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Tektronix®

TG 501
TIME MARK GENERATOR

INSTRUCTION MANUAL

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TG 501
TIME MARK GENERATOR

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

070-1576-02
Product Group 75

Serial Number _____

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WARNING

THE FOLLOWING SERVICE INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

Terms In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

Terms As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

Symbols As Marked on Equipment


DANGER — High voltage.


Protective ground (earth) terminal.


ATTENTION — refer to manual.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Operate Plug-In Unit Without Covers

To avoid personal injury, do not operate this product without covers or panels installed. Do not apply power to the plug-in via a plug-in extender.

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SERVICE SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

Use Care When Servicing With Power On

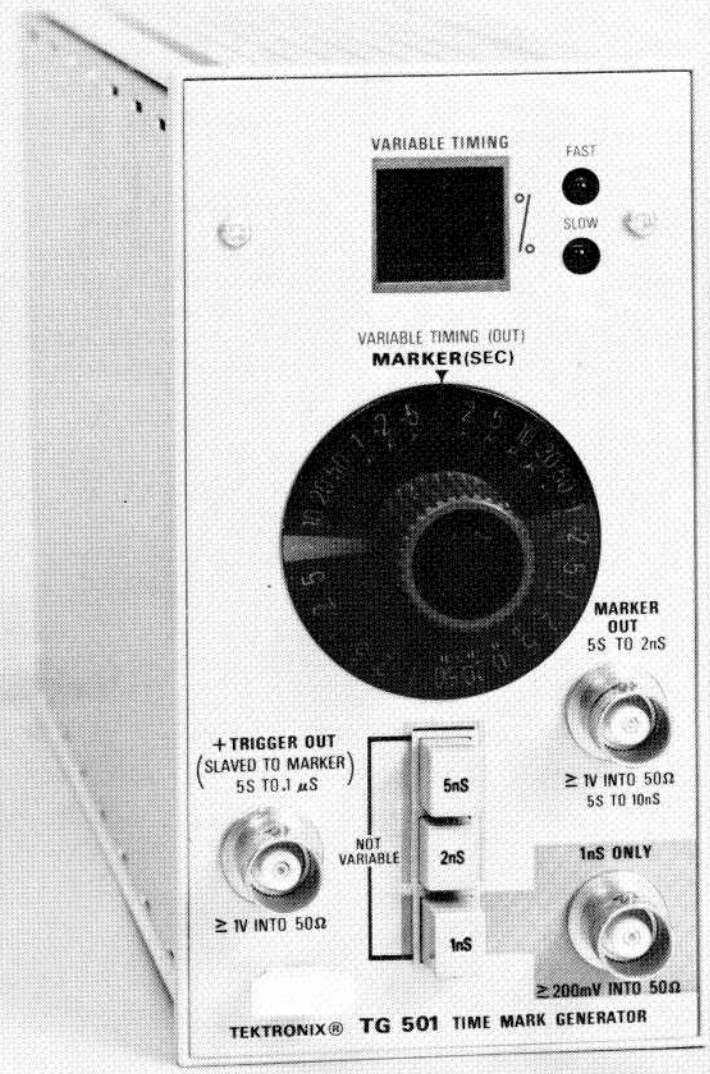
Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

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TG 501 Time Mark Generator

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SPECIFICATION

INTRODUCTION

Description

The TG 501 is a general purpose Time Mark Generator plug-in designed to operate in a TM 500 Series Power Module. A Variable Timing Readout provides a simple but accurate means of measuring timing errors over ±7.5% minimum range. Since many specifications are given in percentages, the error readout eliminates the need for computations and, additionally, lessens parallax discrepancies.

Marker selection from 5 s through 1 ns in a 1, 2, 5, sequence is available. 5 s through 10 ns markers are selected by a rotary switch. 5, 2, and 2 ns modified sine waves are selected by self-canceling push-buttons when the rotary switch is in the 521n position.

All outputs are available at the front-panel connectors, or by modification at the interface connector, located at the back of the plug-in, and the TM 500 Series Power Module.

Power supplies are current limited. The 5 V supply is over-voltage protected to avoid damage to the integrated circuits.

Table 1-1

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements		Supplemental Information
Markers	5 s through 1 ns in a 1, 2, 5 sequence.		5 s through 10 ns are selected by a rotary switch. 5 ns, 2 ns, and 1 ns are push button selected modified sine waves.
Marker Amplitude	⩾1 V peak on 5 s through 10 ns markers. ⩾750 mV peak-to-peak into 50 Ω on 5 ns and 2 ns markers. ⩾200 mV peak-to-peak into 50 Ω on 1 ns markers.		
Trigger Output Signal	Slaved to marker output from 5 s through 100 ns. Remains at 100 ns for all faster markers.		Amplitude same as marker amplitude.
Internal Reference	**Standard**	**Option 01**	
Crystal Frequency	1 MHz	5 MHz	
Stability (0°C to +50°C) after 1/2 hour warm-up	Within 1 part in 10^5	Within 5 parts in 10^7	
Long-Term Drift	1 part or less in 10^5 per month	1 part or less in 10^7 per month	
Setability	Adjustable to within 1 part in 10^7	Adjustable to within 5 parts in 10^9	

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Table 1-1 (cont)

Characteristics	Performance Requirement	Supplemental Information
External Reference Input (Available Only if U50 and jumpers are installed and U100 is removed)		Lift pin 3 of U350 from socket; IC and jumpers for 5 or 10 MHz, 1 MHz external reference requires jumpers.
Acceptable Frequencies	1 MHz, 5 MHz, or 10 MHz.	Internally hard wired so output frequencies counted down to 1 MHz.
Input Amplitude	Must be TTL, compatible.	
Error Readout Range	To ±7.5%.	
Timing Error Measurement Accuracy	Device under test error is indicated to within one least significant digit (i.e., to within one displayed count).	Example: If DUT Timing error reads 3.0% slow, the absolute accuracy will be between 2.9% and 3.1% slow.

Table 1-2

ENVIRONMENTAL CHARACTERISTICS

Characteristics	Description	
Temperature		Meets MIL-T-28800B, class 5.
Operating	0° C to +50° C	
Non-operating	−55° C to +75° C	
Humidity	95% RH, 0° C to 30° C 75% RH, 30° C to 40° C 45% RH, 40° C to 50° C	Exceeds MIL-T-28800B, class 5.
Altitude		Exceeds MIL-T-28800B, class 5.
Operating	4.6 Km (15,000 ft)	
Non-operating	15 Km (50,000 ft)	
Vibration	0.38 mm(0.015 inch peak-to-peak, 5 Hz to 55 Hz, 75 minutes.	Exceeds MIL-T-28800B, class 5, when installed in qualified power modules.
Shock	30 g's (1/2 sine) 11 ms duration, 3 shocks in each direction along 3 major axes, 18 total shocks.	Meets MIL-T-28800B, class 5, when installed in qualified power modules.
Bench Handling	12 drops from 45°, 4 inch or equilibrium, whichever occurs first.	Meets MIL-T-28800B, class 5.
Transportation	Qualified under National Safe Transit Association Preshipment Test Procedures 1A-B-1 and 1A-B-2.	
EMC	Within limits of MIL-461A, and F.C.C. Regulations, Part 15, Subpart J, Class A.	
Electrical Discharge	20 kV maximum charge applied to instrument case.	

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Table 1-3

PHYSICAL CHARACTERISTICS

Characteristics	Description
Finish	Anodized aluminum panel and chassis
Net Weight	2 lbs., 4 oz. (1 kg.)
Dimensions	2.633 in. (66.8 mm) w x 11.240 in. (285.3 mm) d x 4.961 in. (125.9 mm) h

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OPERATING INSTRUCTIONS

Installation

The TG 501 is calibrated and ready for use when received. Referring to Fig. 2-1, install the Generator and turn on the Power Module. Check the front-panel of the Generator to see that the knob skirt is lighted. The TG 501 is designed to operate in any compartment of a TM 500 Series Power Module. Refer to the Power Module Instruction Manual for line voltage requirements and Power Module operation.

Refer to the Controls and Adjustments page for front-panel controls, connectors and indicator descriptions.

CAUTION

Turn the Power Module off before inserting the plug-in; otherwise, damage may occur to the plug-in circuitry.

CONTROLS AND CONNECTORS

MARKER Control

(1) Rotary switch selects individual marker intervals from 5 s to 10 ns. Set to 521n position when using push buttons for 5 ns, 2 ns and 1 ns. Readout Display is turned off in 521n position.

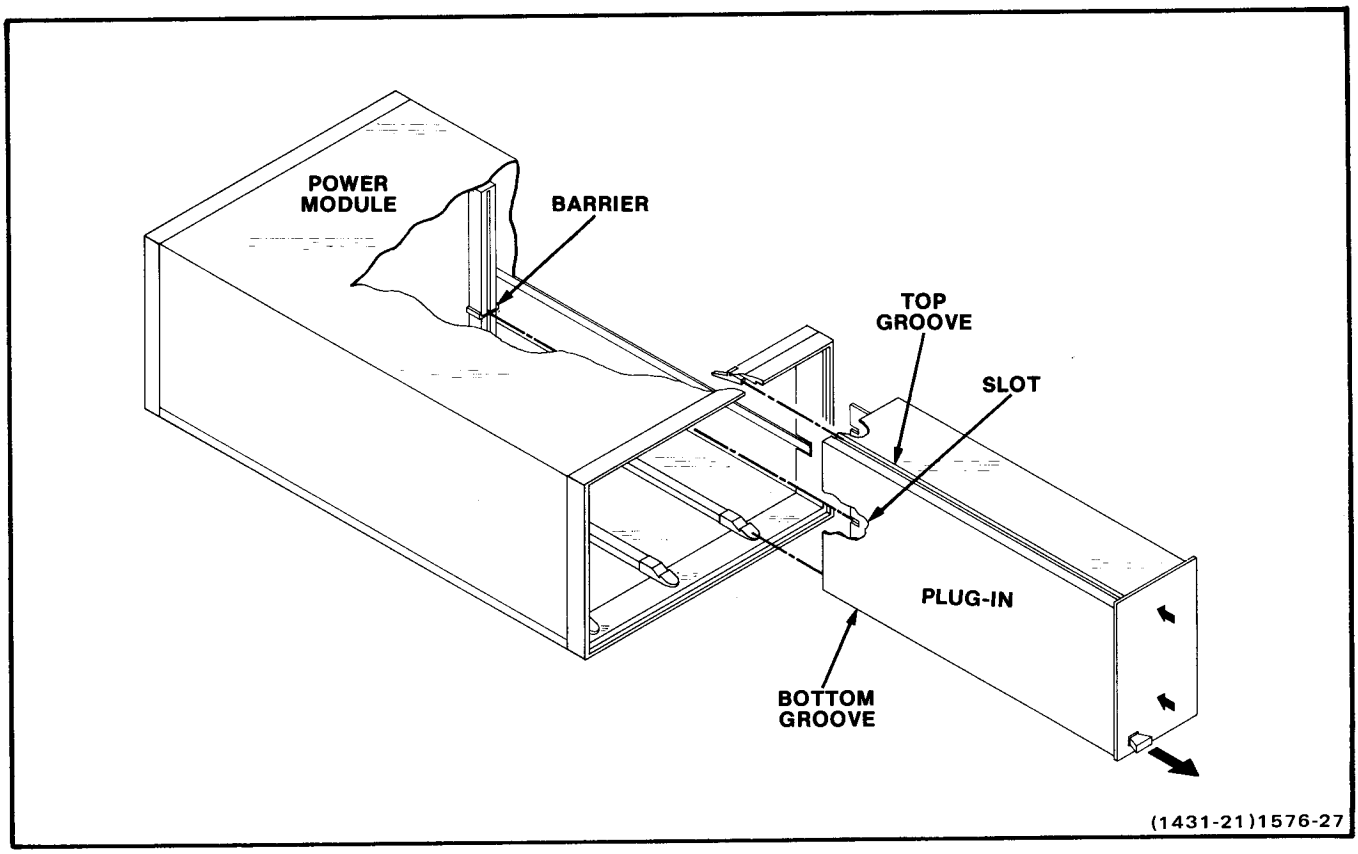


Fig. 2-1. Plug-in installation and removal.

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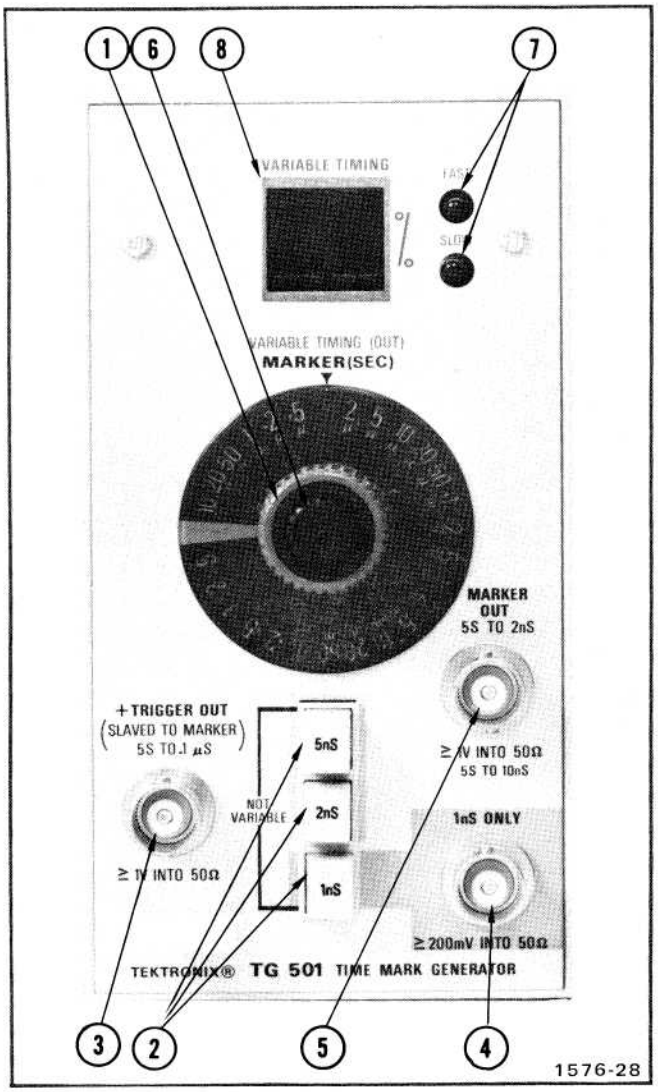


Fig. 2-2. Controls and Connectors.

5 ns, 2 ns AND 1 ns PUSHBUTTON

(2) Self-canceling pushbuttons select modified sine waves for 5, 2, and 1 ns when MARKER control is in 521n position. 1 ns marker has a separate output connector. These aare not variable.

TRIGGER OUT Connector

(3) Provides trigger pulses slaved to Marker Output from 5 s through 100 ns. Remains at 100 ns for all faster markers. Pulse amplitude is ⩾1 V into 50 Ω.

1 ns ONLY Connector

(4) Provides ⩾0.5 V peak-to-peak amplitude into 50 Ω of 1 ns modified sine wave selected by the 1 ns push button when MARKER Control is in 521n position.

MARKER OUT Connector

(5) Provides positive markers of ⩾1 V peak amplitude into 50 Ω for 5 s through 10 ns selected by MARKER Control rotary switch. Provides markers of ⩾1 V peak-to-peak amplitude into 50 Ω for 5 ns and 2 ns modified sine waves, selected by self-canceling push buttons when MARKER Control is in 521n position.

VARIABLE TIMING Control

(6) Concentric with MARKER Control switch. Markers are calibrated when center button is pushed in allowing selection as indicated by the lighted knob skirt. When center button is out, output timing is fast or slow by the percentage indicated on the Readout Display.

FAST-SLOW Indicators

(7) Light when variable timing control is used. 'Fast' lights when timing is faster than the standard indicated by lighted knob skirt. 'Slow' lights when timing is slower. Percentage faster or slower is read from VARIABLE TIMING Readout.

VARIABLE TIMING Readout

(8) Indicates timing variation from standard timing. First digit is in percent units, second indicates one-tenth percent units.

OPERATING MODES

Calibrated Mode

When the center-button of the VARIABLE TIMING Control is pushed in, the MARKER Control selects calibrated marker intervals from 5 s to 10 ns, indicated by the lighted knob skirt. To select 5, 2, or 1 ns modified sine wave markers, set the MARKER Control to 521n position and press the desired pushbutton.

Variable Timing Mode

When the center button of the VARIABLE TIMING Control is out, output timing is faster or slower than the calibrated marker to the percentage indicated by the VARIABLE TIMING READOUT Display and the FAST-SLOW Indicator lights. 5, 2, and 1 ns push-button controlled modified sine waves are not variable and the Readout Display is turned off when the MARKER Control is in the 521n position.

Readout Display Test

To check the operation of the display LED's (Light-Emitting Diodes), press the center button of the VARIABLE TIMING Control (push in firmly). All LED segments should light, displaying 8.8 in the Readout.

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TYPICAL APPLICATIONS

The TG 501 can be used for many applications not described in the manual. Use the following examples to become familiar with the TG 501's VARIABLE TIMING READOUT. Contact your Tektronix Field Office or representative for making specific measurements with this instrument.

