SEPARATE PARTS LIST PL790009  
 2. CONFORMAL COATING TO BE APPLIED  
 AFTER ELECTRICAL INSPECTION.  
 COLUMBIA TECHNICAL CORP. NO. 1A20

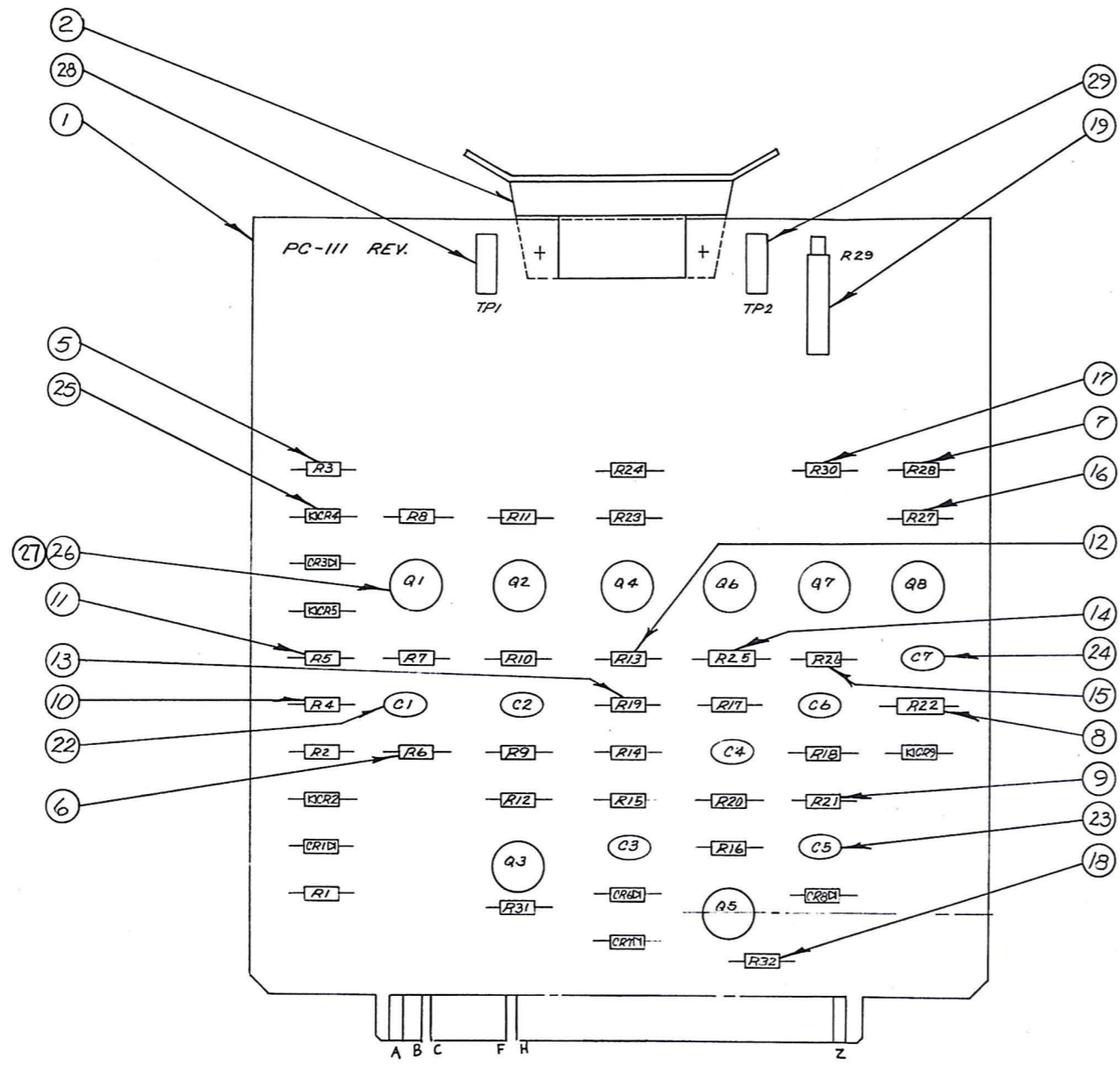
ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780009	PC-109	P. C. BOARD		1	
2	CR/C/10037/3		CARD PULLER (BLUE)		1	VERO
3						
4						
5	RC07	R1,4,5, 7,8,11, 12,14,32, 35,36,38	RESISTORS, FIXED 30K 1/4W ± 5%		12	
6	RN65C	R2	RESISTORS FIXED 13.7K 1/4 ± 1%		1	
7	RN65C	R9	" " 6.8K 1/4W ± 1%		1	
8	RC07	R3,6,10, 13,23 thru 30,37,34, 48 thru 55.	" " 3.9K 1/4W ± 5%		23	
9	RC07	R15,18, 19,22, 31,39	RESISTORS FIXED 16K 1/4W ± 5%		6	
10	RC07	R16,17, 20,21,44, 45,46,47	RESISTORS FIXED 160K 1/4W ± 5%		8	
11	RN65C	R33	RESISTOR FIXED 3.4K 1/4W ± 1%		1	
12	RC07	R41,42	" " 10K 1/4W ± 5%		2	
13	RC07	R40,43	" " 330, 1/2W ± 5%		2	
14						
15						
16	CD6ED870J03	C1-20	CAPACITORS, FIXED 82 pf, 500V		20	Cornell-Dubilier
17	CD7FD151J03	C21-24	" " 150 pf, 500V		4	Cornell-Dubilier
18						
19	T1D32	CR2-20 CR22-34	DIODES		32	Texas Instrument
20	IN456	CR1, 21	DIODES		2	
21	7717-22N	XQ1-8	TRANSISTOR PAD		8	Thermalloy
22	2N404	Q1-Q8	TRANSISTORS		8	
23	1A20		Conformal Coating (Humiseal)		A/R	Columbia Tech. Corp.
24	S78009		SCHEMATIC DIAGRAM		REF	

