INSTRUCTION MANUAL

Serial Number _____

Type 262 PROGRAMMER

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070-399

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WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.

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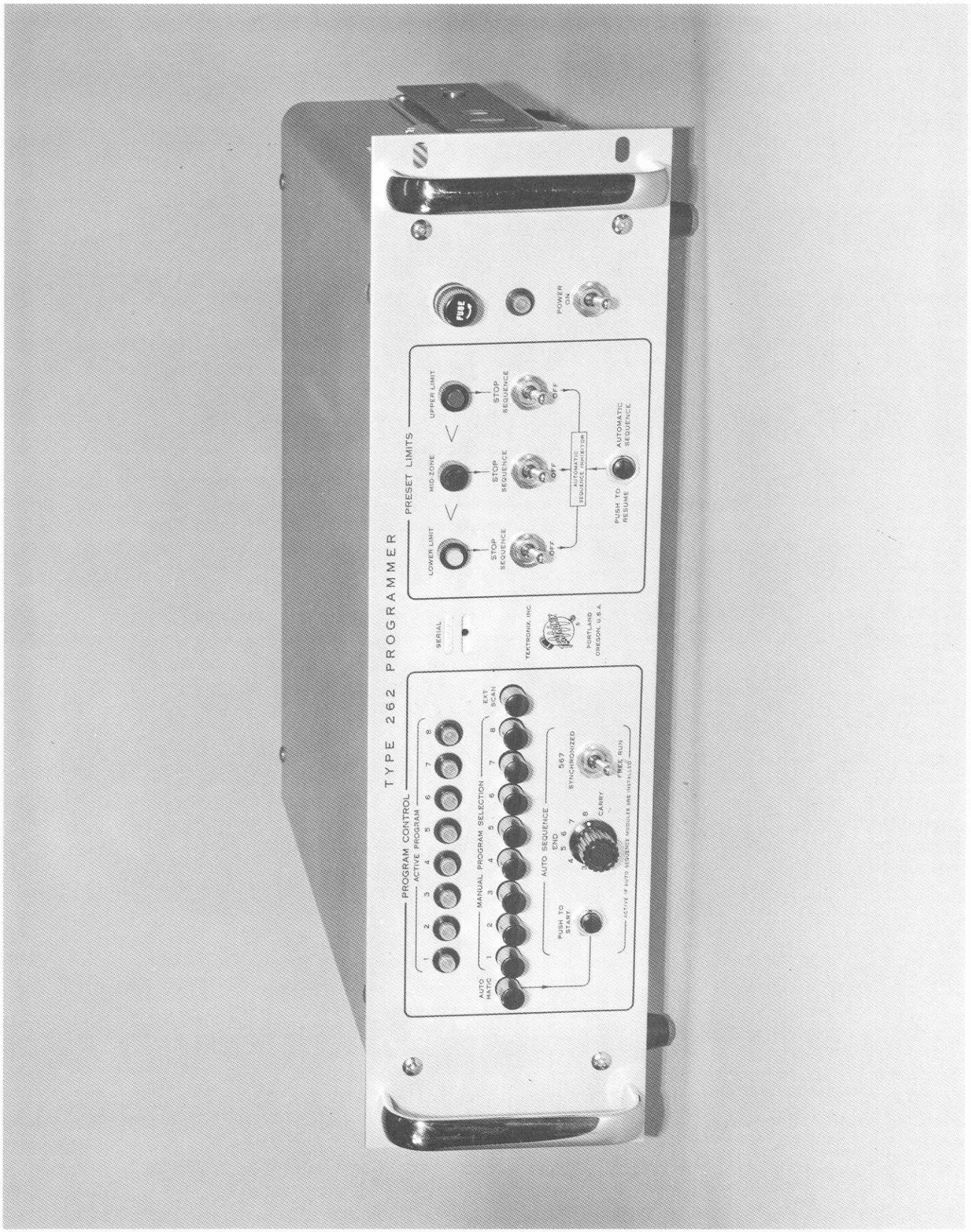


Type 262 Programmer

SECTION 1

CHARACTERISTICS

General Information

The Type 262 Programmer is designed for use with the Tektronix Digital Readout system. The basic unit consists of a power supply, program cards, a No-Go Comparator card, and circuits for manual program switching. Addition of a Synchronizer and Counter card provide automatic program switching. Accessories are also available for external control of devices such as pulse generators and attenuators.

Programs

The Type 262 holds 8 program cards. Several Type 262 Programmers can be connected in series to increase the number of programs.

Test Rate

Eight measurements per second under ideal conditions.

Triggered Operation

In this mode the advance of each program can be externally triggered to synchronize with external devices.

Synchronized Operation

In this mode the programmer will sequence through the test program at a preset rate. At the completion of the last test, the Type 262 stops and waits for further commands from the operator.

External Scan

The control circuits from each program card are available at a rear-panel connector for selecting programs with external mechanical devices.

Preset Limits (Go-No-Go)

Each program card can be programmed with upper and lower test limits. The Type 262 can be instructed to stop if test results are either outside or within the programmed limits. After the limit condition is noted, a pushbutton can be used to manually resume the program.

Auxiliary Programming

An Auxiliary Programming kit can be added to the Type 262. This kit uses program cards to control external equipment related to the measurement program.

Power Supplies

Electronically regulated for stable operation with varying line voltage and load.

Line-Voltage Requirements: 105 to 125 volts rms, or 210 to 250 volts rms, 50 to 60 cps, single-phase ac.

Power Required: Approximately 25 watts.

Fuse: $\frac{1}{2}$-amp fast-blowing type for 117 volts, $\frac{1}{4}$ amp fast-blowing type for 234 volts.

Mechanical

Construction: Aluminum-alloy rack-mount chassis.

Finish: Photo-etched anodized front panel.

Dimensions: $5\frac{1}{4}$" high by 20" wide by 19" deep.

Weight: 18.5 lbs.

Accessories Included

	Tektronix Part No.
2—Instruction Manuals	070-399
1—Cabinet Feet Kit	016-052
1—Power cord	161-013
1—Adapter, 3-wire to 2-wire	103-013

NOTES

SECTION 2
INSTALLATION

General Information

The Type 262 can be permanently mounted in a standard 19" cabinet rack. Slideout tracks allow the instrument to be pulled out of the cabinet for program change and maintenance. Cabinet feet are also provided for bench use.

Ventilation

The Type 262 is forced-air cooled by a fan that draws air into the rear of the instrument. If the temperature rises above a safe level in units wired for 117-volt operation, a thermal relay turns off all power except to the fan motor. In units wired for 234-volt operation, all power is turned off. When the temperature returns to normal, the relay reapplies power.

Location

Allow at least 3 feet in front of the cabinet racks so the instrument can be fully extended on the slideout tracks.

Rack Mounting

Fig. 2-1 shows the parts that make up the slideout tracks. The Type 262 is shipped with the slideout-track chassis section installed. The stationary and intermediate sections are a matched set and should be used as such. The slideout tracks fit all cabinets that are 18½ to 24½ inches between the front and rear rails.

To mount the slideout track assembly in the cabinet, proceed as follows:

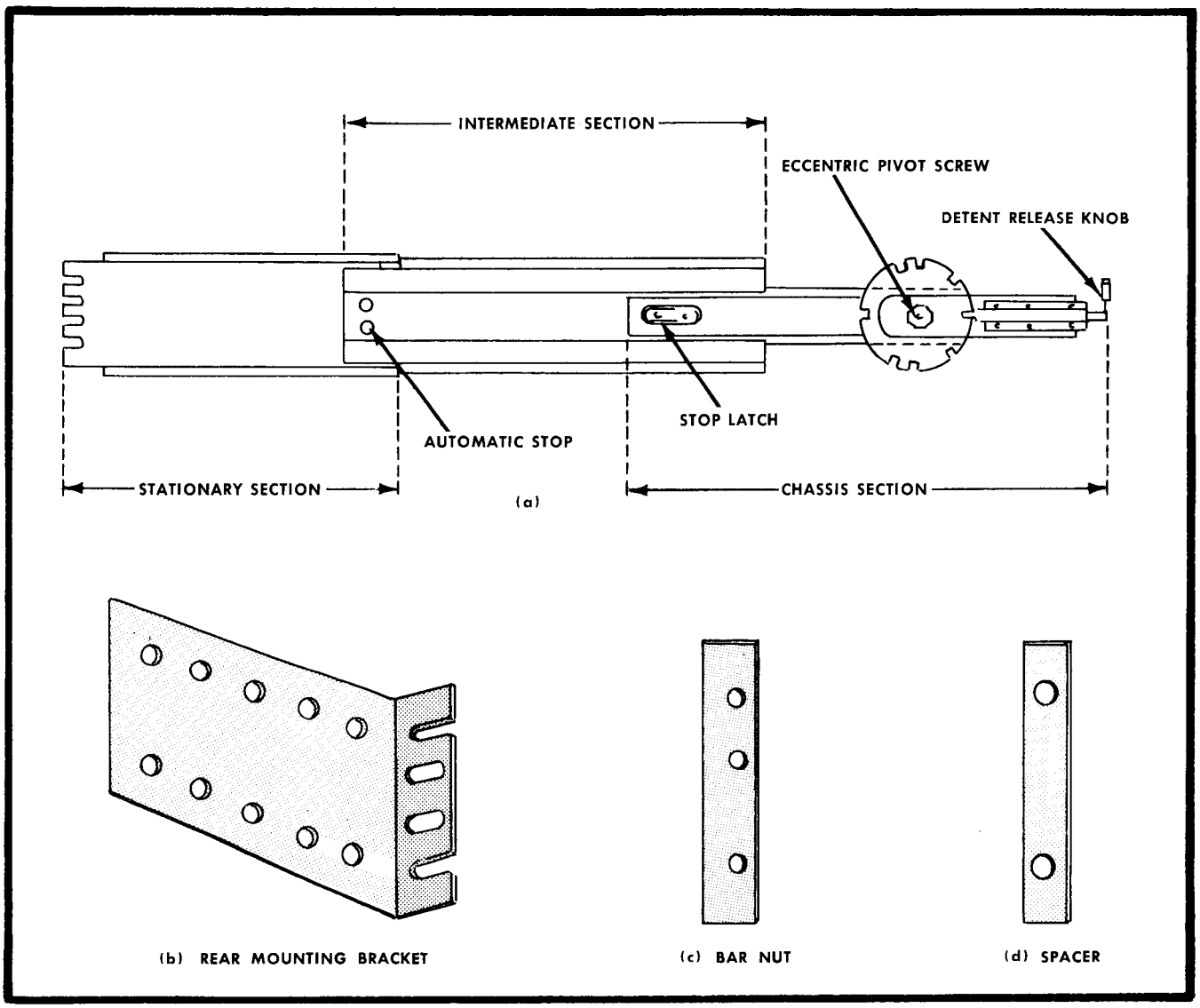


Fig. 2-1. Slideout track assembly.

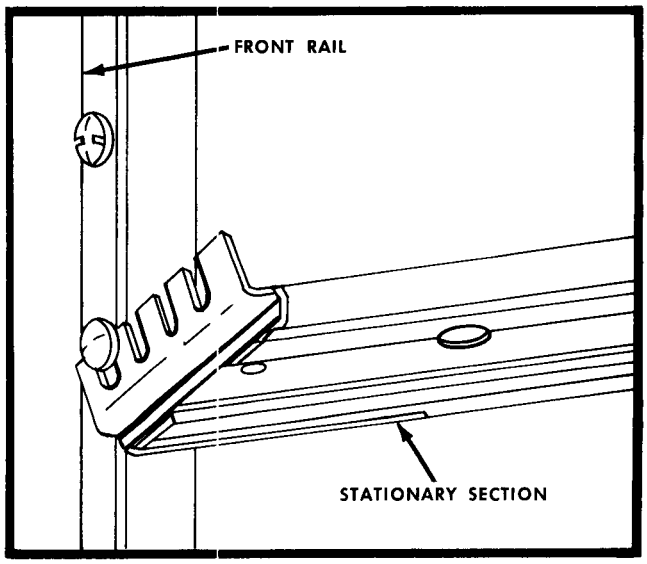


Fig. 2-2. Mounting the slideout track stationary section to the cabinet front rail using threaded holes.

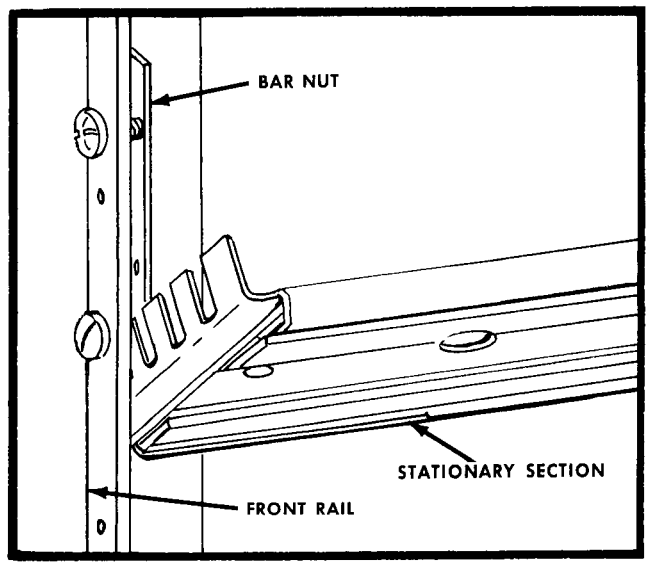


Fig 2-3. Mounting the slideout track stationary section to the cabinet front rail.

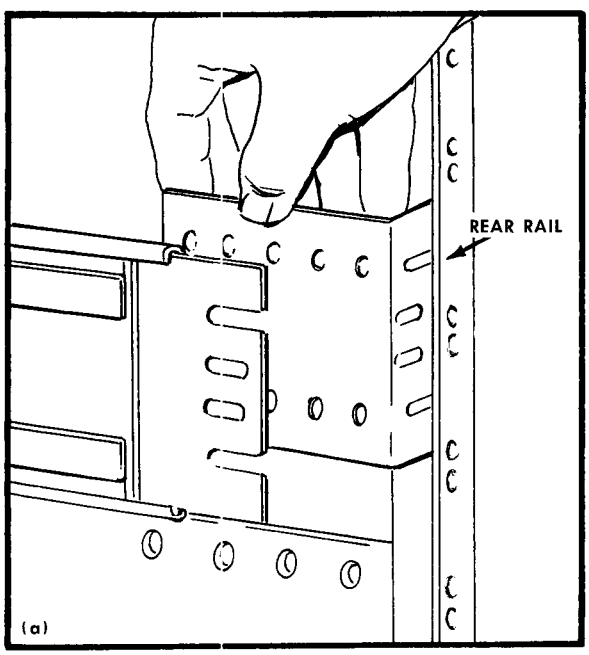
1. Select the desired position of the instrument within the rack. The bottom hole on the front panel of the instrument should line up with a hole in the rail. Mark the hole and remove the instrument. If the hole is tapped for a 10-32 screw, thread one of the BHS screws several turns into the hole. Thread another BHS screw into a hole 1¾ inches above the first one Install the front of the slideout-track stationary section as shown in Fig. 2-2. If the holes are not tapped, slip the screws through the holes (enlarge if necessary) and use the bar nut as shown in Fig. 2-3.

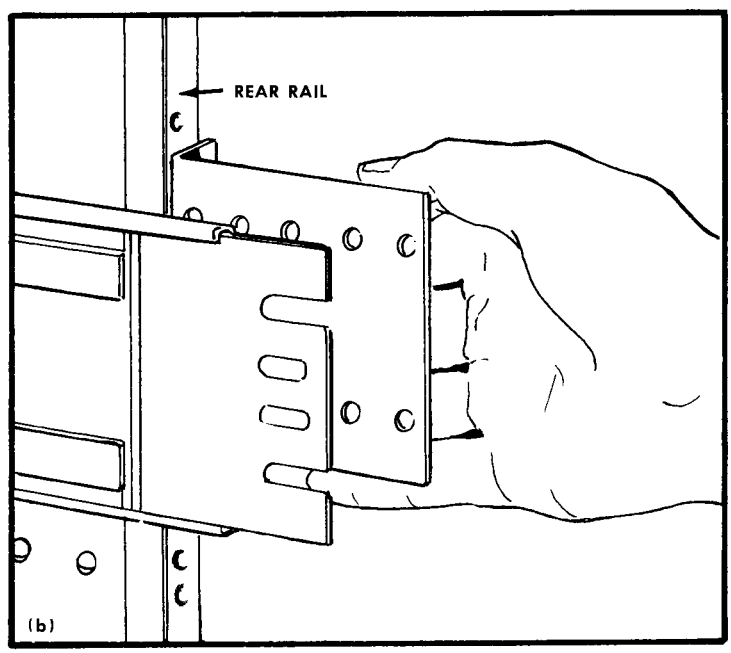
2. The rear end of the stationary section can be secured to the rack by one of the two methods shown in Fig. 2-4 (a) and (b).

3. Before mounting the Type 262 in the rack, check that the slideout-track chassis sections are parallel with the bottom of the instrument. The eccentric pivot screw moves the end of the chassis section up or down relative to the instrument. Loosen the nut inside the frame and adjust the pivot screw to make the chassis section parallel with the bottom of the instrument. Hold the pivot screw in this position and tighten the nut.

4. Pull out the slideout-track intermediate sections to their fully extended position.

5. Slide the chassis section of the Type 262 into the intermediate sections. Depress the stop latches on both chassis sections and push the instrument into the rack.





Figf. 2-4. Determining the mounting position of the slideout track stationary section on the cabinet rear rail: (a) normal position, inside the rear rail; (b) reverse position, outside the rear rail.

6. To adjust the slideout tracks for smooth operation, pull the Type 262 out until the pivot screws are even with the front rail. Loosen the screws that hold both stationary sections to the front rail and allow the slides to adjust to the instrument and the rack. Tighten the screws and push the instrument into the rack. Next, loosen the screws that hold both rear brackets to the rear rail and allow the slides to adjust to the instrument. Tighten the screws.

7. To use the tilt-lock feature, pull the instrument out to its fully extended position, pull both detent release knobs and tilt the instrument to the desired position.

8. To remove the Type 262 from the rack, pull out to the fully extended position, press the stop latches, and carefully slide the instrument out of the rack.

Connecting to the Type 567

The Type 262 can be located in almost any position relative to the Type 567, since the two units are connected by a single 6-foot cable.

To install the cable:

1. Remove the right side-panel from the Type 567.

2. Pry out the accessory-hole cover from the rear panel of the Type 567.

3. Pass the Bendix-connector end of the interconnecting cable through the accessory hole and insert the plug into J34. Turn the plug in the jack to line up the key. Then, twist the plug outer ring clockwise until it seats and locks.

4. Insert the two plugs on the other end of the cable into J101 and J201 on the rear panel of the Type 262. Use the spring locks on each side of the plugs to hold them firmly in place.

5. Connect the power cord from the recessed jack on the rear panel of the Type 262 to a power source.

The system is now ready to be programmed and operated. Refer to the Programming section of this manual for operating details.

Connecting to the Type RM567

The distance between the Type RM567 and the Type 262 is limited by the length of the interconnecting cable. Install the interconnecting cable as follows:

1. Pry out the accessory-hole cover from the rear panel of the Type RM567.

2. Remove the Type 6R1 from the Type RM567.

3. Pass the Bendix-connector end of the interconnecting cable into the Type RM567 through the accessory hole.

4. Bring the cable through the chassis and out through the Type 6R1 compartment.

5. Connect the plug to J34 and reinsert the Type 6R1 into the compartment. As the Type 6R1 is moved into position, withdraw the excess cable from the rear of the Type RM567 to prevent kinks.

6. Insert the two plugs on the other end of the cable into J101 and J201 on the rear panel of the Type 262. Use the spring locks on each side of the plugs to hold them firmly in place.

7. Connect the power cord from the recessed jack on the rear panel of the Type 262 to a power source.

NOTES

SECTION 3

OPERATING INSTRUCTIONS

Introduction

The Type 262 Programmer is the central unit of a measurement system. The simplest system is composed of the Type 262 together with the Type 567 Readout Oscilloscope. More complex systems can be designed that use several instruments with the Type 262.

This section of the manual describes the function of each front-panel control, then, the operation of a simple programmed system followed by an explanation of the modes of operation that can be used for complex measurement systems.

The text assumes that the reader can operate the Type 567 Readout Oscilloscope and associated plug-in units.

FUNCTION OF CONTROLS

The front panel is divided into a Program Control group and a Preset Limits group. The purpose of each control is as follows:

Program Control Group

ACTIVE PROGRAM	A series of 8 neon lamps that show which program card is in use.
AUTOMATIC	A pushbutton switch that operates the Type 262 in the automatic mode. Synchronizer and Counter cards must be installed to operate in this mode.
MANUAL PROGRAM SELECTION	Eight pushbutton switches that activate programs when the Type 262 is in the manual mode. Only one switch can be closed at a time.
EXT SCAN	A pushbutton switch used when an external device selects programs. Also used to release the MANUAL PROGRAM SELECTION switches when two or more Type 262 Programmers are connected in series.
AUTO SEQUENCE	These controls are only active if the Synchronizer and Counter cards are installed.
PUSH TO START	A pushbutton that resets the Type 262 Programmer to the number 1 program used in the automatic mode.
END	An 8-position rotary switch that sets the end of an automatic sequence of programs. The CARRY position is used when two or more Type 262 Programmers are connected in series.
567	A switch that releases the Type 567 display hold from control by the Type 262 Programmer. If the MODE switch of the digital unit is moved from EXT. PROGRAM, this switch must be set to FREE RUN.

Preset Limits Group

The limit lamps are active in both manual and automatic operation; however, the STOP SEQUENCE switches and the PUSH TO RESUME AUTOMATIC SEQUENCE pushbutton are used in automatic operation only.

LOWER LIMIT	A yellow lamp that lights when the test result is less than the programmed lower limit.
MID ZONE	A green lamp that lights when the test result is equal to or between the programmed upper and lower limits.
UPPER LIMIT	A red lamp that lights when the test results exceed the programmed upper limit.
STOP SEQUENCE (AUTOMATIC SEQUENCE INHIBITOR)	Three toggle switches that are used to stop an automatic sequence of programs if limits are exceeded. In addition, the center switch will stop the sequence if the test result is equal to or between the programmed upper and lower limits.
PUSH TO RESUME AUTOMATIC SEQUENCE	If one or more of the STOP SEQUENCE switches is up, and the automatic program sequence stops, the Type 262 will advance to the next program when the PUSH TO RESUME AUTOMATIC SEQUENCE pushbutton is pressd.
POWER ON	Controls the power to the Type 262.

PROGRAMMING

Manual or Automatic

Manually setting the front-panel controls of the digital unit and associated plug-in units is one form of programming. For example, if you set the TIMING START switch to 10% and the TIMING STOP switch to 90%, you have programmed the digital unit to make a risetime measurement. Each time you change the position of the front-panel controls you are programming another measurement. In a long series of measurements, the constant resetting of the controls is time consuming. This problem is eliminated by the Type 262, since a complete program change needs only the push of a button. Even this simple act can be improved upon by using the automatic feature of the Type 262. In this mode, pressing the PUSH TO START button causes the Type 262 to progress through up to 8 programs automatically.

Digital Unit Operation During External Programming

During externally programmed operation, the Start-To-Stop intensified zones show the type of measurement; however, both channels may show this zone. This occurs because the intensified channel is determined by the position of the

TIMING START and TIMING STOP switches and not by the program card. If either of the Timing switches are set at MANUAL, the intensified zone will always appear on both channels even though the measurement is being made on one channel.

When the digital unit completes a measurement, a print-command pulse switches the Type 262 to the next program and starts the display-time period of the digital readout. The readout digits remain until the display-time period ends; however, the unit-of-measure indicator may change immediately (if the program commands a change) when the Type 262 switches to the next program.

How to Wire Program Cards

The Type 262 uses up to eight program cards, and each one can be wired for a different measurement. A card is programmed with bus wire and resistors; no other components are needed.

Since most programs will be time measurements on the 1st slope of the waveform, the Type 262 has been preprogrammed by the logic circuit to operate this way. Thus, all measurements will be time measurements unless a program card commands an A or B voltage measurement. In the same way, all measurements will be on the 1st slope unless the program card commands a 2nd-slope measurement. The logic circuit starts the time clock, and supplies ÷ ground and decimal units ground for time measurements. The logic circuit also starts the voltmeter clock, and supplies A or or B ÷ ground and A or B decimal units ground for voltage measurements.

The following example illustrates the wiring of a program card for a voltage measurement on channel A.

Program: To measure the voltage between the 0% and 100% points of the channel A signal (where the 100% zone is more positive than the 0% zone).

Requirement: Start measurement at the channel A 0% point and stop measurement at the channel A 100% point.

Program Card Wiring:

1. Connect a bus wire from the A 0% to —START.
2. Connect a bus wire from the A 100% to —STOP.
3. Connect a bus wire from VMR (voltmeter ramp) to both +START and +STOP.
4. Connect a bus wire across A VOLTS.

The wired program card should be similar to that shown in Fig. 3-1. Figs. 3-2 through 3-9 illustrate other wired program cards.

To check the program card, insert it into the first card slot (extreme left) of the Type 262 Programmer. Set up the Type 567 and the digital unit to make a channel A voltage measurement. Use the oscilloscope calibrator as a signal source, or a pulse generator if sampling plug-ins are used. Turn on all instruments and set the digital unit to measure channel A voltage. Note the reading. Turn the digital unit MODE switch to EXT. PROGRAM and push in the number 1 program button on the Type 262. The voltage shown on the readout should be the same as noted above; if so, the program card is wired correctly.

No-Go Limits

The limits are placed on a program card by soldering resistors across the NO-GO LIMITS terminals. Table 3-1 lists the resistor values and the corresponding numbers. Precision 1% resistors (Std Mil-Bel) are available for all of the values shown in Table 3-1.

TABLE 3-1

Number	Resistor Value
0	887 Ω
1	1580 Ω
2	2260 Ω
3	3010 Ω
4	3830 Ω
5	4640 Ω
6	5490 Ω
7	6340 Ω
8	7150 Ω
9	8060 Ω

For example, if the desired upper limit is 350, a 3010-ohm resistor (3) is connected across the 100 terminal of the program card UPPER NO-GO LIMITS. A 4640-ohm resistor (5) is connected across the 10 terminal and a 887-ohm resistor (0) across the 1 terminal. Assume a lower limit of 250; a 2260-ohm resistor (2) is connected across the LOWER NO-GO LIMITS 100 terminals, a 4640-ohm resistor (5) across the 10 terminals, and a 887-ohm resistor (0) across the 1 terminals.

The wired NO-GO LIMITS section of the program card should be the same as shown in Fig. 3-10.

With the card wired in this way, any test results from 250 to 350 inclusive will cause the green (MID-ZONE) lamp on the front panel of the Type 262 to light. Any test result above 350 or below 250 will cause either the red (UPPER LIMIT) or yellow (LOWER LIMIT) lamp to light.

The position of the No-Go Comparator card in the Type 262 determines the range of comparison. If the components on the No-Go Comparator card face to the left (looking from the front panel), the unit, tens, and hundreds digits will be compared. If the card position is reversed, with the components facing to the right, the tens, hundreds, and thousands digits will be compared. Although the program cards are marked 1, 10, 100, these numbers only apply when the No-Go Comparator card is in position with the components facing left. The position of the No-Go Comparator card within its slot sets the comparison range for all program cards within the unit.

Rules for Programming Time Measurements

1. If a signal is positive-going at the start point of a measurement, connect the SIGNAL to the +START COMPARATORS terminal.

2. If a signal is positive-going at the stop point of a measurement, connect the SIGNAL to the +START COMPARATORS terminal.

3. If a signal is negative-going at the start point of a measurement, connect the SIGNAL to the —START COMPARATORS terminal.