Time Base Measurements

To accurately determine the timing error of a time base:

1. Connect the MARKER OUT of the TG 501 to the Vertical Input of the oscilloscope. Use a 50 Ω coaxial cable terminated into 50 Ω.

2. Connect the TRIGGER OUT of the TG 501 to the External Trigger Input of the time base. Use a 50 Ω coaxial cable terminated into 50 Ω.

3. Select external trigger source on the time base.

4. Select, for example, the 1 μs sweep rate of the time base.

5. Set the MARKER Control rotary switch of TG 501 to 1 μs.

6. Make sure the center button of VARIABLE TIMING Control, concentric with the MARKER Control, is out (Variable Timing Mode).

7. Use the Horizontal Position control of the time base to make the first time mark coincide with the first graticule line on the oscilloscope. See Fig. 2-3.

8. Rotate the VARIABLE TIMING knob until all time markers coincide with graticule lines on the oscilloscope, as shown in Fig. 2-4.

9. Either the FAST or SLOW Indicator will light showing whether the time base is faster or slower than the calibrated markers of the TG 501. Read the percentage of error from the VARIABLE TIMING READOUT Display.

Pulse Generator Measurements

To accurately determine pulse duration or period of a Pulse Generator:

1. A dual-trace oscilloscope is required. Select alternate mode.

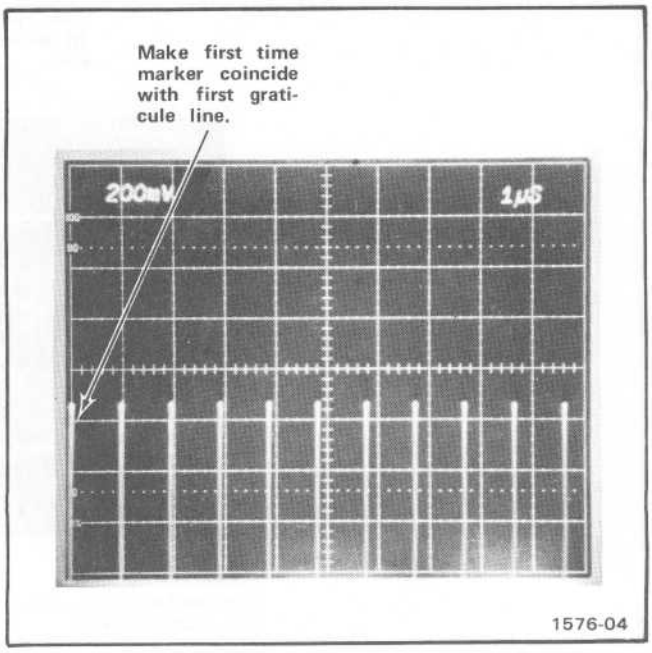


Fig. 2-3. Timing error of time base.

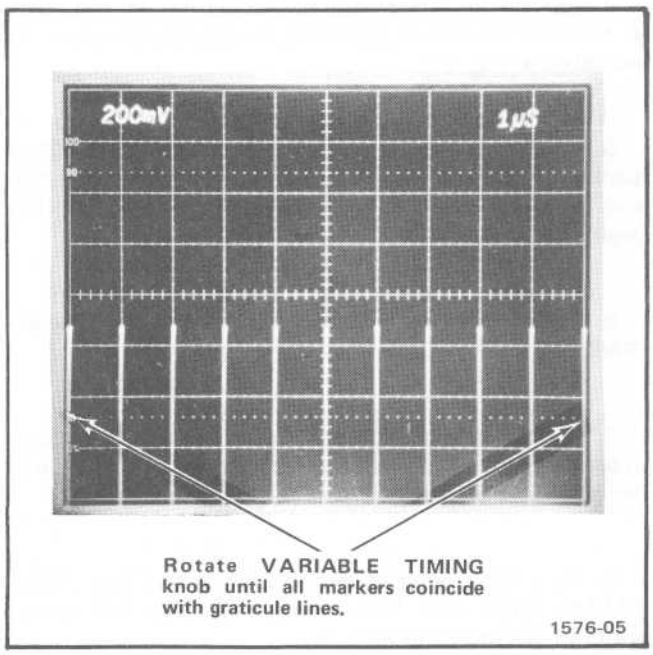


Fig. 2-4. Measuring timing error of time base.

2. Connect the MARKER OUT of the TG 501 to one channel of the dual-trace oscilloscope. Use a 50 Ω coaxial cable terminated in 50 Ω.

3. Connect the Output of the pulse generator to the other channel of the dual-trace, using a 50 Ω coaxial cable terminated in 50 Ω.

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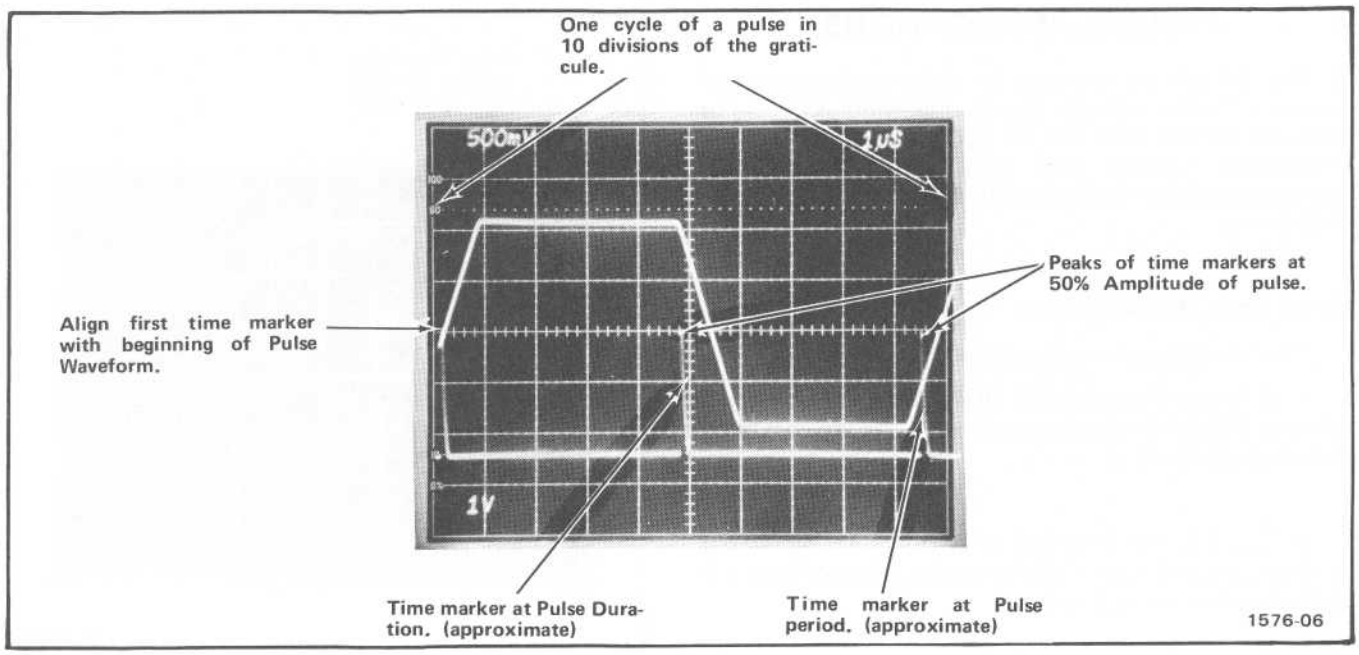


Fig. 2-5. Markers approximately at pulse duration and period.

4. Set the time/div switch to display 1 cycle of a pulse in 10 divisions of the graticule on the oscilloscope, as indicated in Fig. 2-5.

5. Use the MARKER Control switch of the TG 501 to display one time marker approximately at pulse duration and one at pulse period. Align the first time marker with the beginning of pulse wave-form. See Fig. 2-5.

6. Select Variable Timing Mode on the TG 501 (VARIABLE TIMING Control center button out).

7. Use the Vertical Position control of the oscilloscope to set the peaks of the time markers at 50% amplitude of the pulse shown in Fig. 2-5.

8. To check pulse duration, rotate the VARIABLE TIMING knob until time marks coincide with pulse duration, as shown in Fig. 2-6.

9. Either the FAST or SLOW Indicator will light, showing whether the pulse duration of the pulse generator is faster or slower than the calibrated time mark of the TG 501. Read the percentage of error from the VARIABLE TIMING READOUT Display.

10. To check pulse period, rotate the VARIABLE TIMING knob until time marks coincide with pulse period. See Fig. 2-7.

11. Read the VARIABLE TIMING READOUT Display and check the FAST-SLOW Indicators as described in step 9 to find the percentage of error from standard timing.

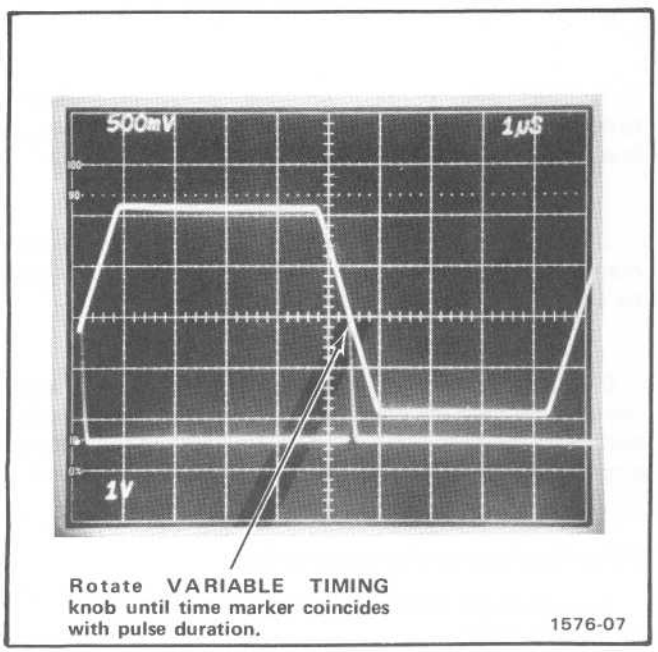


Fig. 2-6. Measuring pulse duration.

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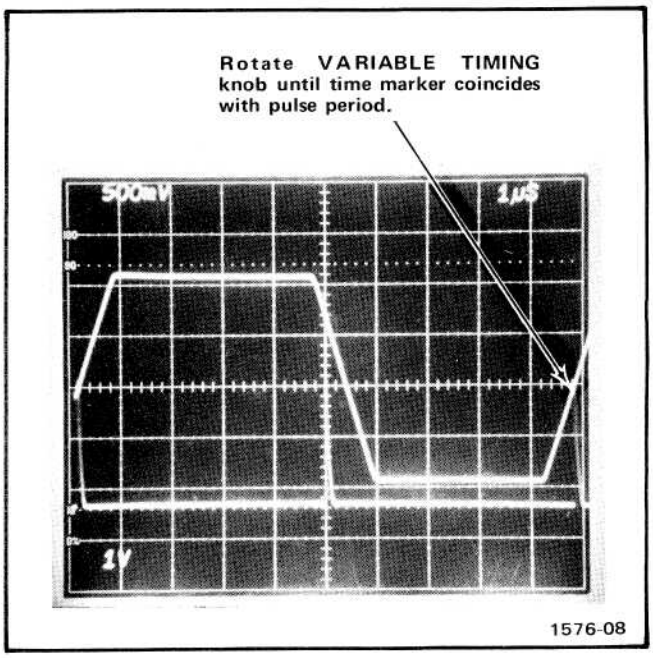


Fig. 2-7. Measuring pulse period.

REPACKAGING FOR SHIPMENT

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted, complete instrument serial number and a description of the service required.

Save and re-use the package in which your instrument was shipped. If the original package is unfit for use or not available, repackage the instrument as follows:

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Refer to the following table for carton test strength requirements.

2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.

4. Seal carton with shipping tape or industrial stapler.

SHIPPING CARTON TEST STRENGTH

Gross Weight (lb)	Carton Test Strength (lb)
1-10	200
10-30	275
30-120	375
120-140	500
140-160	600

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THEORY OF OPERATION

DIAGRAMS 1 & 2

1 MHz Crystal Reference and Enable Gate

The reference frequency is supplied by the 1 MHz crystal reference circuitry of Y100, U100 and U350A. The output of the crystal reference circuit is supplied to pin 12 of U110D, which is part of the enable gate circuit. The enable gate circuit, which determines whether the 1 MHz crystal reference or the 1 MHz variable clock is connected to the phase lock loop, is composed of U110A, U110B, U110D, and U115D. When the VARIABLE TIMING (OUT) knob is pushed in and locked, a low is on pin 11 of U110D, allowing the crystal reference oscillator to be available at pin 13 of U110D. A low is also created at pins 12 and 13 of U115D, resulting in a high at pin 11 of U115D and at pin 3 of U110A. The high at pin 3 of U110A causes a low at pin 5 of U110B, which allows U110B to pass the crystal reference oscillator signal to pin 1 of U230A.

100 MHz Voltage Controlled Oscillator and Dividers

The voltage controlled oscillator (VCO) is composed of an astable multivibrator (Q280-Q285-Q290), an etched capacitor, and Q272, which supplies the charge current for the etched circuit board capacitor. U290D acts as a buffer for the VCO. The NOR output of U290D is connected to the Divide-By-Five Counter. The ÷5 counter contains U310A, U310B, and U315A. The output of the ÷5 counter is translated from ECL into TTL logic levels by Q330, then supplied to ÷2 counter U320.

The output of ÷2 counter U320 is supplied to the input of U325. The output, pin 11 of U325 is applied to another ÷2 counter (U225 pin 12). The Q output of U225 is supplied to pin 5 of U230B.

U230A pin 1 receives 1 MHz from either the crystal reference or the variable clock. U230B pin 5 receives the counted down (÷100) 100 MHz signal from the VCO. Pins 9 and 12 of U230 go high if the negative edges of the input signals coincide; this occurs when the 100 MHz VCO is operating on frequency. The high inputs to U235A produce a low output that clears U230A and U230B. The transition to a low that occurs at pin 12 of U230A is integrated by R231 and C231; the transition to a high level that occurs at pin 8 of U230B is integrated by R239 and C239. The two integrated output levels are summed by R234 and R239. This summation is then fed to the negative input of the loop amplifier/filter.

The input signal to the loop amplifier/filter is amplified and inverted by operational amplifier U250. The output of U250 is kept from changing rapidly by C250 and C251. VR250 level-shifts the output of U250 to a level that can be used to control the current flow through Q272.

Frequency Control of the 100 MHz Oscillator

Assume that the frequency has been correct up to this cycle, and that pins 9 and 12 of U230 are low. When the 100 MHz VCO frequency is slower than 100 MHz the negative edge to the phase comparator will toggle U230A first. This results in a high at pins 8 and 12 of U230 and a more negative voltage at the output of U250. This more negative voltage causes Q272 to conduct harder, which allows the etched circuit board capacitor to charge more quickly, thus increasing the oscillator frequency.

Again assume that the frequency has been correct up to this cycle, but this time the VCO is faster than 100 MHz. The negative edge of the next cycle will toggle U230B first, resulting in a low at pins 8 and 12 of U230. This in turn causes a more positive voltage at the output of U250, which reduces the conduction to Q272. The etched circuit board capacitor now requires longer to charge since its available charging current has been reduced by Q272, and the frequency is decreased.

Out-of-Lock Detector

Ground from the cam switch for all the marker output enable logic gates is via Q270. If the 100 MHz VCO is running slow (out of specifications), the voltage at the output of the loop amplifier/filter operational amplifier Q250 will be low. This low voltage will turn on Q255 and Q260, which will turn off Q270, stopping the marker output.

On the other hand, if the 100 MHz VCO is running fast (out of specifications), the voltage at the output of U250 will be high. This high voltage will turn off normally conducting Q54, which in turn will turn off Q270, breaking the ground on the enable logic gates. Without ground there is no marker output.

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20 ns and .3 μs Divide-By-Two Counters

The 20 ns ÷2 counter contains U315B, U290B and U290A. The input to the counter is the output of the 100 MHz VCO. The 20 ns markers from the ÷2 counter are coupled to enable gate U300B.

The .2 μs ÷2 counter is part of U325. The ÷2 counter output is pin 12 of the integrated circuit, which is supplied to enable gate U330A.

10 ns, 20 ns, or 50 ns and .1 μs, .2 μs, and .5 μs Enable Gates

Enable gates for the 10 ns, 20 ns, and 50 ns markers are U300C, U300B, and U300A respectively, while the enable gates for the .1 μs, .2 μs, and .5 μs markers are U330C, U330A, and U335A-U335B respectively. U335C is an OR gate that couples the selected .1 μs, .2 μs, or .5 μs markers to the decade dividers.

1 MHz Variable Clock

The 1 MHz variable clock circuit is an emitter-coupled astable multibibrator. Temperature compensation transistor Q120, which is the same type of transistor as Q130 and Q135, establishes the power supply voltage for the multivibrator. Q130, Q135, and Q140 are the multivibrator transistors. Q130 controls the charge current available to timing capacitor C127. VR140 provides level shifting for the Q130 base voltage. R135 controls the frequency of the multivibrator by controlling the conduction of Q135. The lower end of R135 is the higher frequency end while the top end reduces the frequency. R145 Variable Timing Center, is used to set the frequency of the multivibrator to 1 MHz when R135 is set to its mechanical midrange position.