FIGURE 33



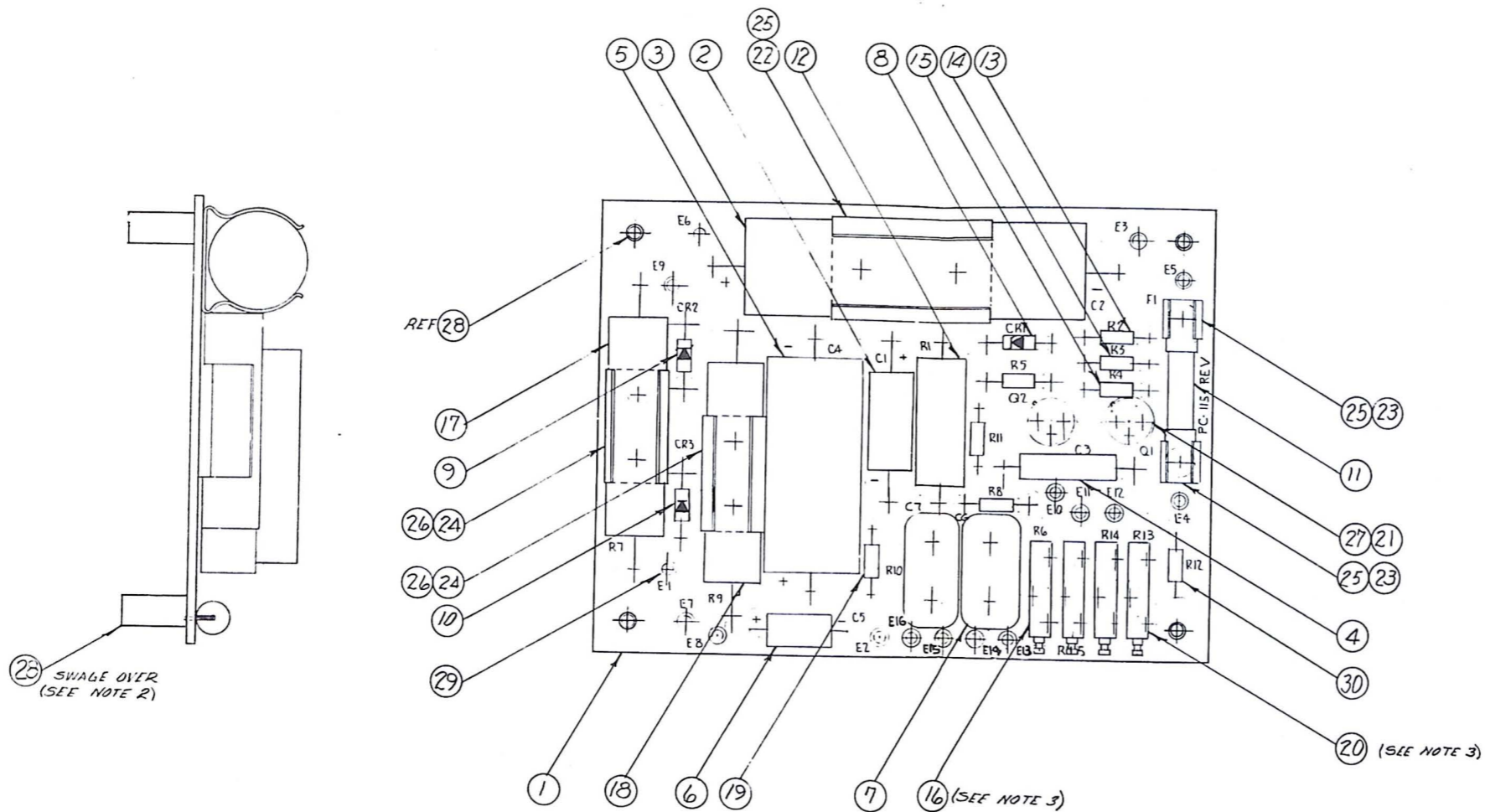
PARTS LIST FOR: TRANSFER TRANS CONTROL ASSEMBLY						SIZE	DRAWING NO.
ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	D	PC780010
1	PC780010	PC-110	P.C. BOARD		1		
2	CH/C/10037/3		CARD PULLER (BLUE)		1		VERO
3							
4							
5	RC20	R1	RESISTOR, FIXED 330, 1/2W ± 5%		1		
6	RC07	R2, 8, 27, 28, 34, 35, 38, 39, 40, 44	" " 30K 1/4W ± 5%		10		
7	RC07	R3, 6, 10, 13, 18	" " 10K 1/4W ± 5%		5		
8	RC20	R7, 12, 16	" " 1K 1/2W ± 5%		3		
9	RC07	R4, 13, 16, 17	" " 120K 1/4W ± 5%		4		
10	RC07	R11, 21, 26, 9	" " 7.5K 1/4W ± 5%		4		
11	RC20	R23, 25, 30, 42	" " 100, 1/2W ± 5%		4		
12	RC20	R45	" " 470, 1/2W ± 5%		1		
13	RC07	R22, 24	" " 62K 1/4W ± 5%		2		
14	RC07	R14, 15, 20, 29, 31, 32, 41	" " 3.9K 1/4W ± 5%		7		
15	RC07	R36, 37	RESISTOR, FIXED 160K 1/4W ± 5%		2		
16	RC07	R33, 43	RESISTOR, FIXED 100K 1/4W ± 5%		2		
17							
18	CD6EC870J03	C1, 3, 15, 18	CAPACITORS, FIXED 82 pf 300V		6		Cornell-Dubilier
19	CK502	C2, 4, 14	" " .005uf .50v 250		3		Centralab
20	CD7FA471J03	C6	" " -470 pf 100V		1		Cornell-Dubilier
21	TGS10	C5	" " -.01 uf ± 2% 100V		1		Sprague
22	CD6CD330J03	C8, 10	" " -33 pf. 500V		2		Cornell-Dubilier
23	NLW 35-50	C12, 13	Capacitors, Fixed -35 uf, 50V		2		Cornell Dubilier
24							
25	CD6ED560J03	C7, 8, 11	Capacitors, Fixed -56 pf 500V		3		Cornell-Dubilier
26							
27	T1D32	CR1-9	DIODES		9		Texas Instrument
28							
29	2N404	Q1, 2, Q5, 6, 8, 9	TRANSISTORS		6		
30	2N2635	Q3, 4	TRANSISTORS		2		
31	2N2635	Q7, Q10	TRANSISTORS		2		
32	119437-H	TP1	P.C. TEST JACK (YELLOW)		1		CINCH MFG.
33	119437-G	TP2	P.C. TEST JACK (BLUE)		1		CINCH MFG.
34							
35	1A20		Conformal Coating (Humiseal)		A/R		Columbia Tech. Corp.
36							
37	S780010		SCHEMATIC DIAGRAM		REF		
38							
39	7717-22N	XQ1, 2, XQ5 thru XQ10	TRANSISTOR PAD		8		Thermalloy
40	7717-44N	XQ3, 4	TRANSISTOR PAD		2		Thermalloy