4. If a signal is negative-going at the stop point of a

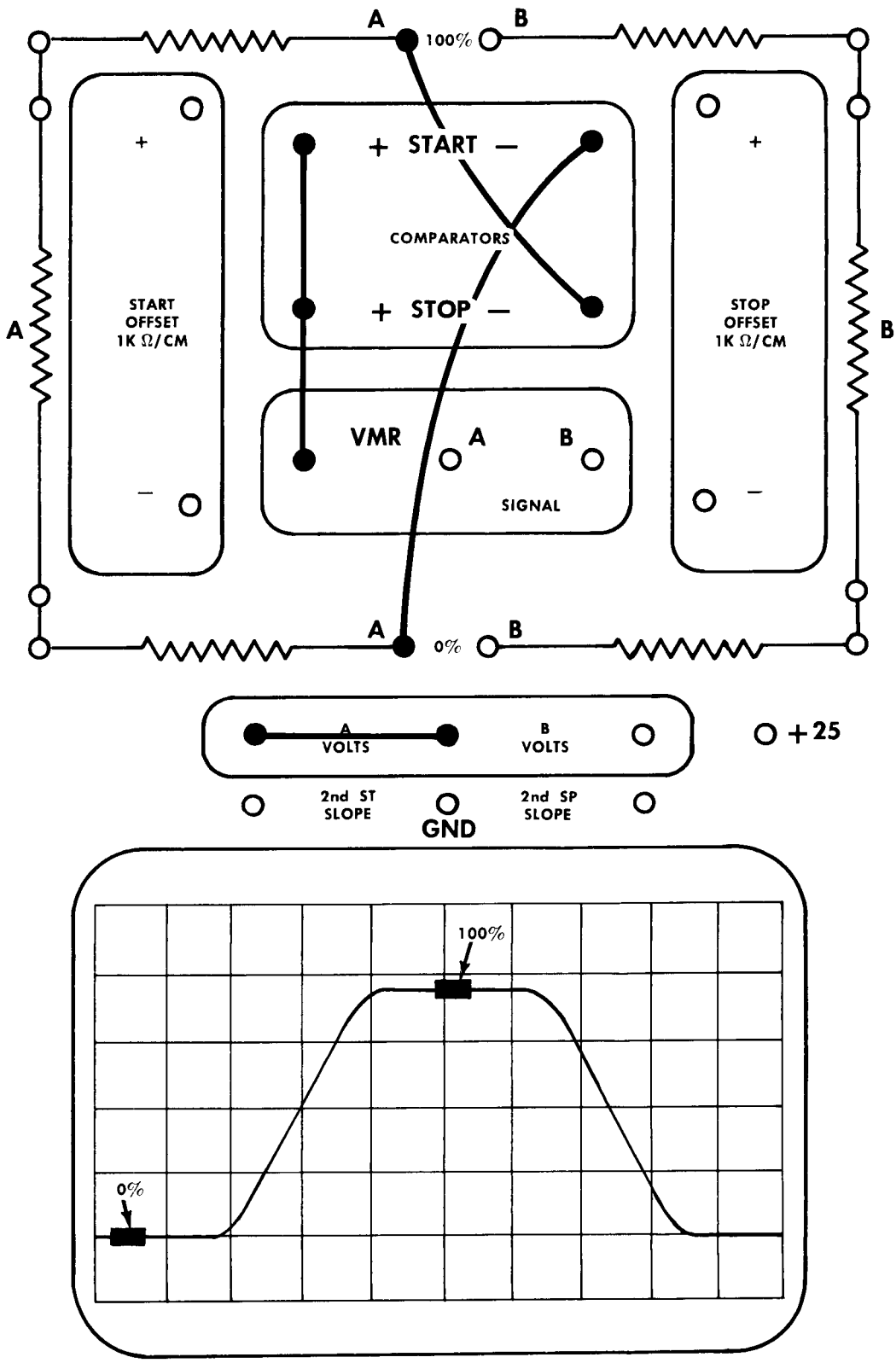


Fig. 3-1. Program card wired for a channel A voltage measurement.

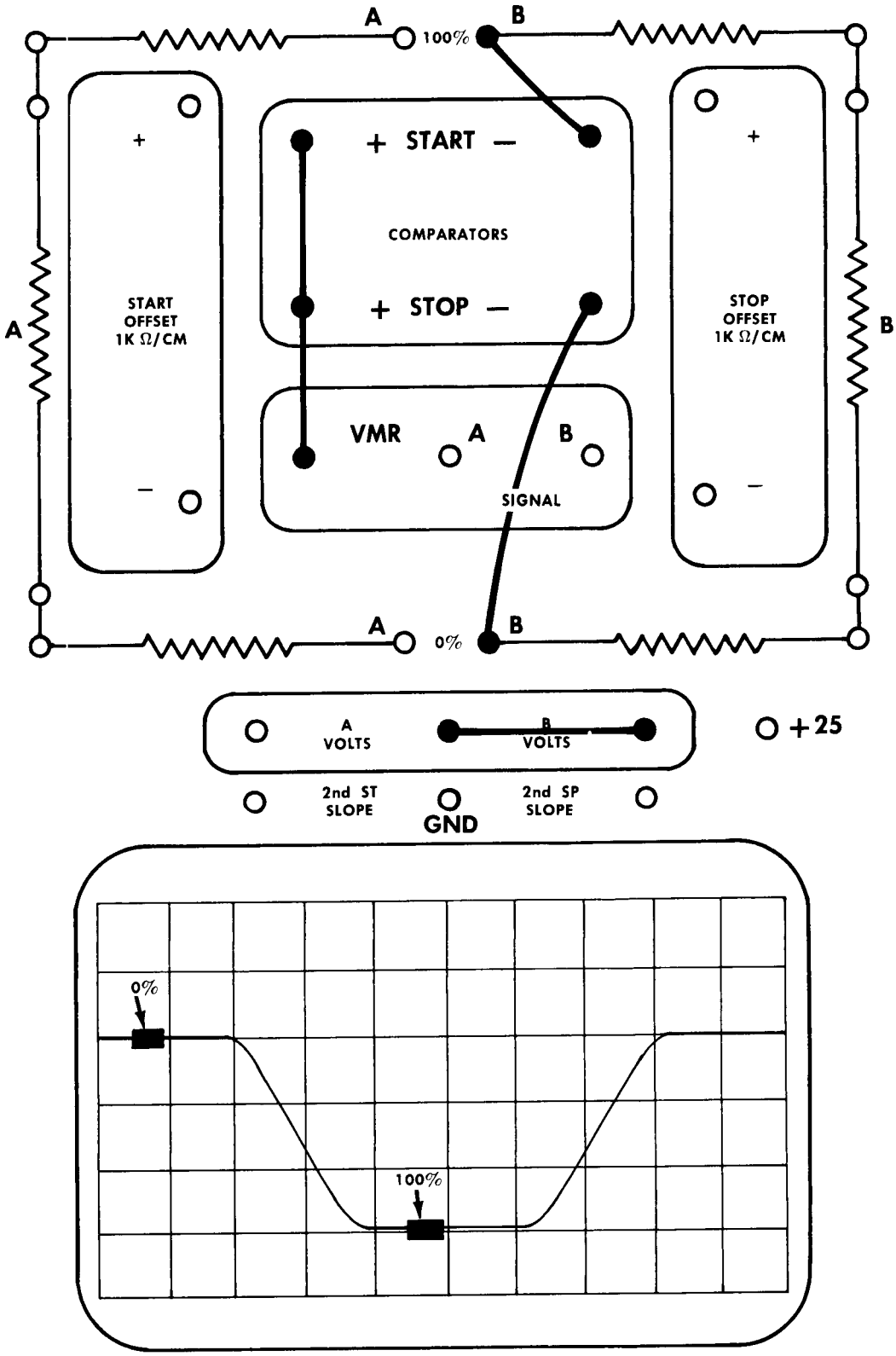


Fig. 3-2 Program card wired for a B voltage negative-going signal measurement between the 0% and 100% zones.

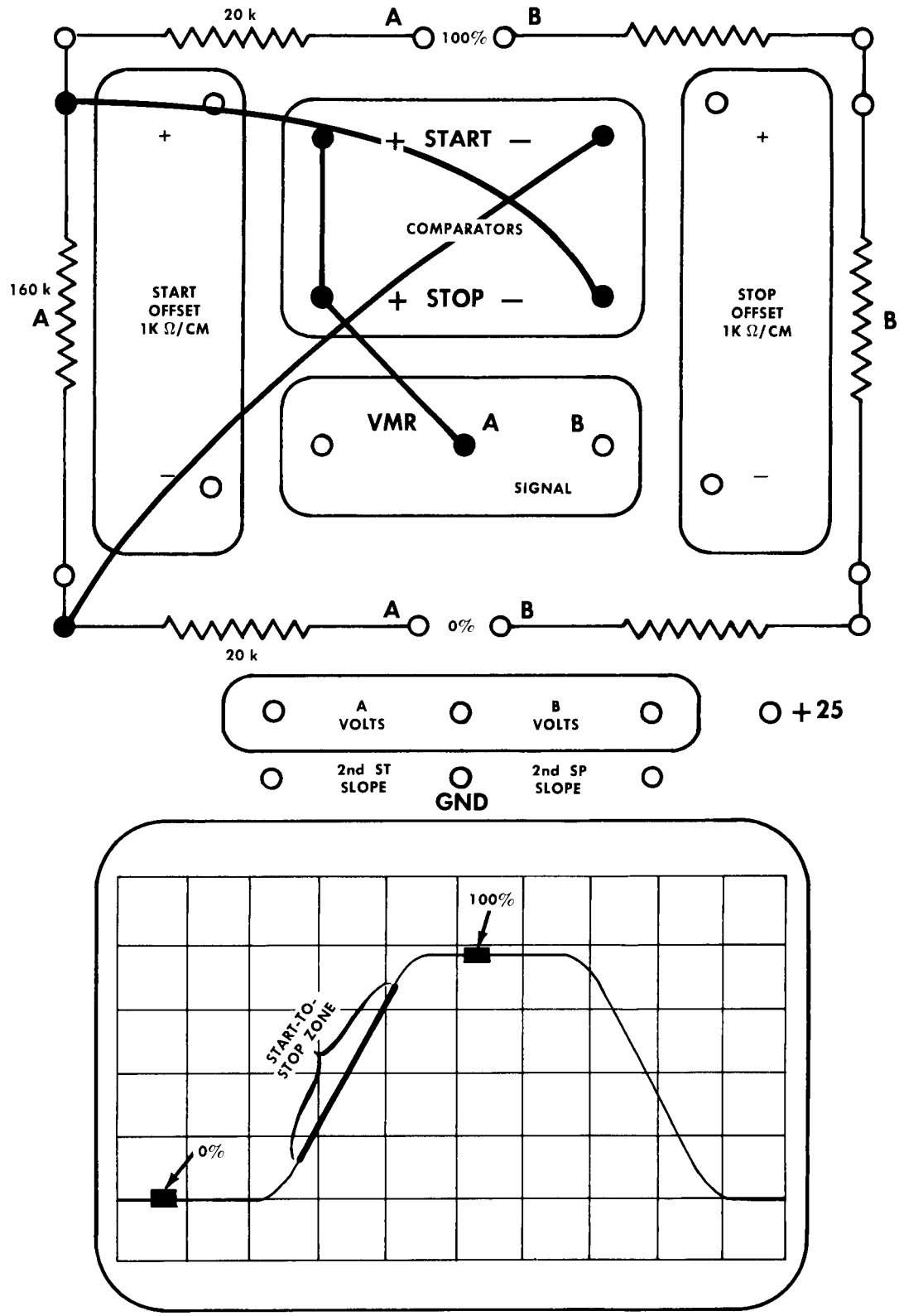


Fig. 3-3. Program card wired for an A signal risetime measurement with the Start-To-Stop Zones between the 10% and 90% zones.

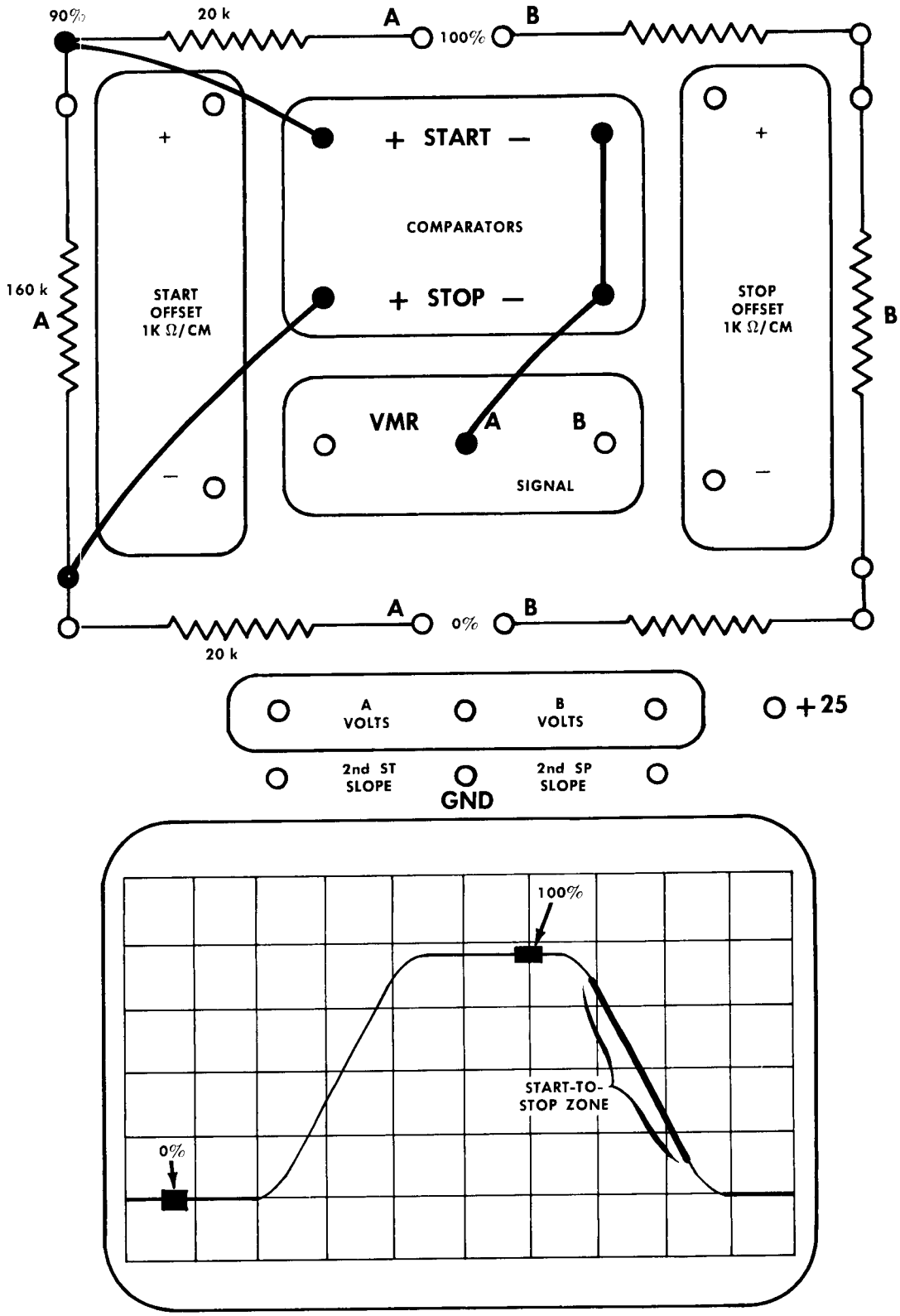


Fig. 3-4. Program card wired for an A signal falltime measurement with the Start-To-Stop Zone between the 90% and 10% zones.

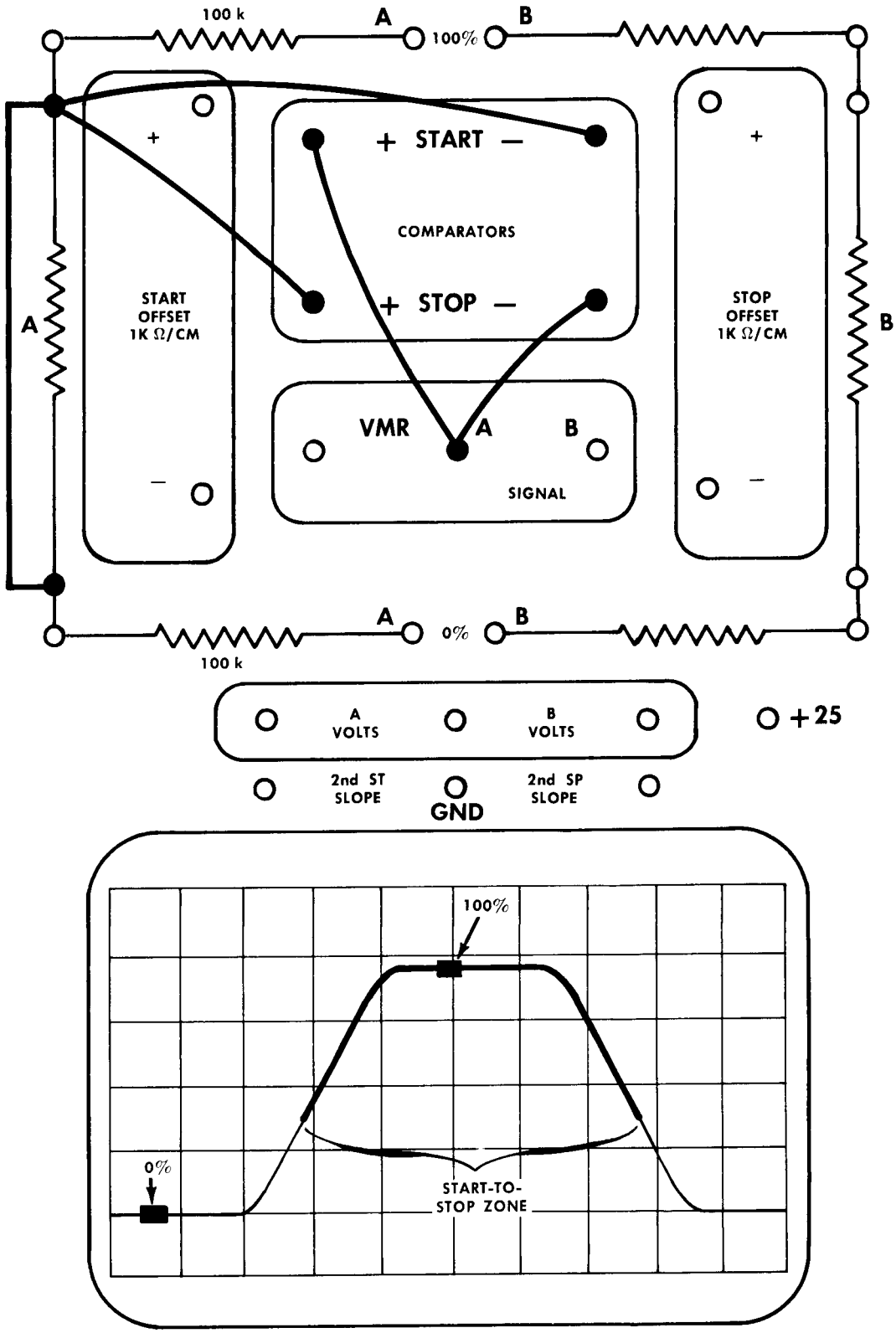


Fig. 3-5. Program card wired for an A signal pulse width measurement with the Start-To-Stop Zone between the 50% 1st + Slope and the 50% 1st — Slope.

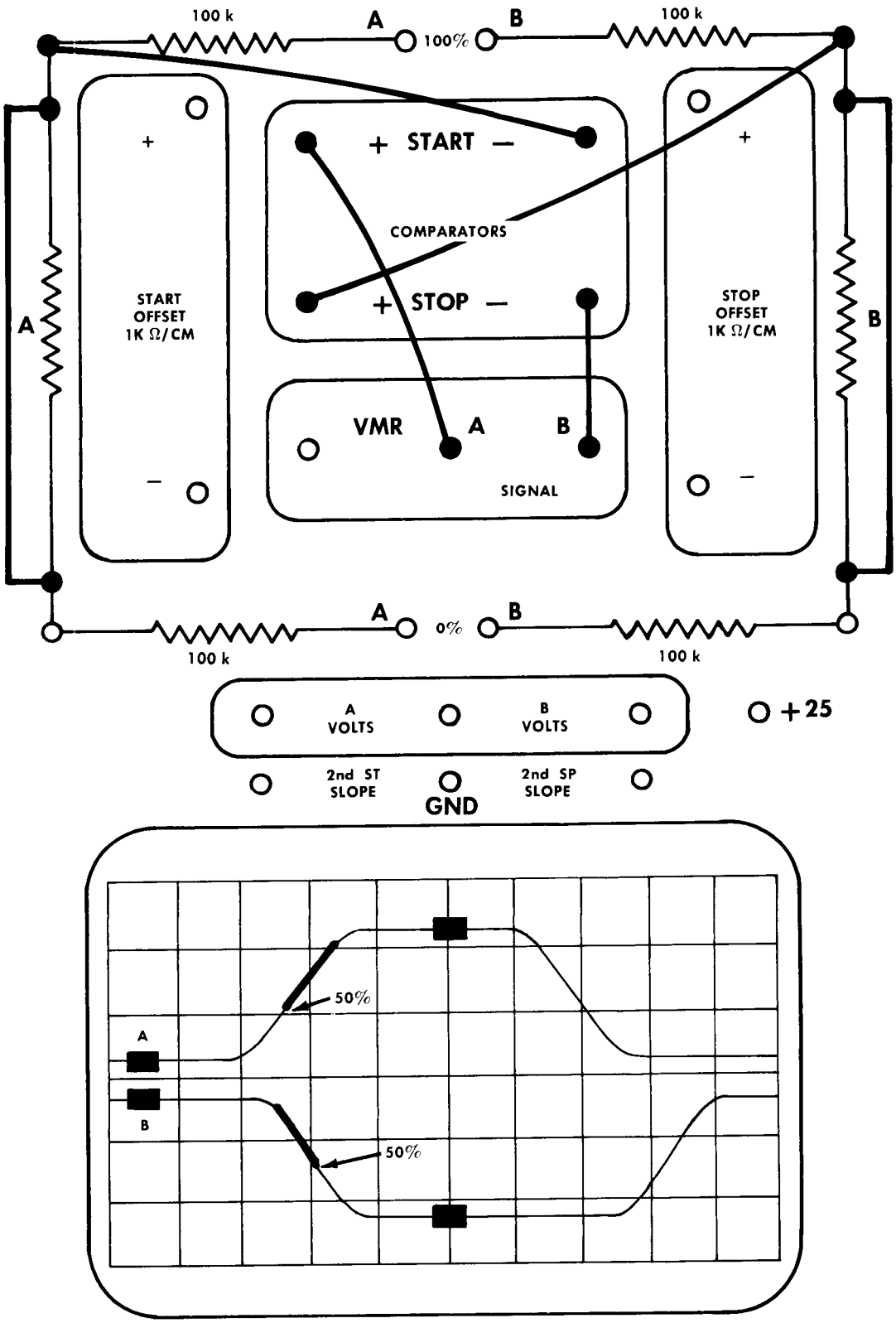


Fig. 3-6. Program card wired for an A signal to B signal delay measurement with the Start-To-Stop Zone between the A 50% 1st + Slope and the B 50% 1st — Slope.

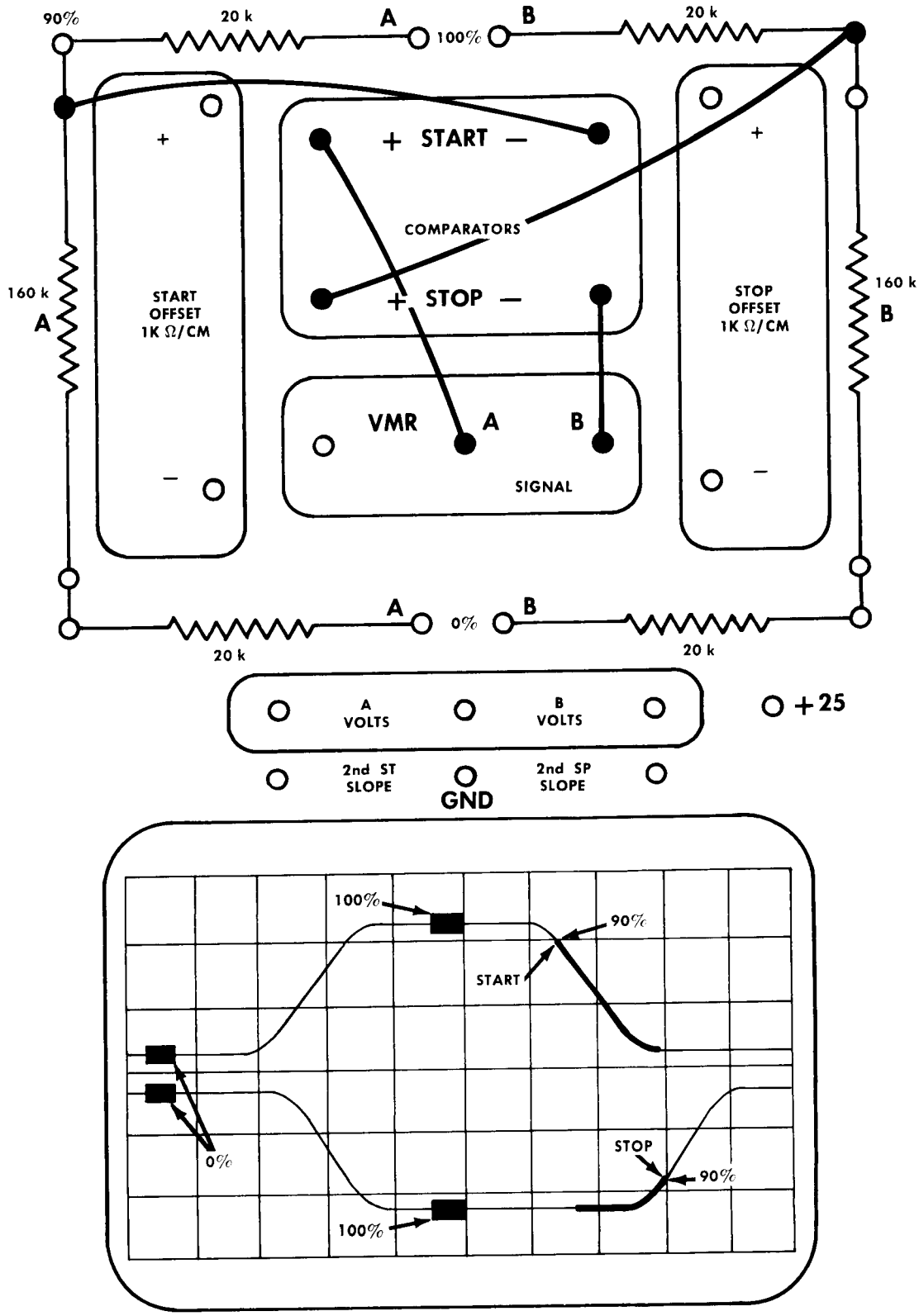


Fig. 3-7. Program card wired for an A signal to B signal storage measurement with the Start-To-Stop Zone between the A 90% 1st — Slope and the B 90% 1st + Slope.