Phase Comparator and Fast-Slow Led's

1 MHz is fed to pin 1 of U150A by either the crystal reference or the variable clock. The 1 MHz crystal reference is fed to pin 5 of U150B. Pins 12 and 9 of U150 will go high if the negative edges of the two 1 MHz input signals coincide. This occurs when the variable clock frequency is 1 MHz. With these inputs high, U115A produces a low that clears U150A and U150B. The low now at pin 9 of U150B and the high now at pin 13 of U150A are summed by R152 and R153. The output of the summing resistors is then fed to the negative input of amplifier U160.

The input signal to U160 is amplified and inverted. The output of U160 is kept from changing rapidly by C160. The slow change in the output of U160 causes it to be an apparent dc level. If U115B has been enabled by releasing the VARIABLE TIMING (OUT) control, the output voltage level of U160 is applied to the junction of DS170 and DS172.

Assume that the frequency has been correct up to this cycle, pins 9 and 12 of U150 are low. When the 1 MHz variable clock frequency is slower than 1 MHz, the negative edge to the phase comparator will toggle U150B first. This results in a high at pins 9 and 13 of U150 and a more positive voltage at the output of U115B. This more positive voltage causes DS172 to conduct and become illuminated.

Again assume that the frequency has been correct up to this cycle, but this time the 1 MHz variable clock frequency is faster than 1 MHz. The negative edge of the next cycle will toggle U150A first, resulting in a low at pins 9 and 13 of U150. This in turn causes a more negative voltage at the output of U115B, which results in the conduction and illumination of DS170.

Digital Mixer and Counter

The 1 MHz Crystal Reference is counted down by a factor of 20,000 (2 times 10^4) using decade counters U220, U218, U212, and U210 and flip-flop U215A. The resultant 50 Hz gate frequency (20 ms gate period) available at the outputs of U210 is used to control the display time of the VARIABLE TIMING % LED. Pin 11 of U210 is the ÷5 output; pin 12 is the ÷2 output. The two outputs of U210 are ANDed by U180D to produce a 2 ms pulse, which is used to clear BCD counters U185 (0.01% digit, which is not displayed), U195 (0.1% digit) and U200 (units % digit).

The 1 MHz Crystal Reference and the 1 MHz variable clock output frequencies are compared by digital mixer U215B, with only the frequency difference of the two input frequencies appearing at the output. The output of U215B is ANDed in U180C with the inverted ÷2 output (10 ms wide gate) of U210. The output of U180C goes to the first of the three BCD counters.

The 2 ms output pulse of U180D and the 10 ms output pulse of U115C go to NOR gate U110C. The output of U110C (which is an 8 ms pulse that determines LED display time) is one input to AND gate U180B. The other input to U180B must be a high from U235B to enable U180B and cause the LED display to be unblanked. A high out of U235B is caused by either pressing the VARIABLE TIMING % control fully in to check the LEDs, or by releasing the VARIABLE TIMING % control to its out position. The low to pin 5 of U235B in the out position of the VARIABLE TIMING % control is from pull-up resistor R450 via CR115 and inverter U115D. In the 521n position of the MARKER Control, the cathode of CR115 is connected to ground via S350 to disable the variable timing circuit, since the 1 ns, 2 ns, or 5 ns markers are not variable.

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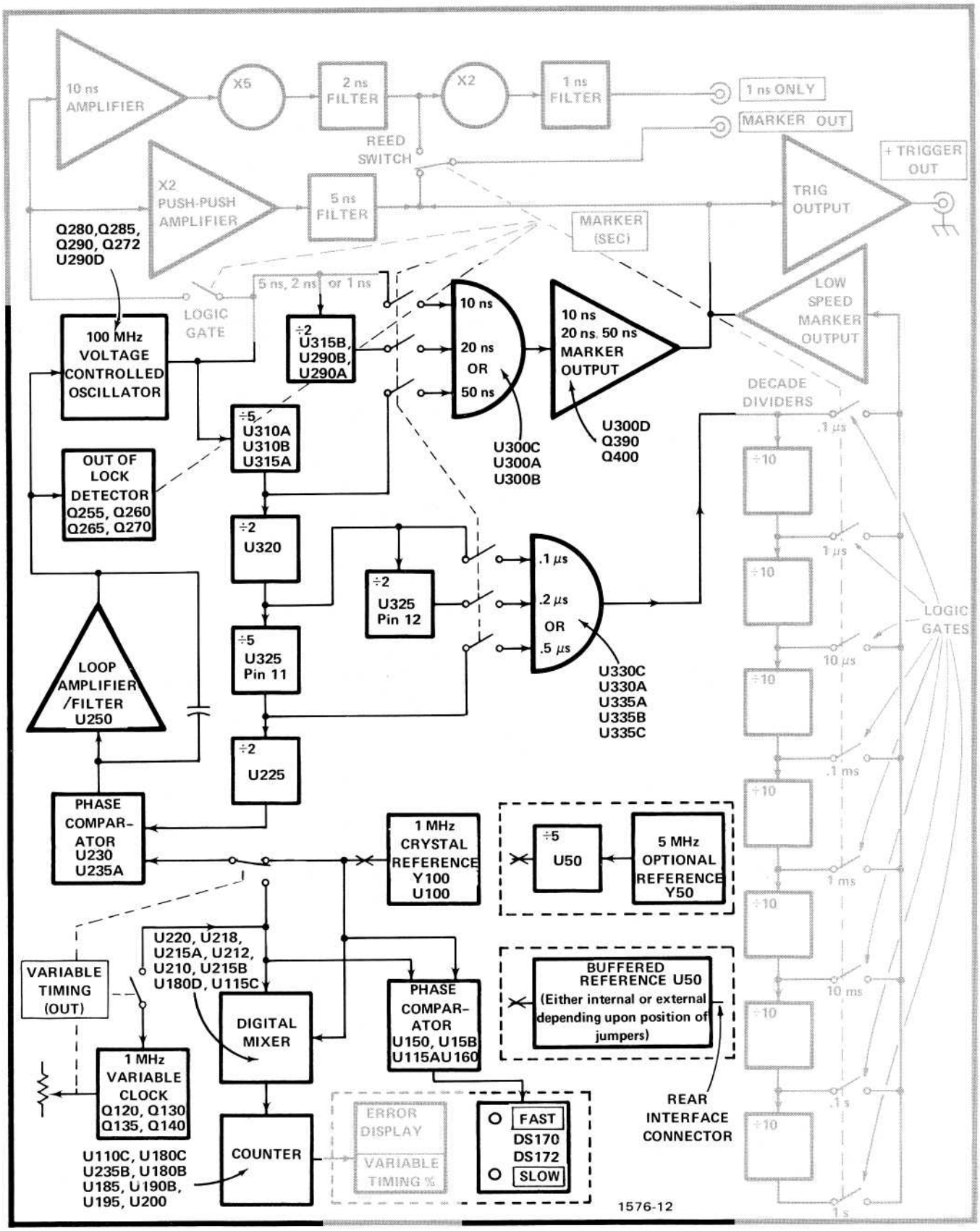


Fig. 3-1. Functional block diagram of schematic diagrams 1 and 2 circuitry.

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DIAGRAM 3

Decade Dividers

The decade dividers operate continuously; however, the output is selected by enabling the appropriate enable logic gate with a low, via the cam switch S350. The ÷10 dividers are U355, U360, U362, U364, U368, and U372. The NAND enable logic gates are U330B, U350B-C, U190A-C-D and U366A-B-C-D. The square-wave pulses from the logic gates are differentiated by an RC circuit using capacitors C358, C360, C362, C366, C368, C370 and C372. The resistance for the RC circuit is selected by cam switch S350 via the 5-2-1 sequence logic gates, depending upon the timing position in the 5-2-1 sequence.

The selection of the resistance for the RC circuit determines the slope of the falling edge of the marker and hence controls the marker brightness. R385, the largest resistance, is selected in all positions of the 5-2-1 sequence. In the 2 position, a low from the 5-2-1 sequence logic gate turns on Q384 and connects R384 in parallel with R385, reducing the resistance and the marker brightness. In the 1 position, Q380 turns on and R381 parallels R385 to reduce the resistance and brightness from that obtained in the 2 position.

Q405 provides a stage of isolation between the decade dividers and the low speed marker output amplitude. The isolation stage increases the impedance seen by the input to the low speed marker output operational amplifier.

Low Speed Marker Output Amplifier

The low speed marker output amplifier is an operational amplifier having a gain of 1.5. The amplifier consists of Q408 and Q415 with R406 and R410 being the input resistor and feedback resistor respectively.

10 ns, 20 ns, 50 ns Marker Output Amplifier

Q390 and Q400 form an emitter coupled switch that is controlled by U300D, and ECL enable logic gate. U300D requires a low from the 10 ns, 20 ns, or 50 ns logic gate to pass the square-wave. The square-wave at output pins 15 and 9 of U300D is differentiated by RC networks C390-R394 and C400-R400. The differentiated signal is coupled through Q400 as long as pin 13 of U300D remains low. The output from Q400 is summed with the output from the low speed marker output amplifier and supplied to the MARKER OUT connector J470.

Trigger Output

At MARKER Control settings of 5 s through .1 μs the marker available at the MARKER OUT connector is used as a slave trigger. The slave trigger from the low speed marker output amplifier is coupled through emitter followers Q430 and Q435 and made available at + TRIGGER OUT connector J435.

At Marker Control settings of 50 ns and faster, the trigger signal rate available at the + TRIGGER OUT connector remains .1 μs. The .1 μs output is obtained by enabling logic gates U235D and U330D. Enabling U330D allows the output square-wave from U320 to be differentiated by RC network R445-C440, then amplified by Q440 before being coupled to the + TRIGGER OUT connector via emitter follower Q435. The rc network determines the width and amplitude of the trigger signal, while R439-C439 network in the emitter of Q440 controls the signal gain. R445 High Speed trigger amplitude provides a means of adjusting the high speed trigger amplitude to match the low speed trigger amplitude.

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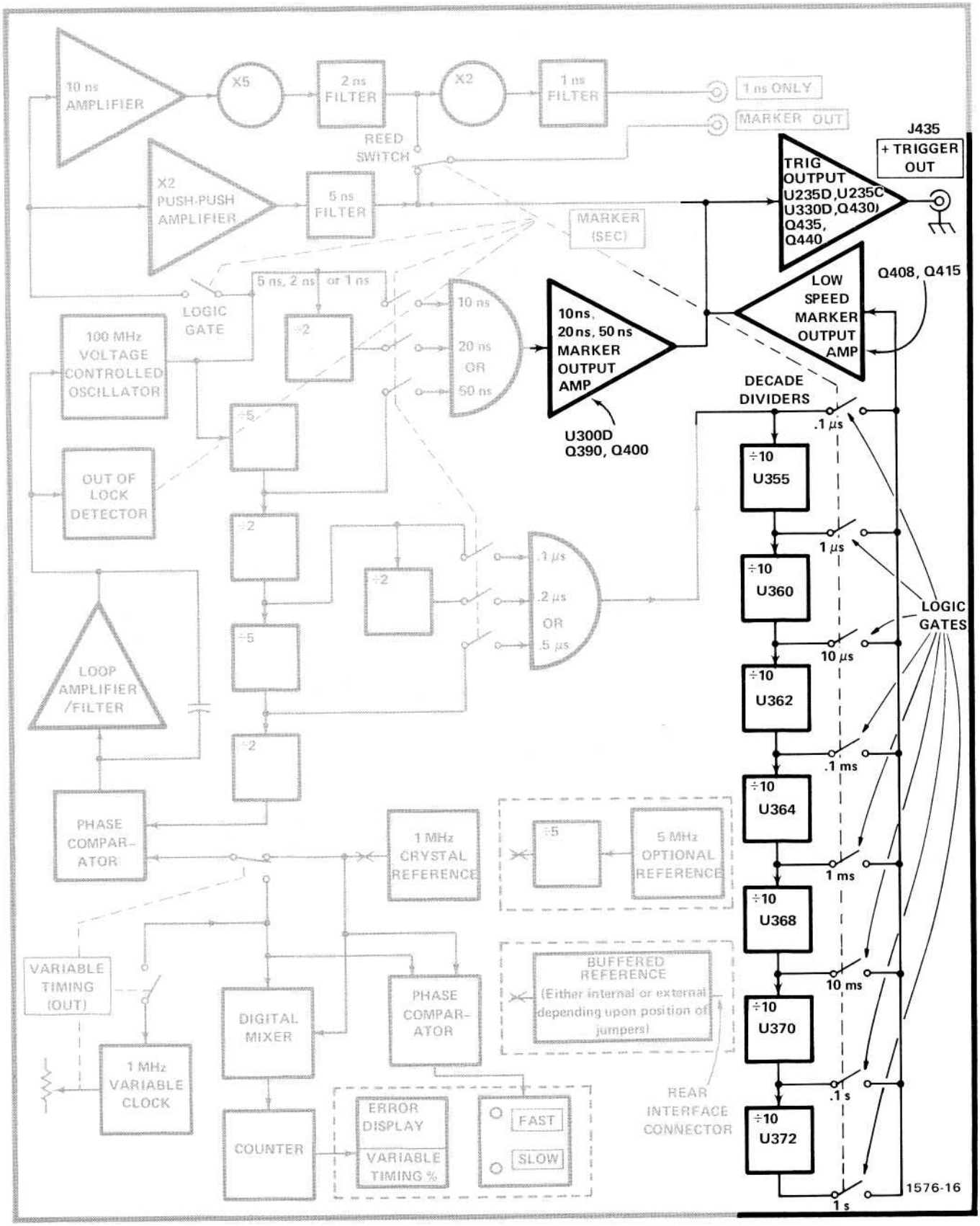


Fig. 3-2. Functional block diagram of schematic diagram 3 circuitry.

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DIAGRAM 4

X2 Push-Push Amplifier and 5 ns Filter

Placing the MARKER (SEC) switch at its 521n position enables ECL logic gate U290C, which allows the 100 MHz signal to pass to J450. Pushing the 5 ns pushbutton enables ECL logic gate U450B, applying the 100 MHz (10 ns) signal to the primary of T450.

T450 is a toroidal transformer having a tapped primary and secondary winding. C450 tunes T450 primary to 100 MHz. The secondary of T450 connects to a push-push amplifier U455, which acts as a frequency doubler. The output of U455 connects to the 5 ns filter, which contains a parallel resonant (as seen at the output) tank circuit consisting of L462 (part of the etched circuit board) and C465. C465 is used to tune the tank circuit to 5 ns (200 MHz). C467 is as an amplitude adjustment for the 5 ns markers. From the output of the 5 ns filter, the 5 ns markers connect to the MARKER OUT connector, J470, via K450-S1 contacts.

10ns Amplifier, X5 2 ns Filter, X2 and 1 ns Filter

Placing the MARKER (SEC) switch at its 521n position enables ECL logic gate U290C, which allows the 100 MHz signal to pass to J450. Pushing the 2 ns or 1 ns pushbutton enables ECL logic gate U450C, applying the 100 MHz (10 ns) signal to the base of Q484.

Q484 and Q486 compose a Class C amplifier. R482 CR482, and R484 make up a temperature compensation network for the amplifier. R482, Amp Bias, is used to peak the amplifier gain.

The output of the amplifier connects to a parallel resonant tank circuit consisting of L490 and C498. C498 is used to tune the tank circuit to 10 ns (100 MHz). L500 (part of the etched circuit board) and C500 make up a matching network for the input to varactor CR500.

CR500 is a snap type varactor, i.e., a varactor that snaps off. The varactor is triggered at a 100 MHz rate. The sudden current change that occurs when CR500 snaps off at its 100 MHz rate causes L502 (part of the etched circuit board) and C504 to ring at a 2 ns (500 MHz) rate. C504 tunes the circuit to resonance.

The 2 ns filter (L510 to L513) is a tuned stub comb filter with each stub tuned successively to resonance. The input to the filter is a damped sine-wave, which is then electromagnetically coupled between the sections of the filter.

The 2 ns output sine-wave is applied to CR515 and connected to J470 the MARKER OUT connector only if K450 has been enabled by depressing the 2 ns pushbutton thus closing K450-S1 contacts to C515.

When the 1 ns or 2 ns buttons are pressed in (and the 5 ns button is released), Q460 is biased on. In this state, Q460 functions as a 5 ns suppression gate by presenting a low impedance path from L465 and R463 to the +5 V supply at the emitter of Q460. Undesirable 5 ns signals that would otherwise appear in the output circuitry are effectively bypassed to signal ground via the +5 V supply.

The 2 ns sine-wave input to CR515 is distorted by the non-linear device (diode) to achieve a 1 ns sine wave. The 1 ns sine wave is then filtered by the 1 ns filter which is similar in operation to the 2 ns filter. The output from the filter is available through the 1 ns ONLY connector. The 1 ns markers are available from the 1 ns ONLY connector whenever the MARKER Control is set to 521n and either the 2 ns or 1 ns pushbutton has been pressed.

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DIAGRAM 5

ERROR DISPLAY

The decoder drivers U550 and U570 are driven by the output signals of the counter circuitry, U195 and U200. U550 output drives the .1% LED display device DS550 while U570 output drives the 1% LED display device DS570.