FIGURE 34



ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC780011	PC-111	P.C. BOARD		1	
2	CH/C/10037/3		CARD PULLER (BLUE)		1	VERO
3						
4						
5	RC07	R1,2,3,14	RESISTOR, FIXED 16K 1/4W ± 5%		4	
6	RC07	R6, 24	" " 30K 1/4W ± 5%		2	
7	RC07	R8,11, 23, 28	" " 160K 1/4W ± 5%		4	
8	RC07	R9,12,16	" " 7.5K 1/4W ± 5%		6	
		17,18,22				
9	RC07	R7, 10,	RESISTOR, FIXED 43K 1/4W ± 5%		5	
		15,20,21				
10	RC07	R4	RESISTOR, FIXED 3.9K 1/4W ± 5%		1	
11	RC07	R5	" " 220K 1/4W ± 5%		1	
12	RC07	R13	" " 47K 1/4W ± 5%		1	
13	RC07	R19	" " 10K 1/4W ± 5%		1	
14	RC20	R25	" " 1K 1/2W ± 5%		1	
15	RC07	R26	" " 33K 1/4W ± 5%		1	
16	RC07	R27	" " 120K 1/4W ± 5%		1	
17	RC07	R30	" " 6.2K 1/4W ± 5%		1	
18	RC07	R31, 32	RESISTOR, FIXED 100K 1/4W ± 5%		2	
19	RC07	R20	Resistor, Variable, 2K 1/4W ± 5%		1	
20						
21						
22	CD7FD151J03	C1-C4	CAPACITORS, FIXED, 150 pf, 500V		4	Cornell-Dubilier
23	CD6EC87QJ03	C5, C6	CAPACITORS, FIXED, 82pf, 300V		2	Cornell-Dubilier
24	DM10E391J0-100WV	C7	CAPACITOR, FIXED 390 pf, 100V		1	El-Menco
25	T1D32	CR1-9	DIODES		9	Texas Instrument
26	2N404	Q1-Q8	TRANSISTORS		8	
27	7717-22N	XQ1-8	TRANSISTOR PAD		8	THERMALLOY
28	119437-H	TP1	P.C. TEST JACK (YELLOW)		1	
29	119437-G	TP2	P.C. TEST JACK (BLUE)		1	
30						
31	1A20		Conformal Coating (Humiseal)		A/R	Columbia Tech. Corp.
32						
33						
34	S780011		SCHEMATIC			REF
35						
36						

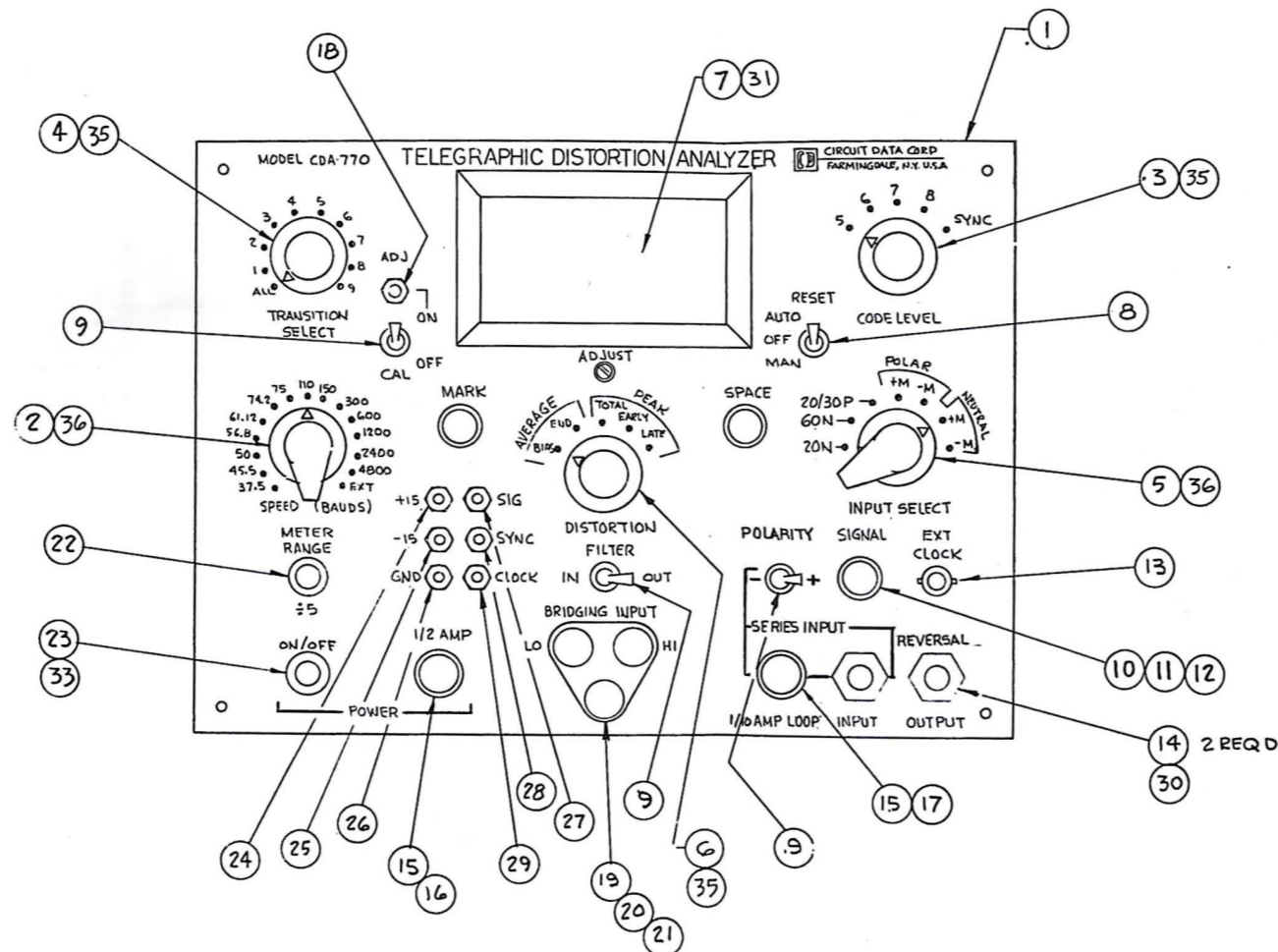
FIGURE 35



ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	PC760015	PC-115	P. C. BOARD		1	
2	MMW05P47	C1	CAPACITOR .47 uf @ 50V		1	Cornell-Dublier
3	977-190	C2	CAPACITOR 1000Mf @ 35V		1	General Instrument
4	192P1039R8	C3	CAPACITOR .01 @ 80V		1	Sprague
5	977-164	C4	CAPACITOR 500Mf @ 35V		1	General Instrument
6	192P2249R8	C5	CAPACITOR 22uf @ 80V		1	Sprague
7	1DPZ - 134	C6, C7	CAPACITOR .1 @ 100V 10%		2	ElMenco
8	1N754A	CR1	DIODE, ZENER 6.8V ± 5%		1	
9	1N4733A	CR2	DIODE, ZENER 5.1V ± 5%		1	
10	1N4005	CR3	DIODE		1	
11	31301.6	F1	FUSE 1.6A 3A Slow-Blow		1	LITTLE FUSE
12	VC9E 1 ohm	R1	RESISTOR 1 ohm .5W ± 5%		1	CLAROSTAT
13	RC07	R2	RESISTOR 120K 1/4W ± 5%		1	
14	RC07	R3, R5	RESISTOR 4.7K 1/4W ± 5%		2	
15	RC07	R4, R8	RESISTOR 1K, 1/2W ± 5%		2	
16	PC3800P502	R6	RESISTOR, Variable 5K 1/4W		1	AMPHENOL
17	VC10F	R7	RESISTOR 50 ohm 10W ± 5%		1	CLAROSTAT
18	VC10F	R9	RESISTOR 40 ohm 10W ± 5%		1	CLAROSTAT
19	RC07	R10, R11	RESISTOR 1.8K 1/4W ± 5%		2	
20	PC 3800 P 201	R13, R14	RESISTOR, Var. 200 ohm 1/4W		3	AMPHENOL
		R15				
21	2N404	Q1, Q2	TRANSISTOR, POWER PNP		2	
22	6018-5A		CLIP CAPACITORS		1	AUGAT
23	121001		CLIP FUSE		2	LITTLE FUSE
24	6010-12A		CLIP RESISTOR		2	AUGAT
25	SE-46		EYELET		4	United Shoe Mach.
26	A2209 (GS3-6)		EYELET		4	STDMPSON
27	7717 22 PAP		PAD TRANSISTOR		2	THERMALLOY
28	9537B-SS-0632		SWAGE TYPE STANDOFF 1/4 Rd.		4	AMATON
29	1026-2	E1 thru	STANDOFFS		16	CAMBION
		E16				
30	RC20	R12	RESISTOR 750 ohms 1/2W ± 5%		1	
31	1A20		Conformal Coating (Humiseal)		A/R	Columbia Tech. Corp.
32	S780015		SCHEMATIC DIAGRAM		REF	