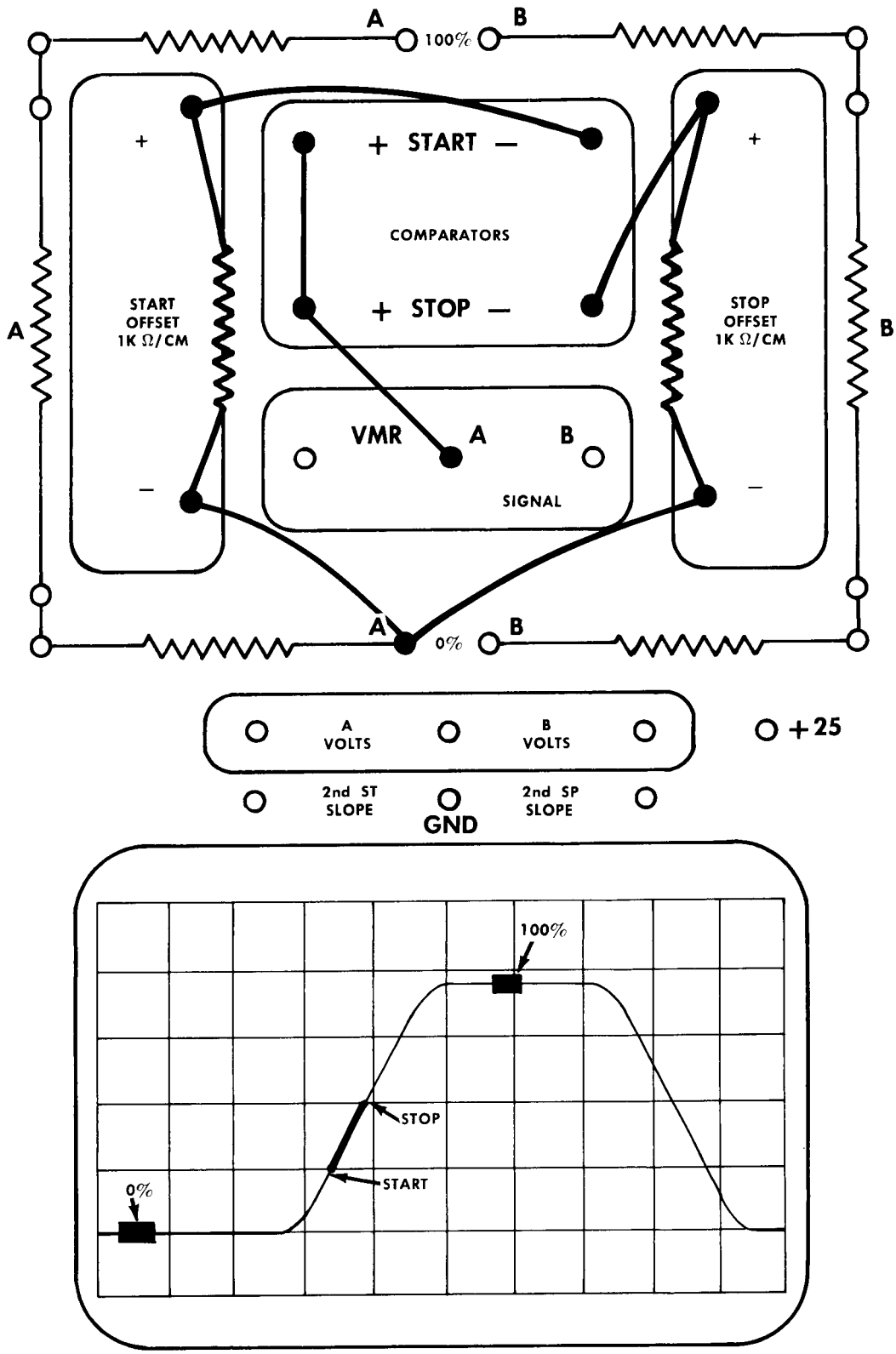


Fig. 3-8. Program card wired for an A signal rate-of-rise measurement with the Start-to-Stop Zone 1-cm up from the 0% and 2-cm up from the 100% zones.

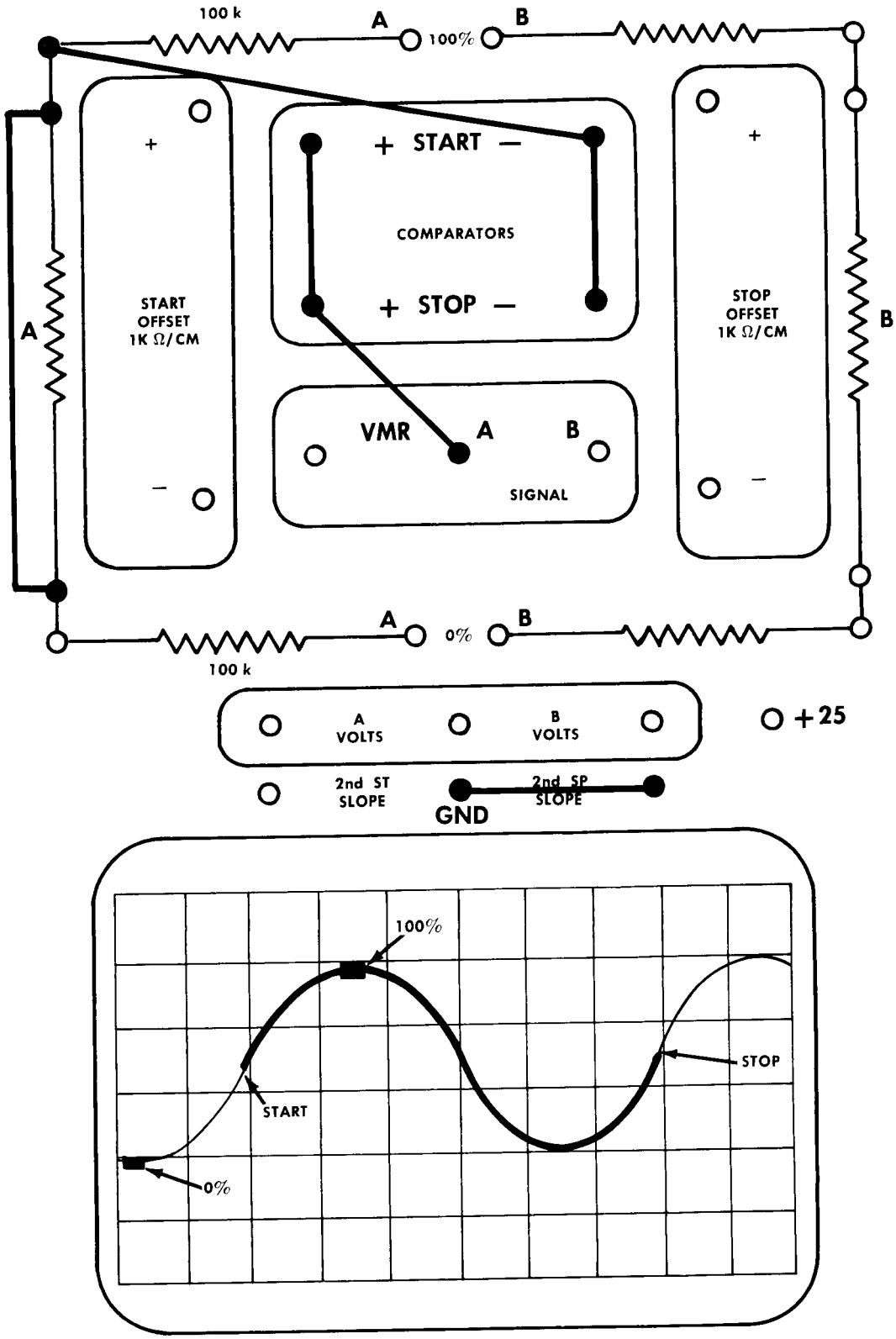


Fig. 3-9. Program card wired for an A signal period of 1 cycle measurement with the Start-To-Stop Zone between the A 50% 1st + Slope and the A 50% 2nd + Slope.

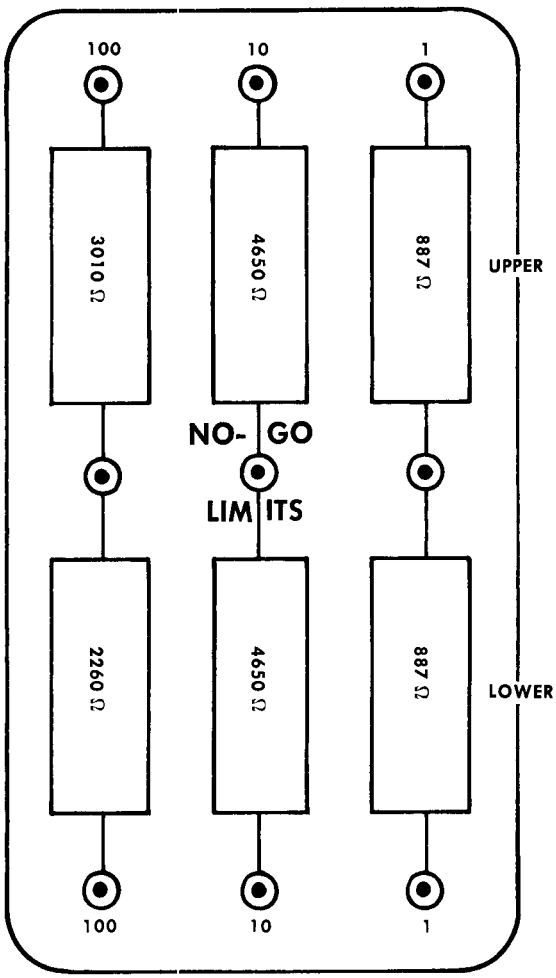


Fig. 3-10. Program card NO-GO LIMITS section wired for 350 upper limit and 250 lower limit.

measurement, connect the SIGNAL to the —STOP COMPARATORS terminal.

5. Once the signal connection is made to COMPARATORS terminals, the memory-signal percentage or offset voltage is connected to the remaining START and STOP terminals.

6. Any signal percentage between 0% and 100% can be obtained from a precision divider across the 0% and 100% Memory terminals. Use a minimum of 200k ohms between the 0% and 100% terminals when programming the Type 6R1 Digital Unit.

7. Both the 0% and 100% Memory voltages can be offset up (+) or down (—) to start or stop a measurement a specific number of divisions from either zone. Use a 1k resistor for each division of offset desired. Connect the resistor across the START OFFSET and/or STOP OFFSET terminals on the program card. To offset the start or stop point up (positive-going signal) from the 0% zone, connect the — terminal of the offset resistor to the 0% terminal of the channel in use. Connect the + terminal of the offset resistor to the —START or —STOP COMPARATORS terminals. To offset the start or stop point down (negative-going signal) from the 0% zone, connect the + terminal of the offset resistor to the 0% terminal of the channel in use. Connect the — terminal of the offset resistor to the +START or +STOP COMPARATORS terminals. To offset the start or stop point down (positive-going signal) from the 100% zone, connect the + terminal of the offset resistor to the 100% terminal of the channel in use. Connect the — terminal of the offset resistor to the —START or —STOP COMPARATORS terminals.

To offset the start or stop point up (negative-going signal) from the 100% zone, connect the — terminal of the offset resistor to the 100% terminal of the channel in use. Connect the + terminal of the offset resistor to the +START or +STOP COMPARATORS terminals.

Rules for Programming Voltage Measurements

1. To measure the voltage of a positive-going signal, connect wires from:

   a. VMR to +START and +STOP COMPARATORS terminals.

   b. 0% of channel in use to —START COMPARATORS terminal.

   c. 100% of channel in use to —STOP COMPARATORS terminal.

   d. Across A VOLTS or B VOLTS terminals, whichever applies.

2. To measure the voltage of a negative-going signal, connector wires from:

   a. VMR to +START and +STOP COMPARATORS terminals.

   b. 0% of channel in use to —STOP COMPARATORS terminal.

   c. 100% of channel in use to —START COMPARATORS terminal.

   d. Across A VOLTS or B VOLTS terminals, whichever applies.

Manual Operation

For manual programming with the Type 262, only the Logic, Regulator, and Program cards are necessary. If preset limits are a part of the programs, a No-Go Comparator card must also be used.

The only front-panel controls of the Type 262 that are used in manual programming are the MANUAL PROGRAM SELECTOR pushbuttons. All other controls are used in either the automatic or external scan modes. The limit lamps operate in all modes if the No-Go Comparator card is in place. The system can be set up for manual operation as follows:

1. Insert the wired program cards into the Type 262.
2. Connect the signal from the device under test to the vertical amplifier plug-in and set the controls for the correct crt display.
3. Set both channel 100% zones in position on the display.
4. Turn the digital unit MODE switch to EXT. PROGRAM and push the number 1 button on the Type 262.

When the results of program number 1 have been recorded, push the number 2 button to call up the next program.

Test results shown on the digital unit readout can be recorded by hand or, if the test is to check for tolerance within programmed limits, only the limit lamps on the front-panel of the Type 262 need be noted.

Automatic Operation

With the addition of a Synchronizer card and Counter card, the Type 262 can automatically switch through up to 8 programs at a preset rate. This preset rate depends on the type of program advance used. When the digital unit completes a measurement, a print-command pulse is formed. This pulse passes to the Type 262 where it is used to control the program-advance circuit.

The program-advance circuit can be arranged in either a synchronized or triggered mode.

Synchronized: The print-command pulse from the digital unit causes a display-time circuit within the Type 262 to start. This circuit (RC) runs up, fires, and advances the Type 262 to the next program. The display time can be varied from about 50 to 500 ms and is set by a control on the Synchronizer card.

Triggered: In this mode, the print-command pulse from the digital unit prepares or arms the program-advance circuit to receive a trigger pulse. On receipt of the trigger pulse, the Type 262 advances to the next program. Since recording the test results is usually the last step in a program, the trigger pulse comes from the recorder when it has completed a printout of the test results. The trigger pulse must be ±5.0 volts with a risetime of at least 100 μsec.

Synchronized Automatic Operation

With the instrument set up for manual operation, insert the automatic sequencer cards (Synchronizer and Counter) into the Type 262 and perform the following steps.

1. Preset the Type 262 controls as follows:

AUTOMATIC pushbutton	Pushed in
END (AUTO SEQUENCE)	8
567	SYNCHRONIZED
STOP SEQUENCE switches	All OFF

2. Push the START button; the programmer should start with program number 1 and progress through to program number 8. The neon lamps above the program pushbuttons show both the active program and the rate of program switching. Adjust the potentiometer on the Synchronizer card to change this rate.

3. If the tests are only to check tolerance limits, set the required STOP SEQUENCE switches up. Any test result that is outside the programmed limits will automatically stop the Type 262. To restart after a stop, push the RESUME SEQUENCE button.

NOTE

Whenever the digital unit MODE switch is turned out of the EXT. PROGRAM position to make an internal measurement, be sure the 567 switch on the Type 262 is set to FREE RUN.

Triggered Automatic Operation

For triggered program advance, a positive- or negative-going trigger pulse must be coupled to the Type 262 through pins 21 (+) or 22 (—) of P201. The trigger-pulse amplitude must be at least 5 volts with a minimum risetime of 100 μs.

Make the connections to P201 as follows:

1. Remove the shell of P201 to expose the rear pins.

2. Solder a jumper wire between pins 29 and 30.

3. Solder an insulated wire to the jumper and feed the other end through the shell. This is the trigger ground.

4. Solder an insulated wire to pin 21 (for + trigger pulse) or pin 22 (for — trigger pulse) and feed the other end through the shell. This is the trigger-pulse input line.

5. If +25 volts (125 ma maximum) is needed for the trigger-pulse circuit, solder an insulated wire to pin 18 and feed the other end through the shell.

6. If the +25 volts is used, solder an insulated wire (or the shield if shielded cable is used) to pin 16. This is chassis ground.

7. Replace the shell on P201.

Connect the trigger input and trigger ground wires to the trigger source. With P201 connected to J201, set up the Type 262 and the digital unit for free-run automatic operation. Press the PUSH TO START button on the Type 262; the programmer should show and hold program number 1 without advancing. If it does advance, adjust the potentiometer on the Synchronizer card to stop the advance.

Once this adjustment is made, the Type 262 will wait until the external trigger pulse is supplied before it moves to the next program. This waiting period is unlimited. Thus, recording devices can complete their printout and follow with a trigger pulse to shift the Type 262 to the next program. Or, the programmer can be made to wait until conditions (temperature, pressure, etc.) have reached preset points before the program is called up by the trigger pulse.

Programmers in Series

A single Type 262 Programmer operating in a system can supply up to 8 different test programs. To increase the number of test programs, 2 or more Type 262 Programmers can be connected in series. Thus, 2 programmers can supply 16 programs, and 3 programmers can supply 24 programs. (Cable capacitance and environmental noise may limit the number of programmers that can be used in series.)

Programmers in series can operate in either the manual or the automatic mode (with automatic sequencers in each unit). The same types of automatic operation (free-run, triggered) described for a single programmer can be used with programmers in series.

Manual Operation (Two Programmers In Series)

A single 4-foot interconnecting cable (Tektronix Part No. 012-082) is the only connection needed between the two programmers. Connect one end to J102 of the first Type 262 (connected to the digital unit). Connect the other end of the cable to J101 of the second Type 262. Be sure both units are connected to an ac power source. Operate the units as follows:

1. Insert up to 16 program cards into the two programmers.

2. Apply ac power to both units.

3. Push in the EXT SCAN button on the second programmer.

4. Push the program buttons on the first programmer in any sequence desired.

5. When all programs have been completed in the first programmer, push in the EXT SCAN button on this unit.

6. Push the program buttons on the second programmer in any sequence desired.

In manual operation with two or more programmers, always push in the EXT SCAN button on the inactive units.

Automatic Operation (Two or More Programmers in Series)

When two or more programmers are used in series, the first unit (connected to the digital unit) is considered the master, while following units are slaves. The master unit controls the slaves and its sequence rate is the rate for all slaved programs. In triggered program advance, the trigger pulse is still connected to the master programmer as previously described (see "Triggered Automatic Operation" in this section), even though slave units are supplying the programs.

The programmers are coupled together by a 4-foot interconnecting cable (Tektronix Part No. 012-082). One end connects to J102 on the master programmer and the other end to J101 on the first slave programmer. If additional slave programmers are used, always connect the cable from J102 (programmer closest to the master) to J101 (added slave programmer). Operate the units as follows:

1. Be sure each unit contains the automatic sequencer (Synchronizer and Counter) cards and is connected to ac power.

2. Set the SLAVE-NORMAL switch on the master programmer synchronizer card to NORMAL, and on all slave programmers to SLAVE.

3. Set all programmer front-panel controls as follows:

AUTOMATIC pushbutton	Pushed in
END	CARRY
567	SYNCHRONIZED
STOP SEQUENCE switches	All OFF

4. Turn on all instruments and set up for automatic programming. Press the PUSH TO START button on the master programmer. The programs, as shown by the neon lamps, should progress through the master programmer, then shift to the first slave, and on to any further slave units being used. If the programs should switch through the master but not advance through the first slave, adjust the potentiometer counterclockwise on the first slave Synchronizer card until the neons show program switching in the slave. If the slave free-runs, adjust the control clockwise to make the advance rate the same as the master. This adjustment should also be made on subsequent slave units that fail to switch programs.

5. To change the program switching rate, only the master programmer need be adjusted.

6. If limits are programmed, and you want the system to stop if a measurement exceeds the preset limits, push up the STOP SEQUENCE switches (use LOWER LIMIT and UPPER LIMIT or MID-ZONE). If all three switches are pushed up, the programmers will not advance. If the program stops because of an out-of-tolerance reading and you want to resume the sequence, push the RESUME SEQUENCE button on the programmer that contains the stopped program.

External Scan and Remote Control

The test to this point has described manual operation with program pushbuttons and automatic operation with the automatic sequencer cards. One additional method of program advance is external scan.

External scan means switching the individual program cards within the Type 262 by use of some external device. This device can be a rotary switch, stepper switch, or even a series of relays.

There are eight enable lines present at connector J201 on the rear panel of the Type 262. A ground connection to any of these lines will close the relay on the corresponding program card. This has the same affect as pushing the MANUAL PROGRAM SELECTION buttons on the front panel. Two additional lines (pin 11 and 12 of J201) must be brought out to the external scan device. If only one Type 262 is used, pins 11 and 12 of J201 can be jumpered together and a single wire brought out as the external-scan ground return. If two or more programmers are used in series, a wire is needed from both pin 11 and pin 12. The wire from pin 12 is the ground return while the wire from pin 11 is only grounded on the active programmer so that only the logic circuit in the active programmer is turned on (by grounding pin 11) while the logic circuits in the inactive programmer must remain turned off.

Remote control of the Type 262 is possible through connections to J201 on the instrument rear-panel (See Interconnection diagram). The remote control pins of J201 and their function are described as follows:

Pins of J201	Function
20	SEQUENCE HOLD: If this pin is grounded, automatic program advance will stop.
21	+TRIGGER: Connection pin for a positive-going trigger pulse in triggered operation.
22	—TRIGGER: Connection pin for a negative-going trigger pulse in triggered operation.
23	$\overline{\text{ENABLE}}$: This pin is near ground during program advance and rises to +28 volts at the completion of the progam.
24	START: A ground at this pin will start the advance at the number 1 program in the automatic mode. If ground is through an external transistor, risetime must be at least 100 μs.
25	RESUME SEQUENCE: A ground at this pin will advance the programmer when it has been stopped by preset limits.
31	DISPLAY: A positive pulse that represents the length of the Type 262 display period.
32	$\overline{\text{DISPLAY}}$: A negative pulse that represents the length of the Type 262 display period.

J201 also contains outputs from the three limit transistors on the No-Go Comparator card (pins 14, 15, and 16 of J201). These pins can be connected to external limit circuits; however, the load on any single line should not exceed 10 ma.

SECTION 4

CIRCUIT DESCRIPTION

Introduction

The Type 262 interconnects a variety of circuits within the digital unit, compares a measurement against preset limits and displays the result as a high, low, or mid-zone condition, and programs external equipment to make changes to suit each individual program.

The following circuit description contains a discussion of manual and automatic operation followed by a description of the Logic, Synchronizer, No-Go-Comparator, Counter and Regulator cards, and the Power Supply chassis.

Manual Operation

When the digital unit MODE switch is turned to EXT. PROGRAM, a group of circuits within the digital unit are broken, and their input and output leads connect to J34 on the rear of the chassis. A cable connects these lines to the Type 262. Within the Type 262, program cards, a Logic and a No-Go Comparator card supply a program to the digital unit. See the block diagram in Fig. 4-1 for the circuits used in manual operation. The output and input lines of the digital unit are shown in Fig. 4-2.

If each of these lines were routed to a program card, the number of pins and the size of the card would be quite large. Since several of the circuits exist in only two conditions (1st slope, 2nd slope) only one command from a program card is needed. If no command is given by a program card, the program will always measure on the 1st slope. On command from a program card, a 2nd slope measurement is made. In the same way, if no voltage-measurement command is given, the digital unit will make a time measurement, which includes starting the time clock, supplying the ÷ ground and the horizontal decimal ground.

A single command from the program card to measure channel A voltage causes the Logic card to program the voltmeter oscillator, channel A vertical ÷ ground, and vertical decimal ground.

In addition to commands to the logic circuits, the program cards also contain connections between the memory outputs, the signal, the voltmeter ramp, and the start and stop comparators. The type of connections made on the program card depend on the program desired.

Once the program cards are wired and inserted in place, the MANUAL PROGRAM SELECTION pushbuttons activate the individual programs. If the program cards contain no-go limit resistors, a comparison is made on the No-Go Comparator card and the front-panel lamps show the results.

An auxiliary program card rack (optional accessory) can be used to program external equipment. These auxiliary program cards can contain a reed relay similar to those on the regular program cards. When a program is activated, the relay on a program card closes; at the same time, the relay on the auxiliary program card also closes.

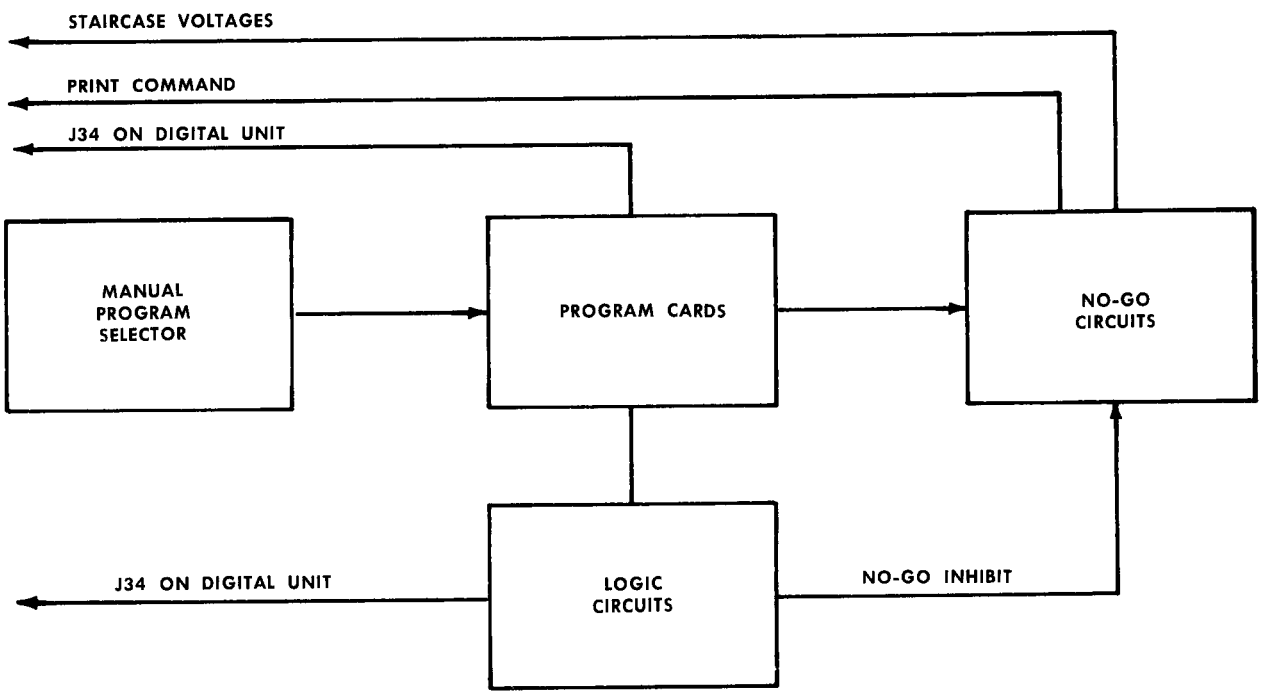


Fig. 4-1. Circuits used for manual operation.

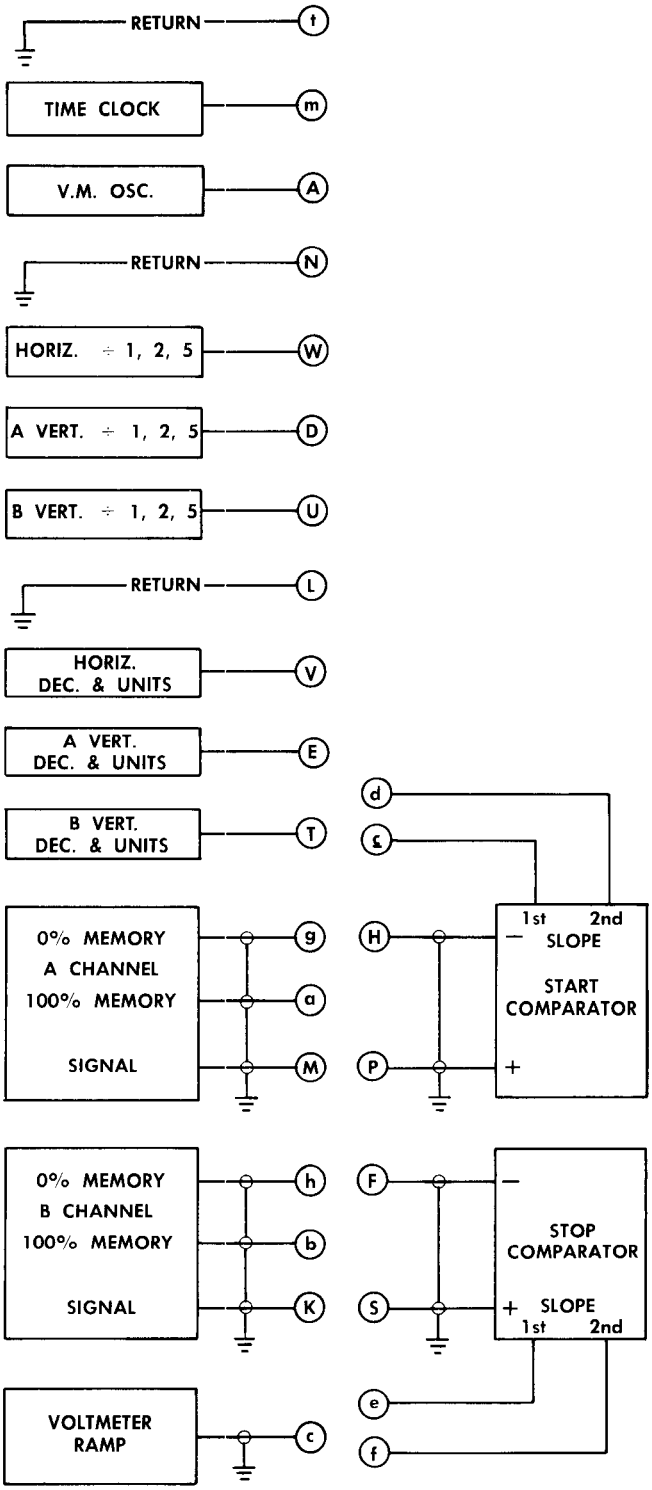


Fig. 4-2. Circuits used to interconnect an external program.

A single card contains the power supply regulator circuits. These circuits are described in detail later in the text.

Automatic Operation

The Type 262 can operate automatically if a Synchronizer and Counter card (optional accessories) are inserted. Fig. 4-3 shows the relationship between the circuits.