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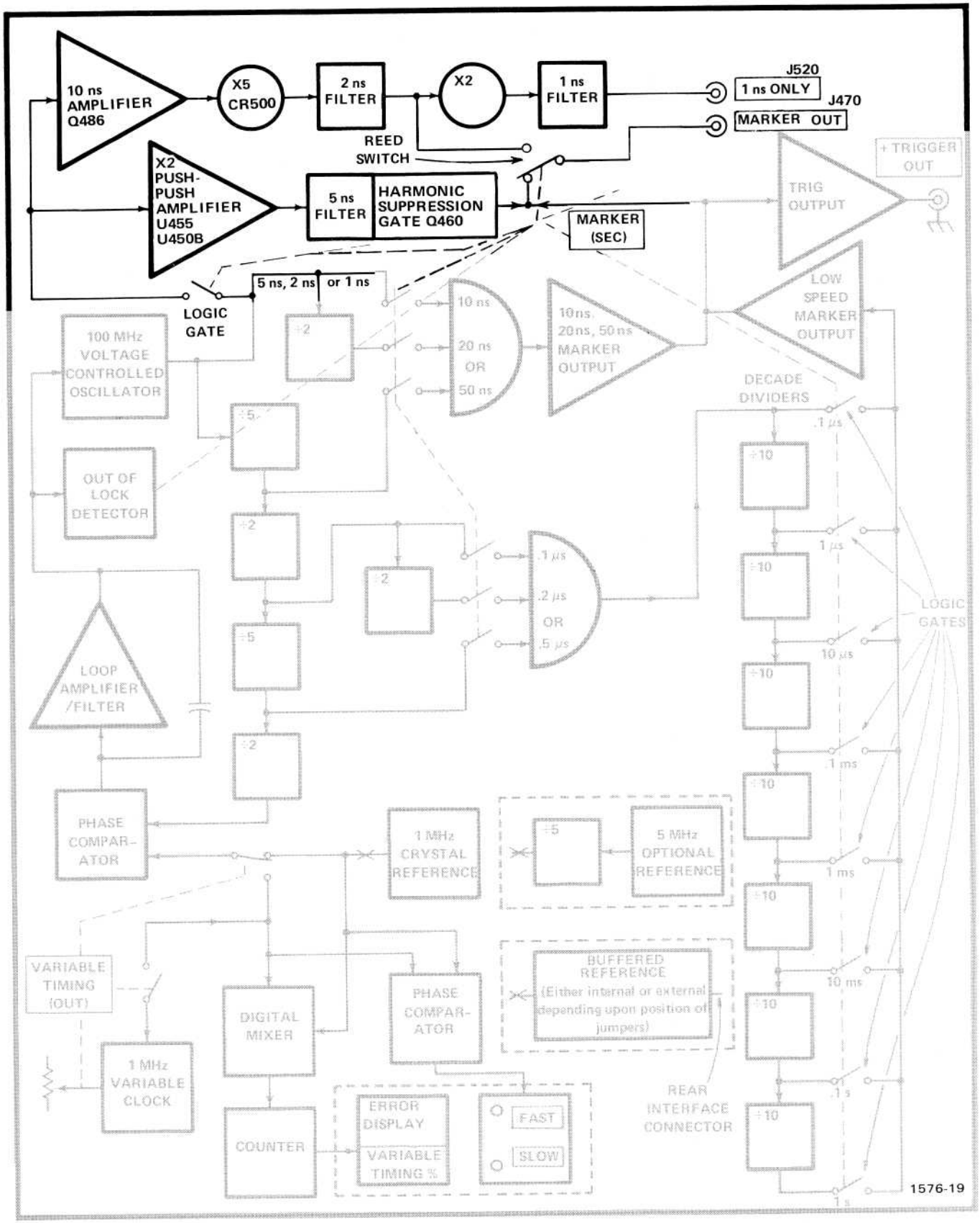


Fig. 3-3. Functional block diagram of schematic diagram 4 circuitry.

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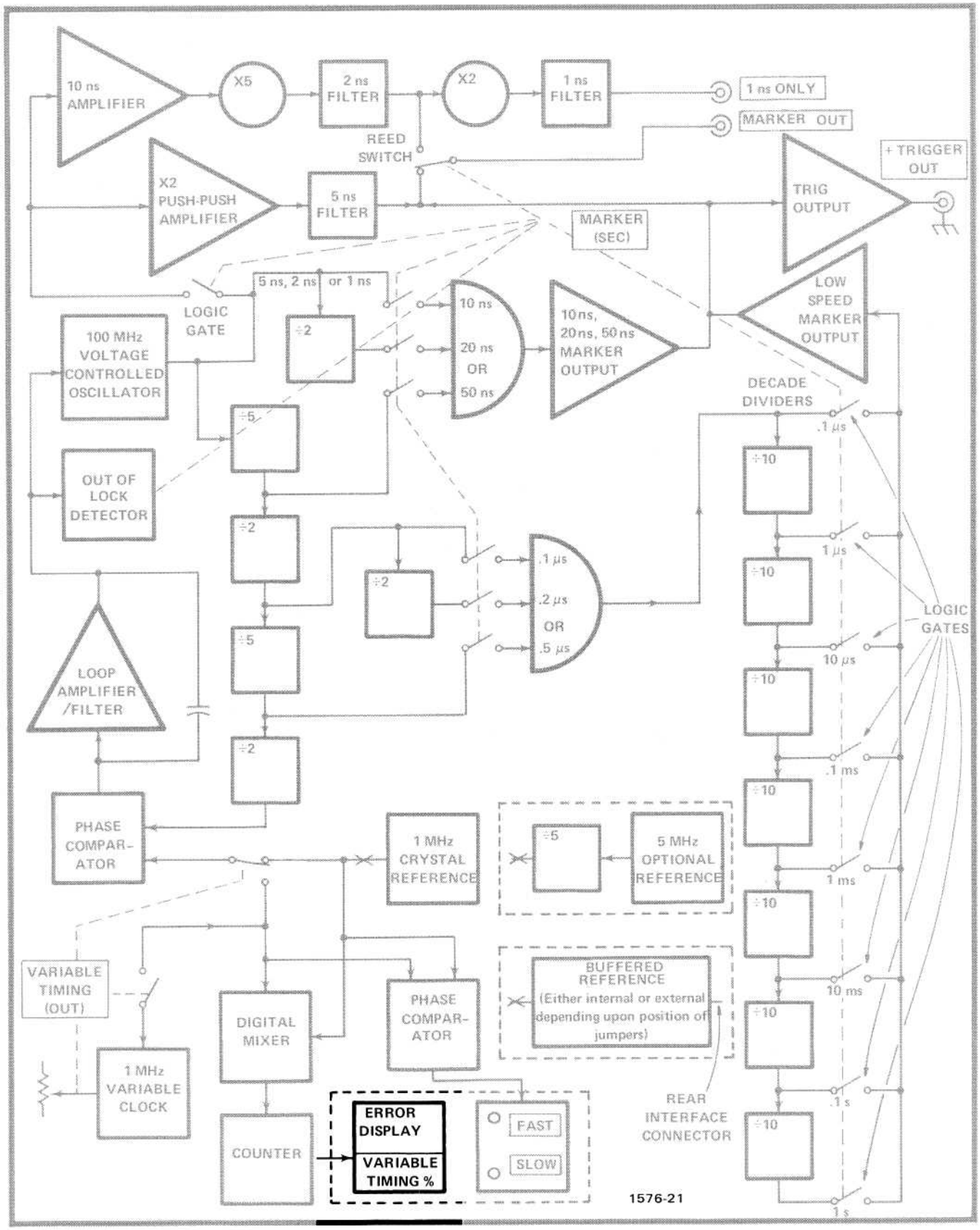


Fig. 3-4. Functional block diagram of schematic diagram 5 circuitry.

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DIAGRAM 6

POWER SUPPLY

+15 Volt Supply

The regulator for the +15 V supply consists of error sensing amplifier transistor Q605, amplifier transistor Q600, reference Zener diode VR605, and a Darlington transistor pair (Q610 and a series-pass transistor located in the power module mainframe). The supply voltage is established by comparing the supply voltage sample (which is established by the R616-R606-R605 divider at the base of Q605) with the reference voltage established by VR605 at the emitter of Q605. Potentiometer R606 is adjusted for a +15 V supply output of +15.2 V. (15.2 V is optimum for the option 01 oscillator.) Any change between the Q605 base and emitter is amplified by Q605 and Q600, and used to change the conduction of the series-pass transistor to correct the output voltage. VR605 is temperature compensated by the base-emitter junction of Q605. R614 provides current limiting for the series pass transistor. R603 and Zener diode VR600 establish the operating voltage range for Q600.

If the +15 V output is shorted (i.e., output goes low), Q605 starts to turn off, which pulls the base of Q600 high through R600. Consequently, transistor Q600 saturates against the voltage established by 3 V Zener VR600 and R603. Thus, the voltage at the collector of Q600 is nearly 3 V below the unregulated line. The 3 V is reduced by the voltage drops at the base-emitter of Q610 and the base-emitter of the series-pass transistor in the power module mainframe to a maximum of approximately 1.6 V across R614. The 1.6 V across R614 establishes the maximum current that can be drawn from the +15 V supply.

+5 Volt Supply

The regulator for the +5 V supply consists of error sensing amplifier U625, short circuit protection transistor Q620, over-voltage protection circuit VR640-Q640 and a Darlington transistor pair (Q635 and a series-pass transistor in the power module mainframe). The supply voltage is established by comparing the supply voltage sample at the negative input to U625 with the reference at the positive input to U625. Any difference between the inputs to U625 causes an amplified correction voltage to be sent to the base of Q635, which in turn will cause a change in the conduction of the series pass transistor to correct the output voltage. R621 provides current limiting for the series pass transistor.

If the +5 V output is shorted (i.e., output goes low), the increased voltage drop across R621 causes Q620 to turn on. This pulls the negative input of U625 positive, which turns off Q635 and the series pass transistor. Fuse F620 protects the supply if the short causes excessive current to be drawn.

In case the regulator causes the output voltage to become more positive (i.e., +7 V or more), VR640 will conduct, silicon controlled rectifier Q640 will fire, short the +5 V output to ground and open F620.

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WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

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CALIBRATION PROCEDURE

PERFORMANCE CHECK PROCEDURE

Introduction

This procedure checks the electrical performance requirements as listed in the Specification section in this manual. Perform the Adjustment Procedure if the instrument fails to meet these checks. In some cases, recalibration may not correct the discrepancy; circuit troubleshooting is then indicated. Also, use this procedure to determine acceptability of performance in an incoming inspection facility.

For convenience, many steps in this procedure check the performance of this instrument at only one value in the specified performance range. Any value within the specified range, within appropriate limits, may be substituted. Performance requirements for various temperature ranges are listed in this procedure; when performing the procedure, use only the Display Limits listed for the ambient temperature in which the instrument is operating.

Calibration Interval

To ensure instrument accuracy, check the calibration every 2000 hours of operation or at a minimum of every six months if used infrequently.

Services Available

Tektronix, Inc. provides complete instrument repair and adjustment at local field service centers and at the factory service center. Contact your local Tektronix field office or representative for further information.

Before using any test equipment to make measurements on static-sensitive components or assemblies, be certain that any voltage or current supplied by the test equipment does not exceed the limits of the component to be tested.

Limits and Tolerances

Tolerances given are for the instrument under test and do not include test equipment error. Limits and tolerances in this check, are instrument specifications only if they are called out as performance requirements in the Specification section.

Preliminary Procedure

NOTE

The performance of this instrument can be checked at any temperature between 0° C and +40° C. Make any adjustment at a temperature between +23° C and +30° C (+68° F and +86° F).

NOTE

The output waveforms from the TG 501 will be correct only when the OUTPUTS are terminated in 50Ω.

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Table 4-1

LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Applications	Example
Power Module		All tests	TEKTRONIX TM 503, TM 504
Digital Voltmeter	Range 0—20 V Accuracy ±0.1%	Voltage measurements	TEKTRONIX DM 501A DM 502A
Oscilloscope	Real time 0—50 MHz Sampling 1 GHz	Output waveshape, amplitude, timing	5403 oscilloscope 5B52 sweep plug-in 5A48 Vertical plug-in 5S14 sampling plug-in
WWVB Receiver	Receive 60 kHz WWVB	01 Option frequency checks	8161 Receiver Spectracom Corp.
Flexible Extension		all calibration tests	Tektronix 067-0645-02
50 Ω Feed-thru termination	50 Ω 2%	All tests (2 ea)	Tektronix 011-0049-01
50 Ω Coaxial Cable	Bnc connectors, length 42 inch	all tests (2 ea)	Tektronix 012-0057-01
Digital Counter	Accuracy ⩽.001%	Standard model frequency checks	TEKTRONIX DC 501 Option 01

1. Check that the correct nominal line selector block has been installed on the line selector pins in the Power Module (refer to Power Module manual).

2. Install the TG 501 into a Power Module plug-in compartment.

3. Set the following TG 501 controls:

MARKER (SEC)	1 μ
VARIABLE TIMING	In
5 ns, 2 ns, 1 ns	Pushbuttons as they are

4. Turn on Power Module. Allow at least a 30 minutes warm-up time before starting the Performance Check Procedure.

1A. Check Variable Timing

a. Push TG 501 VARIABLE TIMING in and hold.

b. CHECK—TG 501 readout for 8.8

c. CHECK—All segments of all digits on readout for proper illumination while rotating TG 501 VARIABLE TIMING.

d. Turn TG 501 VARIABLE TIMING full cw and full ccw.

e. CHECK—TG 501 readout for at least +7.5% and −7.5% from 0.0% reference.

f. Set TG 501 MARKER (SEC) to 5-2-1 ns.

g. CHECK—TG 501 readout and FAST and SLOW lights go out.

h. Set TG 501 VARIABLE TIMING In.

1B. Check Timing Error Measurement Accuracy

NOTE

Device under test error is indicated to within one least significant digit. (i.e., to within one displayed count).

a. Connect TG 501 MARKER OUT to digital counter through a 50-ohm terminator. Set TG 501 MARKER (SEC) to .1m, digital counter to 1s gate time. Adjust counter trigger level for a stable display.

b. Set TG 501 VARIABLE TIMING out.

c. Check to within one displayed count as per table:

Table 4-2

TG 501	ERROR	DC 503
0.0%	±.1%	9.990 to 10.010 kHz
5.0% FAST	±.1%	10.490 to 10.510 kHz
5.0% SLOW	±.1%	9.490 to 9.510 kHz

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d. Remove cable from TG 501 and DC 503.

2A. Check Standard Clock Accuracy

a. Set

TG 501

MARKER (SEC)	1 μ
VARIABLE TIMING	In
5,2, and 1 ns	Pushbuttons as they are

DC 501

Display Time	ccw
Function	10 Hz
Trigger Level	As desired
Source	Ext

b. Connect 50 Ω cable and 50 Ω terminator from TG 501 MARKER OUT to DC 501 Input. The terminator should be placed at the DC 501 end of the cable.

c. CHECK—DC 501 for reading of 1,000,010 Hz to 999,990 Hz.

d. Remove TG 501 MARKER OUT from DC 501 Input.

2B. Check Option 01 Clock Accuracy

a. Set:

TG 501

MARKER (SEC)	1 μ
VARIABLE TIMING	In
5, 2, and 1 ns	Pushbuttons as they are

b. Connect 1 MHz Frequency from the WWVB receiver output to the ext trig input of the test oscilloscope.

c. Connect TG 501 1 μs time marker (via a 50 Ω cable and 50 Ω terminator) from MARKER OUT to oscilloscope vert input.

d. Set:

Test Oscilloscope

Volts/Div	0.5
Time/Div	1 μs
Triggering Source	External

e. CHECK—Test oscilloscope display drift for a rate of $\leq$5 div/10s. This establishes the clock accuracy to $\pm 5 \times 10^{-7}$.

f. Remove 1 MHz Frequency input and TG 501 cables from test oscilloscope.

3. Check Timing Accuracy and Marker Amplitude

a. Set:

TG 501

MARKER (SEC)	.1 μ
VARIABLE TIMING	In
5, 2, and 1 ns	Pushbuttons as they are

Oscilloscope Vertical Amplifier

Polarity	+ up
Input	DC
Volts/Div	.5 V

Oscilloscope Time Base

Display Mode	Time Base
Time/Div	.1 μs
Variable	Cal
Level/Slope	+
Mode	Auto
Coupling	AC
Source	Ext
Magnifier	X1

b. Connect 50 Ω cable and 50 Ω terminator from TG 501 + TRIGGER OUT to the oscilloscope time base Ext Trig In. Connect a second 50 Ω cable and 50 Ω terminator from the TG 501 MARKER OUT to the oscilloscope vertical amplifier Input. The terminators should be placed at the oscilloscope end of the cables.

c. Set TG 501 MARKER (SEC) control to each position on the dial (.1 μs through 5 s).

d. Set Time base Time/Div to the same time division that the TG 501 MARKER is set to.

e. CHECK—Each setting has marker amplitude of $\geq$1 V and 1 marker per div.

f. Set TG 501 MARKER dial to .1 μs.