PC 115 POWER SUPPLY

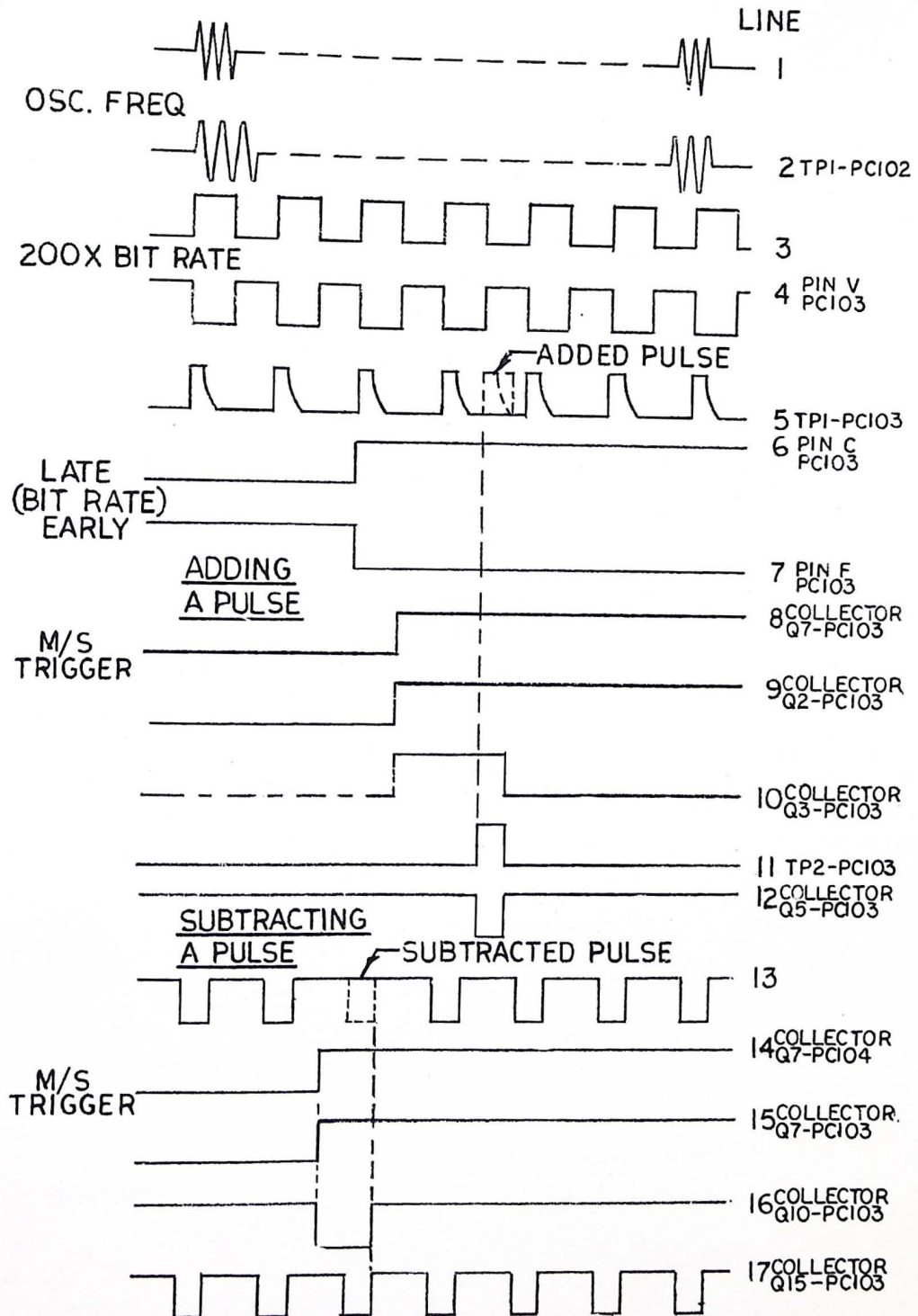
FIGURE 36



ITEM NO.	DRAWING OR PART NO.	DESIG	DESCRIPTION	MILITARY SPEC	QTY PER UNIT	REMARKS
1	770003		FRONT PANEL		REF	
2	PA-651-143	S5	SWITCH, ROTARY (Speed Bauds)		1	CENTRALAB
3	PA-024-7218	S2	SWITCH " (CODE LEVEL)		1	CENTRALAB
4	PA-024-7720	S1	SWITCH " (TRANSITION)		1	CENTRALAB
5	PA-024-7219	S7	SWITCH " (INPUT SELECT)		1	CENTRALAB
6	PA-024-7218	S6	SWITCH " (DISTORTION)		1	CENTRALAB
7	320G	M1	METER (0-100)D.C. Micro Amperes		1	TRIPLET
8	LFB-231	S4	SWITCH, TOGGLE (ON OFF ON)		1	JBT (J-0129)
9	LFB-223	S3,9,11	SWITCH, TOGGLE (ON NONE ON)		3	JBT (J-0128)
10	CM30-3000	XDS1,	LAMPHOLDER		3	CHICAGO MINIATURE
			2, 3,			
11	CM30-0737		LENS (CLEAR)		3	CHICAGO MINIATURE
12	244	DSL2,3	LAMP		3	CHICAGO MINIATURE
13	UG-1094/U	J1	JACK, BNC		1	ECCO
14	JJ-089	J2,J3	JACK		2	
15	FIN-20G	XF1,2	FUSE HOLDER		2	BUSSMAN
16		F1	FUSE 1/2A (PWR)		1	BUSSMAN
17		F2	FUSE 1/10A (LOOP)		1	BUSSMAN
18	273-500-TYPE M	R1	RESISTOR, VAR. (H41P) BRKT		1	BOURNS
19	29B33-1		MTG BASE, BLACK (Binding Post)		1	SPECTROL
20	29-1	BP3	BINDING POST (BLACK)		1	GRAYHILL
21	29-1	BP1,2	BINDING POST (RED)		2	GRAYHILL
22	903	S8	SWITCH, Pushbutton W/7C1040Nut		1	SWITCHCRAFT
23	616-7-1	S10	LAMP, Pushbutton (GREEN LENS)		1	MARCO OAK
24	1501-102	TP1	TEST POINT (RED)		1	H. H. SMITH
25	1501-101	TP2	TEST POINT (WHIT)		1	H. H. SMITH
26	1501-103	TP3	TEST POINT (BLACK)		1	H. H. SMITH
27	1501-105	TP4	TEST POINT (BLUE)		1	H. H. SMITH
28	1501-107	TP5	TEST POINT (YELLOW)		1	H. H. SMITH
29	1501-104	TP6	TEST POINT (GREEN)		1	H. H. SMITH
30	2158		WASHER, FIBRE (J2, J3)		2	H. H. SMITH
31	505-4 018-BRS-ITT		LUGS, TERMINAL		1	Zierick Mfg. (on Meter)
32	780013		BD. COMPONENT		1	
33	282		LAMP, GLOW, NEON		1	CHICAGO MINIATURE
34						
35	406PD2K1		KNOB (BAR)		2	RAYTHEON
36	407D2K1		KNOB		3	RAYTHEON
37						
38						
39						
40						
41	700XML5W	R3	RESISTOR, FIXED 700, 5W		1	Ward Leonard
42	RC07	R4	RESISTOR, FIXED 3.9K, 1/4W		1	
43	RC07	R5	RESISTOR, FIXED 3.9K, 1/4W		1	
44	RC07	R6	RESISTOR, FIXED 30K, 1/4W		1	
45	RC07	R7	RESISTOR, FIXED 3.9K, 1/4W		1	
46	RC07	R8	RESISTOR, FIXED 30K, 1/4W		1	

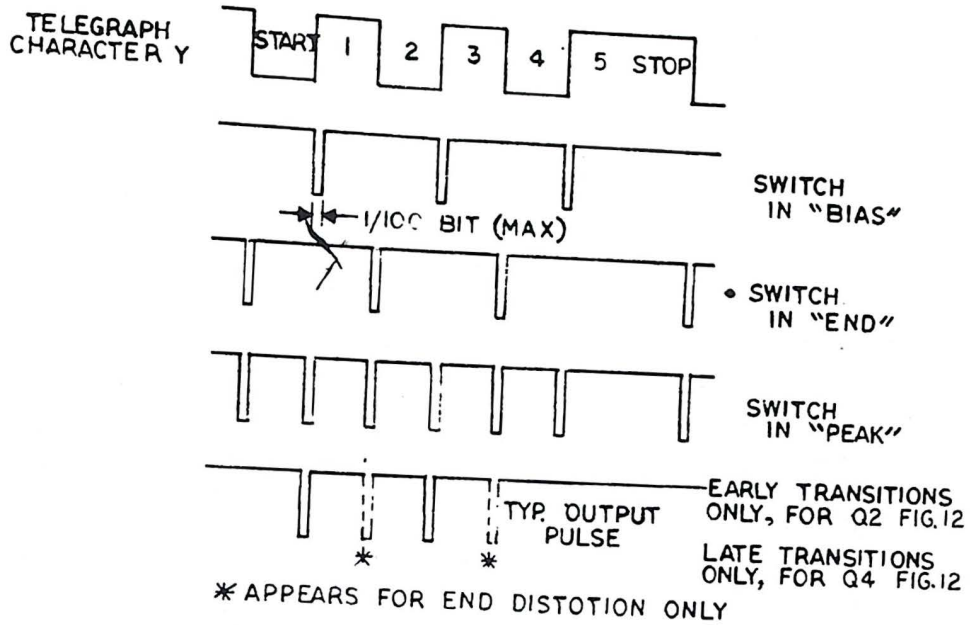
FIGURE 37



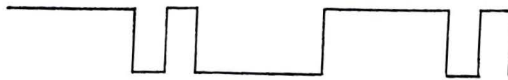
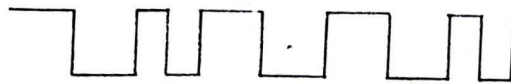
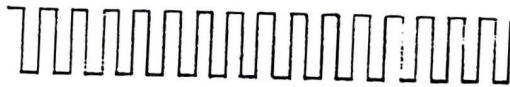