The Synchronizer card contains the control circuits for the rest of the programmer. The front-panel AUTOMATIC button is pushed in and the PUSH TO START button is pressed. This causes a multivibrator on the Synchronizer card to change states and allow (enable) the programmer to operate. In addition, pressing the PUSH TO START button also resets the counter to reactivate the number 1 program. From this point, the programmer is either advanced by the print-command pulse from the digital unit, or triggered from external equipment. If external triggering is used, the print-command pulse from the digital unit prepares or arms a sequence-advance multivibrator to receive a trigger pulse. If no external trigger is used, the print-command pulse causes the programmer to shift to the next program at the end of the Type 262 display period.

Logic Card

The Logic card on command from a program card sets the type of measurement made by the digital unit and also reduces the number of connections required of each program card. For example, a program card can order either A or B volts. If neither of these are ordered, the Logic card tells the digital unit to measure time. In the same way, the Logic card always tells the digital unit to measure on the 1st slope, unless the program card commands a 2nd-slope measurement.

The logic circuits are only active when the digital unit MODE switch is turned to EXT. PROGRAM. In all other positions of the MODE switch, the circuits are disabled. Q54 must be turned off before the logic circuits can operate. And Q54 is only turned off when two signals are present. First is the ÷ ground at pin 22. This is present when the digital unit MODE switch is set to EXT. PROGRAM. Second is the enable at pin 23 from the Synchronizer card. This must be down (near ground). Thus, these two signals form an 'and' gate and both must be present before Q1 will turn off.

The collector of Q54 must be at +25 volts before any of the circuits can operate. This only occurs when Q54 is turned off.

If a time measurement is programmed, only Q24 turns on. The reed switch in the collector circuit of Q24 closes and connects the ÷ ground to the time control circuits (time clock, ÷ ground, decimal and units). If pin 20 (A volts) is grounded by a program card, Q14 turns on and its reed switch closes. The ÷ ground of pin 22 is now connected to the A voltage controls (pins 19, 16, and 14). In addition, a diode in the base circuit of Q24 is foward-biased by this ground, and Q24 (time circuit) turns off. The action of Q34 (B voltage) is the same.

Q84 and Q94 control the start slope of a measurement. Pins 25 and 26 connect to the start comparator circuit in the digital unit. Both transistor components are the same; however, diode D84 in the collector of Q84 causes Q84 to turn on first. This, in turn, causes a negative voltage at the base of Q94 and holds it off. When Q84 turned on, it became a ground path for the 1st slope circuit in the digital unit signal comparator. If a program calls for a 2nd-slope measurement, pin 28 (base circuit of Q84) is grounded by the program card and Q84 turns off. D84 is back-biased and Q94 turns on. Now the 2nd-slope circuit of the digital unit is grounded and the measurement takes place on the 2nd slope.

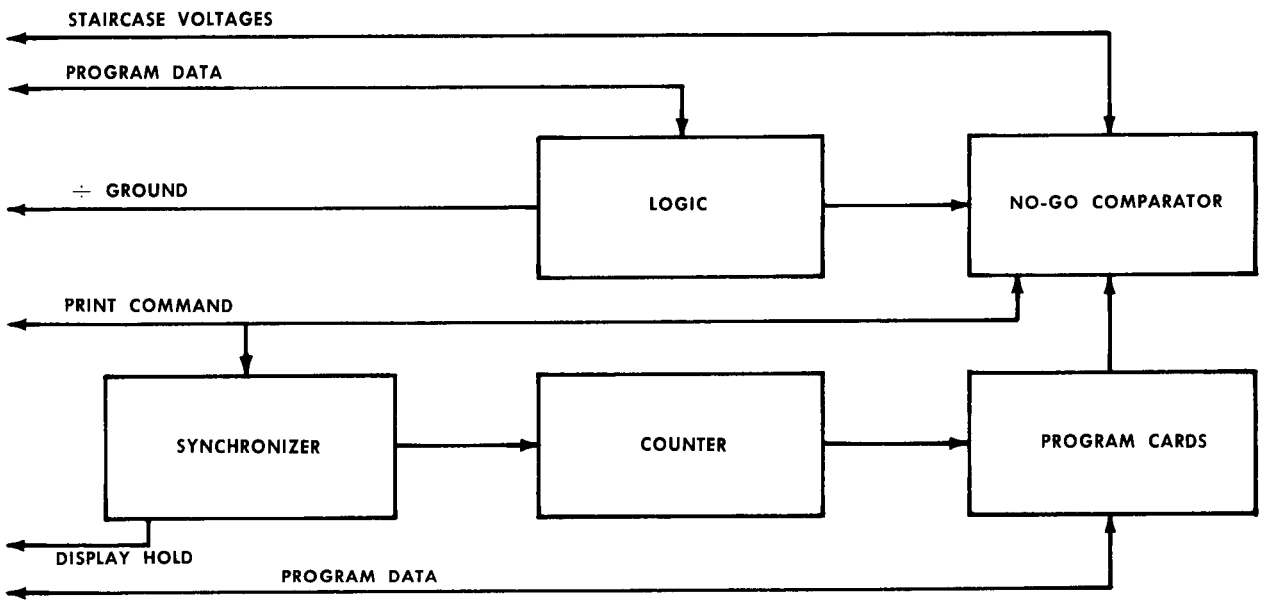


Fig. 4-3. Circuits used for automatic operation.

The stop-slope circuit action is the same as that described for the start slope.

The offset circuits are similar to those in the digital unit except that the voltage division takes place on the program cards. Connections to the comparators also takes place on the program cards.

The no-go comparator circuit is inhibited anytime the collector of Q54 goes to ground. This is explained in the No-Go Comparator card description.

Synchronizer Card

Before the start of a program sequence, Q95 is off and Q85 is on. Thus, enable is up and the logic circuits are locked out.

The PUSH TO START button (front panel) grounds pin 27 and causes a negative pulse to fire D75. When D75 fires, a positive pulse develops across R76 and passes to the base of Q85. The multi switches as Q85 turns on and Q95 turns off. The collector of Q85 is near ground and thus, the enable is down. The pulse from diode D75 also passes to the base of Q45. This turns Q45 on and sets the sequence-advance multi in the correct position. In addition, the pulse couples through C58 to pin 28 to reset the counter to the number 1 program. When Q45 turns on, pin 19 goes to ground through Q45 and ends the display period of the digital unit. The number 1 program measurement is made.

When the measurement ends, a print-command pulse from the digital unit couples to pin 2 of the card. This back-biases D10 and causes a sharp pulse to fire D65. The pulse from D65 switches Q55 and Q45 off. Since the collector of Q55 is near ground, the source voltage for D65 is grounded and D65 is locked out (cannot be fired). On the other side of the multi, Q45 turned off and unlocked D35. Note the symmetry of D35 to Q45 and D65 to Q55. D35 can be fired by: (1) a ± trigger pulse, (2) release of sequence hold, or (3) it can free run. When D35 fires, a pulse is coupled out through pin 7 to advance the counter to the next program. The pulse also couples to the base of Q45 to switch back the sequence-advance multi. Q45 turns on, D35 is locked out, and D65 can be fired by the next print-command pulse. The PUSH TO RESUME AUTOMATIC SEQUENCE button connects to pin 1. When the button is pressed, D75 fires and its pulse couples through pin 7 to advance the counter to the next program. Thus, if D35 is locked out for some reason, the PUSH TO RESUME AUTOMATIC SEQUENCE button bypasses the sequence-advance multi and moves the counter ahead.

No-Go Comparator Card

When the digital unit completes a measurement, voltage levels that represent the number on the readout are transmitted to the No-Go Comparator card. These voltage levels are compared with programmed voltage levels and the LOWER LIMIT MID-ZONE, or UPPER LIMIT lamp is turned on. This voltage level comparison takes place in the No-Go Comparator card circuit.

On the No-Go Comparator schematic diagram note that Q224 and Q244 are ground returns for both the UPPER LIMIT and LOWER LIMIT lamps. If either one of these transistors turns on, the base of Q254 (MID-ZONE) goes negative and the transistor is held off. If both Q224 and Q244 are off, the base of Q254 goes positive and it turns on and lights the MID-ZONE lamp.

Q263 is a 'gate' transistor for the limit lamps. In the absence of a print-command pulse from the digital unit at pin 2, Q263 is turned on and the three lamp control transistors are held off. With Q263 turned on, diodes D214, D263, and D234 are forward-biased. This causes the voltage at the bases of Q254, Q224, and Q244 to go negative and hold them off.

The circuit is 'gated' on by the print-command pulse applied to the base of Q263. Q263 turns off and if there is not a ground at pin V (No-Go Inhibit, see No-Go Comparator schematic), diodes D214, D263, and D234 back-bias and allow the lamp control transistors to operate. The No-Go Inhibit lines at pin V connect to both the Synchronizer and Logic cards. The object of this circuit is to lock out the limit lamps at all times except during a no-go comparison.

The description from this point assumes that a print-command pulse is present at pin 2 and there is no inhibit ground at pin V. Thus, the limit lamps can operate.

If the test result shown on the digital readout is lower than the programmed lower limit, Q244 will turn on and light the LOWER LIMIT lamp. In the same way, if the test result exceeds the programmed upper limit, Q214 will turn off. This allows Q244 to turn on and light the UPPER LIMIT lamp. If the test result is equal to or between the programmed upper and lower limits, Q234 and Q214 will turn on; Q224 and Q244 will turn off; and Q254 will turn on and light the MID-ZONE lamp.

Since the upper and lower limit comparators are almost the same, only the lower limit circuit is described in detail.

The comparators on the circuit card compare three digits of the test result; either the 100's 10's and units, or if the circuit card is reversed in its plug, the 1000's, 100's and 10's.

Q194 and Q184 compare the 100's digit. In these comparators the transistor with the least positive base turns on. The 100's limit resistor wired on a program card connects between pin 8 and ground and becomes the bottom resistor in a string of three between the +100-volt supply and ground. The value of the program-card resistor sets the base voltage of Q194 and Q174. The base of Q174 is always about 1.8 volts higher than the base of Q194. For example, assume the program card resistor to be 4640 ohms. The voltage at the base of Q194 is 11.5 volts, and the voltage at the base of Q174 is 13.2 volts. See Table 4-1.

TABLE 4-1

Number	Program Card Resistor	Limit Voltage	Lockout Voltage	Digital Unit Staircase Voltage
0	887	2.9	4.7	3.8
1	1580	4.6	6.4	5.6
2	2260	6.3	8.1	7.3
3	3010	8.0	9.7	8.9
4	3830	9.7	11.5	10.6
5	4640	11.5	13.2	12.4
6	5490	13.3	14.7	14.0
7	6340	15.0	16.6	15.8
8	7150	16.7	18.3	17.5
9	8060	18.5	20.0	19.2

When the digital unit completes a measurement, a voltage that corresponds to the 100's digit on the readout is applied to the bases of Q184 and Q164. If the 100's digit on the readout is 5, the voltage is 12.4 volts. Thus, there is 11.5 volts on the base of Q194 and 12.4 volts on the base of Q184. Q194 being least positive, turns on. The collector of Q194 goes positive and D194 is back-biased. If D194 is not back-biased by the comparator because the readout voltage is lower than the programmed voltage, the base of Q234 will go negative and turn off. This allows Q234 to turn on and light the LOWER LIMIT lamp. Q154 in the 10's comparator must back-bias D154, and Q114 in the units comparator must back-bias D114. If any one of these three diodes (D194, D154, D114) becomes forward-biased, the LOWER LIMIT lamp will light.

Since the individual digits of a number are compared, it is possible for the total number on the readout to be larger than the programmed limit, and yet have one or more of the individual digits lower. For example, with a programmed lower limit of 350, and a readout of 420, the first digit of the readout (4) is larger than the first programmed digit (3), but the second digit of the readout (2) is lower than the second programmed digit (5). If only three comparators were used, this condition could cause a false reading. To avoid this, the 100's and 10's comparators use a second comparator to lock out the remainder of the circuit when the readout number exceeds the programmed number.

From the previous example, with a readout of 420 and a programmed lower limit of 350, the voltage levels of the 100's comparator are as shown in Fig. 4-4.

In the first comparator (Q194 and Q184), Q144 turns on and D194 is back-biased. In the second comparator (Q174 and Q164), Q174 turns on and finds a current path through D153 and D113. This raises the cathode voltage and back-biases D154 and D114. Thus D194, D154, and D114 are back-biased and the condition of the 10's and units comparators connot affect Q234. These comparators have been locked out because the 100's digit of the readout was greater than the programmed 100's digit. In a case where the 100's digit of the readout is the same as the programmed 100's digit, Q174 in the second comparator does not turn on and lockout does not take place. A lockout comparator is also used in the 10's comparator, since the readout 10's digit can be greater than the programmed 10's digit while the units digit may be smaller. A lockout is not necessary for the units comparator.

Counter Card

The Counter card advances the programs when the Type 262 is used in the automatic mode.

The Counter card consists of three binary sets (multivibrators) and a group of logic transistors that supply ground connections to the program cards.

The positive input pulses to the Counter card are through pin 7. The first binary set will have one output pulse for each two input pulses. The second binary set has one output pulse for each four input pulses at pin 7, and the third binary set makes a change of states (switches) on the fourth and eighth pulse at pin 7. Due to the switching of the three binary sets, there are eight possible on-off condition combinations. These combinations drive the logic transistors in such a way that only one of the eight output lines is grounded at any given state of the counter.

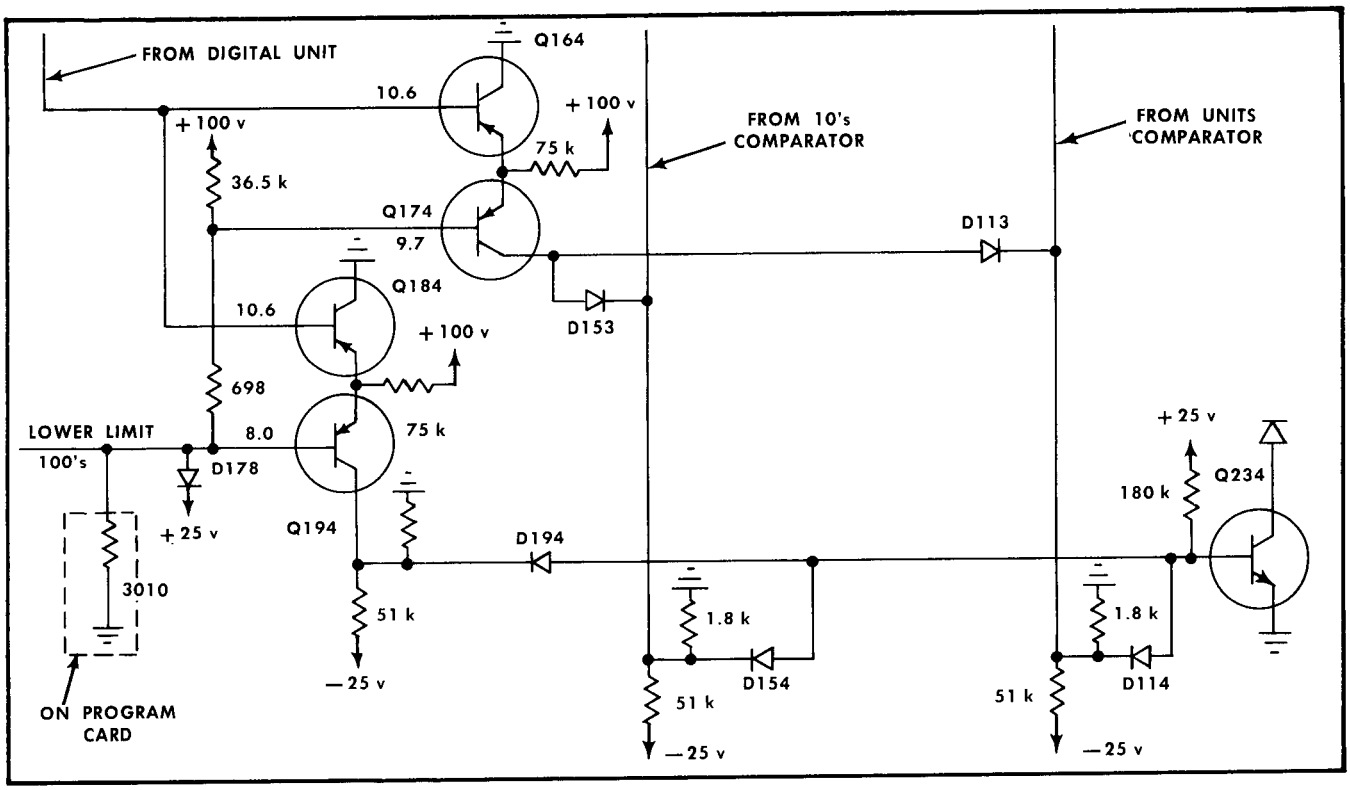


Fig. 4-4. Simplified schematic of the lockout comparator.

When the PUSH TO START button on the Type 262 is pressed, a reset pulse couples to pin 28 of the Counter card. This positive pulse turns off Q15, Q35, and Q55. The number 1 program card will be activated by a ground path through pin 8 of the Counter card. To find this path, trace back from pin 8 to Q101. The base of Q101 is in the collector circuit of Q25, and since Q25 is turned on, the voltage supplied to the base of Q101 is positive, thus Q101 also turns on. The emiter of Q101 is connected to the collector of Q124. The base of Q124 is in the collector circuit of Q45, and since Q45 is turned on, Q124 is also turned on. The emitter of Q124 is connected to the collector of Q144. Since the base of Q144 is in the collector circuit of Q65, Q114 turns on because Q65 is on. The path to ground ends at the emitter of Q144.

The first pulse at pin 7 switches Q15 and Q25. Q102 then turns on to supply a ground at pin 9. The remainder of the ground path for Q102 is the same as that for Q101. The other logic transistors follow the same pattern as the counter moves through the eight separate conditions.

Power Supply and Regulator

The Type 262 power supply furnishes series regulated voltages of —25, +25, and —100 volts. Each regulator circuit is driven by a secondary winding to T601. Each circuit contains a full-wave, four-diode, bridge rectifier.

Since the +25-volt supply serves as the reference voltage for the other supplies, its operation will be described in more detail. The ground return of the +25-volt supply is through series regulator transistor Q667. Q667 is in series with the load and is therefore capable of varying the current; thus, controlling the voltage across the load. Q667 is controlled by a differential amplifier circuit that changes the bias on Q667 as the voltage across the load changes.

The differential amplifier circuit of the +25-volt supply consists of Q644 and Q654. The base of Q654 is connected to a reference voltage from a Zener diode. The other base of the differential amplifier Q644 is connected to a voltage that is adjusted during calibration for a +25-volt output. The collector of Q654 connects to a double emitter-follower (Q653 and Q663) that drives the base of Q667. The following sequence takes place as the voltage across the load attempts any change. A voltage change takes place on the base of Q644; thus, changing the collector current of Q654 and affecting the bias on Q653 and Q663. This, in turn, changes the voltage at the common emitters of Q653 and Q663 and varies the bias of series regulator transistor Q667. This ultimate change causes a canceling effect on the original change in voltage across the load.

Operation of the —25- and +100-volt supplies is similar to the +25-volt supply. The series requlator transistors in these supplies are Q637 in the —25-volt supply and Q697 in the +100-volt supply. Instead of using a Zener diode for a reference voltage, the other supplies use the +25-volt supply as a reference. Notice the very close similarity between the +100- and +25-volt supplies. Also, notice the base of Q684 connected to the Zener reference diode.

The circuitry of the —25-volt supply is a bit less similar to the +25-volt supply. Series regulator transistor Q637 is directly in series with the load rather than in the ground

return path as in the other supplies. Q614 is the basic control transistor. The base of Q614 is connected to a voltage divider that has one end tied to +25 volts and the other end tied to —25 volts. The voltage divider causes the base of Q614, under nominal voltages, to set at a fraction of a volt negative. Assuming that the +25-volt supply is very stable, the only change in bias will result from a change in the —25-volt supply. Hence, if the voltage attempts to change, Q614 collector current changes and thus the bias on Q623 also changes. This changes the bias on Q633 and then on series regulator transistor Q637. This corrects for the original attempt of the voltage across the load to change.

SECTION 5

MAINTENANCE AND CALIBRATION

Visual Inspection

The Type 262 should be inspected occasionally for such visible defects as poor connections, broken or damaged ceramic strips, improperly seated transistors, and heat-damaged parts. The remedy for most visible defects is obvious: however, particular care must be taken if heat-damaged parts are detected. Overheating can be caused by other, less apparent troubles in the circuit. For this reason, it is essential to determine the actual cause of overheating before the parts are replaced; otherwise, the damage may be repeated.

Transistor Replacement

Transistors should not be replaced unless they are actually defective. If transistors are removed and found to be acceptable, be sure to return them to their original sockets. This will avoid recalibration because of different transistor characteristics.

The best way to check a transistor is by substitution. That is, replace the suspected transistor with one of the same type that you know is good. Then, check to see if the instrument operates properly. If not, return the original transistor to its socket.

Soldering Precautions

In the production of Tektronix instruments, a silver-bearing solder is used to establish a bond to the ceramic terminal strips. This bond may be broken by repeated use of ordinary tin-lead solder, and by excessive heating of the terminal strip with a soldering iron. Occasional use of ordinary 60/40 solder is permissible if applied with moderate heat. For general repair work, however, solder used for the ceramic strips should contain about 3% silver. If this type of solder in not available locally, it may be purchased directly from Tektronix in one-pound rolls (part number 251-514).

A wedge-shaped tip on the soldering iron is best for soldering or unsoldering parts on the ceramic strip. This type of tip allows you to apply heat directly to the solder-slot on the strip, reducing the overall heating effect. Use as little heat as possible to establish a good solder bond.

The following procedure is recommended for soldering and unsoldering short-lead components: (1) Use long-nose pliers for a heat sink. Attach the pliers between the component and the point where the heat is applied. (2) Use a hot soldering iron for a short time. (3) Carefully manipulate the leads to prevent lead or insulation damage. (4) Use only a small amount of solder; just enough to make a good bond.

Calibration

Since the Type 262 circuits are primarily of the switching type, only the calibration of the power supplies is necessary.

To calibrate the power supplies, proceed as follows:

1. Remove the Regulator card and reconnect it through the 56-pin extender board.

2. Turn the Type 262 power on and connect a 1% dc voltmeter to pin 17 of the Regulator card.

3. Adjust R645 for exactly +25 volts.

4. Connect the meter to pin 15 of the Regulator card. The voltage should be +100 volts, ±3%.

5. Connect the meter to pin 12 of the Regulator card. The voltage should be −25 volts, ±3%.

NOTES

SECTION 6
PARTS LIST AND SCHEMATICS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

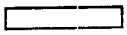
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

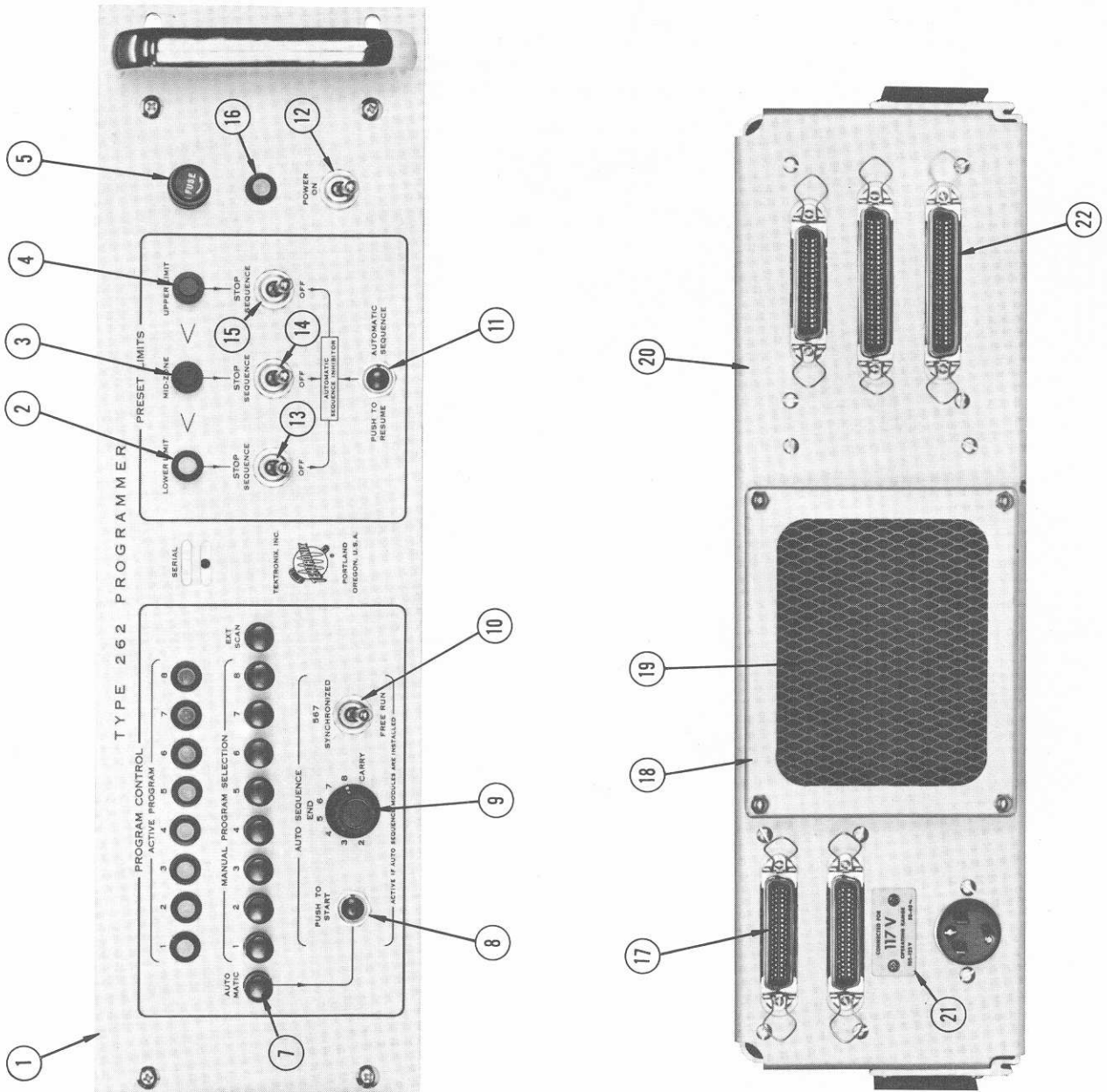
ABBREVIATIONS AND SYMBOLS

a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle
mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