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g. Set Time Base Time/Div to .1 μs.

h. Remove 50 Ω cables from vertical amplifier Input and time base Ext Trig In.

i. Connect 50 Ω cable from time base Ext Trig In to the TG 501 MARKER OUT.

j. Connect 50 Ω cable from vertical amplifier Input to the TG 501 + TRIGGER OUT.

k. CHECK—TRIGGER OUT amplitude ≥1.0 V display.

l. Note TRIGGER OUT amplitude.

m. Set TG 501 MARKER dial to 50 ns.

n. CHECK—Approximately the same trigger amplitude as noted at .1 μs, ≥1.0 V.

o. Remove TG 501 MARKER OUT and + TRIGGER OUT from vertical amplifier input and time base Ext Trig In.

4. Check 50-20-10-5-2-1 ns Marker Amplitude

a. Set:

TG 501

MARKER (SEC)	50 ns
VARIABLE TIMING	In
5 ns	Pushbutton in
2 and 1 ns	Pushbutton out

SAMPLING UNIT

mVolts/Div	200 mV
Mode	CH 1

SAMPLE SWEEP UNIT

Delaying Sweep	50 ns
Delayed Sweep	50 ns
Delay Time Mult (2nd Dot)	0.0
Delay Zero (1st Dot)	ccw
Swp pushbutton	OUT
Int CH 1 pushbutton	Out
HF Sync pushbutton	Out
Auto Trig pushbutton	In
+ Slope pushbutton	In
Rep pushbutton	In

b. Connect 50 Ω cable from TG 501 MARKER OUT to sampling head.

c. Connect 50 Ω cable from TG 501 + TRIGGER OUT to sample sweep unit Ext Input.

d. Set Sampling unit Triggering Level, Triggering Hold Off, and scan controls for a suitable stable display.

e. CHECK—Test oscilloscope display for a marker amplitude of ≥1 V and a display of 1 marker per div.

f. Set TG 501 MARKER (SEC) control and the sampling sweep unit Delayed Sweep control to 20 ns and then to 10 ns, each time repeating part e of this step.

g. Set TG 501 MARKER (SEC) control to 5-2-1 ns and sampling sweep unit Delayed Sweep to 5 ns.

h. CHECK—Amplitude of display is ≥750 mV peak-to-peak.

i. Set Sampling unit mVolts/Div to 200 mV.

j. Set TG 501 2 ns pushbutton in.

k. Set Sampling sweep unit Time/Div to 2 ns.

l. CHECK—Amplitude of display is ≥750 mV peak-to-peak.

m. Remove 50 Ω cable from TG 501 MARKER OUT and reconnect it to TG 501 1 ns only connector.

n. Set TG 501 1 ns button in.

o. Set Sampling unit mVolts/Div to 100 mV.

p. CHECK—Amplitude of display is ≥200 mV peak-to-peak.

q. Remove TG 501 MARKER OUT and + TRIGGER OUT output cables from sampling head and sampling sweep unit Trigger Input respectively.

r. This completes the performance check.

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ADJUSTMENT PROCEDURE

Introduction

Use the Adjustment Procedure to restore the TG 501 to original performance requirements. This Adjustment Procedure need not be performed unless the instrument fails to meet the Performance Requirements of the electrical characteristics listed in the Specification section, or if the Performance Check procedure cannot be completed satisfactorily. If the instrument has undergone repairs, the Adjustment Procedure is recommended.

Satisfactory completion of all adjustment steps in this procedure ensures that the instrument will meet the Performance Requirements.

Test Equipment Required

The test equipment (or equivalent) listed in Table 4-1 is required for adjustment of the TG 501. Specifications given for the test equipment are the minimum necessary for accurate adjustment. All test equipment is assumed to be correctly calibrated and operating within specifications.

If other test equipment is substituted, calibration setup may need to be altered to meet the requirements of the equipment used.

Preparation

Access to the internal adjustments is achieved most easily when the TG 501 is connected to the power module with a flexible plug-in extender. Make adjustments at an ambient temperature between 21°C and 25°C (70°F and 77°F). Allow at least 30 minutes of warm-up time.

1. Check Power Supplies

a. Set the TG 501 controls as follows:

MARKER	1μs
VARIABLE TIMING	Pushed in

b. Refer to the Adjustments pull-out page and connect a digital voltmeter between the +15 V test point and ground.

c. Check for a voltage between +14.3 and +15.7 V. If the reading is not between these limits it will be necessary to adjust R606. (There was no R606 in serial numbers below B031770 except for some Option 01 instruments.)

NOTE

Adjustment of R606 will necessitate a re-check of the entire TG 501 adjustment procedure.

d. Adjust R606, if necessary, for a meter reading of +15.2 V.

e. Connect the digital voltmeter between the +5 V test point and ground.

f. Check for a voltage between +4.94 V and +5.46 V.

2. Adjust Time Reference Set

a. Set the TG 501 controls as follows:

MARKER	1 μs
VARIABLE TIMING	Pushed in

(STANDARD)

b. Connect a 50 Ω coaxial cable through a 50 Ω terminator to the input of the frequency counter.

c. Check for a frequency between 1,000,010 Hz and 999,990 Hz.

d. If the frequency is not within these limits, adjust C102 for exactly 1 MHz.

(OPTION 01)

b. Connect a 50 Ω coaxial cable through a 50 Ω terminator to the input of the oscilloscope vertical amplifier.

c. Connect the 1 MHz signal from the WWVB receiver to the external trigger input on the oscilloscope.

d. Set the oscilloscope as follows:

VOLTS/DIV	0.5
TIME/DIV	1 μs
Trigger Source	External

e. Test the oscilloscope display for a drift rate ≤5 div/10 sec ($\pm 5 \times 10^{-7}$).

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f. If the frequency is not within these limits, remove the multiplier board, remove the screw in the TXCO and adjust the internal screw for minimum horizontal drift.

g. Check all markers from 10 ns to 5 s for an amplitude of at least one volt and correct timing.

3. Adjust VARIABLE TIMING range

a. Set the controls of the TG 501 as follows:

MARKER	1 μs
VARIABLE TIMING	Out

b. Rotate the VARIABLE TIMING control from one end to the other of its range. Check that the range is at least ±7.5%.

c. Adjust Variable Timing Center control R145 to center the range of coverage if necessary.

4. Adjust High Speed Trigger Amplitude

a. Set the controls of the TG 501 as follows:

MARKER	0.1 μs
VARIABLE TIMING	In

b. Connect a 50 Ω coaxial cable terminated into 50 Ω from the TG 501 + TRIGGER OUT to the vertical input of the oscilloscope. Terminate the MARKER OUT with 50 Ω also.

c. Set the oscilloscope controls as follows:

Vertical Sensitivity	0.2 V/Div
Time/Div	0.1 μs/Div
Triggering Source	Internal

d. Switch the TG 501 MARKER switch back and forth from 0.1 μs to 50 ns noting the marker amplitude at both switch positions.

e. Adjust R445 (Hi Speed Trig Ampl) so that the marker amplitude at both switch positions is approximately the same. (≥1.0 V)

5. Adjust 5 ns Marker out

a. Set the controls of the TG 501 as follows:

MARKER	521n
VARIABLE TIMING	In
5 ns Button	In

b. Connect a 50 Ω coaxial cable (the sampling scope input is 50 Ω) from the TG 501 MARKER OUT to the input of the sampling oscilloscope.

c. Set the oscilloscope controls as follows:

Vertical sensitivity	0.2 V/Div
Time/Div	5 ns/Div
Triggering Source	Internal

d. Adjust C450, C465, and C467 for maximum marker amplitude.

6. Adjust 2 ns Marker out

a. Set the TG 501 controls as follows:

MARKER	521n
VARIABLE TIMING	In
2 ns Button	In

b. Set the oscilloscope as follows:

Vertical Sensitivity	0.2 V/Div
Time/Div	2 ns/Div
Triggering Source	Internal

c. Adjust C498 and R492 for maximum aplitude on the oscilloscope.

d. Adjust C505 and C504 (also R500 above SN B010218) for maximum amplitude on the oscilloscope.

e. Adjust C510, C511, C512, and C513 in the order of the arrow direction for maximum amplitude on the test oscilloscope. (See the adjustment location pull-out sheet.)

7. Adjust 1 ns Marker out

a. Set the TG 501 controls as follows:

MARKER	521n
VARIABLE TIMING	In
1 ns Button	In

b. Set the oscilloscope as follows:

Vertical Sensitivity	0.1 V/Div
Time/Div	1 ns/Div
Triggering Source	Internal

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c. Remove the coaxial output cable from the TG 501 MARKER OUT connector and connect it to the 1 ns ONLY connector.

d. Adjust C517, C518, C519, and C520 in the order indicated by the arrow on the adjustment location pull-out. Adjust for maximum amplitude.

e. Adjust C515 so the amplitude of the 1 ns marker is over 200 mV peak-to-peak and the amplitude of the 2 ns marker is over 750 mV peak-to-peak.

f. Recheck step 6 because step 7 interacts with its adjustments.

g. This completes the adjustment procedure.

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MAINTENANCE

GENERAL

Introduction

This section of the manual is meant to support the TM 500 Series family of modules with a general coverage of the most commonly-needed service information pertinent to preventive maintenance, troubleshooting, ordering parts, and replacing components and sub-assemblies.

Cabinet Removal

WARNING

Dangerous potentials exist at several points throughout the system. When the system must be operated with the cabinet removed, do not touch exposed connections or components. Some transistors have voltage present on their cases. Disconnect power before cleaning the system or replacing parts.

Cleaning

CAUTION

Avoid using chemical cleaning agents which might damage plastic parts. Avoid chemicals containing benzene, toluene, xylene, acetone, or similar solvents.

Exterior. Loose dust may be removed with a soft cloth or a dry brush.

Interior. Cleaning the interior of a unit should precede calibration since the cleaning processes could alter the settings of calibration adjustments. Use low-velocity compressed air to blow off accumulated dust. Hardened dirt can be removed with a soft brush, cotton tipped swab, or a cloth dampened in a solution of water and mild detergent.

Preventive Maintenance

Preventive maintenance steps performed on a regular basis will increase the reliability of the instrumentation systems. However, periodic checks of the semiconductors in the absence of a malfunction are not recommended as preventive maintenance measures. See the semiconductor checking information under Troubleshooting Techniques which follow. A convenient time to perform preventive maintenance is just before instrument calibration.

Calibration

To ensure accurate signal generation and measurement, the performance of individual units in the system should be checked periodically. Refer to the Instruction Manual for each unit for complete calibration and verification procedures.

TROUBLESHOOTING AIDS

Introduction

The following is provided to augment information contained elsewhere in this and other TM 500 series family manuals when troubleshooting becomes necessary.

Circuit Description

Each manual has a section devoted to explaining circuit operating theory. Used with the schematics, this can be a powerful analytic tool.

Diagrams

Block diagrams and detailed circuit schematics are located on foldout pages in the schematics section. The schematic diagrams show the component values and assigned circuit reference numbers on each part necessary to the circuit design. The first page of the service section defines the circuit symbols and reference designators used in that particular instrument. Major circuits are usually identifiable by a series of component numbers. Important waveforms and voltages may be shown within the diagrams or on adjoining aprons. Those portions of the circuits located on circuit boards are enclosed with a dark outline.

Cam Switch Charts

Cam switches shown on the diagrams (see Display and Switch Details diagram) are coded on charts. To locate the cam number of the switch contact in the complete switch assembly, count from the front, or knob end, toward the

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rear of the switch. The charts indicate with a solid dot when each contact is closed.

Circuit Board Illustrations

Line illustrations showing component locations, keyed with a grid scheme for each circuit board, are usually placed on the back of a foldout page and sequenced as close as possible to an associated schematic. The GRID LOC columns located near the Parts Location Grid, keys each component for each location on the board.

Component and Wiring Color Codes

Color stripes or dots on electrical components signify electrical values, tolerances, etc., according to EIA standards. Components not color-coded usually have information printed on the body. The wiring coding follows the same EIA standards with the exception of the ac power cord of the Power Modules. It is coded like this:

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

Testing Equipment

Generally, a wide-band oscilloscope, a probe, and a multimeter are all that is needed to perform basic waveform and voltage checks for diagnostic purposes. The calibration procedures in the manual for each plug-in module list specific test equipment and the features necessary to adequately check out that particular module.

TROUBLESHOOTING TECHNIQUES

Introduction

This troubleshooting procedure is arranged in an order that checks the simple trouble possibilities before proceeding to extensive troubleshooting.

Control Settings

Incorrect control settings can seem like a trouble that does not actually exist. If there is any question about the correct function or operation of any control, see the Operating Instructions section of the manual for the instrument involved.

System and Associated Equipment

Before troubleshooting the TM 500 Series system, check that the instruments in the system are operating correctly. Check for proper interconnection between the power module and the plug-in modules. Check the line voltage at the power source. Verify that the signal is properly connected and that the interconnecting cables and signal source are not defective.

The associated plug-in modules can be checked for proper operation quickly by subsituting other like units known to be operating properly. If the trouble persists after substitution, then the power module is probably at fault. Moving a properly operating plug-in from compartment to compartment will help determine if one or more compartments have a problem.

Visual Check

Inspect the portion of the system in which the trouble is suspected. Many troubles can be located by visual clues such as unsoldered connections, broken wires, damaged circuit board, damaged components, etc.

Instrument Calibration

Check the calibration of the suspected plug-in module or the affected circuit if the trouble is obviously in a certain circuit. The trouble may only be a result of misadjustment and may be corrected by re-calibration. Complete calibration instructions are given in the manual for each instrument in the system.

Circuit Isolation

Note the trouble symptoms. These often identify the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by making waveform and voltage measurements.

Incorrect operation of all circuits often means trouble in the power supplies. Using a multimeter, check first for correct voltages of the individual regulated supplies according to the plug-in module schematics and calibration procedures. Then check the unregulated supplies of the power modules. Defective components elsewhere in the instruments can appear as power supply problems. In these instances, suspected circuits should be disconnected from apparently bad power supplies one at a time to narrow the search.

Voltages and Waveforms

Often defective components can be located by using waveform and voltage indications when they appear on

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the schematic or in the calibration procedures. Such waveforms and voltage labels are typical indications and will vary between instruments.

Component Checking

If a component cannot be disconnected from its circuit, then the effects of the associated circuitry must be considered when evaluating the measurement. Except for soldered-in transistors and integrated circuits, most components can be lifted at one end from the circuit board.

Transistors and IC's. Turn the power switch off before removing or replacing any semiconductor.

A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been checked previously). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions. An approved anti-static suction-type desoldering tool must be used to remove soldered-in transistors; see component replacement procedure for details.

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits using IC's. Operating waveforms, logic levels, and other operating information for the IC's are given in the circuit description information of the appropriate manual. Use care when checking voltages and waveforms around the IC's so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin in-line IC's is with an integrated circuit test clip. This device also doubles as an extraction tool.

Diodes. Do not use an ohmmeter that has a high internal current. High currents may damage a diode.

A diode may be checked for an open or shorted condition by measuring the resistance. With an ohmmeter scale having an internal source of between 800 mV, and 1.5 V, the resistance should be very high in one direction and very low when the leads are reversed.

Resistors. Check the resistors with an ohmmeter. Resistor tolerances are given in the Electrical Parts List in every manual. Resistors do not normally need to be replaced unless the measured value varies widely from the specified value.

Capacitors. A leaky or shorted capacitor can be detected by checking resistance with an ohmmeter on the highest scale. Use an ohmmeter that will not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacity meter, or by checking whether it passes ac signals.

PARTS ORDERING AND REPLACING

Ordering

Obtaining Replacement Parts. Most electrical and mechanical parts can be obtained through your local Tektronix field office or representative. However, you should be able to obtain many of the standard components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix, Inc., check the electrical parts list for the proper value rating, tolerance and description.

Special Parts. Some parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured for Tektronix, Inc., to our specifications. Most of the mechanical parts used in this system have been manufactured by Tektronix, Inc. Order all special parts directly from the local Tektronix Field Office or representative.

Ordering Procedure. When ordering replacement parts from Tektronix, Inc., please include the following minimum information:

1. Instrument Type (PS 501, SG 502, DC 501, etc.)

2. Instrument Serial Number (For example, B010251)

3. A description of the part (if electrical include the circuit number)

4. Tektronix part number

Please do not return any instruments or parts before receiving directions from Tektronix, Inc.

A listing of Tektronix Field Offices, Service Centers and Representatives can be found in the Tektronix Product Catalog and Supplements.

Replacing

The exploded view drawings with the Mechanical Parts List, located to the rear of most manuals, may be especially helpful when disassembling or reassembling individual components or sub-assemblies.

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Circuit Boards. If a circuit board is damaged beyond repair, the entire assembly including all soldered-on components can be replaced.

To remove or replace a board, proceed as follows:

1. Disconnect all leads connected to the board (both soldered lead connections and solderless pin connections).

2. Remove all screws holding the board to the chassis or other mounting surface. Some boards may be held fast by plastic mounting clips around the board edges. For these, push the mounting clips away from the circuit board edges to free the board. Also, remove any knobs, etc., that would prevent the board from being lifted out of the instrument.

3. Lift the circuit board out of the unit. Do not force or bend the board.

4. To replace the board, reverse the order of removal. Use care when replacing pin connectors. If forced into place incorrectly positioned, the pin connectors may be damaged.

Transistors and IC's. Transistors and IC's should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement or switching of semiconductor devices may affect the calibration of the instruments. When a transistor is replaced, check the operation of the part of the instrument that may be affected.