A, OSCILLATOR & COUNTDOWN SYNCHRONIZER

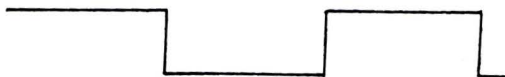
FIGURE 38



100 X BIT RATE

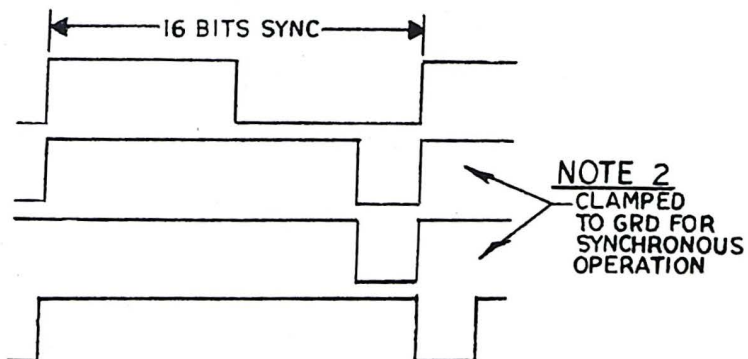
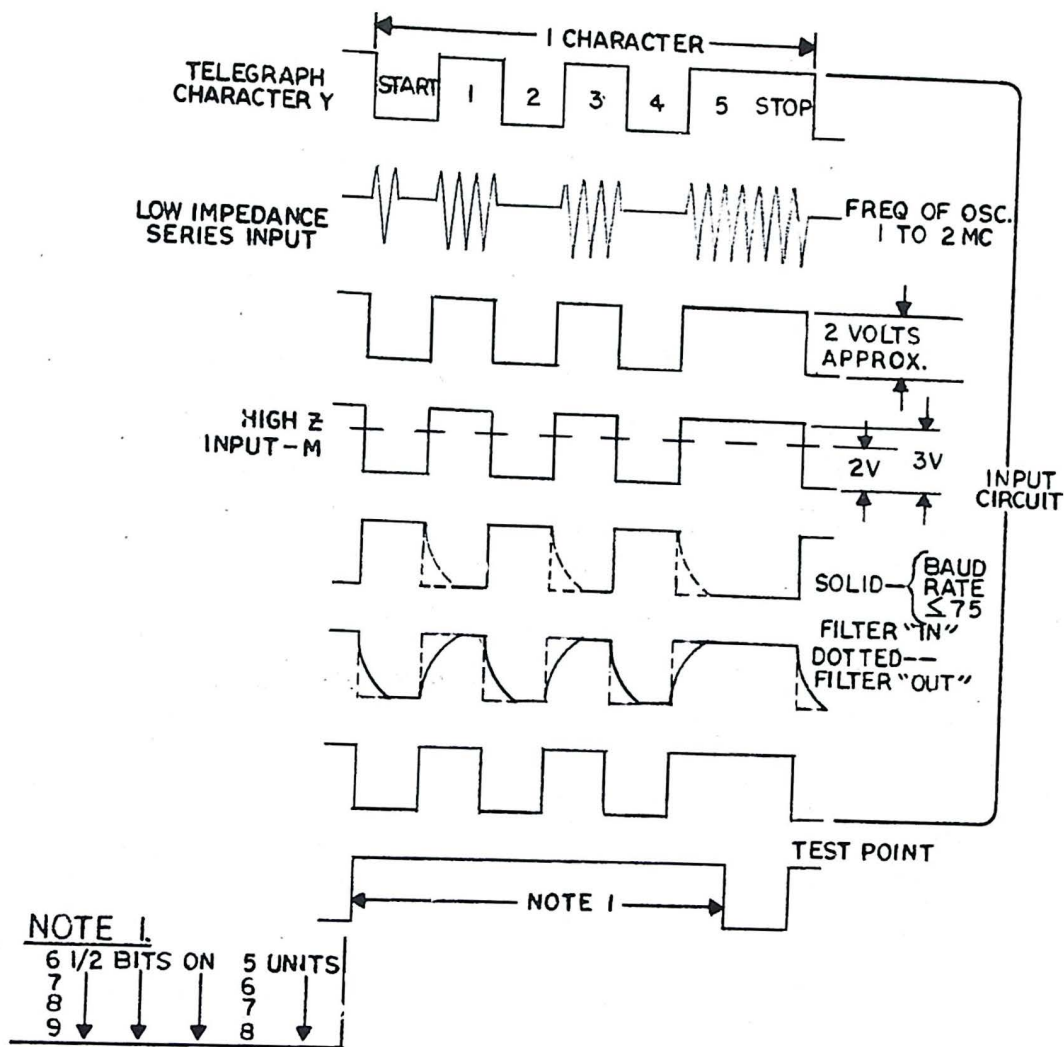