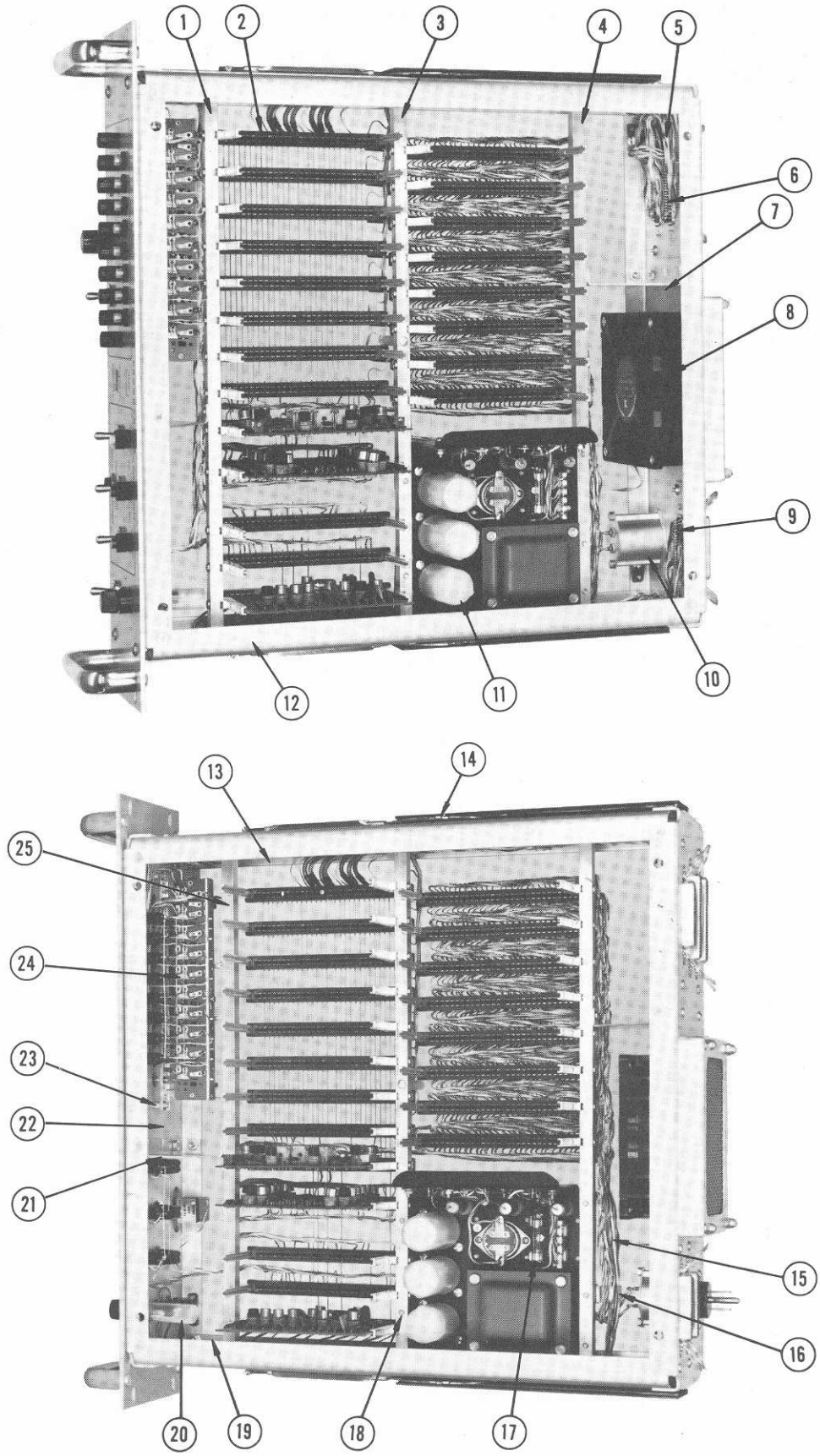
FRONT AND REAR



FRONT AND REAR

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	333-777			1	PANEL, front
2	136-164			1	SOCKET, light
	150-032			1	BULB, amber
3	136-164			1	SOCKET, light
	150-033			1	BULB, green
4	136-164			1	SOCKET, light
	150-034			1	BULB, red
5	352-002			1	HOLDER, fuse 3AG assembly
	.....			.	Includes:
	200-015			1	CAP, fuse
	210-873			1	WASHER, rubber, $\frac{1}{2}$ ID x $\frac{11}{16}$ OD x $\frac{3}{64}$ inch
	352-010			1	HOLDER, fuse 3AG
	.....			1	NUT (no number)
6	367-032			2	HANDLE
7	200-114			10	CAP, pushbutton
8	260-574			1	SWITCH, PUSH TO START
9	260-541			1	SWITCH, AUTO SEQUENCE
	366-136			1	KNOB, black
10	260-134			1	SWITCH, SYNCHRONIZED - FREE RUN
11	260-574			1	SWITCH, PUSH TO RESUME AUTOMATIC SEQUENCE
12	260-134			1	SWITCH, POWER ON
13	260-134			1	SWITCH, LOWER LIMIT STOP SEQUENCE - OFF
14	260-134			1	SWITCH, MID-ZONE STOP SEQUENCE - OFF
15	260-134			1	SWITCH, UPPER LIMIT STOP SEQUENCE - OFF
16	151-019			9	BULB, neon with holder
17	131-294			3	CONNECTOR, 36 pin, chassis mount
18	200-541			1	COVER, filter
19	378-024			1	FILTER, dust
	378-764			2	SCREEN, filter
20	387-835			1	PLATE, frame back
21	334-649			1	TAG, voltage rating
22	131-290			2	CONNECTOR, 50 pin chassis mount

TOP



TOP

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	381-222			1	BAR, support
2	131-292			21	CONNECTOR, 56 pin
3	381-223			1	BAR, support
4	381-224			1	BAR, support
5	179-823			1	CABLE, harness
6	387-840			1	PLATE, connector
7	387-841			1	PLATE, gusset, back
8	119-026			1	FAN
9	387-838			1	PLATE, blank
10	361-015			1	SPACER, line filter
	387-025			1	PLATE, line filter
11	432-045			3	BASE, nylon
12	122-114			2	ANGLE, top
13	122-115			1	ANGLE, rail left
14	351-039			1	GUIDE, track (pair)
15	179-824			1	HARNESS, cable
16	343-006			1	CLAMP, cable ½ inch
17	441-527			1	CHASSIS, power
18	387-837			1	PLATE, gusset, center (under bar)
19	122-116			1	ANGLE, rail right
20	200-237			1	COVER, insulator
21	387-836			1	PLATE, gusset, front
22	387-834			1	PLATE, front sub panel
23	166-031			2	TUBE, spacer
24	260-540			1	SWITCH, automatic-manual program selection
25	351-059			42	GUIDE, p/c board

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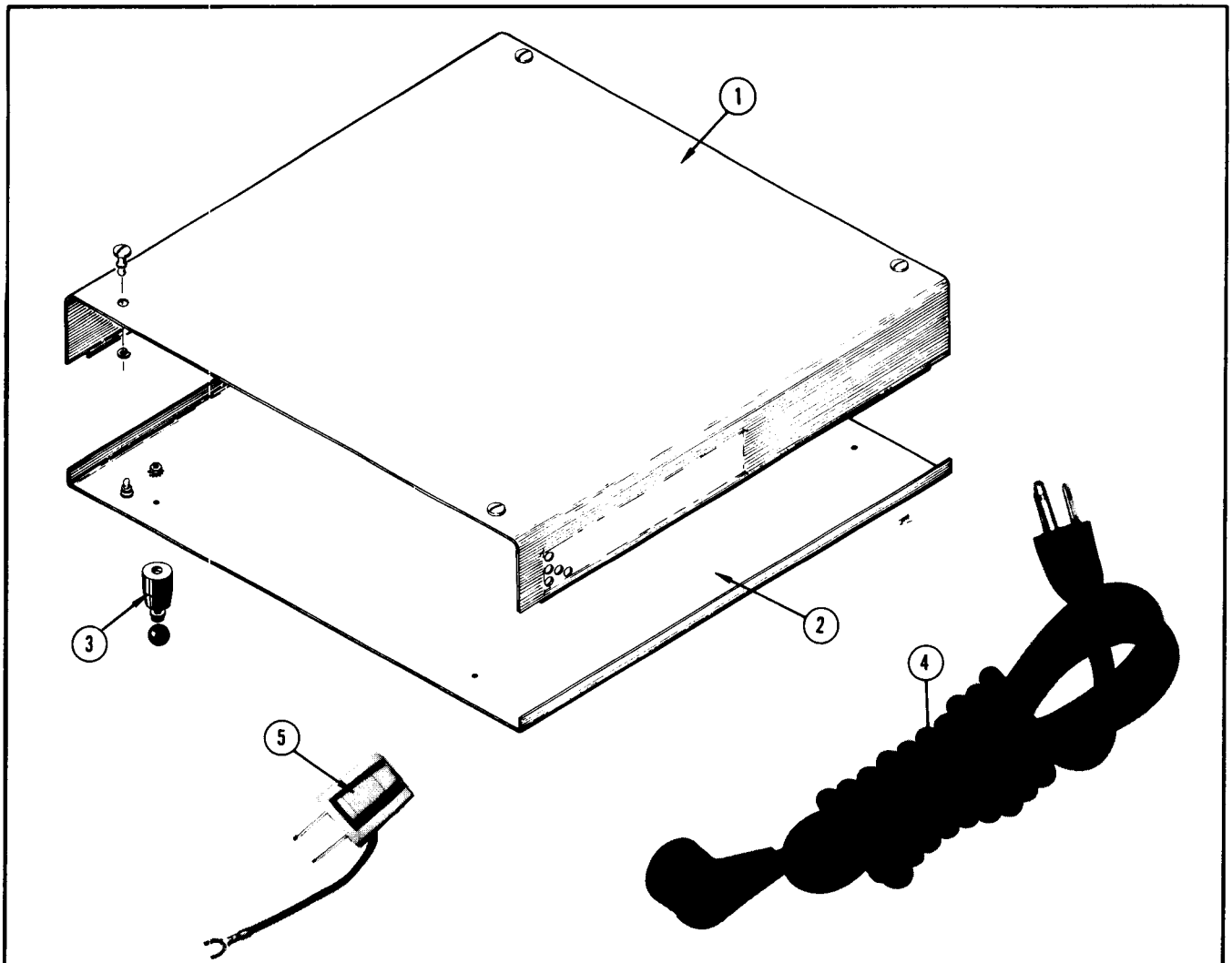
CABINET AND ACCESSORIES



REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	200-540			1	COVER, top
	.....			.	Includes:
	214-389			4	FASTENER, retainer
	214-390			4	FASTENER, stud
2	200-542			1	COVER, bottom
	.....			.	Includes:
	214-389			4	FASTENER, retainer
	214-390			4	FASTENER, stud
3	.....			.	CABINET, feet kit
	.....			.	Consisting of:
	210-457			4	NUT, keps, 6-32 x 5/16 inch
	210-803			4	WASHER, 61 x 3/8 inch
	211-511			4	SCREW, 6-32 x 1/2 inch BHS
	348-014			4	FOOT, molded black
	348-015			4	CUSHION, rubber ball
4	161-013			1	CORD, power, 18 gage, 8 ft, 3 conductor
5	103-013			1	ADAPTER, power cord, 3 to 2 wire

ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
		Bulbs	
B411	150-019	Neon, w/holder	
B412	150-019	Neon, w/holder	
B413	150-019	Neon, w/holder	
B414	150-019	Neon, w/holder	
B415	150-019	Neon, w/holder	
B416	150-019	Neon, w/holder	
B417	150-019	Neon, w/holder	
B418	150-019	Neon, w/holder	
B421	150-032	28 v Amber lens	LOWER LIMIT
B423	150-033	28 v Green lens	MID ZONE
B425	150-034	28 v Red lens	UPPER LIMIT
		Diodes	
D421	152-107	Silicon 6107	
D423	152-107	Silicon 6107	
D425	152-107	Silicon 6107	
		Connectors	
J1	131-292	56 pin contact	
J2	131-292	56 pin contact	
J3	131-292	56 pin contact	
J4	131-292	56 pin contact	
J5	131-292	56 pin contact	
J6	131-292	56 pin contact	
J7	131-292	56 pin contact	
J8	131-292	56 pin contact	
J9	131-292	56 pin contact	
J10	131-292	56 pin contact	
J11	131-292	56 pin contact	
J12	131-292	56 pin contact	
J13	131-292	56 pin contact	
J101	131-296	50 pin contact	
J102	131-296	50 pin contact	
J201	131-294	36 pin contact	
		Resistors	

Resistors are fixed, composition, ±10% unless otherwise indicated.

R411	302-225	2.2 meg	½ w
R412	302-225	2.2 meg	½ w
R413	302-225	2.2 meg	½ w

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Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description	S/N Range
R414	302-225	2.2 meg	½ w	
R415	302-225	2.2 meg	½ w	
R416	302-225	2.2 meg	½ w	
R417	302-225	2.2 meg	½ w	
R418	302-225	2.2 meg	½ w	
R419	302-104	100 k	½ w	

Switches

SW407	260-574	Pushbutton	PUSH TO START	
SW409	260-574	Pushbutton	PUSH TO RESUME AUTOMATIC SEQUENCE	
SW411 A-K	260-540	Pushbutton	MANUAL PROGRAM SELECTION	
SW421	260-134	Toggle	AUTOMATIC SEQUENCE INHIBITOR	
SW423	260-134	Toggle	AUTOMATIC SEQUENCE INHIBITOR	
SW425	260-134	Toggle	AUTOMATIC SEQUENCE INHIBITOR	
SW431	260-541	Rotary	END	
SW435	260-134	Toggle	FREE RUN	

PROGRAM Series A

Ckt. No.	Tektronix Part No.	Description	Model No.
	*605-031	Complete Board	

Diodes

D10	152-107	Silicon 6107
D11	152-107	Silicon 6107
D20	152-107	Silicon 6107
D22	152-107	Silicon 6107
D24	152-107	Silicon 6107
D30	152-107	Silicon 6107
D32	152-107	Silicon 6107
D34	152-107	Silicon 6107
D36	152-107	Silicon 6107
D38	152-107	Silicon 6107
D40	152-107	Silicon 6107

Inductors

L10	*108-276	Coil, fixed, Reed drive

Switches

SW10	*260-552	Dry Reed

LOGIC Series B

Ckt. No.	Tektronix Part No.	Description	Model No.
	*605-022	Complete Board	

Diodes

D14	152-107	Silicon 6107	
D24	152-107	Silicon 6107	
D34	152-107	Silicon 6107	
D40	152-107	Silicon 6107	
D55	152-107	Silicon 6107	
D64	152-107	Silicon 6107	
D84	152-107	Silicon 6107	
D95	152-107	Silicon 6107	
D96	152-107	Silicon 6107	
D97	152-107	Silicon 6107	
D98	152-107	Silicon 6107	
D101	152-107	Silicon 6107	
D102	152-107	Silicon 6107	
D103	152-107	Silicon 6107	
D104	152-107	Silicon 6107	
D105	152-107	Silicon 6107	
D106	152-107	Silicon 6107	
D107	152-146	Zener 1N991A	
D111	152-107	Silicon 6107	
D112	152-107	Silicon 6107	
D113	152-107	Silicon 6107	
D121	152-107	Silicon 6107	
D122	152-107	Silicon 6107	
D123	152-107	Silicon 6107	

Inductors

L14	*108-275	Coil, fixed, Reed drive	
L24	*108-275	Coil, fixed, Reed drive	
L34	*108-275	Coil, fixed, Reed drive	

Resistors

R10	301-153	15 k	½ w	5%
R11	301-334	330 k	½ w	5%
R12	301-103	10 k	½ w	5%
R20	301-103	10 k	½ w	5%
R21	301-392	3.9 k	½ w	5%

Resistors *(Cont'd.)*

Ckt. No.	Tektronix Part No.		Description				Model No.
R22	301-104	100 k	½ w			5%	
R30	301-153	15 k	½ w			5%	
R31	301-334	330 k	½ w			5%	
R34	301-103	10 k	½ w			5%	
R40	301-333	33 k	½ w			5%	
R41	301-223	22 k	½ w			5%	
R50	301-164	160 k	½ w			5%	
R51	301-563	56 k	½ w			5%	
R52	301-124	120 k	½ w			5%	
R54	301-333	33 k	½ w			5%	
R60	301-683	68 k	½ w			5%	
R61	301-333	33 k	½ w			5%	
R62	301-274	270 k	½ w			5%	
R64	301-332	3.3 k	½ w			5%	
R70	301-683	68 k	½ w			5%	
R71	301-333	33 k	½ w			5%	
R72	301-274	270 k	½ w			5%	
R74	301-332	3.3 k	½ w			5%	
R80	301-683	68 k	½ w			5%	
R81	301-333	33 k	½ w			5%	
R82	301-274	270 k	½ w			5%	
R84	301-332	3.3 k	½ w			5%	
R90	301-683	68 k	½ w			5%	
R91	301-333	33 k	½ w			5%	
R92	301-274	270 k	½ w			5%	
R94	301-332	3.3 k	½ w			5%	
R101	301-332	3.3 k	½ w			5%	
R103	301-152	1.5 k	½ w			5%	
R107	301-473	47 k	½ w			5%	
R111	301-332	3.3 k	½ w			5%	
R113	301-152	1.5 k	½ w			5%	
R121	301-332	3.3 k	½ w			5%	
R123	301-152	1.5 k	½ w			5%	
R135	323-373	75 k	½ w		Prec	1%	
R145	311-267	10 k		Var	WW	START OFFSET CAL	
R146	301-203	20 k	½ w			5%	
R155	323-373	75 k	½ w		Prec	1%	
R165	311-267	10 k		Var	WW	STOP OFFSET CAL	
R166	301-203	20 k	½ w			5%	

Switches

SW14	*260-553	Dry Reed
SW24	*260-553	Dry Reed
SW34	*260-553	Dry Reed

Transistors

Ckt. No.	Tektronix Part No.	Description	Model No.
Q14	151-093	2N2043	
Q24	*151-103	Tek Spec	
Q34	151-093	2N2043	
Q54	*151-103	Tek Spec	
Q64	*151-103	Tek Spec	
Q74	*151-103	Tek Spec	
Q84	*151-103	Tek Spec	
Q94	*151-103	Tek Spec	
Q134	151-093	2N2043	
Q144	*151-096	Tek Spec	
Q154	151-093	2N2043	
Q164	*151-096	Tek Spec	

NO-GO COMPARATOR Series C

	*605-024	Complete Board	

Diodes

D8	152-107	Silicon 6107	
D12	152-075	Germanium 6075	
D13	152-075	Germanium 6075	
D14	152-107	Silicon 6107	
D28	152-107	Silicon 6107	
D33	152-075	Germanium 6075	
D34	152-107	Silicon 6107	
D68	152-107	Silicon 6107	
D74	152-107	Silicon 6107	
D112	152-075	Germanium 6075	
D113	152-075	Germanium 6075	
D114	152-107	Silicon 6107	
D118	152-107	Silicon 6107	
D138	152-107	Silicon 6107	
D153	152-075	Germanium 6075	
D154	152-107	Silicon 6107	
D178	152-107	Silicon 6107	
D194	152-107	Silicon 6107	
D214	152-107	Silicon 6107	
D224	152-107	Silicon 6107	
R234	152-107	Silicon 6107	
D244	152-107	Silicon 6107	
D263	152-107	Silicon 6107	

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Resistors

Ckt. No.	Tektronix Part No.		Description			Model No.
R7	323-343	36.5 k	1/2 w	Prec	1%	
R8	322-178	698 Ω	1/4 w	Prec	1%	
R13	301-182	1.8 k	1/2 w		5%	
R14	301-513	51 k	1/2 w		5%	
R15	301-753	75 k	1/2 w		5%	
R27	323-343	36.5 k	1/2 w	Prec	1%	
R28	322-178	698 Ω	1/4 w	Prec	1%	
R33	301-182	1.8 k	1/2 w		5%	
R34	301-513	51 k	1/2 w		5%	
R35	301-753	75 k	1/2 w		5%	
R55	301-753	75 k	1/2 w		5%	
R67	323-343	36.5 k	1/2 w	Prec	1%	
R68	322-178	698 Ω	1/4 w	Prec	1%	
R73	301-182	1.8 k	1/2 w		5%	
R74	301-513	51 k	1/2 w		5%	
R75	301-753	75 k	1/2 w		5%	
R95	301-753	75 k	1/2 w		5%	
R113	301-182	1.8 k	1/2 w		5%	
R114	301-513	51 k	1/2 w		5%	
R115	301-753	75 k	1/2 w		5%	
R117	323-343	36.5 k	1/2 w	Prec	1%	
R118	322-178	698 Ω	1/4 w	Prec	1%	
R135	301-753	75 k	1/2 w		5%	
R137	323-343	36.5 k	1/2 w	Prec	1%	
R138	322-178	698 Ω	1/4 w	Prec	1%	
R153	301-182	1.8 k	1/2 w		5%	
R154	301-513	51 k	1/2 w		5%	
R155	301-753	75 k	1/2 w		5%	
R175	301-753	75 k	1/2 w		5%	
R177	323-343	36.5 k	1/2 w	Prec	1%	
R178	322-178	698 Ω	1/4 w	Prec	1%	
R193	301-182	1.8 k	1/2 w		5%	
R194	301-513	51 k	1/2 w		5%	
R195	301-753	75 k	1/2 w		5%	
R210	301-184	180 k	1/2 w		5%	
R214	301-473	47 k	1/2 w		5%	
R216	301-392	3.9 k	1/2 w		5%	
R217	301-473	47 k	1/2 w		5%	
R224	301-473	47 k	1/2 w		5%	
R225	301-470	47 Ω	1/2 w		5%	
R226	301-392	3.9 k	1/2 w		5%	
R227	301-473	47 k	1/2 w		5%	
R228	301-470	47 Ω	1/2 w		5%	
R230	301-184	180 k	1/2 w		5%	
R234	301-473	47 k	1/2 w		5%	

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description		Model No.
R236	301-392	3.9 k	½ w	5%	
R237	301-473	47 k	½ w	5%	
R245	301-470	47 Ω	½ w	5%	
R260	301-154	150 k	½ w	5%	

Transistors

Q4	151-071	2N1305			
Q14	151-071	2N1305			
Q24	151-071	2N1305			
Q34	151-071	2N1305			
Q44	151-071	2N1305			
Q54	151-071	2N1305			
Q64	151-071	2N1305			
Q74	151-071	2N1305			
Q84	151-071	2N1305			
Q94	151-071	2N1305			
Q104	151-071	2N1305			
Q114	151-071	2N1305			
Q124	151-071	2N1305			
Q134	151-071	2N1305			
Q144	151-071	2N1305			
Q154	151-071	2N1305			
Q164	151-071	2N1305			
Q174	151-071	2N1305			
Q184	151-071	2N1305			
Q194	151-071	2N1305			
Q214	151-069	2N1304			
Q224	*151-103	Tek Spec			
Q234	151-069	2N1304			
Q244	*151-103	Tek Spec			
Q254	*151-103	Tek Spec			
Q263	151-093	2N2043			

COUNTER Series D

	*605-030	Complete Board			

Capacitors

Tolerance ±20% unless otherwise indicated.
Tolerancy of all electroyltic capacitors are as follows (with exceptions):

3 V — 50 V = −10%, +250%
51 V — 350 V = −10%, +100%
351 V — 450 V = −10%, +50%

C12	281-536	.001 μf	Cer	500 v	10%
C16	281-525	470 pf	Cer	500 v	
C22	281-536	.001 μf	Cer	500 v	10%

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Capacitors *(Cont'd.)*

Ckt. No.	Tektronix Part No.		Description			Model No.
C26	281-525	470 pf	Cer	500 v		
C32	281-536	.001 μf	Cer	500 v	10%	
C36	281-525	470 pf	Cer	500 v		
C42	281-536	.001 μf	Cer	500 v	10%	
C46	281-525	470 pf	Cer	500 v		
C52	281-536	.001 μf	Cer	500 v	10%	
C56	281-525	470 pf	Cer	500 v		
C62	281-536	.001 μf	Cer	500 v	10%	
C66	281-525	470 pf	Cer	500 v		

Diodes

D11	152-107	Silicon 6107				
D12	152-107	Silicon 6107				
D13	152-107	Silicon 6107				
D14	152-107	Silicon 6107				
D15	152-107	Silicon 6107				
D22	152-107	Silicon 6107				
D23	152-107	Silicon 6107				
D24	152-107	Silicon 6107				
D25	152-107	Silicon 6107				
D31	152-107	Silicon 6107				
D32	152-107	Silicon 6107				
D42	152-107	Silicon 6107				
D51	152-107	Silicon 6107				
D52	152-107	Silicon 6107				
D62	152-107	Silicon 6107				

Resistors

R5	301-472	4.7 k	½ w		5%	
R6	301-203	20 k	½ w		5%	
R12	301-105	1 meg	½ w		5%	
R14	301-183	18 k	½ w		5%	
R16	301-223	22 k	½ w		5%	
R17	301-304	300 k	½ w		5%	
R22	301-105	1 meg	½ w		5%	
R23	301-182	1.8 k	½ w		5%	
R24	301-183	18 k	½ w		5%	
R26	301-223	22 k	½ w		5%	
R27	301-304	300 k	½ w		5%	
R32	301-105	1 meg	½ w		5%	
R33	301-182	1.8 k	½ w		5%	
R34	301-183	18 k	½ w		5%	
R36	301-223	22 k	½ w		5%	

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description	Model No.
R37	301-304	300 k	½ w	5%
R42	301-105	1 meg	½ w	5%
R43	301-182	1.8 k	½ w	5%
R44	301-183	18 k	½ w	5%
R46	301-223	22 k	½ w	5%
R47	301-304	300 k	½ w	5%
R52	301-105	1 meg	½ w	5%
R53	301-182	1.8 k	½ w	5%
R54	301-183	18 k	½ w	5%
R56	301-223	22 k	½ w	5%
R57	301-304	300 k	½ w	5%
R62	301-105	1 meg	½ w	5%
R63	301-182	1.8 k	½ w	5%
R64	301-183	18 k	½ w	5%
R66	301-223	22 k	½ w	5%
R67	301-304	300 k	½ w	5%

Transistors

Q15	151-093	2N2043
Q25	151-093	2N2043
Q35	151-093	2N2043
Q45	151-093	2N2043
Q55	151-093	2N2043
Q65	151-093	2N2043
Q101	*151-103	Tek Spec
Q102	*151-103	Tek Spec
Q103	*151-103	Tek Spec
Q104	*151-103	Tek Spec
Q105	*151-103	Tek Spec
Q106	*151-103	Tek Spec
Q107	*151-103	Tek Spec
Q108	*151-103	Tek Spec
Q124	*151-103	Tek Spec
Q134	*151-103	Tek Spec
Q144	*151-103	Tek Spec
Q154	*151-103	Tek Spec
Q164	*151-103	Tek Spec
Q174	*151-103	Tek Spec

SYNCHRONIZER Series E

*605-029	Complete Board

Capacitors

Ckt. No.	Tektronix Part No.		Description		Model No.
C18	283-000	.001 μf	Cer	500 v	
C19	283-000	.001 μf	Cer	500 v	
C22	283-012	.1 μf	Cer	100 v	
C24	283-028	.0022 μf	Cer	50 v	
C25	281-525	470 pf	Cer	500 v	
C32	290-026	5 μf	EMT	25 v	
C35	281-525	470 pf	Cer	500 v	
C46	281-550	120 pf	Cer	500 v	10%
C56	281-550	120 pf	Cer	500 v	10%
C58	283-012	.1 μf	Cer	100 v	
C60	283-010	.05 μf	Cer	50 v	
C64	283-000	.001 μf	Cer	500 v	
C65	281-525	470 pf	Cer	500 v	
C68	283-028	.0022 μf	Cer	50 v	
C71	283-028	.0022 μf	Cer	50 v	
C74	283-028	.0022 μf	Cer	50 v	
C75	281-525	470 pf	Cer	50 v	
C78	290-121	2 μf	EMT	25 v	
C86	281-550	120 pf	Cer	500 v	10%
C96	281-550	120 pf	Cer	500 v	10%

Diodes

D10	152-107	Silicon 6107
D11	152-107	Silicon 6107
D25	*152-136	Shockley, Tek Spec
D26	152-107	Silicon 6107
D32	152-107	Silicon 6107
D33	152-107	Silicon 6107
D35	*152-136	Shockley, Tek Spec
D36	152-107	Silicon 6107
D37	152-107	Silicon 6107
D60	152-107	Silicon 6107
D63	152-107	Silicon 6107
D65	*152-136	Shockley, Tek Spec
D68	152-107	Silicon 6107
D72	152-107	Silicon 6107
D73	152-107	Silicon 6107
D74	152-107	Silicon 6107
D75	*152-136	Shockley, Tek Spec
D76	152-107	Silicon 6107
D101	152-107	Silicon 6107
D102	152-107	Silicon 6107
D103	152-107	Silicon 6107
D104	152-107	Silicon 6107
D106	152-107	Silicon 6107

Resistors

Ckt. No.	Tektronix Part No.		Description			Model No.
R12	301-224	220 k	½ w		5%	
R14	301-102	1 k	½ w		5%	
R15	301-103	10 k	½ w		5%	
R18	301-103	10 k	½ w		5%	
R19	301-103	10 k	½ w		5%	
R20	301-824	820 k	½ w		5%	
R21	301-184	180 k	½ w		5%	
R22	301-204	200 k	½ w		5%	
R24	301-512	5.1 k	½ w		5%	
R31	303-333	33 k	1 w		5%	
R32	311-269	500 k	.2 w	Var		
R36	301-101	100 Ω	½ w		5%	
R37	301-104	100 k	½ w		5%	
R40	301-104	100 k	½ w		5%	
R41	301-302	3 k	½ w		5%	
R42	301-153	15 k	½ w		5%	
R44	301-332	3.3 k	½ w		5%	
R46	301-243	24 k	½ w		5%	
R47	301-274	270 k	½ w		5%	
R48	301-752	7.5 k	½ w		5%	
R54	301-332	3.3 k	½ w		5%	
R56	301-243	24 k	½ w		5%	
R57	323-310	16.5 k	½ w	Prec	1%	
R58	301-153	15 k	½ w		5%	
R60	301-302	3 k	½ w		5%	
R61	301-204	200 k	½ w		5%	
R63	301-105	1 meg	½ w		5%	
R66	301-101	100 Ω	½ w		5%	
R68	323-313	17.8 k	½ w	Prec	1%	
R70	301-273	27 k	½ w		5%	
R71	301-682	6.8 k	½ w		5%	
R72	301-473	47 k	½ w		5%	
R74	301-105	1 meg	½ w		5%	
R76	301-101	100 Ω	½ w		5%	
R77	301-105	1 meg	½ w		5%	
R78	301-204	200 k	½ w		5%	
R80	301-752	7.5 k	½ w		5%	
R84	303-223	22 k	1 w		5%	
R85	301-123	12 k	½ w		5%	
R86	301-433	43 k	½ w		5%	
R87	301-224	220 k	½ w		5%	
R94	303-223	22 k	1 w		5%	
R96	301-433	43 k	½ w		5%	
R97	301-224	220 k	½ w		5%	