Replacement semiconductors should be of the original type or a direct replacement. Figure 5-1 shows the lead configurations of the semiconductors used in this instrument system. When removing soldered-in transistors, use an approved anti-static suction-type desoldering tool to remove the solder from the holes in the circuit board.

An extracting tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix Part No. 003-0619-00. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the IC. Avoid having one end of the IC disengage from the socket before the other end.

To replace one of the power transistors mounted on the Power Module chassis adjacent to the interface circuit board, first unsolder the leads. Then, loosen the nuts which clamp the transistor to the chassis. Remove the defective transistor. When replacing the transistor, use silicone grease on the metal tab to increase heat transfer from the transistor to the chassis.

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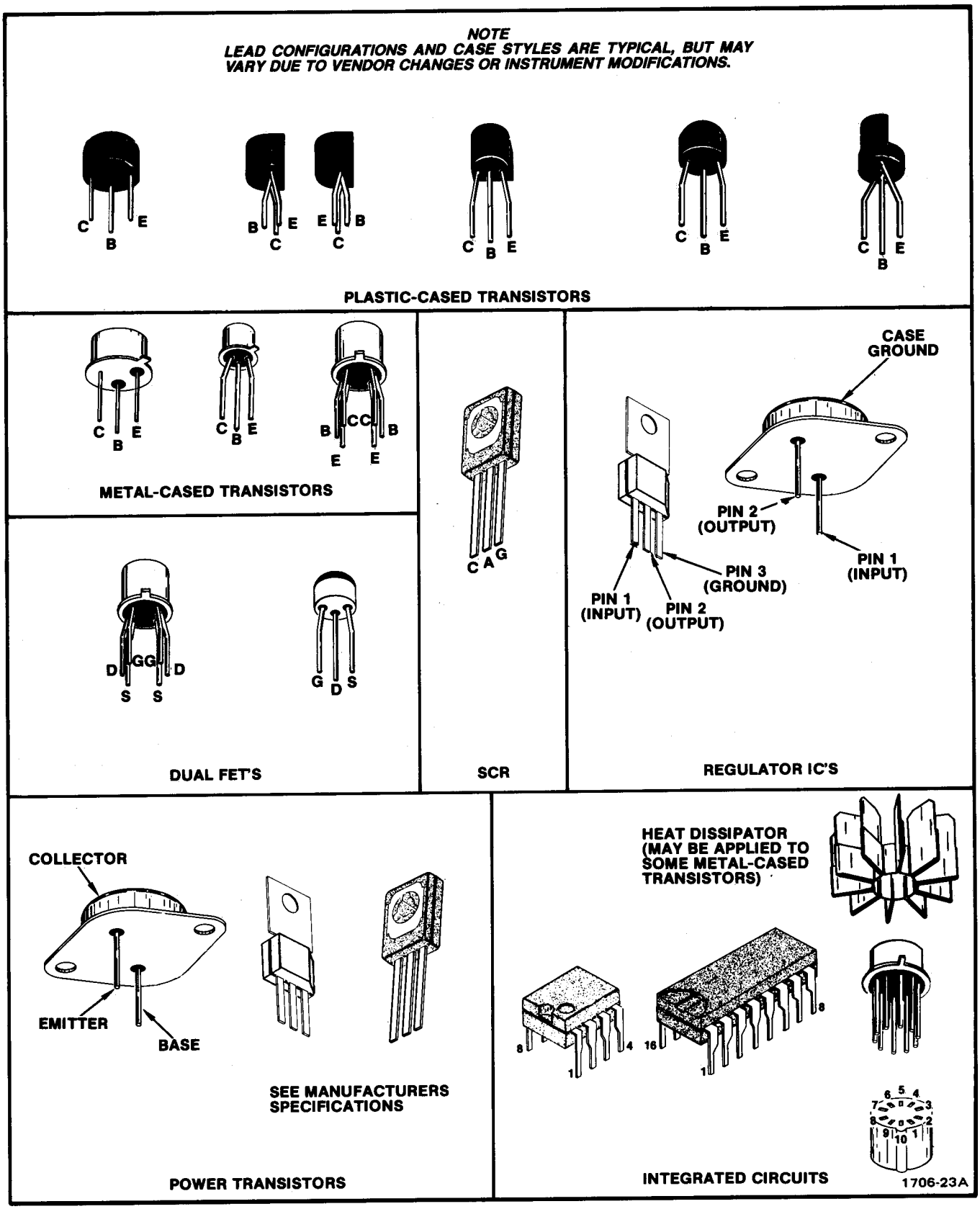


Fig. 5-1. Semiconductor device lead configurations found in the TM 500 family.

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Table 5-1

MAINTENANCE AIDS

The following maintenance aids include items required for some maintenance procedures in this instrument. Equivalent products may be substituted for examples given providing characteristics are similar.

Description	Specifications	Use	Example
1. Soldering Iron	15 Watt	General soldering and unsoldering	ANTEX PRECISION Model C
2. Screwdriver	Phillips No. 1 tip	Assembly and Disassembly	Xcelite Model X108
3. Screwdriver	Phillips No. 2 tip	Assembly and Disassembly	Xcelite Model X102
4. Screwdriver	Three-inch shaft; 3/32 inch flat bit	General	Xcelite R3323
5. Torque Screwdriver	1.5 inch-pounds	Cam switch assembly	Sturtevant-Richmont Torque Products Model PM-5 Roto-Torq
6. Nutdrivers	1/4 inch, 5/16 inch 3/8 inch, 7/16 inch	General	Xcelite No. 8, No. 10, No. 12 and No. 14
7. Open End Wrench	11/16 inch	General	
8. Solder Wick		Unsoldering	Hex Wik No. 887-10
9. Lubricant	Versilube	Cam switch lubration	Tektronix Part No. 006-1353-00
10. Spray Cleaner	No Noise	Cam switch pad cleaning	Tektronix Part No. 006-0442-02
11. Vacuum Desoldering Tool	Antistatic	General	Tektronix Part No. 003-0795-00
12. I.C. Extracting Tool		General	Tektronix Part No. 003-0619-00
13. Cam Switch Repair Kit		Cam switches	Tektronix Part No. 040-0541-00
14. Extender Cables		General	Tektronix Part No. 067-0645-02

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Static-Sensitive Components

CAUTION

Static discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 5-2 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.

2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.

3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Keep the component leads shorted together whenever possible.

6. Pick up components by the body, never by the leads.

7. Do not slide the components over any surface.

8. Avoid handling components in areas that have a floor or work-surface covering capable of generating a static charge.

9. Use a soldering iron that is connected to earth ground.

10. Use only special antistatic suction type or wick type desoldering tools.

Table 5-2

RELATIVE SUSCEPTIBILITY TO STATIC DISCHARGE DAMAGE

Semiconductor Classes	Relative Susceptibility Levels[a]
MOS or CMOS microcircuits or discretes, or linear microcircuits with MOS inputs. (Most Sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFETs	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (Least Sensitive)	9

[a] **Voltage equivalent for levels:**

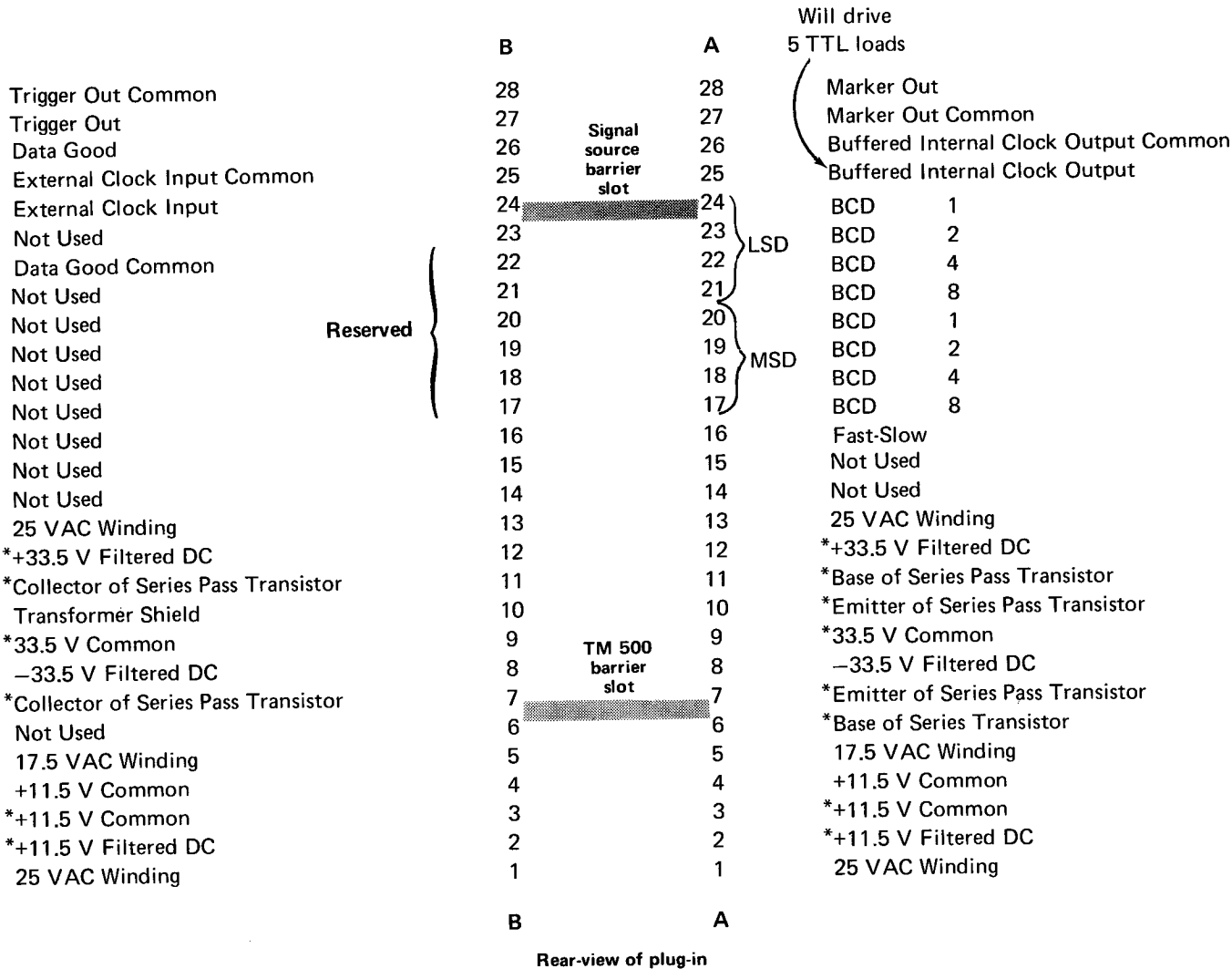
1 = 100 to 500 V
2 = 200 to 500 V
3 = 250 V
4 = 500 V
5 = 400 to 600 V
6 = 600 to 800 V
7 = 400 to 1000 V (est.)
8 = 900 V
9 = 1200 V

(Voltage discharged from a 100 pF capacitor through a resistance of 100 ohms.)

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REAR CONNECTOR PIN ASSIGNMENTS

Table 5-3



Assignments listed for pins 1A—13A and 1B—13B are available in all power modules; however only those pins marked with an asterisk (*) are used by the TG 501.

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OPERATING CONSIDERATIONS

The internal reference of the TG 501 is a 1 MHz crystal. If Option 01 is ordered, a high accuracy 5 MHz crystal is provided and Integrated Circuit U50 is installed on the back of the main circuit board. Provisions are made for buffered output of either 1 MHz or 5 MHz internal clock through interface connector pin 25A with associated ground on pin 26A.

External Clock Input

A 1 MHz or 10 MHz external clock can be substituted for the internal clock. Interface contact 24B is used for the external clock input with the associated ground on contact 25B.

To use an external 5 or 10 MHz clock, U50 must be installed on the back of the main circuit board (and the necessary jumpers added) to divide down the input to meet the 1 MHz internal requirement. For a 1 MHz external clock, U50 is not required but jumpers must be added.

Standard Clock

Remove U100 and disconnect pin 3 of U350 before using an external clock. To disconnect pin 3, remove U350, bend pin 3 out, then insert U350 back into its socket.

Option 01 Clock

Remove jumper J3 if using a 5 MHz or 10 MHz external clock. If a 1 MHz external clock is to be used, remove jumpers J3, J4, and J7.

If the external clock source is a TTL output, then remove R52, Fig. 5-2 shows the location on the main circuit board of the jumpers that must be installed to use the TG 501 with the various clock choices. The required changes are:

External 1 MHz Clock Frequency	Install J1 and J5

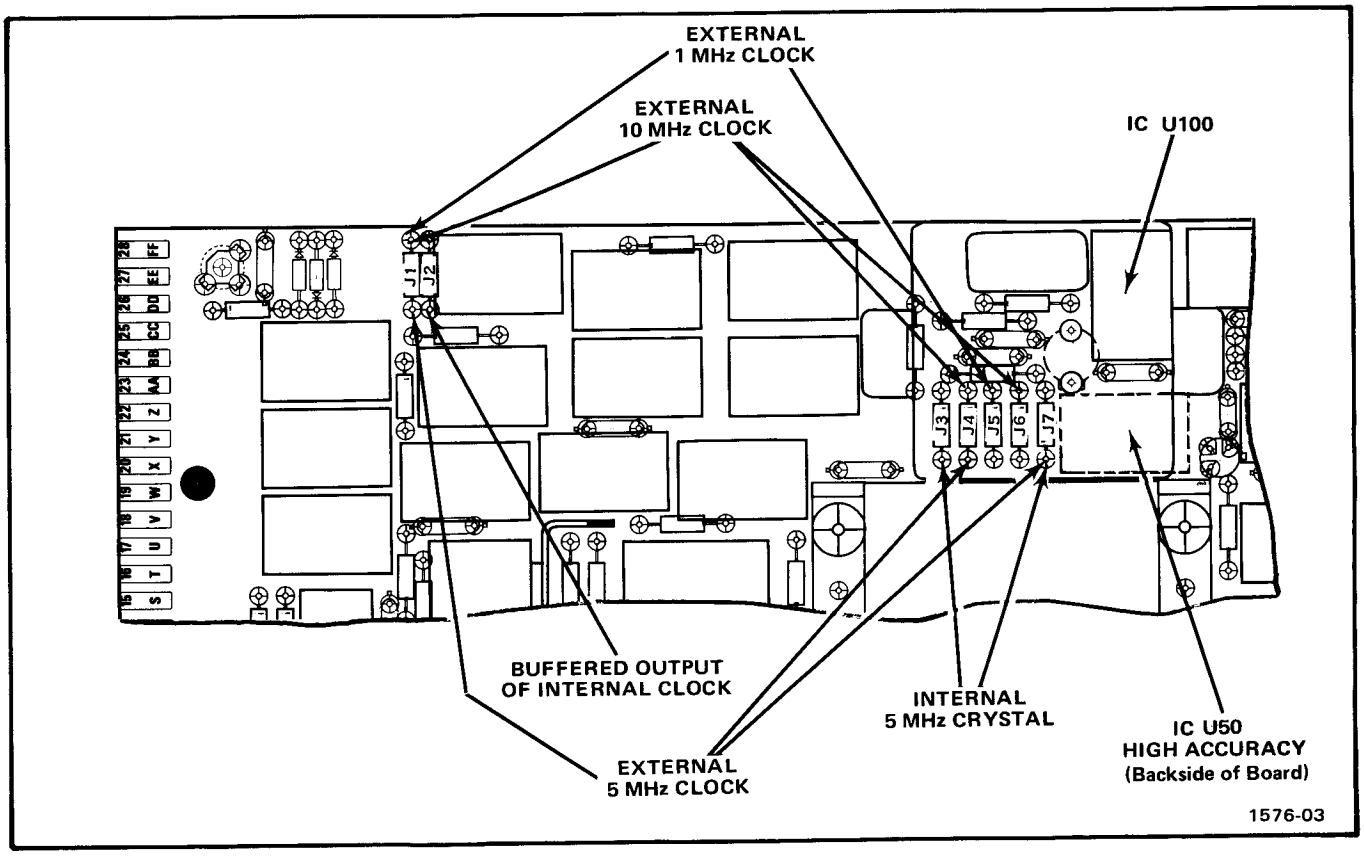


Fig. 5-2. Location of jumpers and integrated circuits required for clock options.

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External 5 MHz Clock Frequency	Install J1, J4, J7 and U50
External 10 MHz Clock Frequency	Install J1, J4, J6 and U50
Standard Internal Reference 1 MHz Crystal	No Jumpers Required
Buffered Output of Internal Clocks	Install J2
Internal 5 MHz Clock (Option 01)	Install J3, J4, J7 and add U50 and Y50

INTERFACE NOTES

Marker Out

Marker output pulses (5 s to 2 ns) can be supplied to contact 28A by disconnecting the coaxial cable going to the MARKER OUT front-panel connector (the cable, connector pulls out of the back of the BNC connector). Connect the cable to the connector at the rear of the plug-in which is connected to contact 28A. Coil the excessive cable length so that the coil loop is near the rear of the TG 501. The output of contact 28A must be terminated into 50 Ω.

NOTE

The output signal may not meet specifications due to variables introduced by using the rear interface.

Buffered Internal Clock Output

Interface contact 25A supplies the internal 1 MHz clock pulses of the TG 501 for external use. To connect the internal 1 MHz clock pulses via a buffer to contact 25A, jumper J2 (see Fig. 6-2) must be installed. This output will drive 5 TTL loads (8 mA).