10 X BIT RATE



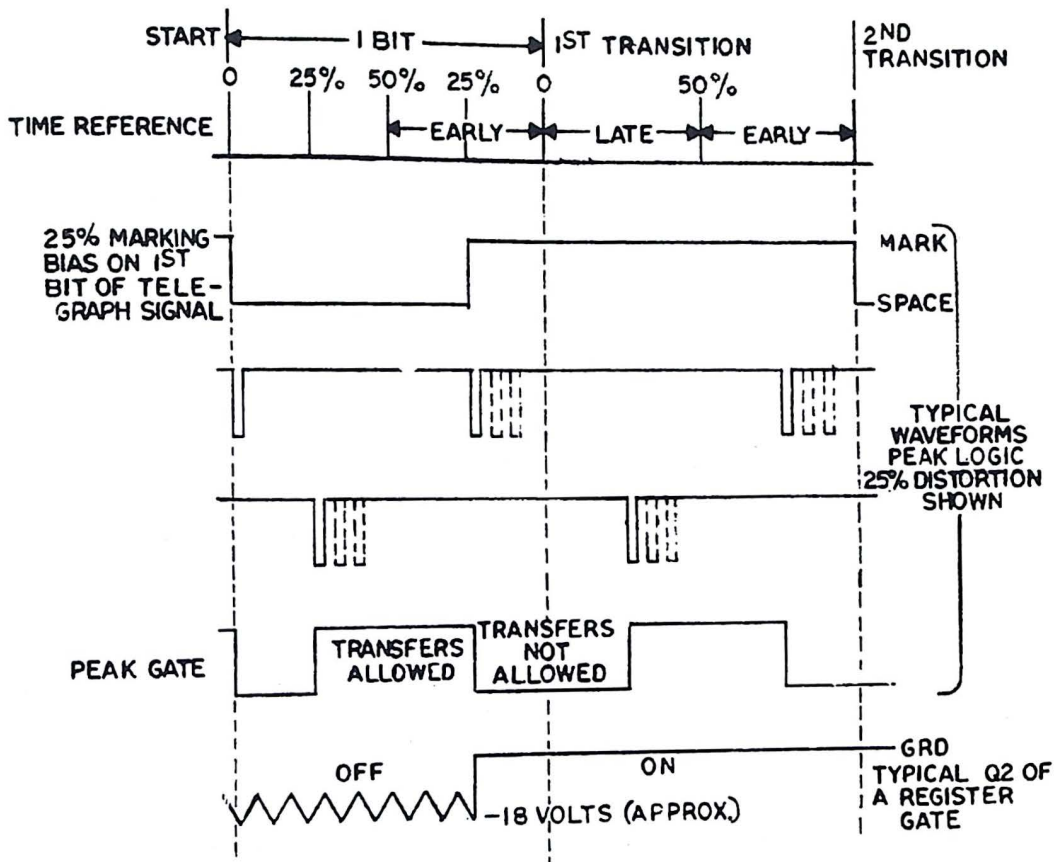
WAVEFORMS FOR 1X BIT RATE  
SAME AS ABOVE AT 1/10 THE SPEED

TRANSFER & DECADE COUNTER  
FIGURE 39



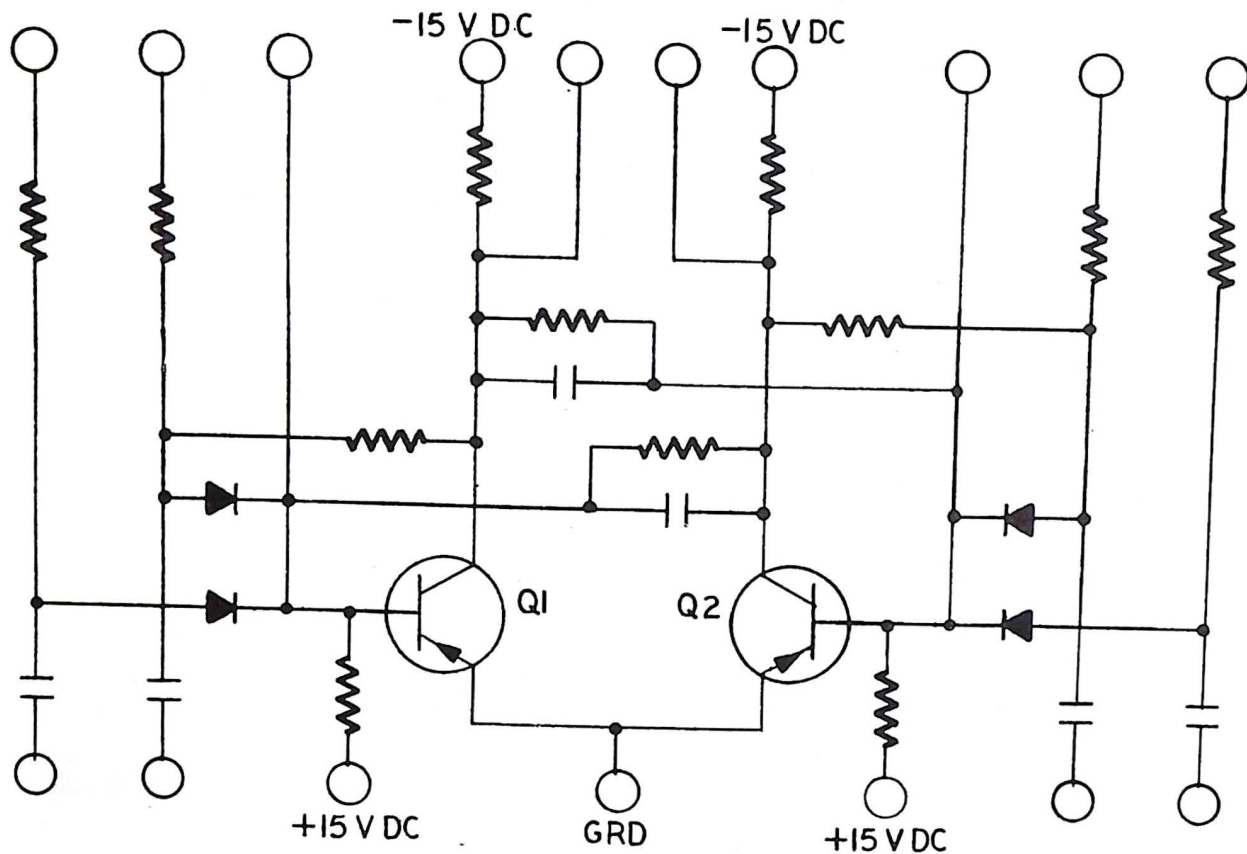
B. INPUT & BIT COUNTER

FIGURE 40



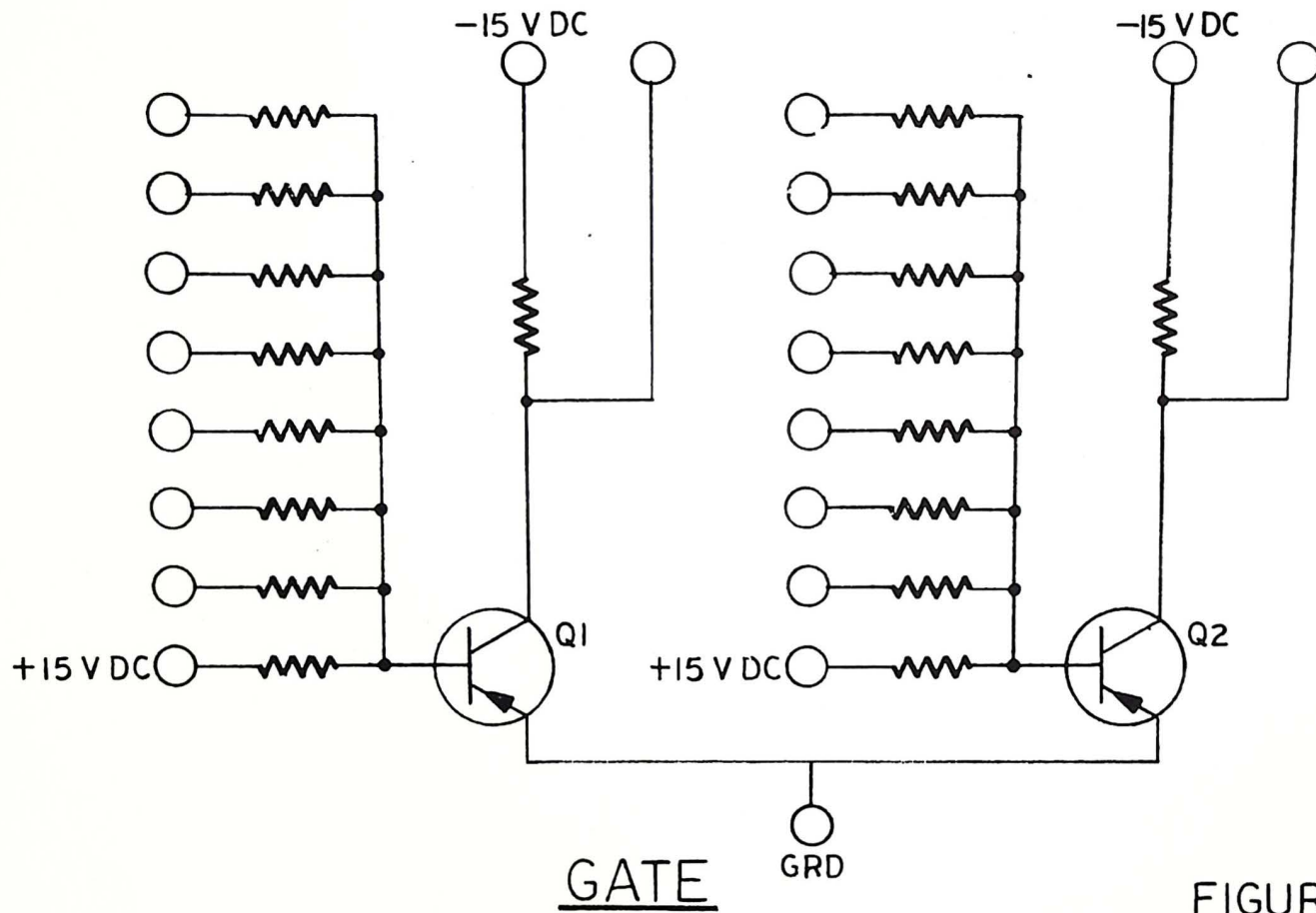
REGISTER & PEAK LOGIC

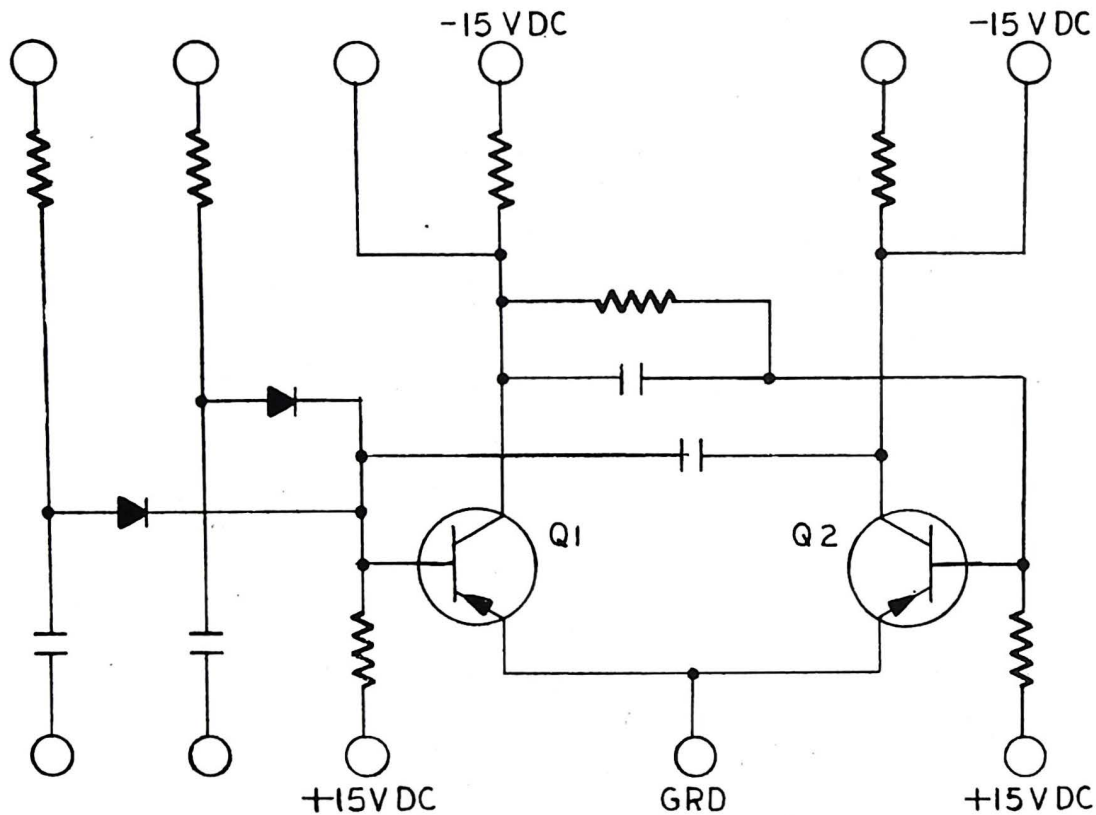
FIGURE 41



BINARY FLIP-FLOP

FIGURE 50





MONOSTABLE MULTIVIBRATOR

FIGURE 52