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Switches *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description	Model No.
SW68	260-583	Slide SLAVE NORMAL	

Transistors

Q45	*151-103	Tek Spec
Q55	*151-103	Tek Spec
Q85	*151-103	Tek Spec
Q95	*151-103	Tek Spec

POWER SUPPLY AND REGULATOR Series F

	*605-023	Complete Board

Bulbs

B601	150-019	Neon, w/holder

Capacitors

C600A	281-559	.0015 μf	Cer	500 v
C600B	281-559	.0015 μf	Cer	500 v
C612	290-024	2 x 75 μf	EMC	150 v
C619	290-107	25 μf	EMT	25 v
C621	283-012	.1 μf	Cer	100 v
C637	290-117	50 μf	EMT	50 v
C642	290-068	3 x 75 μf	EMC	150 v
C655	283-026	.2 μf	Cer	25 v
C667	290-117	50 μf	EMT	50 v
C672	290-012	2 x 40 μf	EMC	250 v
C697	290-200	12 μf	EMT	150 v

Diodes

D612A,B,C,D	152-066	Silicon 1N3194
D633	152-107	Silicon 6107
D642A,B,C,D	152-066	Silicon 1N3194
D657	152-105	Zener 1N2620
D672A,B,C,D,	152-066	Silicon 1N3194
D684	152-107	Silicon 6107

Fuses

F601	159-025	½ Amp	3AG	Fast-Blowing Type	117 v, 50-60 cycles
	159-028	¼ Amp	3AG	Fast-Blowing Type	234 v, 50-60 cycles
F697	159-028	¼ Amp	3AG	Fast-Blowing Type	

Resistors

Ckt. No.	Tektronix Part No.		Description				Model No.
R601	301-823	82 k	½ w			5%	
R614	301-103	10 k	½ w			5%	
R615	301-153	15 k	½ w			5%	
R616	301-222	2.2 k	½ w			5%	
R618	324-193	1 k	1 w		Prec	1%	
R619	324-191	953 Ω	1 w		Prec	1%	
R621	301-152	1.5 k	½ w			5%	
R622	304-102	1 k	1 w				
R623	301-562	5.6 k	½ w			5%	
R633	301-221	220 Ω	½ w			5%	
R644	323-282	8.45 k	½ w		Prec	1%	
R645	311-409	1 k		Var	WW	+25	VOLTS
R646	323-255	4.42 k	½ w		Prec	1%	
R649	301-202	2 k	½ w			5%	
R654	301-822	8.2 k	½ w			5%	
R655	301-821	820 Ω	½ w			5%	
R657	301-222	2.2 k	½ w			5%	
R658	304-102	1 k	1 w				
R663	304-102	1 k	1 w				
R674	323-335	30.1 k	½ w		Prec	1%	
R676	323-289	10 k	½ w		Prec	1%	
R678	301-682	6.8 k	½ w			5%	
R679	301-273	27 k	½ w			5%	
R683	301-682	6.8 k	½ w			5%	
R684	301-183	18 k	½ w			5%	
R685	301-102	1 k	½ w			5%	
R688	304-102	1 k	1 w				
R693	301-272	2.7 k	½ w			5%	
R696	315-200	20 Ω	¼ w			5%	

Switches

SW601	260-134	Toggle	POWER ON
TK601	260-497		Thermal Cut Out 133° F

Transformers

T600	*120-164	Toroid, 3T Bifilar
T601	*120-330	L. V. Power

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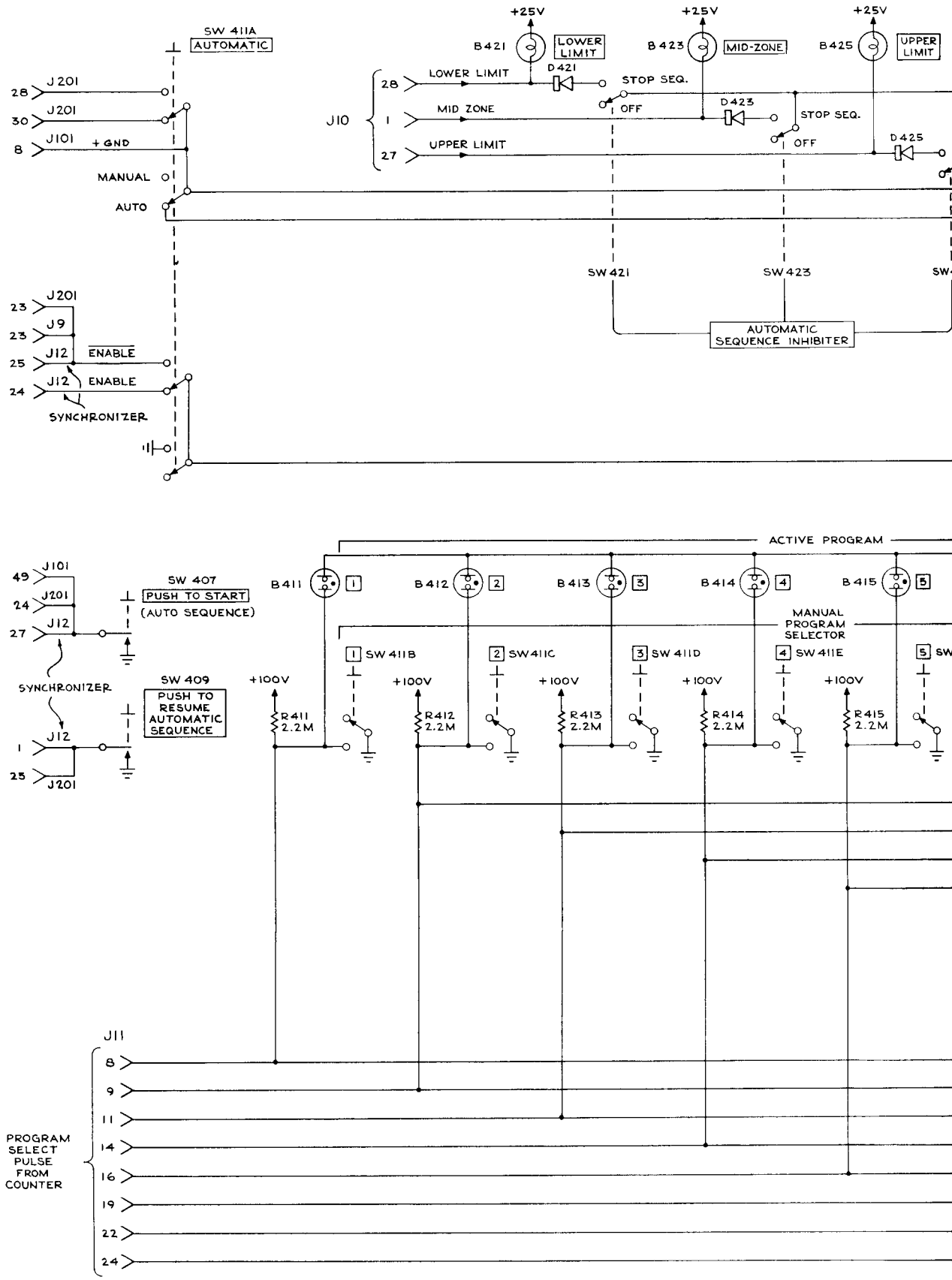
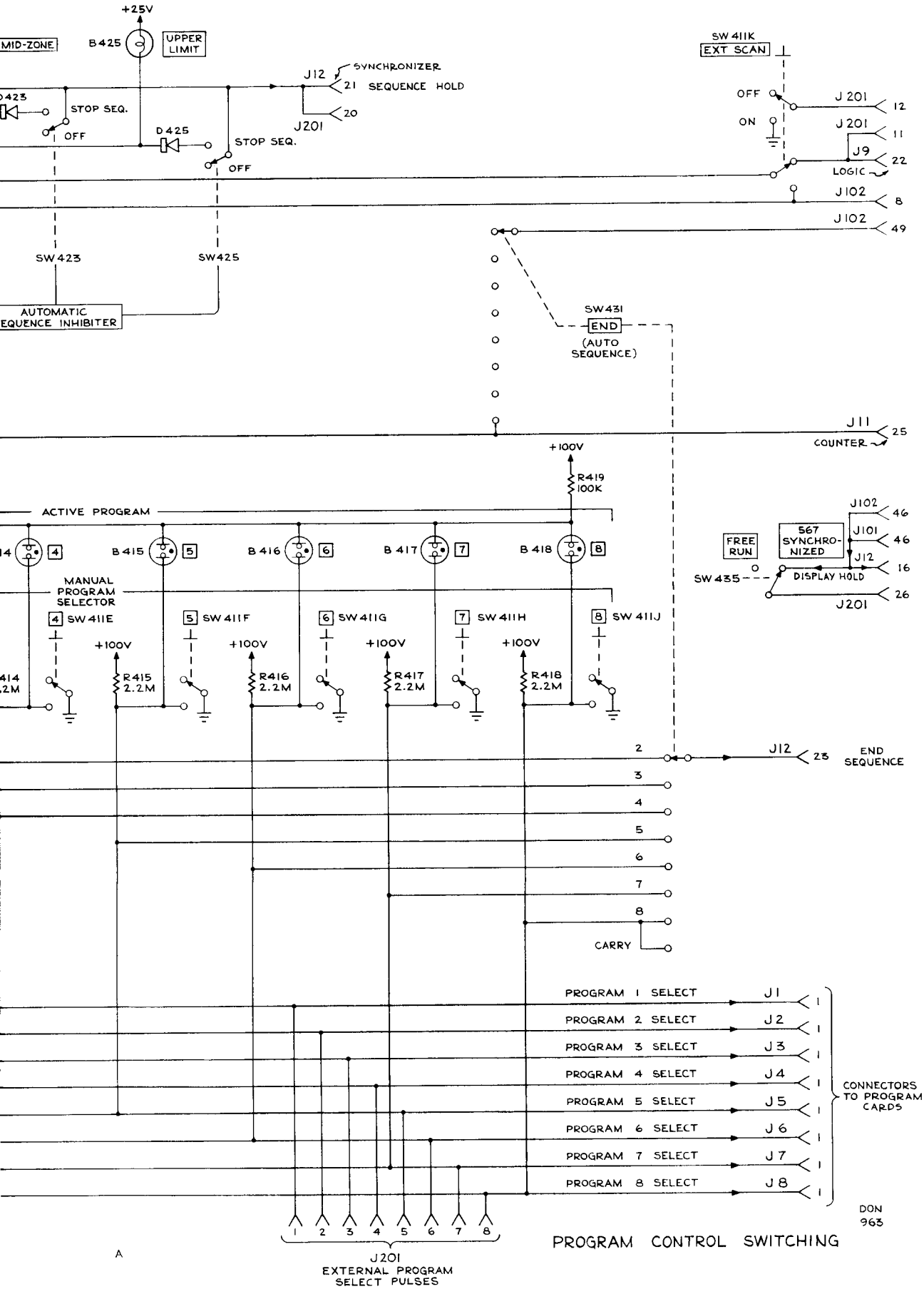
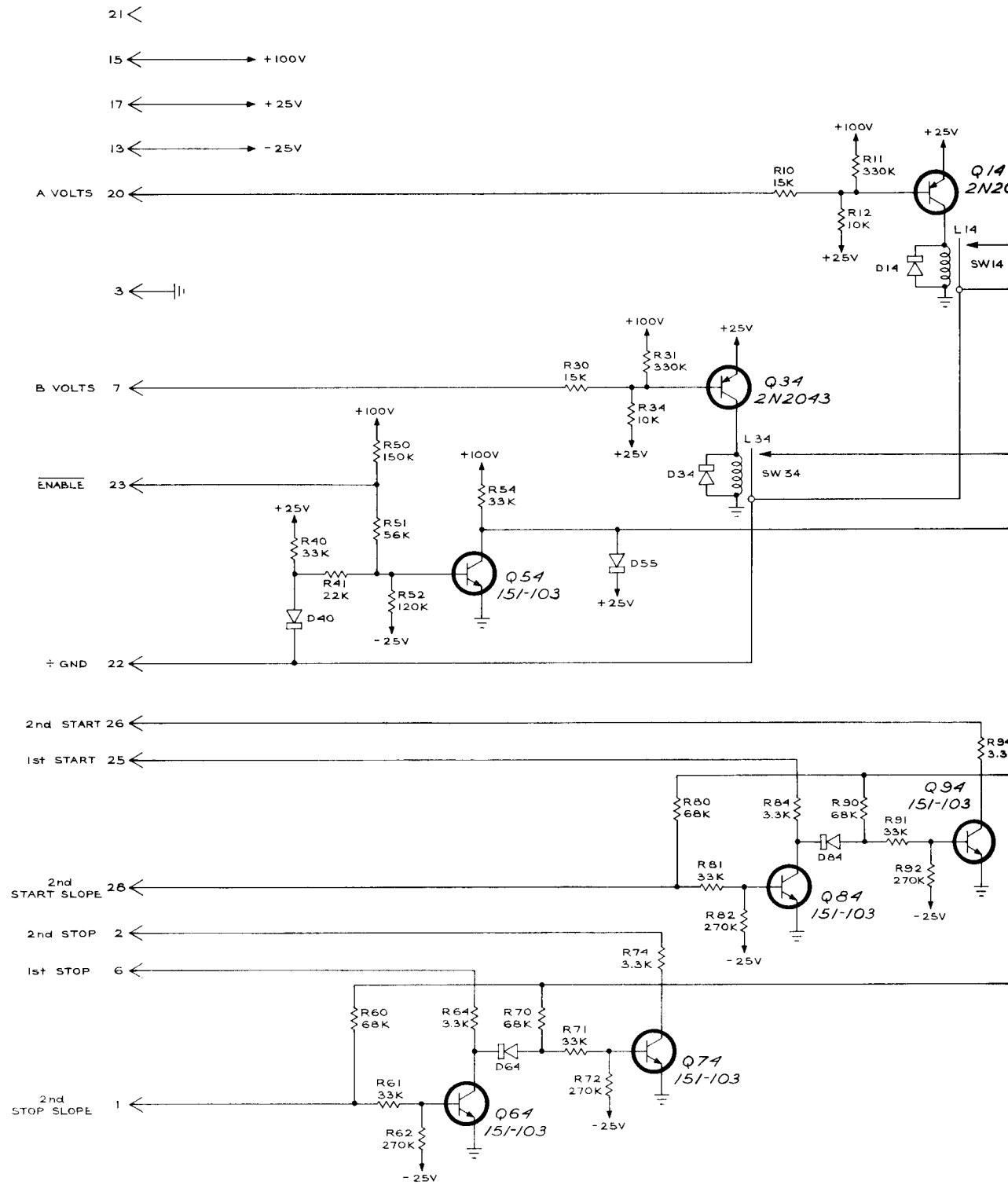
Transistors

Ckt. No.	Tektronix Part No.	Description	Model No.
Q614	151-087	J3138	
Q623	*151-103	Tek Spec	
Q633	151-087	J3138	
Q637	151-128	2N2140	
Q644	151-087	J3138	
Q653	*151-103	Tek Spec	
Q654	151-087	J3138	
Q663	151-087	J3138	
Q667	151-128	2N2140	
Q674	151-087	J3138	
Q683	*151-103	Tek Spec	
Q684	151-087	J3138	
Q693	151-087	J3138	
Q697	151-128	2N2140	


SW 411A
AUTOMATIC
MANUAL
AUTO
J201
28
J201
30
J101
8
+GND
+25V
B421
LOWER LIMIT
D421
B423
MID-ZONE
B425
UPPER LIMIT
J10
28
LOWER LIMIT
STOP SEQ.
OFF
1
MID ZONE
D423
STOP SEQ.
OFF
27
UPPER LIMIT
D425
SW421
SW423
AUTOMATIC SEQUENCE INHIBITER
J201
23
J9
23
J12
ENABLE
25
J12
ENABLE
24
SYNCHRONIZER
ACTIVE PROGRAM
B411
1
B412
2
B413
3
B414
4
B415
5
MANUAL PROGRAM SELECTOR
1 SW 411B
2 SW 411C
3 SW 411D
4 SW 411E
5 SW
+100V
R411 2.2M
R412 2.2M
R413 2.2M
R414 2.2M
R415 2.2M
J101
49
J201
24
J12
27
SW 407
PUSH TO START
(AUTO SEQUENCE)
SYNCHRONIZER
SW 409
PUSH TO RESUME AUTOMATIC SEQUENCE
J12
1
25
J201
J11
8
9
11
14
16
19
22
24
PROGRAM SELECT PULSE FROM COUNTER

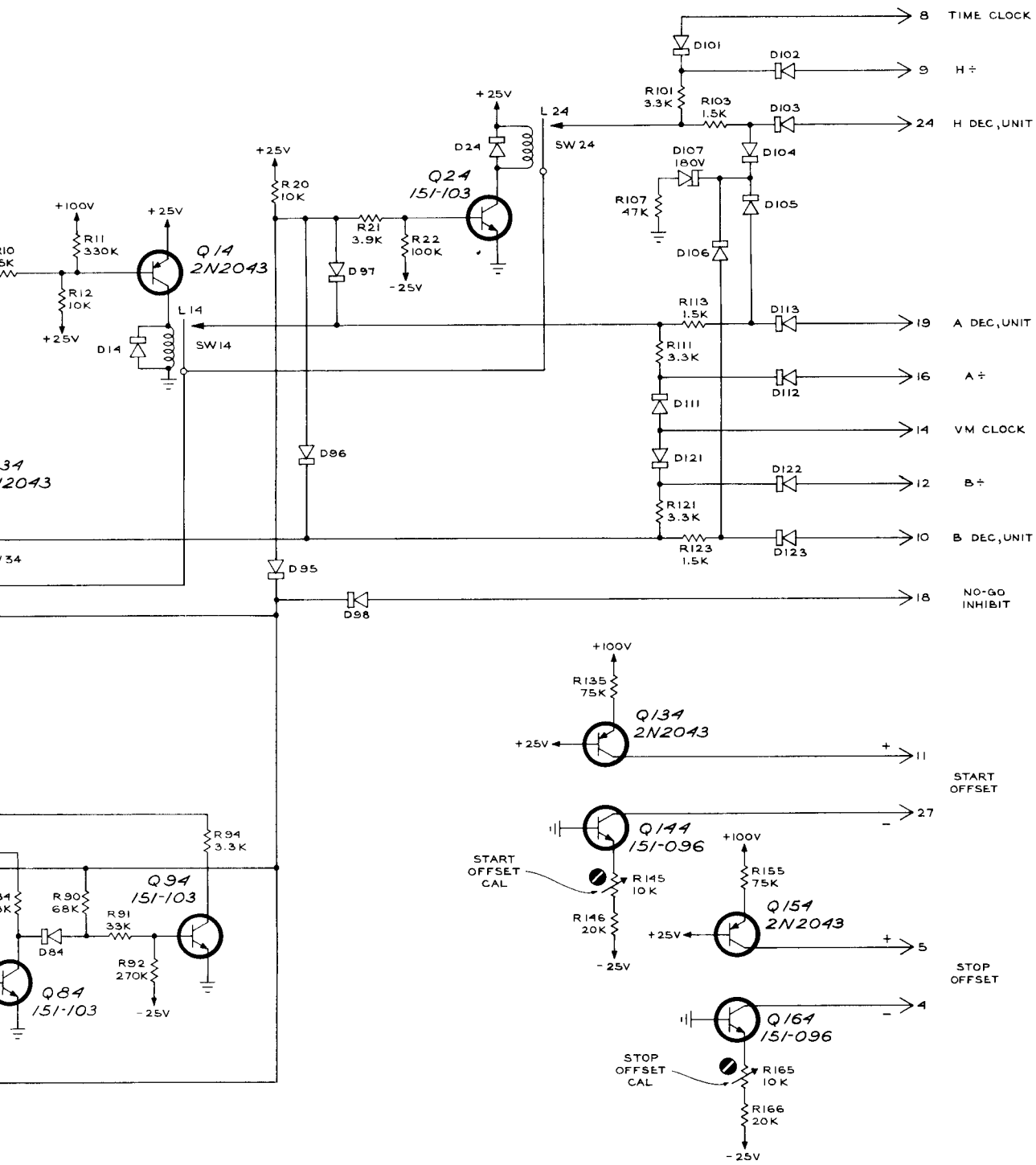
TYPE 262


+25V
MID-ZONE
B425
UPPER LIMIT
J12
SYNCHRONIZER
21 SEQUENCE HOLD
20
J201
D423
STOP SEQ.
OFF
D425
STOP SEQ.
OFF
SW411K
EXT SCAN
OFF
ON
J201
12
J201
11
J9
22
LOGIC
J102
8
J102
49
SW423
SW425
AUTOMATIC SEQUENCE INHIBITER
SW431
END
(AUTO SEQUENCE)
J11
25
COUNTER
+100V
R419
100K
ACTIVE PROGRAM
B415
5
B416
6
B417
7
B418
8
MANUAL PROGRAM SELECTOR
5 SW411F
6 SW411G
7 SW411H
8 SW411J
+100V
R415
2.2M
R416
2.2M
R417
2.2M
R418
2.2M
J102
46
J101
46
FREE RUN
567 SYNCHRONIZED
J12
16
SW435
DISPLAY HOLD
26
J201
2
J12
23
END SEQUENCE
3
4
5
6
7
8
CARRY
PROGRAM 1 SELECT
J1
PROGRAM 2 SELECT
J2
PROGRAM 3 SELECT
J3
PROGRAM 4 SELECT
J4
PROGRAM 5 SELECT
J5
PROGRAM 6 SELECT
J6
PROGRAM 7 SELECT
J7
PROGRAM 8 SELECT
J8
CONNECTORS TO PROGRAM CARDS
1 2 3 4 5 6 7 8
J201
EXTERNAL PROGRAM SELECT PULSES
DON 963
PROGRAM CONTROL SWITCHING
A


21
15
+100V
17
+25V
13
-25V
A VOLTS 20
R10 15K
R11 330K
R12 10K
Q14 2N2
L14
D14
SW14
3
B VOLTS 7
R30 15K
R31 330K
R34 10K
Q34 2N2043
L34
D34
SW34
ENABLE 23
R50 150K
R51 56K
R40 33K
R41 22K
R52 120K
D40
R54 33K
Q54 151-103
D55
÷ GND 22
2nd START 26
1st START 25
2nd START SLOPE 28
R80 68K
R84 3.3K
R90 68K
R91 33K
D84
R81 33K
R82 270K
Q84 151-103
Q94 151-103
R92 270K
2nd STOP 2
1st STOP 6
R74 3.3K
R60 68K
R64 3.3K
R70 68K
R71 33K
D64
R72 270K
Q74 151-103
2nd STOP SLOPE 1
R61 33K
R62 270K
Q64 151-103