BCD Outputs (LSD—8, 4, 2, 1 and MSD—8, 4, 2, 1 Code)

Contacts 24A, 23A, 22A, 21A, 20A, 19A, 18A, and 17A provide BCD data directly to the Power Module interface. Each digit of the error count is transmitted in a serial-by-digit method. The binary levels for each digit use positive-true logic (HI=1, LO=0). Each output data line is capable of driving 2 TTL loads (3.2 mA). Caution must be exercised in connecting external loads to the BCD data lines, since they are not buffered.

Fast-Slow Indicator Control Line

The output level on rear contact 16A is high (about 5 V) when the SLOW indicator is lit and is low (about 0 V) when the FAST indicator is lit. This output line will drive 2 TTL load (3.2 mA). Caution must be exercised in connecting external loads to this line, since it is not buffered.

Trigger Out

Trigger output pulses can be supplied to contact 27B by disconnecting the coaxial cable going from the circuit board to the + TRIGGER OUT front-panel connector. Connect another 50 Ω coaxial cable (having characteristics similar to RG174U) from the circuit board trigger output and shield solder pads (from which coaxial cable was just removed to contacts 27B (center conductor) and 28B (shield). The output of contact 27B must be terminated into 50 Ω.

Data Good

A positive-true pulse is transmitted directly to rear contact 26B at each updating of the counters. The Data Good pulse goes high and stays high for about 8 ms, which coincides with the LED display time. This output will drive at least 2 TTL loads (3.2 mA). Caution must be exercised in connecting external loads to this line since it is not buffered.

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OPTIONS

OPTION 01

The TG 501 Option 01 is equipped with a temperature-compensated, 5 MHz crystal oscillator for a highly stable and precise internal clock. U50 provides countdown circuitry for the 5 MHz crystal.

Remove U100 and disconnect pin 3 of U350 before using external clocks. To disconnect Pin 3 remove U350, bend pin 3 out then insert U350 back into circuit board.

The main circuit board jumpers that must be installed for Option 01 are: J3 and J7 (see Fig. 5-2 for jumper location).

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REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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, instrument type or number, 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, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

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CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000FD	A.T.R. COIL	210 WEST ALLEN	BOLLMINGTON, INDIANA 47401
00136	MC COY ELECTRONICS COMPANY	WATTS AND CHESTNUT STR.	MT. HOLLY SPRINGS, PA 17065
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05397	UNION CARBIDE CORPORATION, MATERIALS SYSTEMS DIVISION	11901 MADISON AVENUE	CLEVELAND, OH 44101
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
12617	HAMLIN, INC.	GROVE & LAKE STS.	LAKE MILLS, WI 53551
13571	ELECTRONIC RESEARCH CO.	P O BOX 913	SHAWNEE MISSION, KS 66201
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
31718	FAIRCHILD MICROWAVE AND OPTOELECTRONICS, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	4001 MIRANDA AVE.	PALO ALTO, CA 94304
32159	WEST-CAP ARIZONA	2201 E. ELVIRA ROAD	TUCSON, AZ 85706
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50434	HEWLETT-PACKARD COMPANY	640 PAGE MILL ROAD	PALO ALTO, CA 94304
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
71034	BLILEY ELECTRIC CO.	2545 W. GRANDVIEW BLVD.	ERIE, PA 16512
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-2737-00	B010100	B029999	CKT BOARD ASSY:MAIN (STANDARD ONLY)	80009	670-2737-00
A1	670-2737-02	B030000	B031769	CKT BOARD ASSY:MAIN (STANDARD ONLY)	80009	670-2737-02
A1	670-2737-03	B031770	B032459	CKT BOARD ASSY:MAIN (STANDARD ONLY)	80009	670-2737-03
A1	670-2737-04	B032460	B036899	CKT BOARD ASSY:MAIN (STANDARD ONLY)	80009	670-2737-04
A1	670-2737-05	B036900	B037779	CKT BOARD ASSY:MAIN (STANDARD ONLY)	80009	670-2737-05
A1	670-2737-06	B037780		CKT BOARD ASSY:MAIN (STANDARD ONLY)	80009	670-2737-06
A1	670-3415-00	B010100	B029999	CKT BOARD ASSY:MAIN (OPTION 01 ONLY)	80009	670-3415-00
A1	670-3415-01	B030000	B031389	CKT BOARD ASSY:MAIN (OPTION 01 ONLY)	80009	670-3415-01
A1	670-3415-02	B031390	B032499	CKT BOARD ASSY:MAIN (OPTION 01 ONLY)	80009	670-3415-02
A1	670-3415-03	B032500	B034509	CKT BOARD ASSY:MAIN (OPTION 01 ONLY)	80009	670-3415-03
A1	670-3415-04	B034510	B036951	CKT BOARD ASSY:MAIN (OPTION 01 ONLY)	80009	670-3415-04
A1	670-3415-05	B036952	B037829	CKT BOARD ASSY:MAIN (OPTION 01 ONLY)	80009	670-3415-05
A1	670-3415-06	B037830		CKT BOARD ASSY:MAIN (OPTION 01 ONLY)	80009	670-3415-06
A2	670-2992-00	B010100	B032459	CKT BOARD ASSY:MULTIPLIER (STANDARD ONLY)	80009	670-2992-00
A2	670-2992-01	B032460	B034449	CKT BOARD ASSY:MULTIPLIER (STANDARD ONLY)	80009	670-2992-01
A2	670-2992-02	B034450		CKT BOARD ASSY:MULTIPLIER (STANDARD ONLY)	80009	670-2992-02
A2	670-2992-00	B010100	B032499	CKT BOARD ASSY:MULTIPLIER (OPTION 01 ONLY)	80009	670-2992-00
A2	670-2992-01	B032500	B034509	CKT BOARD ASSY:MULTIPLIER (OPTION 01 ONLY)	80009	670-2992-01
A2	670-2992-02	B034510		CKT BOARD ASSY:MULTIPLIER (OPTION 01 ONLY)	80009	670-2992-02
A3	670-2878-00			CKT BOARD ASSY:DISPLAY	80009	670-2878-00
C50	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C100	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V (STANDARD ONLY)	59660	301-000C0G0150J
C102	281-0166-00			CAP.,VAR,AIR DI:1.9-15.7PF,250V (STANDARD ONLY)	74970	187-0109-005
C105	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V (STANDARD ONLY)	59660	301-055C0G0100F
C125	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C127	283-0627-00			CAP.,FXD,MICA D:0.0033UF,5%,500V	00853	D195E332J0
C137	290-0536-00	B010100	B036899	CAP.,FXD,ELCTLT:10UF,20%,25V (STANDARD ONLY)	90201	TDC106M025FL
C137	283-0059-00	B036900		CAP.,FXD,CER DI:1UF,+80-20%,25V (STANDARD ONLY)	72982	8131N031Z5U0105Z
C137	290-0536-00	B010100	B036951	CAP.,FXD,ELCTLT:10UF,20%,25V (OPTION 01 ONLY)	90201	TDC106M025FL
C137	283-0059-00	B036952		CAP.,FXD,CER DI:1UF,+80-20%,25V (OPTION 01 ONLY)	72982	8131N031Z5U0105Z
C138	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C150	283-0067-00	XB010210		CAP.,FXD,CER DI:0.001UF,10%,200V (STANDARD ONLY)	56289	19C607
C150	283-0067-00	XB010260		CAP.,FXD,CER DI:0.001UF,10%,200V (OPTION 01 ONLY)	56289	19C607
C160	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C231	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C239	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C246	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C250	290-0529-00			CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C251	290-0529-00			CAP.,FXD,ELCTLT:47UF,20%,20V	05397	T368C476M020AZ
C268	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C271	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C272	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C275				(PART OF CIRCUIT BOARD)		
C285	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C290	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	59660	301-000C0G0150J
C292	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C295	281-0627-00	XB031770		CAP.,FXD,CER DI:1PF,+/-0.25PF,500V (STANDARD ONLY)	04222	7001-1340
C295	281-0627-00	XB031390		CAP.,FXD,CER DI:1PF,+/-0.25PF,500V (OPTION 01 ONLY)	04222	7001-1340
C297	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C298	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C330	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C331	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C352	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	59660	301-000C0G0220K
C355	281-0516-00			CAP.,FXD,CER DI:39PF,+/-3.9PF,500V	59660	301-000U2J0390K
C358	281-0536-00			CAP.,FXD,CER DI:1000PF,10%,500V	72982	301000 X 5P0102K
C360	281-0536-00			CAP.,FXD,CER DI:1000PF,10%,500V	72982	301000 X 5P0102K
C362	285-0674-00			CAP.,FXD,PLSTC:0.01UF,10%,100V	56289	410P10391
C366	290-0572-00			CAP.,FXD,ELCTLT:0.1UF,20%,50V	56289	196D104X0050HA1
C368	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C370	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C372	290-0531-00			CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC107M010WLC
C390	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	59660	301-000C0G0220K
C400	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	59660	301-000C0G0220K
C404	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C405	290-0533-00	B010100	B010217	CAP.,FXD,ELCTLT:330UF,20%,,6V (STANDARD ONLY)	90201	TDC337M006WLD
C405	290-0530-00	B010218		CAP.,FXD,ELCTLT:68UF,20%,6V (STANDARD ONLY)	90201	TDC686M006NLF
C405	290-0533-00	B010100	B010261	CAP.,FXD,ELCTLT:330UF,20%,,6V (OPTION 01 ONLY)	90201	TDC337M006WLD
C405	290-0530-00	B010262		CAP.,FXD,ELCTLT:68UF,20%,6V (OPTION 01 ONLY)	90201	TDC686M006NLF
C413	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C415	290-0533-00			CAP.,FXD,ELCTLT:330UF,20%,,6V	90201	TDC337M006WLD
C416	283-0156-00	B010100	B010217X	CAP.,FXD,CER DI:1000PF,+100-0%,200V (STANDARD ONLY)	72982	8111A208Z5U0102Z
C416	283-0156-00	B010100	B010261X	CAP.,FXD,CER DI:1000PF,+100-0%,200V (OPTION 01 ONLY)	72982	8111A208Z5U0102Z
C417	281-0540-00	XB032460		CAP.,FXD,CER DI:51PF,5%,500V (STANDARD ONLY)	59660	301-000U2J0510J
C417	281-0540-00	XB032500		CAP.,FXD,CER DI:51PF,5%,500V (OPTION 01 ONLY)	59660	301-000U2J0510J
C430	290-0531-00			CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC107M010WLC
C432	290-0532-00			CAP.,FXD,ELCTLT:150UF,20%,6V	90201	TDC157M006WLC

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C439	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
C440	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	59660	301-000C0G0220K
C450	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C452	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C454	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C455	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C457	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C458	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C462	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C465	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C467	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C481	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	273C5
C489	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C490	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C492	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C494	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C495	290-0519-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C496	290-0531-00			CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC107M010WLC
C498	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C499	281-0578-00			CAP.,FXD,CER DI:18PF,5%,500V	59660	301-050C0G0180J
C500	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	59660	301-000C0G0220K
C504	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C505	281-0153-00			CAP.,VAR,AIR DI:1.7-10PF,250V	74970	187-0106-005
C510	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C511	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C512	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C513	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C515	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C517	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C518	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C519	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C520	281-0168-00			CAP.,VAR,AIR DI:1.3-5.4PF,250V	74970	187-0103-035
C550	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C610	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C615	290-0519-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	TDC107M020WLD
C616	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C624	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C626	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C640	290-0531-00			CAP.,FXD,ELCTLT:100UF,20%,10V	90201	TDC107M010WLC
C641	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C660	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C662	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C664	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C666	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C668	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
	----- -----			(STANDARD ONLY)		
C670	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C672	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C674	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C676	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C678	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C680	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C682	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C684	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C686	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
C688	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
	----- -----			(STANDARD ONLY)		

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C690	283-0156-00			CAP.,FXD,CER DI:1000PF,+100-0%,200V	72982	8111A208Z5U0102Z
C692	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Z5U-102P
CR50	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR52	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR54	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR115	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR167	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR168	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR350	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR358	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR359	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR360	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR361	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR363	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR364	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR366	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR367	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR369	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR370	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR372	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR373	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR375	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR376	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR415	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR445	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR450	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR468	152-0153-00 ----- -----	XB010218		SEMICOND DEVICE:SILICON,15V,50MA (STANDARD ONLY)	07263	FD7003
CR468	152-0153-00 ----- -----	XB010262		SEMICOND DEVICE:SILICON,15V,50MA (OPTION 01 ONLY)	07263	FD7003
CR470	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	07263	FD7003
CR482	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR500	152-0503-00			SEMICOND DEVICE:SILICON,SNAP-OFF	80009	152-0503-00
CR515	152-0536-00			SEMICOND DEVICE:SILICON,HOT CARRIER,4V	80009	152-0536-00
CR600	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR626	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
DS170	150-1001-01			LAMP,LED:RED,2V,100MA	50434	HLMP-3200
DS172	150-1001-01			LAMP,LED:RED,2V,100MA	50434	HLMP-3200
DS550	150-1011-00 ----- -----	B010100	B032559	LAMP,LED:RED,7-SEQUENCE (STANDARD ONLY)	31718	FND70
DS550	150-1011-01 ----- -----	B032560		LAMP,LED,RDOUT:RED SINGLE DIGIT (STANDARD ONLY)	07263	FND5169
DS550	150-1011-00 ----- -----	B010100	B032669	LAMP,LED:RED,7-SEQUENCE (OPTION 01 ONLY)	31718	FND70
DS550	150-1011-01 ----- -----	B032670		LAMP,LED,RDOUT:RED SINGLE DIGIT (OPTION 01 ONLY)	07263	FND5169
DS570	150-1011-00 ----- -----	B010100	B032559	LAMP,LED:RED,7-SEQUENCE (STANDARD ONLY)	31718	FND70
DS570	150-1011-01 ----- -----	B032560		LAMP,LED,RDOUT:RED SINGLE DIGIT (STANDARD ONLY)	07263	FND5169
DS570	150-1011-00 ----- -----	B010100	B032669	LAMP,LED:RED,7-SEQUENCE (OPTION 01 ONLY)	31718	FND70
DS570	150-1011-01 ----- -----	B032670		LAMP,LED,RDOUT:RED SINGLE DIGIT (OPTION 01 ONLY)	07263	FND5169
DS630	150-0048-00			LAMP,INCAND:5V,60MA	08806	683

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F620	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC 2
J1	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
	----- -----			(USED WITH CUSTOM MODIFICATIONS)		
J2	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
	----- -----			(USED WITH CUSTOM MODIFICATIONS)		
J3	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
J4	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
	----- -----			(USED WITH CUSTOM MODIFICATIONS)		
J5	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
	----- -----			(USED WITH CUSTOM MODIFICATIONS)		
J6	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
	----- -----			(USED WITH CUSTOM MODIFICATIONS)		
J7	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
J8	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
J290	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J420	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J435	131-1315-00			CONN,RCPT,ELEC:BNC,FEMALE	80009	131-1315-00
J450	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J465	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J468	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
J470	131-1315-00			CONN,RCPT,ELEC:BNC,FEMALE	80009	131-1315-00
J472	131-1003-00			CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
	----- -----			(OPTION 01 ONLY)		
J520	131-1315-00			CONN,RCPT,ELEC:BNC,FEMALE	80009	131-1315-00
K450	108-0357-00			COIL,REED SW:REED DRIVE,6V,SINGLE	80009	108-0357-00
L137	108-0317-00	B010100	B029999X	COIL,RF:FIXED,15UH	32159	71501M
L297	108-0317-00			COIL,RF:FIXED,15UH	32159	71501M
L458	108-0371-00			COIL,RF:0.23UH	000FD	108-0371-00
L460	108-0371-00			COIL,RF:0.23UH	000FD	108-0371-00
L462	----- -----			(PART OF CIRCUIT BOARD)		
L465	108-0509-00	XB010218		COIL,RF:2.45UH	80009	108-0509-00
	----- -----			(STANDARD ONLY)		
L465	108-0509-00	XB010262		COIL,RF:2.45UH	80009	108-0509-00
	----- -----			(OPTION 01 ONLY)		
L486	108-0371-00	XB010210		COIL,RF:0.23UH	000FD	108-0371-00
	----- -----			(STANDARD ONLY)		
L486	108-0371-00	XB010260		COIL,RF:0.23UH	000FD	108-0371-00
	----- -----			(OPTION 01 ONLY)		
L490	108-0347-00			COIL,RF:0.12UH	80009	108-0347-00
L492	108-0371-00			COIL,RF:0.23UH	000FD	108-0371-00
L494	108-0371-00			COIL,RF:0.23UH	000FD	108-0371-00
L500	----- -----			(PART OF CIRCUIT BOARD)		
L502	----- -----			(PART OF CIRCUIT BOARD)		
L510	----- -----			(PART OF CIRCUIT BOARD)		
L511	----- -----			(PART OF CIRCUIT BOARD)		
L512	----- -----			(PART OF CIRCUIT BOARD)		
L513	----- -----			(PART OF CIRCUIT BOARD)		
L517	----- -----			(PART OF CIRCUIT BOARD)		
L518	----- -----			(PART OF CIRCUIT BOARD)		
L519	----- -----			(PART OF CIRCUIT BOARD)		
L520	----- -----			(PART OF CIRCUIT BOARD)		
Q120	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q130	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q135	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q140	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q255	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q260	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246