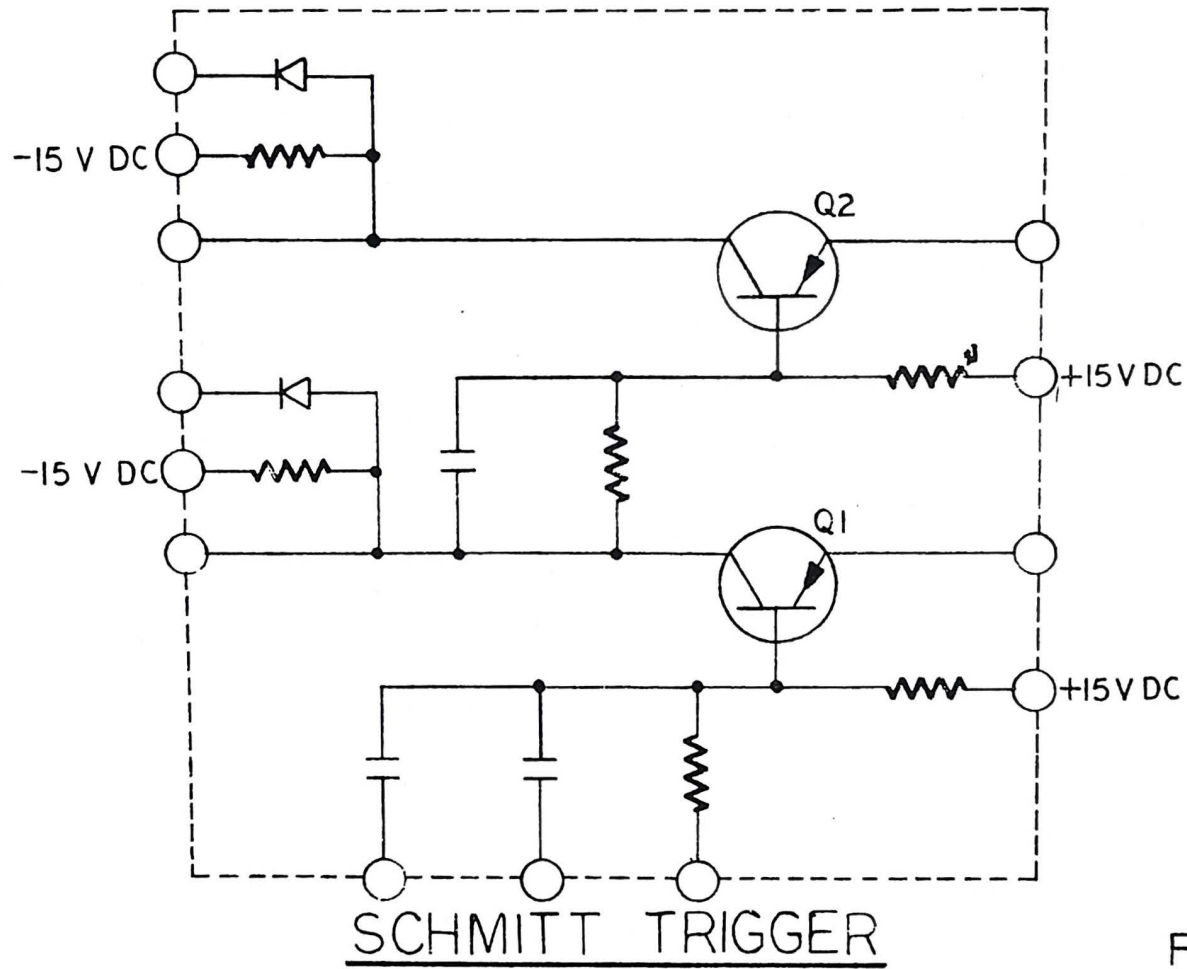


FIGURE 53



INSTRUCTION MANUAL, SIGNAL ANALYZER - CDA 770, EDITION 1

ERRATA SHEET #1

Fig. 26	Item 18	Delete "1C4"	Substitute "1C5"
	Item 19	Delete "5"	Substitute "4"
Fig. 30	Item 8	Add "41, 42"	to Designation

15 December 1970

INSTRUCTION MANUAL, SIGNAL ANALYZER - GDA 770, EDITION 1

ERRATA SHEET #2

NOMENCLATURE CHANGE

The following units bear the designation "DOT CYCLE" on the front panel output signal jack. All other units bear the designation "REVERSALS". The function of the jack and the signal is not changed.

770540	770564
770541	770565
770542	770566
770543	770567
770544	770568
770545	770569
770546	770570
770547	770571
770548	770572
770549	770573
770550	770574
770551	770575
770552	770576
770553	770577
770554	770578
770555	770579
770556	770580
770558	770581
770559	770582
770561	770583
770562	770584
770563	770586

770609