TYPE 262

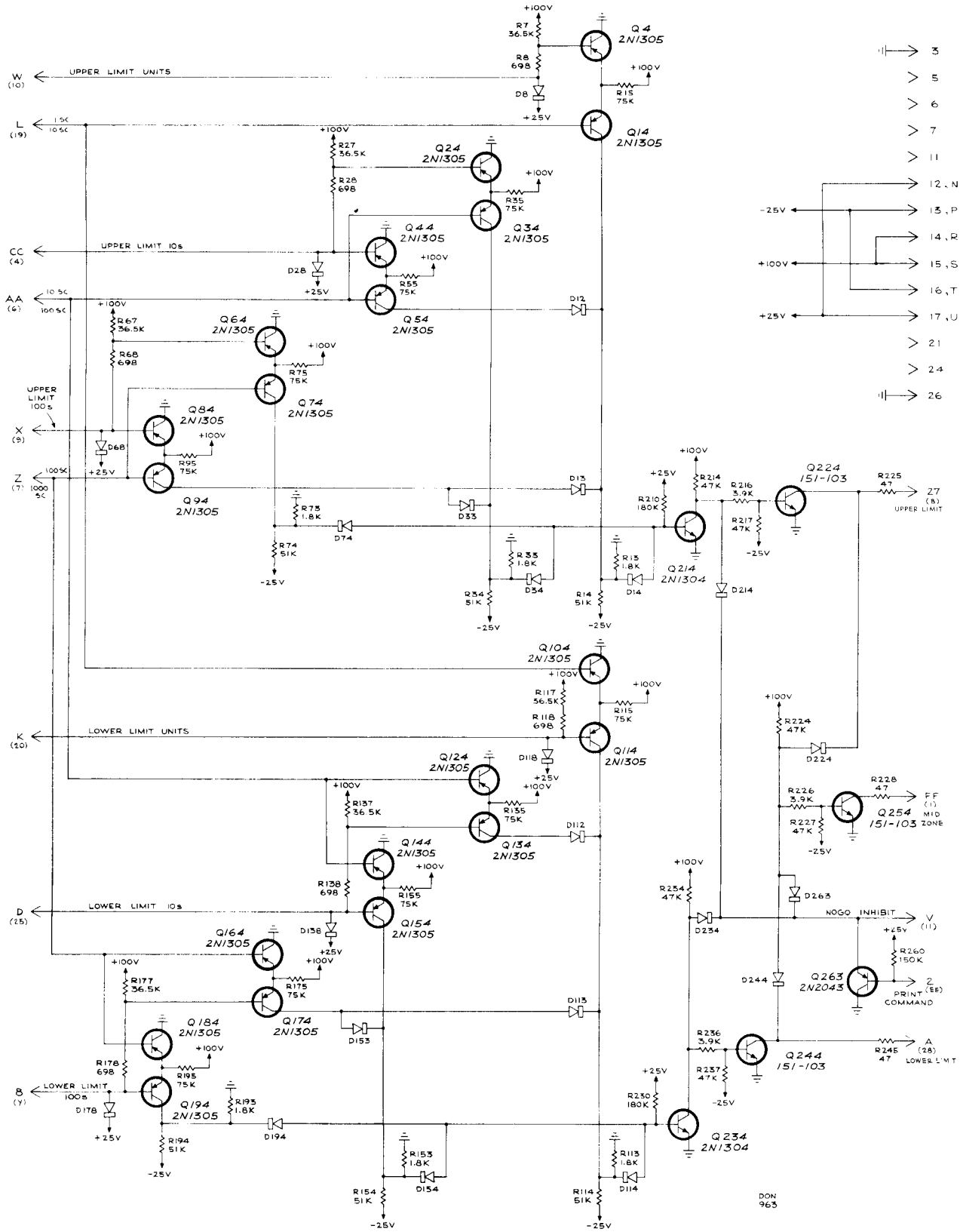
A



CMD 963

LOGIC

SERIES B
MODEL 1

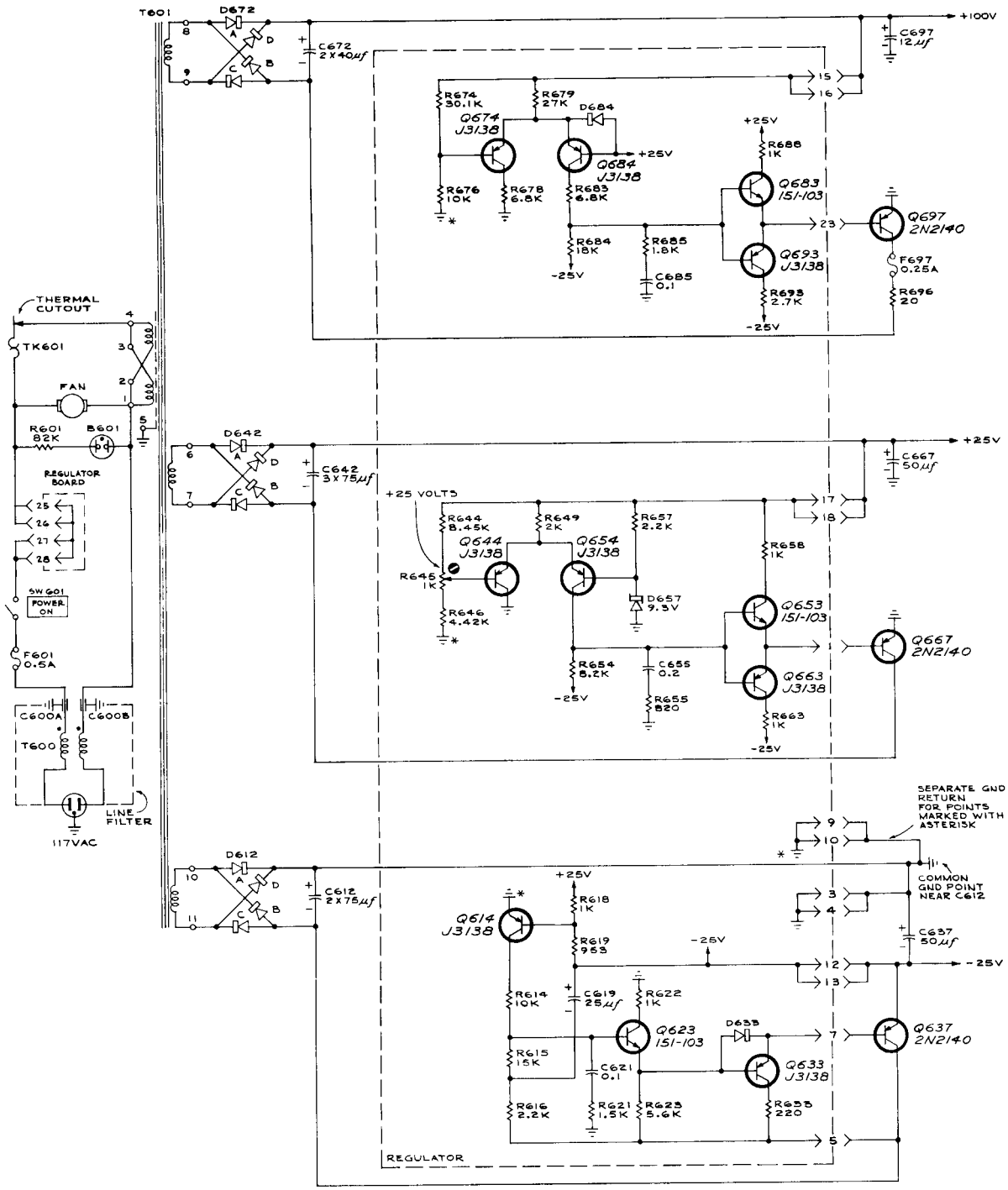


TYPE 262

A

NO-GO COMPARATOR

SERIES C
MODEL 1



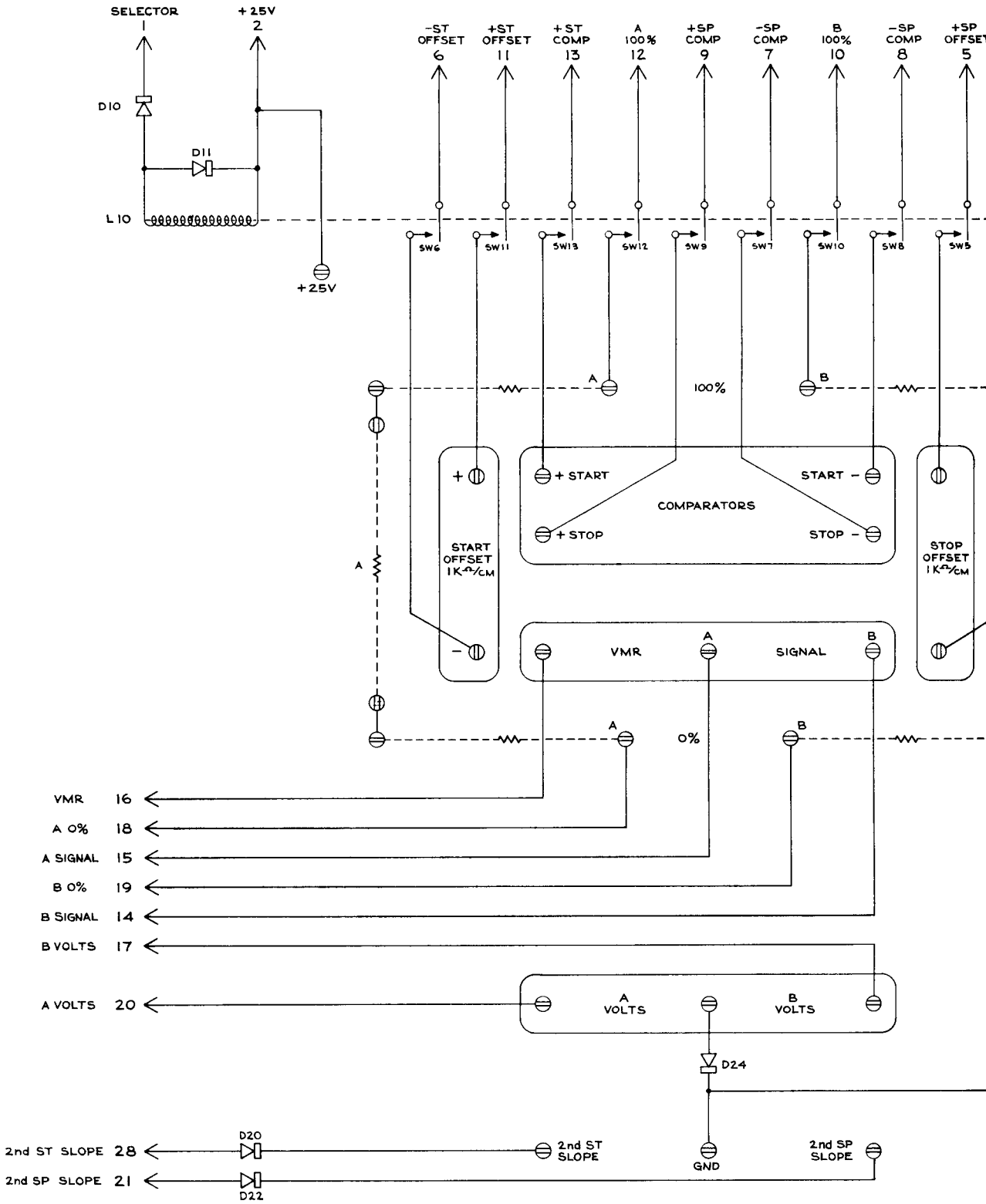
TYPE 262

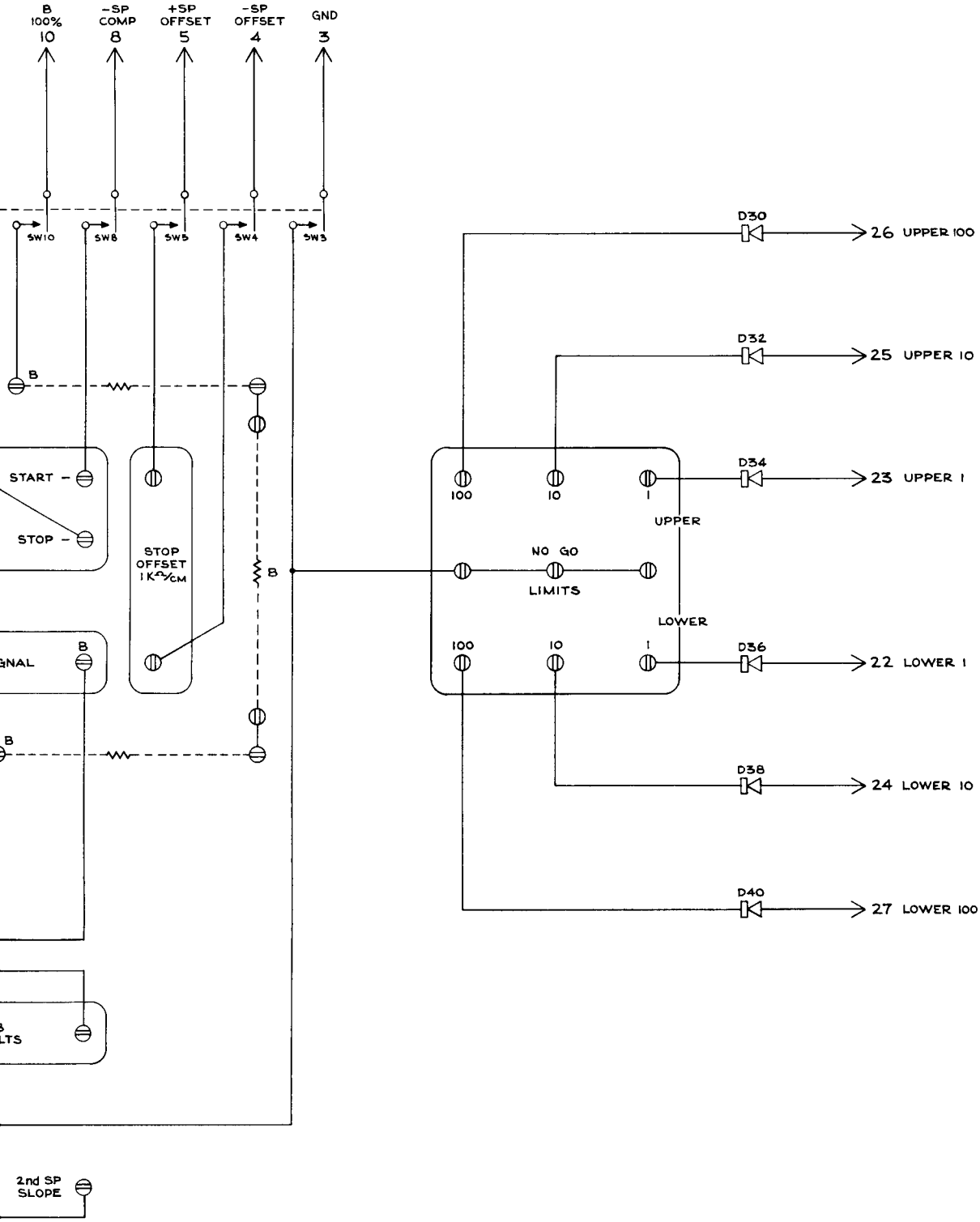
A

MRH 963

POWER SUPPLY AND REGULATOR

SERIES F MODEL 1

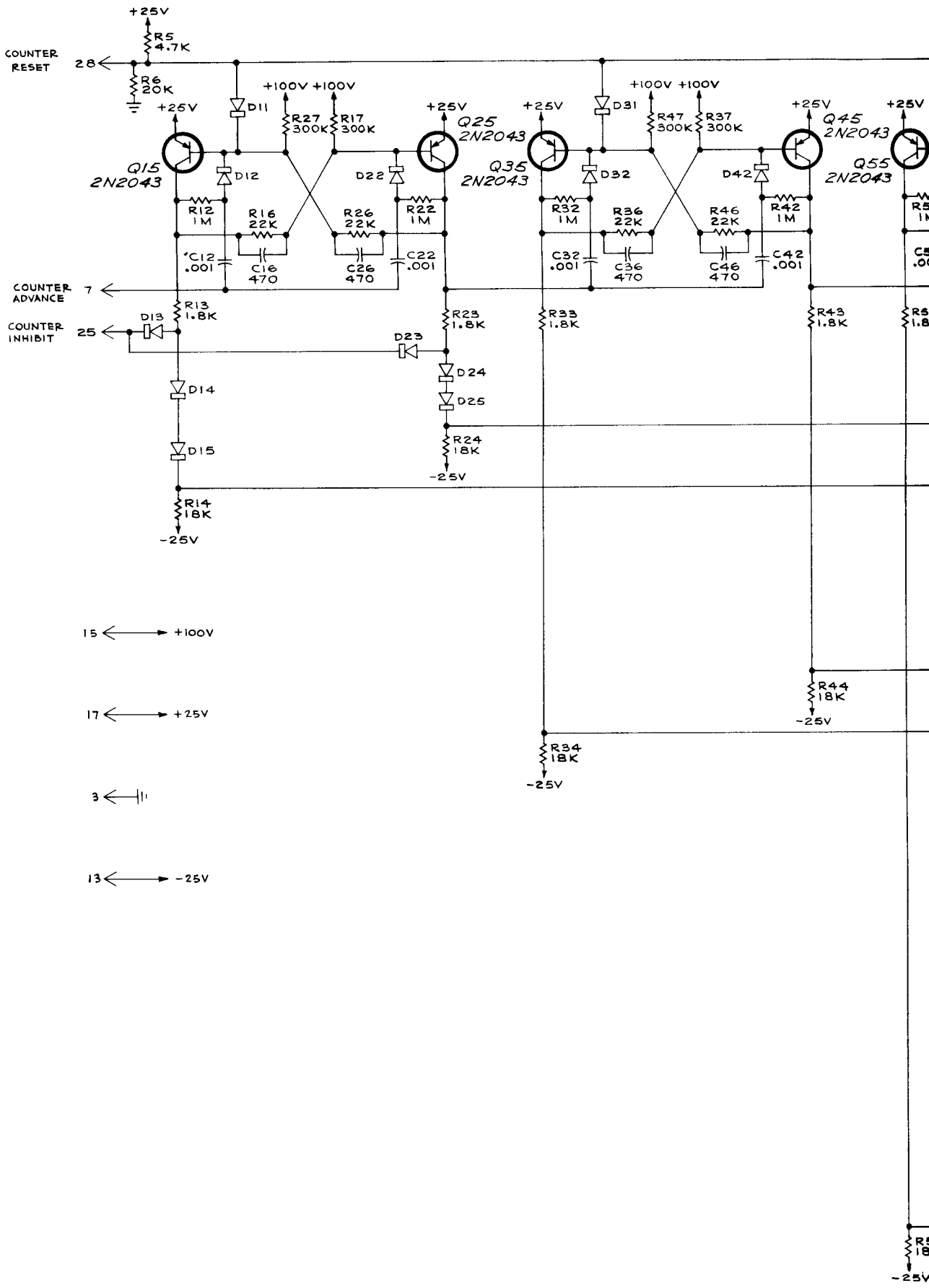

SELECTOR
1
+25V
2
D10
D11
L10
+25V
-ST OFFSET
6
+ST OFFSET
11
+ST COMP
13
A 100%
12
+SP COMP
9
-SP COMP
7
B 100%
10
-SP COMP
8
+SP OFFSET
5
SW6
SW11
SW13
SW12
SW9
SW7
SW10
SW8
SW5
A
100%
B
+
START OFFSET 1KΩ/CM
-
+ START
START -
COMPARATORS
+ STOP
STOP -
STOP OFFSET 1KΩ/CM
VMR
A
SIGNAL
B
A
0%
B
VMR 16
A 0% 18
A SIGNAL 15
B 0% 19
B SIGNAL 14
B VOLTS 17
A VOLTS 20
A VOLTS
B VOLTS
D24
2nd ST SLOPE 28
2nd SP SLOPE 21
D20
D22
2nd ST SLOPE
GND
2nd SP SLOPE

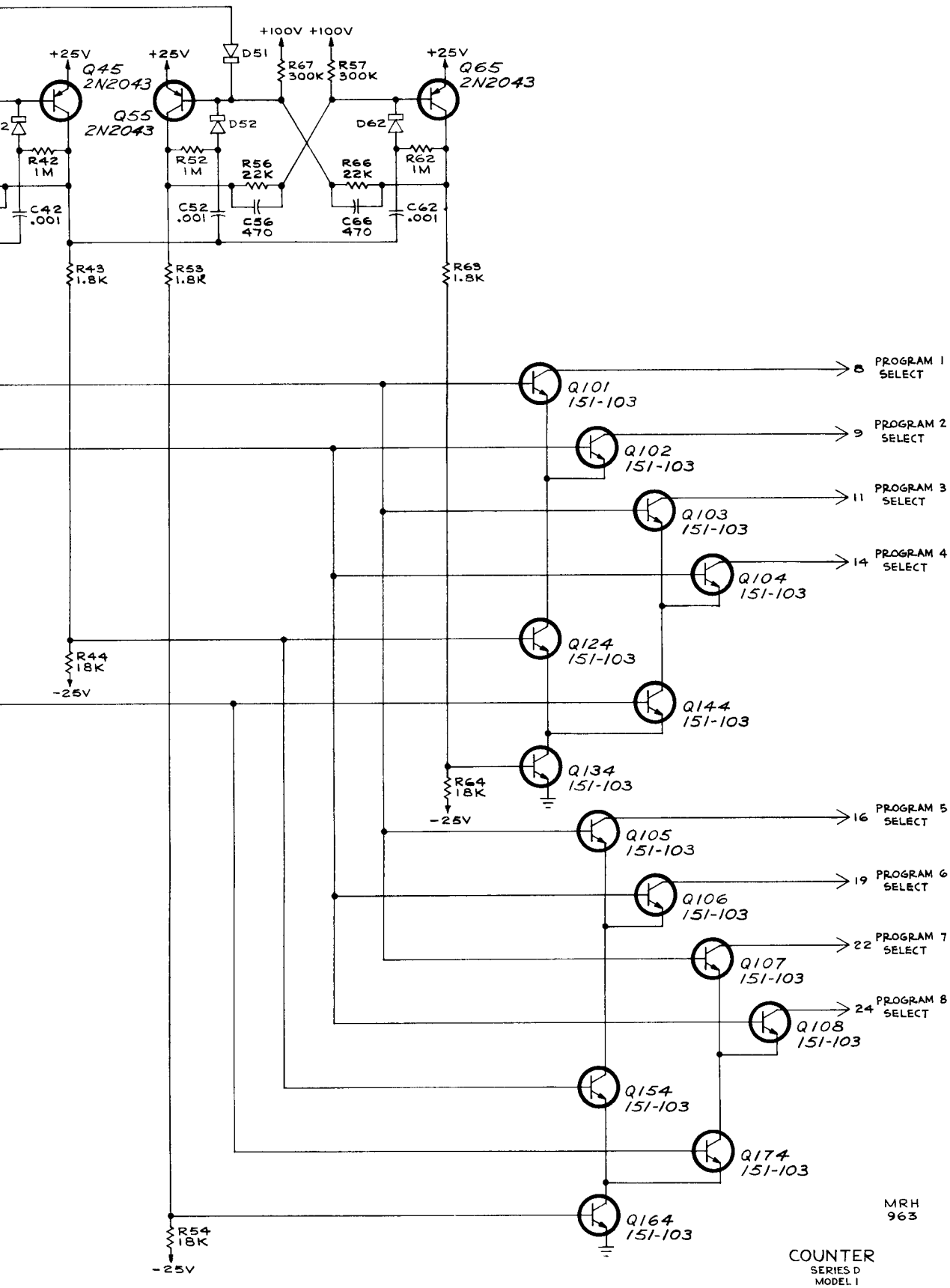


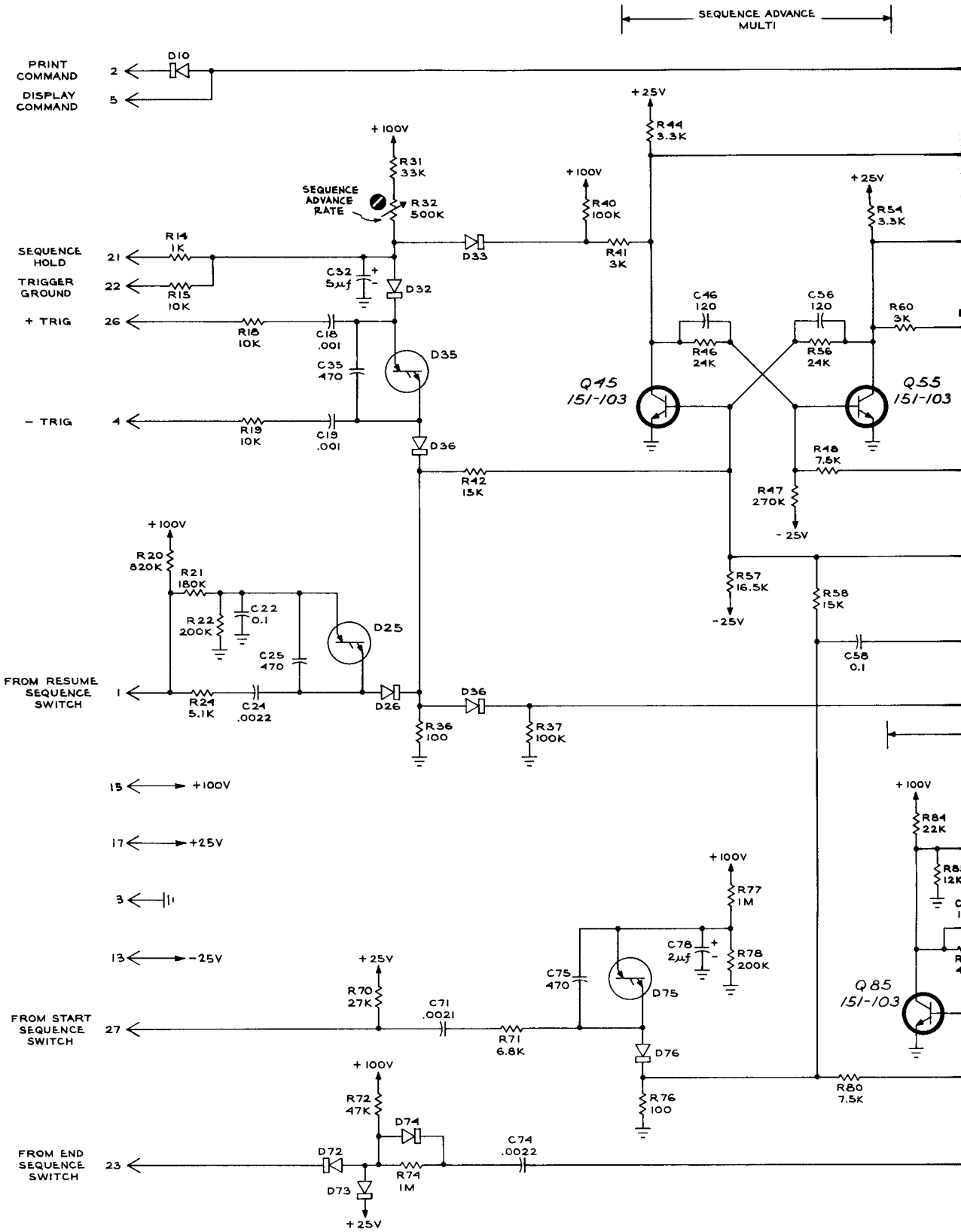
A

DON
963

PROGRAM
SERIES A
MODEL 1

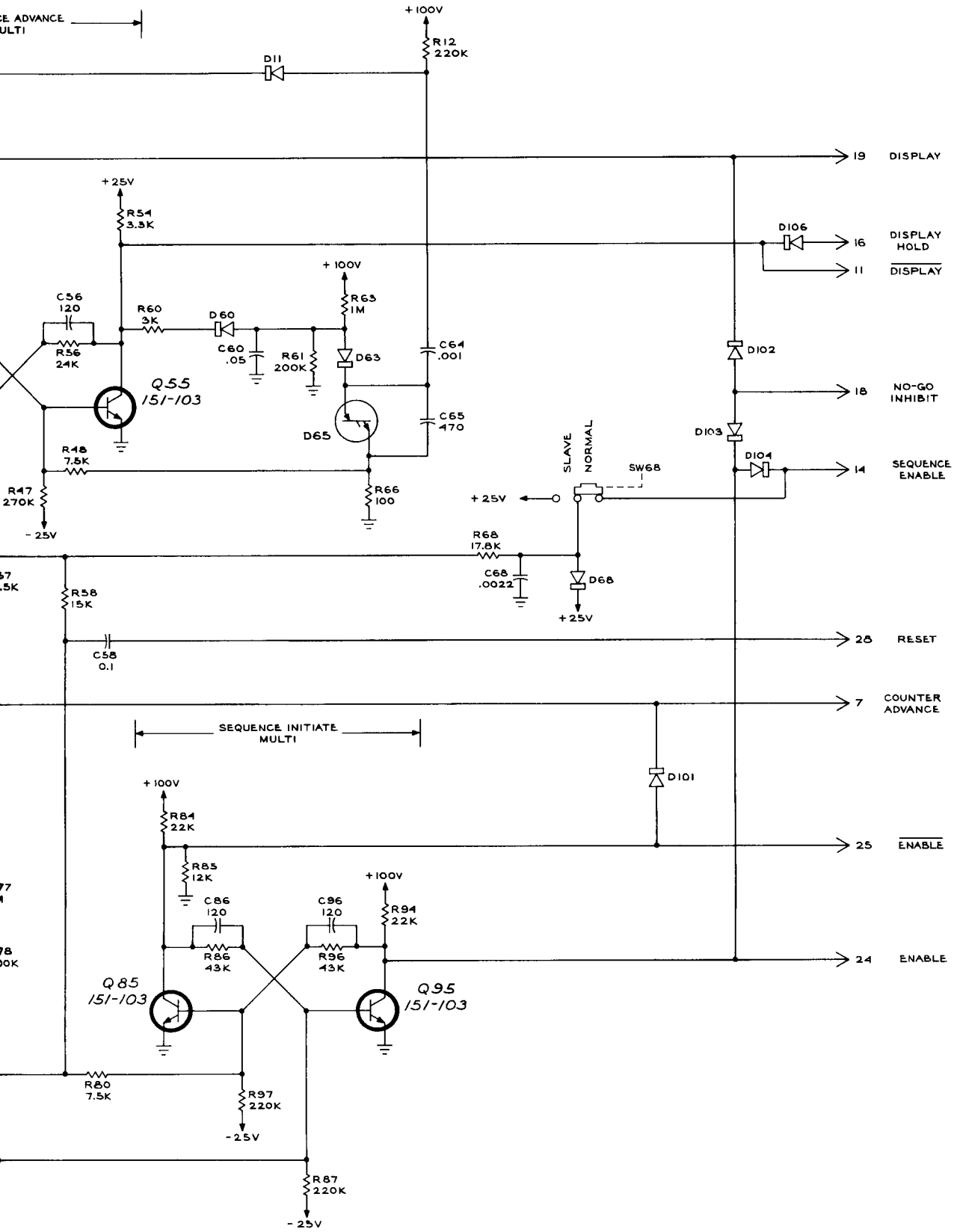

+25V
R5 4.7K
COUNTER RESET
28
R6 20K
+100V +100V
D11
R27 300K
R17 300K
Q15 2N2043
D12
R12 1M
R16 22K
R26 22K
R22 1M
C12 .001
C16 470
C26 470
C22 .001
Q25 2N2043
D22
D31
R47 300K
R37 300K
Q35 2N2043
D32
R32 1M
R36 22K
R46 22K
R42 1M
C32 .001
C36 470
C46 470
C42 .001
Q45 2N2043
Q55 2N2043
COUNTER ADVANCE
7
COUNTER INHIBIT
25
D13
R13 1.8K
D23
R23 1.8K
R33 1.8K
R43 1.8K
D24
D25
D14
D15
R24 18K
-25V
R14 18K
-25V
15 +100V
17 +25V
3
13 -25V
R44 18K
-25V
R34 18K
-25V


+100V +100V
+25V
+25V
+25V
D51
R67 300K
R57 300K
Q45 2N2043
Q55 2N2043
Q65 2N2043
D52
D62
R42 1M
R52 1M
R62 1M
R56 22K
R66 22K
C42 .001
C52 .001
C62 .001
C56 470
C66 470
R43 1.8K
R53 1.8K
R63 1.8K
Q101 151-103
Q102 151-103
Q103 151-103
Q104 151-103
Q124 151-103
Q144 151-103
Q134 151-103
Q105 151-103
Q106 151-103
Q107 151-103
Q108 151-103
Q154 151-103
Q174 151-103
Q164 151-103
8 PROGRAM 1 SELECT
9 PROGRAM 2 SELECT
11 PROGRAM 3 SELECT
14 PROGRAM 4 SELECT
16 PROGRAM 5 SELECT
19 PROGRAM 6 SELECT
22 PROGRAM 7 SELECT
24 PROGRAM 8 SELECT
R44 18K
-25V
R64 18K
-25V
R54 18K
-25V
MRH 963
COUNTER
SERIES D
MODEL 1
A


SEQUENCE ADVANCE MULTI
PRINT COMMAND
DISPLAY COMMAND
2
5
D10
+100V
R31 33K
SEQUENCE ADVANCE RATE
R32 500K
+25V
R44 3.3K
+100V
R40 100K
+25V
R54 3.3K
SEQUENCE HOLD
21
R14 1K
TRIGGER GROUND
22
R15 10K
C32 5μf
D32
D33
R41 3K
+ TRIG
26
R18 10K
C18 .001
C35 470
D35
C46 120
R46 24K
C56 120
R56 24K
R60 3K
Q45 151-103
Q55 151-103
- TRIG
4
R19 10K
C19 .001
D36
R42 15K
R48 7.5K
R47 270K
- 25V
+100V
R20 820K
R21 180K
R22 200K
C22 0.1
C25 470
D25
R57 16.5K
-25V
R58 15K
C58 0.1
FROM RESUME SEQUENCE SWITCH
1
R24 5.1K
C24 .0022
D26
D36
R36 100
R37 100K
15
+100V
17
+25V
3
13
-25V
+100V
R84 22K
+100V
R77 1M
C78 2μf
R78 200K
+25V
R70 27K
C75 470
D75
Q85 151-103
FROM START SEQUENCE SWITCH
27
C71 .0021
R71 6.8K
D76
R80 7.5K
+100V
R72 47K
D74
R76 100
FROM END SEQUENCE SWITCH
23
D72
D73
R74 1M
C74 .0022
+25V

TYPE 262

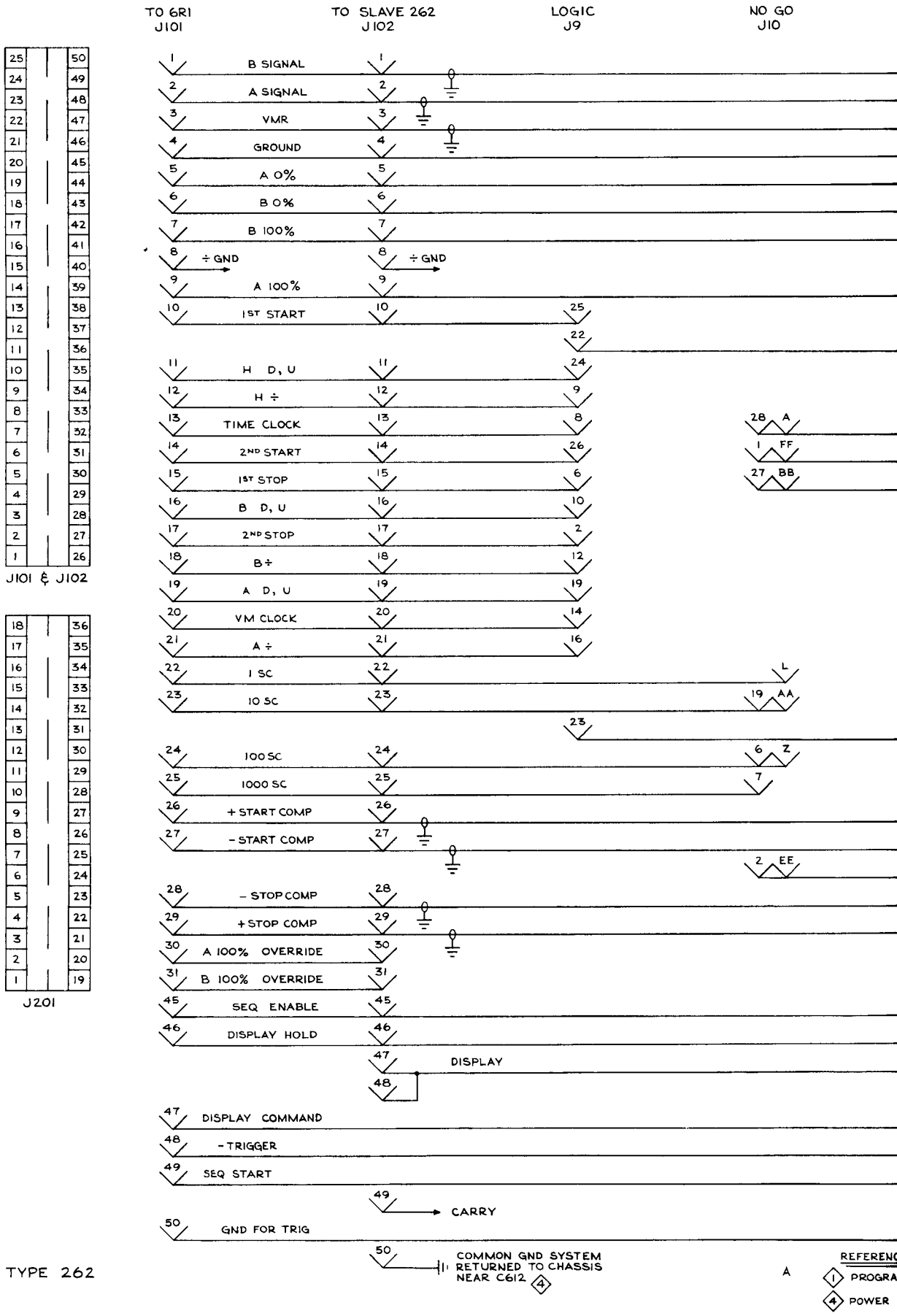
A

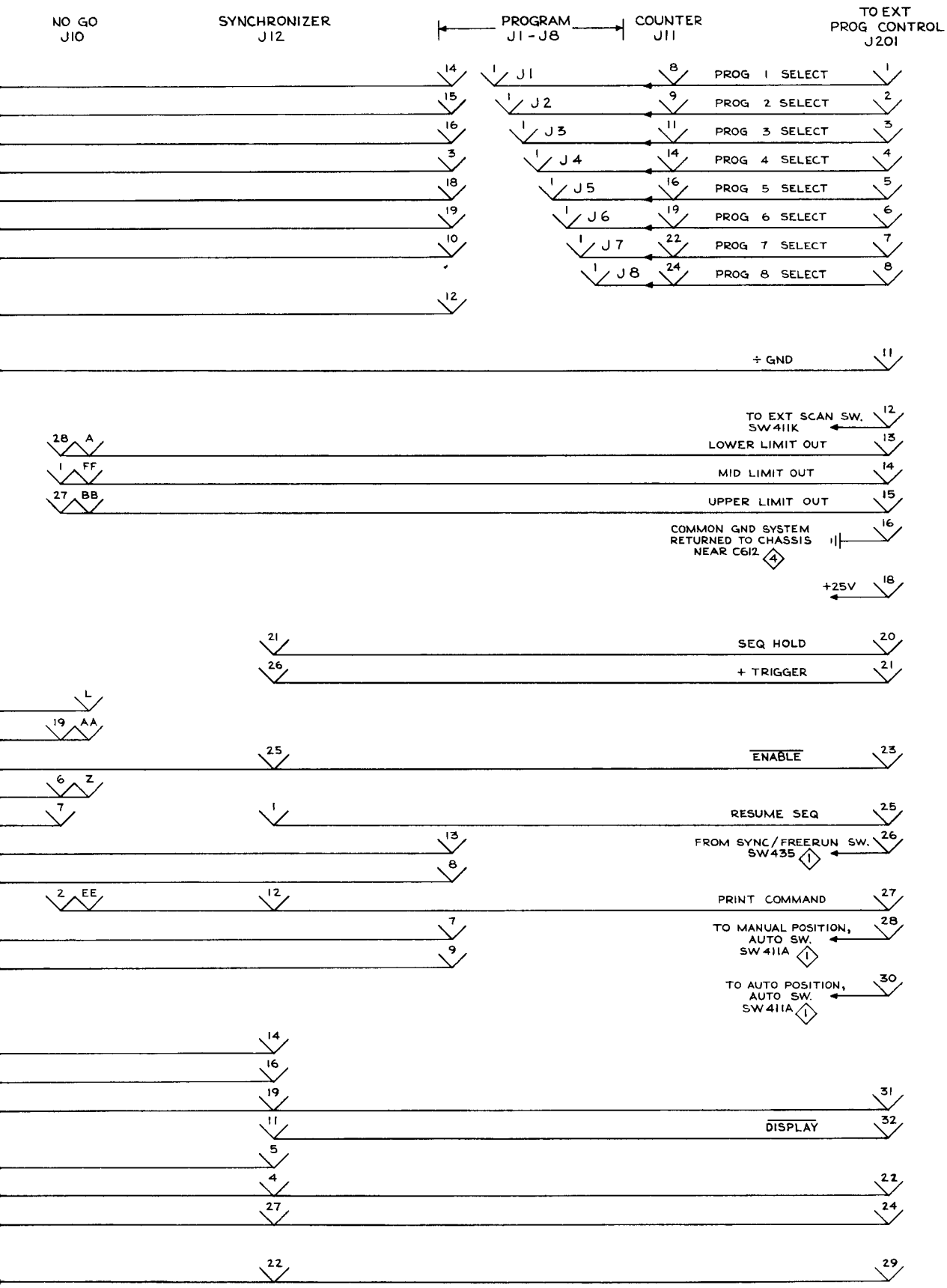


CMD
963

A

SYNCHRONIZER
SERIES E
MODEL 1


TO 6R1
J101
TO SLAVE 262
J102
LOGIC
J9
NO GO
J10
J101 & J102
J201
B SIGNAL
A SIGNAL
VMR
GROUND
A 0%
B 0%
B 100%
÷ GND
A 100%
1ST START
H D, U
H ÷
TIME CLOCK
2ND START
1ST STOP
B D, U
2ND STOP
B ÷
A D, U
VM CLOCK
A ÷
1 SC
10 SC
100 SC
1000 SC
+ START COMP
- START COMP
- STOP COMP
+ STOP COMP
A 100% OVERRIDE
B 100% OVERRIDE
SEQ ENABLE
DISPLAY HOLD
DISPLAY
DISPLAY COMMAND
- TRIGGER
SEQ START
CARRY
GND FOR TRIG
COMMON GND SYSTEM
RETURNED TO CHASSIS
NEAR C612 4
TYPE 262
A
REFERENC
1 PROGRA
4 POWER



REFERENCE DRAWINGS

1 PROGRAM CONTROL SWITCHING

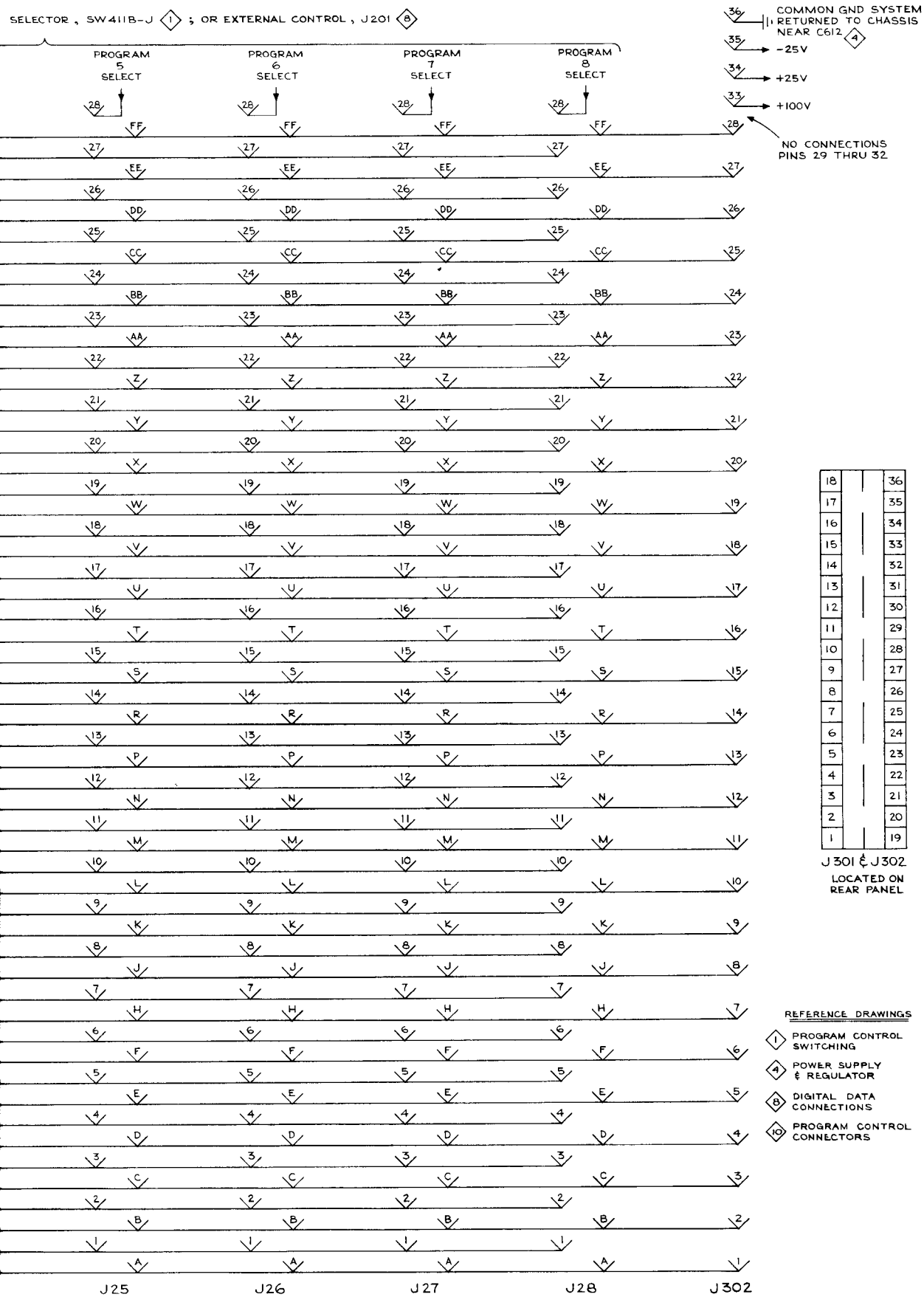
4 POWER SUPPLY & REGULATOR

DIGITAL DATA CONNECTIONS

A

DON 963

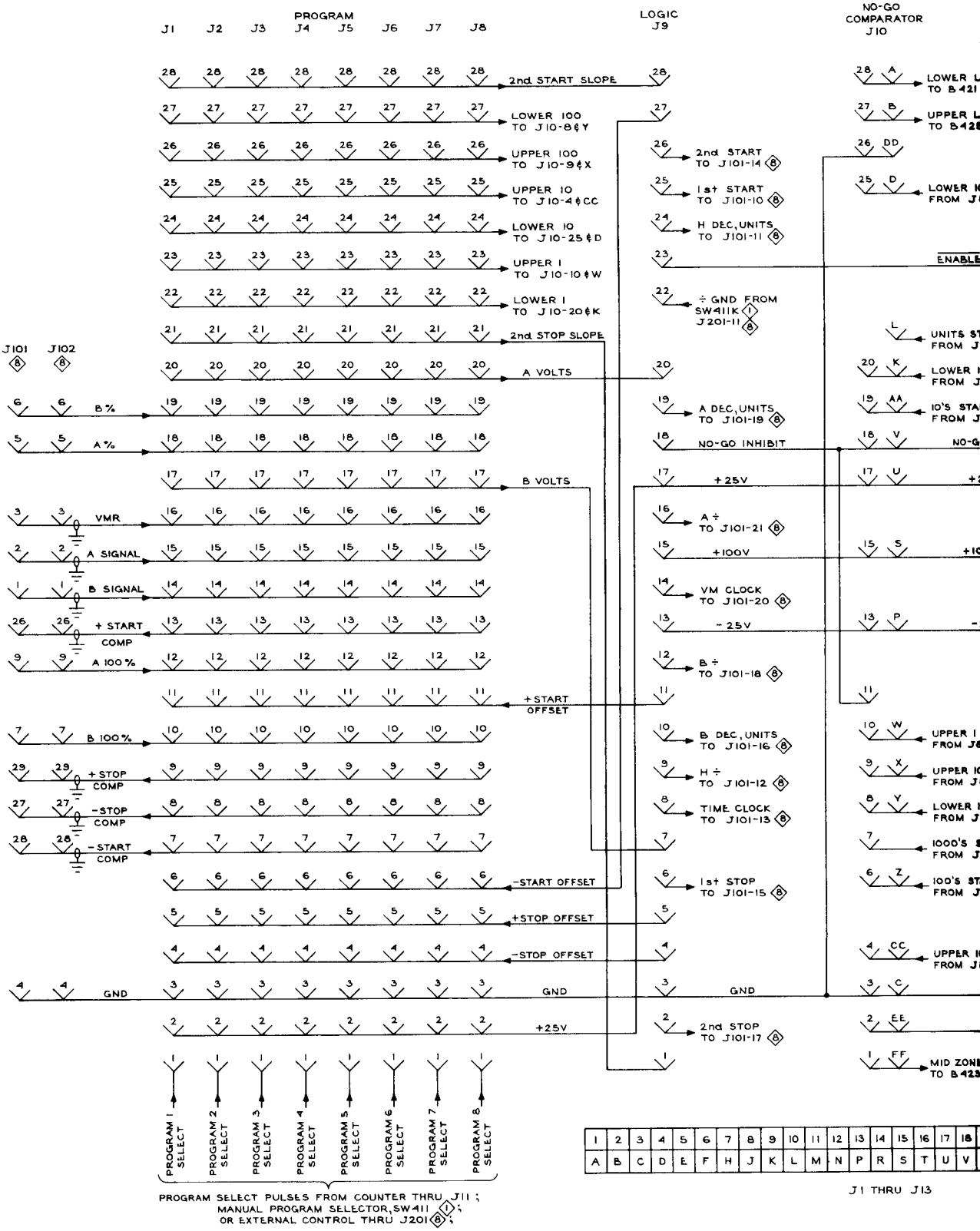

FROM COUNTER , J11 ⟨10⟩ ; MANUAL PROGRAM SELECTOR , SW411B-J ⟨1⟩ ;
+25V
PROGRAM 1 SELECT
PROGRAM 2 SELECT
PROGRAM 3 SELECT
PROGRAM 4 SELECT
PROGRAM 5 SELECT
NO CONNECTIONS PINS 27 THRU 36
J 301 TO EXT EQUIP.
J21
J22
J23
J24
J25
TYPE 262
A

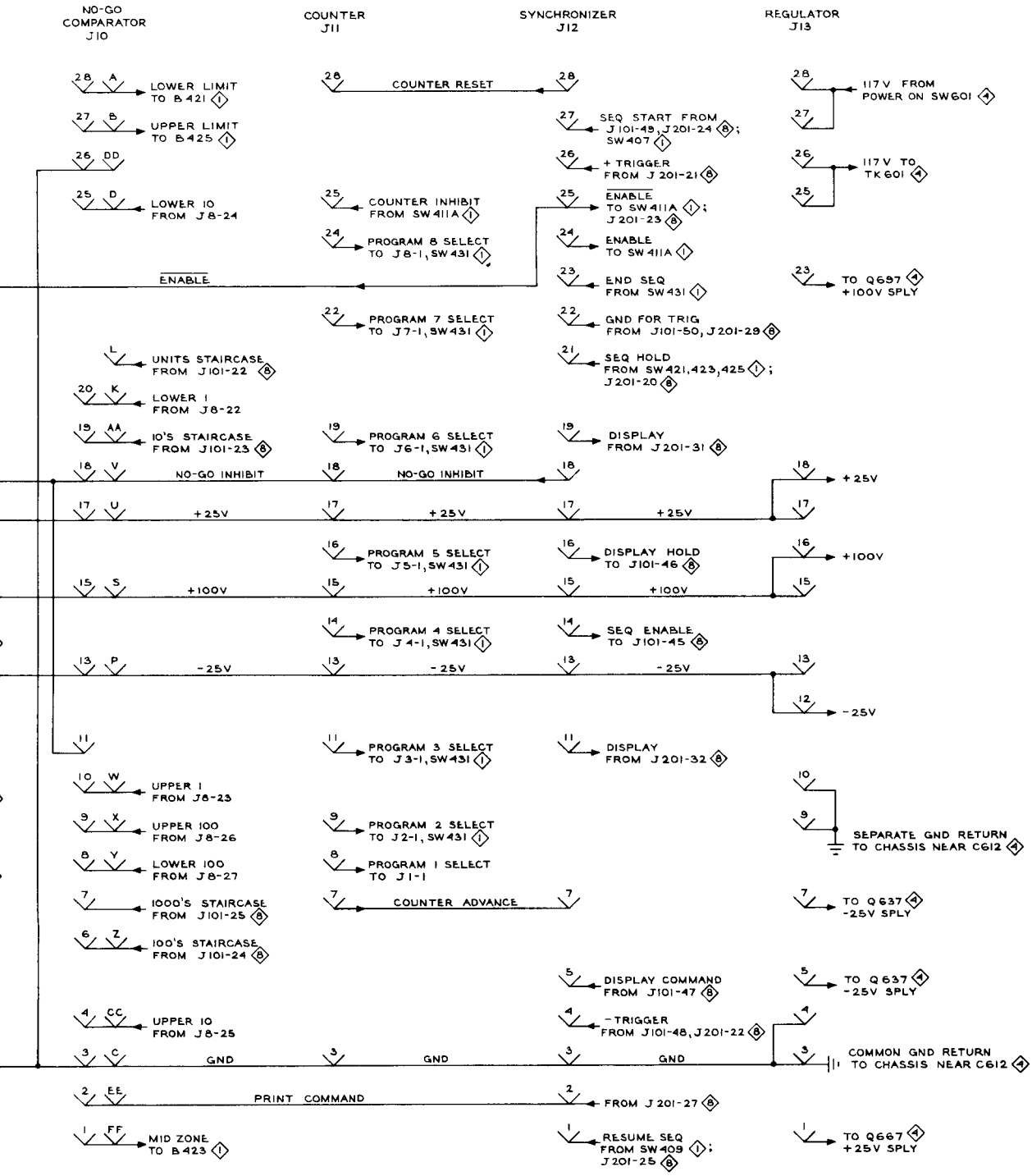


A

PROGRAMMED EQUIPMENT CONNECTORS

DON 963


PROGRAM
J1 J2 J3 J4 J5 J6 J7 J8
LOGIC
J9
NO-GO
COMPARATOR
J10
2nd START SLOPE
LOWER 100
TO J10-8¢Y
UPPER 100
TO J10-9¢X
UPPER 10
TO J10-4¢CC
LOWER 10
TO J10-25¢D
UPPER 1
TO J10-10¢W
LOWER 1
TO J10-20¢K
2nd STOP SLOPE
A VOLTS
B VOLTS
+START OFFSET
-START OFFSET
+STOP OFFSET
-STOP OFFSET
GND
+25V
J101
J102
B%
A%
VMR
A SIGNAL
B SIGNAL
+ START COMP
A 100%
B 100%
+STOP COMP
-STOP COMP
-START COMP
2nd START TO J101-14
1st START TO J101-10
H DEC, UNITS TO J101-11
÷ GND FROM SW411K J201-11
A DEC, UNITS TO J101-19
NO-GO INHIBIT
+25V
A ÷ TO J101-21
+100V
VM CLOCK TO J101-20
-25V
B ÷ TO J101-18
B DEC, UNITS TO J101-16
H ÷ TO J101-12
TIME CLOCK TO J101-13
1st STOP TO J101-15
GND
2nd STOP TO J101-17
ENABLE
UNITS ST FROM J
LOWER FROM J
10'S STA FROM J
NO-G
+2
+10
UPPER I FROM J
UPPER I FROM J
LOWER FROM J
1000'S FROM J
100'S ST FROM J
UPPER I FROM J
MID ZONE TO B423
LOWER L TO B421
UPPER L TO B42
LOWER H FROM J
PROGRAM 1 SELECT
PROGRAM 2 SELECT
PROGRAM 3 SELECT
PROGRAM 4 SELECT
PROGRAM 5 SELECT
PROGRAM 6 SELECT
PROGRAM 7 SELECT
PROGRAM 8 SELECT
PROGRAM SELECT PULSES FROM COUNTER THRU J11;
MANUAL PROGRAM SELECTOR, SW411 (1);
OR EXTERNAL CONTROL THRU J201 (8);
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A B C D E F H J K L M N P R S T U V
J1 THRU J13



10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
L	M	N	P	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF

J1 THRU J13

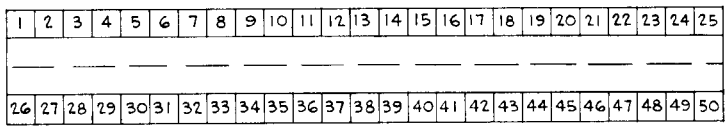
REFERENCE DRAWINGS

① PROGRAM CONTROL SWITCHING
④ POWER SUPPLY & REGULATOR
⑧ DIGITAL DATA CONNECTIONS

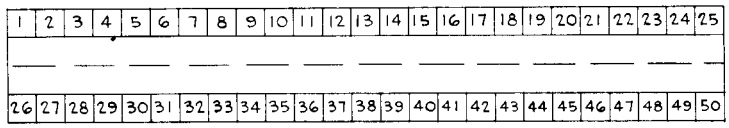
CMD 963

PROGRAM CONTROL CONNECTORS

A



P101
PROGRAMMER (MASTER)



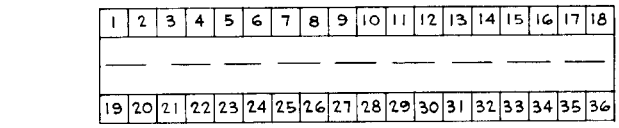
P102
PROGRAMMER (SLAVE)

1	B SIGNAL	26	+ START COMPARATOR
2	A SIGNAL	27	− START COMPARATOR
3	VOLTMETER RAMP	28	− STOP COMPARATOR
4	GROUND	29	+ STOP COMPARATOR
5	A 0%	30	B 100% OVERRIDE
6	B 0%	31	A 100% OVERRIDE
7	B 100%	32	SPARE PINS
8	÷ GROUND	33	
9	A 100%	34	
10	1ST START	35	NO PIN CONNECTIONS
11	HORIZ. DEC. UNITS	36	
12	HORIZ. ÷	37	
13	TIME CLOCK	38	
14	2ND START	39	
15	1ST STOP	40	
16	B DEC. UNITS	41	
17	2ND STOP	42	
18	B ÷	43	
19	A DEC. UNITS	44	
20	VOLTMETER CLOCK	45	SEQUENCE ENABLE
21	A ÷	46	DISPLAY HOLD
22	1 STAIRCASE	47	DISPLAY COMMAND
23	10 STAIRCASE	48	− TRIGGER
24	100 STAIRCASE	49	START
25	1000 STAIRCASE	50	GROUND FOR TRIGGER

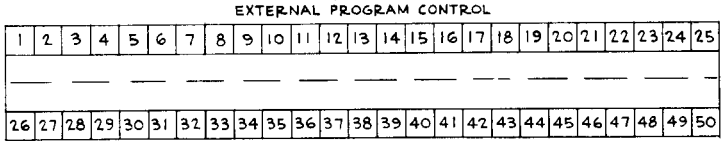
P34

A
B
C V
D
E
F −S
G
H −ST
J B
K
L D
M
N
P +ST
R A
S +S
T
U
V
W
X

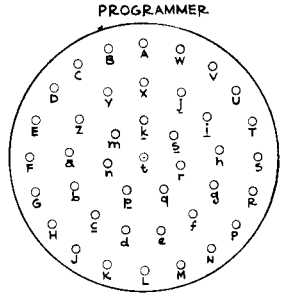
PROGRAMMER (MASTER) TO PROGRAMMER (SLAVE)



P201
EXTERNAL PROGRAM CONTROL



P101
PROGRAMMER



P34
DIGITAL UNIT

P34		P101
A	GROUND	4
B	SWEEP	35
C	VOLTMETER RAMP	3
D	A ÷	21
E	A DEC. UNITS	19
F	-STOP COMPARATOR	28
G	+20V	
H	-START COMPARATOR	27
J	B 100% OVERRIDE	30
K	B SIGNAL	1
L	DEC. UNITS RETURN	
M	A SIGNAL	2
N	÷ GROUND	8
P	+START COMPARATOR	26
R	A 100% OVERRIDE	31
S	+STOP COMPARATOR	29
T	B DEC. UNITS	16
U	B ÷	18
V	HORIZ. DEC. UNITS	11
W	H ÷	12
X	A 0% OVERRIDE	36

P34		P101	P201
Y	1 KC STAIRCASE	25	
Z	B 0% OVERRIDE	37	
a	A 100%	9	
b	B 100%	7	
c	1ST START	10	
d	2ND START	14	
e	1ST STOP	15	
f	2ND STOP	17	
g	A 0%	5	
h	B 0%	6	
i	SPARE		
j	1 STAIRCASE	22	
k	SPARE		
m	TIME CLOCK	13	
n	PRINT COMMAND	42	27
p	100 STAIRCASE	24	
q	10 STAIRCASE	23	
r	DISPLAY HOLD	44	26
s	VOLTMETER CLOCK	20	
t	VOLTMETER OSC.		

LAVE)

DIGITAL TO PROGRAMMER & EXTERNAL PROGRAM CONTROL

PLUG DETAILS

963

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.