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Q265	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q270	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
Q272	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q280	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q285	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q290	151-0424-00	B010100	B031669	TRANSISTOR:SILICON,NPN (STANDARD ONLY)	04713	SPS8246
Q290	151-0472-00	B031670		TRANSISTOR:SILICON,NPN (STANDARD ONLY)	80009	151-0472-00
Q290	151-0424-00	B010100	B031389	TRANSISTOR:SILICON,NPN (OPTION 01 ONLY)	04713	SPS8246
Q290	151-0472-00	B031390		TRANSISTOR:SILICON,NPN (OPTION 01 ONLY)	80009	151-0472-00
Q330	151-0410-00	B010100	B037779	TRANSISTOR:SILICON,PNP (STANDARD ONLY)	80009	151-0410-00
Q330	151-0188-00	B037780		TRANSISTOR:SILICON,PNP (STANDARD ONLY)	04713	SPS6868K
Q330	151-0410-00	B010100	B037829	TRANSISTOR:SILICON,PNP (OPTION 01 ONLY)	80009	151-0410-00
Q330	151-0188-00	B037830		TRANSISTOR:SILICON,PNP (OPTION 01 ONLY)	04713	SPS6868K
Q380	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q384	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q390	151-0271-00			TRANSISTOR:SILICON,PNP	04713	SPS8236
Q400	151-0271-00			TRANSISTOR:SILICON,PNP	04713	SPS8236
Q405	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q408	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
Q415	151-0271-00	B010100	B010217	TRANSISTOR:SILICON,PNP (STANDARD ONLY)	04713	SPS8236
Q415	151-0221-00	B010218	B032459	TRANSISTOR:SILICON,PNP (STANDARD ONLY)	04713	SPS246
Q415	151-0325-00	B032460		TRANSISTOR:SILICON,PNP,SEL FROM 2N4258 (STANDARD ONLY)	80009	151-0325-00
Q415	151-0271-00	B010100	B010261	TRANSISTOR:SILICON,PNP (OPTION 01 ONLY)	04713	SPS8236
Q415	151-0221-00	B010262	B032499	TRANSISTOR:SILICON,PNP (OPTION 01 ONLY)	04713	SPS246
Q415	151-0325-00	B032500		TRANSISTOR:SILICON,PNP,SEL FROM 2N4258 (OPTION 01 ONLY)	80009	151-0325-00
Q430	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
Q435	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
Q440	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q460	151-0221-00	XB010218		TRANSISTOR:SILICON,PNP (STANDARD ONLY)	04713	SPS246
Q460	151-0221-00	XB010262		TRANSISTOR:SILICON,PNP (OPTION 01 ONLY)	04713	SPS246
Q484	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q486	151-0411-00			TRANSISTOR:SILICON,NPN	80009	151-0411-00
Q600	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q605	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q610	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q620	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q635	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q640	151-0515-01			SCR:SILICON	04713	2N4441
R50	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R52	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R53	315-0242-00	XB030000		RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425

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R100	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
	----- -----			(STANDARD ONLY)		
R105	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
	----- -----			(STANDARD ONLY)		
R108	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
	----- -----			(STANDARD ONLY)		
R120	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R121	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R123	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R125	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R127	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R128	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R130	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R132	315-0102-00	XB030000	B031769	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
	----- -----			(STANDARD ONLY)		
R132	315-0331-00	B031770		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
	----- -----			(STANDARD ONLY)		
R132	315-0102-00	XB030000	B031389	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
	----- -----			(OPTION 01 ONLY)		
R132	315-0331-00	B031390		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
	----- -----			(OPTION 01 ONLY)		
R134	315-0471-00	XB010302	B029999	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
	----- -----			(STANDARD ONLY)		
R134	315-0102-00	B030000	B031769	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
	----- -----			(STANDARD ONLY)		
R134	315-0331-00	B031770		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
	----- -----			(STANDARD ONLY)		
R134	315-0102-00	XB030000	B031389	RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
	----- -----			(OPTION 01 ONLY)		
R134	315-0331-00	B031390		RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
	----- -----			(OPTION 01 ONLY)		
R135	311-1416-00	B010100	B010209	RES.,VAR,NONWIR:200 OHM,20%,1W	01121	10M917
	----- -----			(STANDARD ONLY)		
R135	311-0169-00	B010210		RES.,VAR,NONWIR:100 OHM,20%,0.50W	01121	W-7564B
	----- -----			(STANDARD ONLY)		
R135	311-1416-00	B010100	B010259	RES.,VAR,NONWIR:200 OHM,20%,1W	01121	10M917
	----- -----			(OPTION 01 ONLY)		
R135	311-0169-00	B010260		RES.,VAR,NONWIR:100 OHM,20%,0.50W	01121	W-7564B
	----- -----			(OPTION 01 ONLY)		
R136	315-0160-00	B010100	B010217	RES.,FXD,CMPSN:16 OHM,5%,0.25W	01121	CB1605
	----- -----			(STANDARD ONLY)		
R136	315-0180-00	B010218	B032459	RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
	----- -----			(STANDARD ONLY)		
R136	315-0180-00	B032460		RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
	----- -----			(STANDARD ONLY)		
R136	315-0160-00	B010100	B010261	RES.,FXD,CMPSN:16 OHM,5%,0.25W	01121	CB1605
	----- -----			(OPTION 01 ONLY)		
R136	315-0180-00	B010262	B032499	RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
	----- -----			(OPTION 01 ONLY)		
R136	315-0180-00	B032500		RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
	----- -----			(OPTION 01 ONLY)		
R137	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R138	307-0106-00	XB030000		RES.,FXD,CMPSN:4.7 OHM,5%,0.25W	01121	CB47G5
R140	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R142	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R143	315-0300-00			RES.,FXD,CMPSN:30 OHM,5%,0.25W	01121	CB3005
R145	311-1568-00			RES.,VAR,NONWIR:50 OHM,20%,0.50W	73138	91-90-0

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R150	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R151	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R153	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R154	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R158	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R159	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R162	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R163	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R165	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R167	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R172	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R230	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R231	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R234	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R236	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R238	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R239	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R245	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R246	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R248	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R250	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R252	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R253	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R254	315-0102-00	XB010337		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R255	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R256	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R262	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R263	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R265	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R266	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R271	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R272	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R280	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R282	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R283	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R285	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R286	315-0910-00			RES.,FXD,CMPSN:91 OHM,5%,0.25W	01121	CB9105
R290	317-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.125W	01121	BB2715
R292	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R294	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R295	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R300	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R302	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R304	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R305	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R310	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R312	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R314	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R316	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R318	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R320	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R322	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R323	315-0510-00 ----- -----	XB036900		RES.,FXD,CMPSN:51 OHM,5%,0.25W (STANDARD ONLY)	01121	CB5105
R323	315-0510-00 ----- -----	XB036952		RES.,FXD,CMPSN:51 OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB5105
R324	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115

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R325	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R330	315-0150-00			RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
R331	315-0131-00			RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R333	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R335	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R350	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R352	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R355	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R358	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R360	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R362	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R366	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R368	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R370	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R372	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R380	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R381	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R383	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R384	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R385	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R387	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R390	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R391	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R393	315-0182-00			RES.,FXD,CMPSN:1.8K OHM,5%,0.25W	01121	CB1825
R394	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R396	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R398	315-0271-00	B010100	B010217	RES.,FXD,CMPSN:270 OHM,5%,0.25W (STANDARD ONLY)	01121	CB2715
R398	315-0221-00	B010218	B031769	RES.,FXD,CMPSN:220 OHM,5%,0.25W (STANDARD ONLY)	01121	CB2215
R398	301-0221-00	B031770		RES.,FXD,CMPSN:220 OHM,5%,0.50W (STANDARD ONLY)	01121	EB2215
R398	315-0271-00	B010100	B010261	RES.,FXD,CMPSN:270 OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB2715
R398	315-0221-00	B010262	B031389	RES.,FXD,CMPSN:220 OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB2215
R398	301-0221-00	B031390		RES.,FXD,CMPSN:220 OHM,5%,0.50W (OPTION 01 ONLY)	01121	EB2215
R400	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R405	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R406	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R408	315-0471-00	B010100	B010116	RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R408	315-0751-00	B010117		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R410	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R412	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R413	315-0242-00	B010100	B010217	RES.,FXD,CMPSN:2.4K OHM,5%,0.25W (STANDARD ONLY)	01121	CB2425
R413	315-0202-00	B010218		RES.,FXD,CMPSN:2K OHM,5%,0.25W (STANDARD ONLY)	01121	CB2025
R413	315-0242-00	B010100	B010261	RES.,FXD,CMPSN:2.4K OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB2425
R413	315-0202-00	B010262		RES.,FXD,CMPSN:2K OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB2025
R415	315-0390-00	B010100	B010217	RES.,FXD,CMPSN:39 OHM,5%,0.25W (STANDARD ONLY)	01121	CB3905
R415	315-0200-00	B010218		RES.,FXD,CMPSN:20 OHM,5%,0.25W (STANDARD ONLY)	01121	CB2005

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R415	315-0390-00	B010100	B010261	RES.,FXD,CMPSN:39 OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB3905
R415	315-0200-00	B010262		RES.,FXD,CMPSN:20 OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB2005
R417	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R420	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R430	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R432	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R435	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R437	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R439	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R440	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R445	311-1565-00			RES.,VAR,NONWIR:250 OHM,20%,0.50W	73138	91-87-0
R447	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R450	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R451	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R452	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R460	315-0102-00	XB010218		RES.,FXD,CMPSN:1K OHM,5%,0.25W (STANDARD ONLY)	01121	CB1025
R460	315-0102-00	XB010262		RES.,FXD,CMPSN:1K OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB1025
R461	315-0103-00	XB010218		RES.,FXD,CMPSN:10K OHM,5%,0.25W (STANDARD ONLY)	01121	CB1035
R461	315-0103-00	XB010262		RES.,FXD,CMPSN:10K OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB1035
R463	315-0471-00	XB010218		RES.,FXD,CMPSN:470 OHM,5%,0.25W (STANDARD ONLY)	01121	CB4715
R463	315-0471-00	XB010262		RES.,FXD,CMPSN:470 OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB4715
R465	315-0103-00	XB010218		RES.,FXD,CMPSN:10K OHM,5%,0.25W (STANDARD ONLY)	01121	CB1035
R465	315-0103-00	XB010262		RES.,FXD,CMPSN:10K OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB1035
R478	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R480	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R481	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R482	311-1563-00	B010100	B010182	RES.,VAR,NONWIR:1K OHM,20%,0.50W	73138	91-85-0
R482	311-1225-00	B010183		RES.,VAR,NONWIR:1K OHM,20%,0.50W	32997	3386F-T04-102
R484	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R486	315-0510-00	B010100	B010209	RES.,FXD,CMPSN:51 OHM,5%,0.25W (STANDARD ONLY)	01121	CB5105
R486	315-0151-00	B010210		RES.,FXD,CMPSN:150 OHM,5%,0.25W (STANDARD ONLY)	01121	CB1515
R486	315-0510-00	B010100	B010259	RES.,FXD,CMPSN:51 OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB5105
R486	315-0151-00	B010260		RES.,FXD,CMPSN:150 OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB1515
R487	317-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.125W	01121	BB2205
R488	317-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.125W	01121	BB2005
R489	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R500	315-0302-00	B010100	B010217	RES.,FXD,CMPSN:3K OHM,5%,0.25W (STANDARD ONLY)	01121	CB3025
R500	311-1559-00	B010218		RES.,VAR,NONWIR:10K OHM,20%,0.50W (STANDARD ONLY)	73138	91-81-0
R500	315-0302-00	B010100	B010261	RES.,FXD,CMPSN:3K OHM,5%,0.25W (OPTION 01 ONLY)	01121	CB3025
R500	311-1559-00	B010262		RES.,VAR,NONWIR:10K OHM,20%,0.50W (OPTION 01 ONLY)	73138	91-81-0

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R553	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R554	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R555	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R556	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R557	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R558	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R559	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R570	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R573	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R574	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R575	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R576	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R577	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R578	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R579	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R600	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R601	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R603	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R605	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
R606	311-1262-00	XB031770		RES.,VAR,NONWIR:750 OHM,10%,0.50W	32997	3329P-L58-751
	----- -----			(STANDARD ONLY)		
R606	311-1262-00	XB031390		RES.,VAR,NONWIR:750 OHM,10%,0.50W	32997	3329P-L58-751
	----- -----			(OPTION 01 ONLY)		
R607	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R610	302-0560-00			RES.,FXD,CMPSN:56 OHM,10%,0.50W	01121	EB5601
R612	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R614	308-0703-00			RES.,FXD,WW:1.8 OHM,5%,2W	75042	BWH-1R800J
R616	321-0237-00			RES.,FXD,FILM:2.87K OHM,1%,0.125W	91637	MFF1816G28700F
R620	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R621	308-0702-00			RES.,FXD,WW:0.33 OHM,5%,2W	75042	BWH-R3300J
R623	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R624	321-0262-00			RES.,FXD,FILM:5.23K OHM,1%,0.125W	91637	MFF1816G52300F
R626	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R628	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R629	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R634	302-0121-00			RES.,FXD,CMPSN:120 OHM,10%,0.50W	01121	EB1211
R635	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R640	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
S1	260-0817-00			SWITCH,REED:SPDT,0.25A,100V	12617	1152234160
S110	----- -----			(REFER TO MPL,INDEX NO. 48, 72 AND 75)		
S350	263-1008-00			SW CAM ACTR AS:	80009	263-1008-00
S450A-C	260-1571-00			SWITCH,PUSH:5NS/2NS/1NS	71590	2KBC030000-XXX
T450	120-0870-00			XFMR,TOROID:2 WINDINGS	80009	120-0870-00
U50	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
	----- -----			(OPTION 01 ONLY)		
U100	156-0113-00			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE	80009	156-0113-00
	----- -----			(STANDARD ONLY)		
U110	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U115	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U150	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	80009	156-0039-00
U160	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
U180	156-0129-00			MICROCIRCUIT,DI:QUAD 2-INPUT GATE	80009	156-0129-00
U185	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U190	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U195	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00

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Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U200	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U210	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U212	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U215	156-0041-00			MICROCIRCUIT,DI:DUAL D-TYPE FLIP-FLOP	27014	DM7474N
U218	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U220	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U225	156-0038-00			MICROCIRCUIT,DI:J-K MASTER SLAVE FLIP-FLOP	80009	156-0038-00
U230	156-0039-00			MICROCIRCUIT,DI:DUAL J-K FLIP FLOP	80009	156-0039-00
U235	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U250	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
U290	156-0205-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	04713	MC10102 (P OR L)
U300	156-0205-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	04713	MC10102 (P OR L)
U310	156-0230-00			MICROCIRCUIT,DI:DUAL D MA-SLAVE FLIP-FLOP	80009	156-0230-00
U315	156-0230-00			MICROCIRCUIT,DI:DUAL D MA-SLAVE FLIP-FLOP	80009	156-0230-00
U320	156-0100-00			MICROCIRCUIT,DI:J-K EDGE TRIGGERED FF	80009	156-0100-00
U325	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U330	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U335	156-0178-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NOR GATE	01295	SN7427N
U350	156-0030-00	B010100	B032459	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE (STANDARD ONLY)	01295	SN7400(N OR J)
U350	156-0180-00	B032460		MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE (STANDARD ONLY)	01295	SN74S00(N OR J)
U350	156-0030-00	B010100	B032499	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE (OPTION 01 ONLY)	01295	SN7400(N OR J)
U350	156-0180-00	B032500		MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE (OPTION 01 ONLY)	01295	SN74S00(N OR J)
U355	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U360	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U362	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U364	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U366	156-0043-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NOR GATE	80009	156-0043-00
U368	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U370	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U372	156-0079-00			MICROCIRCUIT,DI:DECADE COUNTER,TTL	80009	156-0079-00
U450	156-0252-00			MICROCIRCUIT,DI:TRIPLE 4-3-3 INP NOR GATE	80009	156-0252-00
U455	156-0033-00			MICROCIRCUIT,LI:RF/IF AMPLIFIER	80009	156-0033-00
U550	156-0379-00			MICROCIRCUIT,DI:BCD TO 7-SEGMENT DCDR/DRVR	80009	156-0379-00
U570	156-0379-00			MICROCIRCUIT,DI:BCD TO 7-SEGMENT DCDR/DRVR	80009	156-0379-00
U625	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	02735	85145
VR140	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR250	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZG35010RL
VR255	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZG35010RL
VR282	152-0279-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZG35010RL
VR600	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
VR605	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
VR640	152-0280-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	80009	152-0280-00
Y50	119-0262-00	B010100	B034509	OSCILLATOR,RF:XTAL CONTROLLED,5 MHZ ADJ (OPTION 01 ONLY)	13571	EROS-600-TK-9
Y50	119-0503-00	B034510		OSCILLATOR,RF:5MHZ (OPTION 01 ONLY)	71034	T15B141
Y100	158-0079-00			XTAL UNIT,QTZ:1 MHZ,+/-0.001% (STANDARD ONLY)	00136	OBD

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DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it is in the low state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

American National Standard Institute
1430 Broadway
New York, New York 10018

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

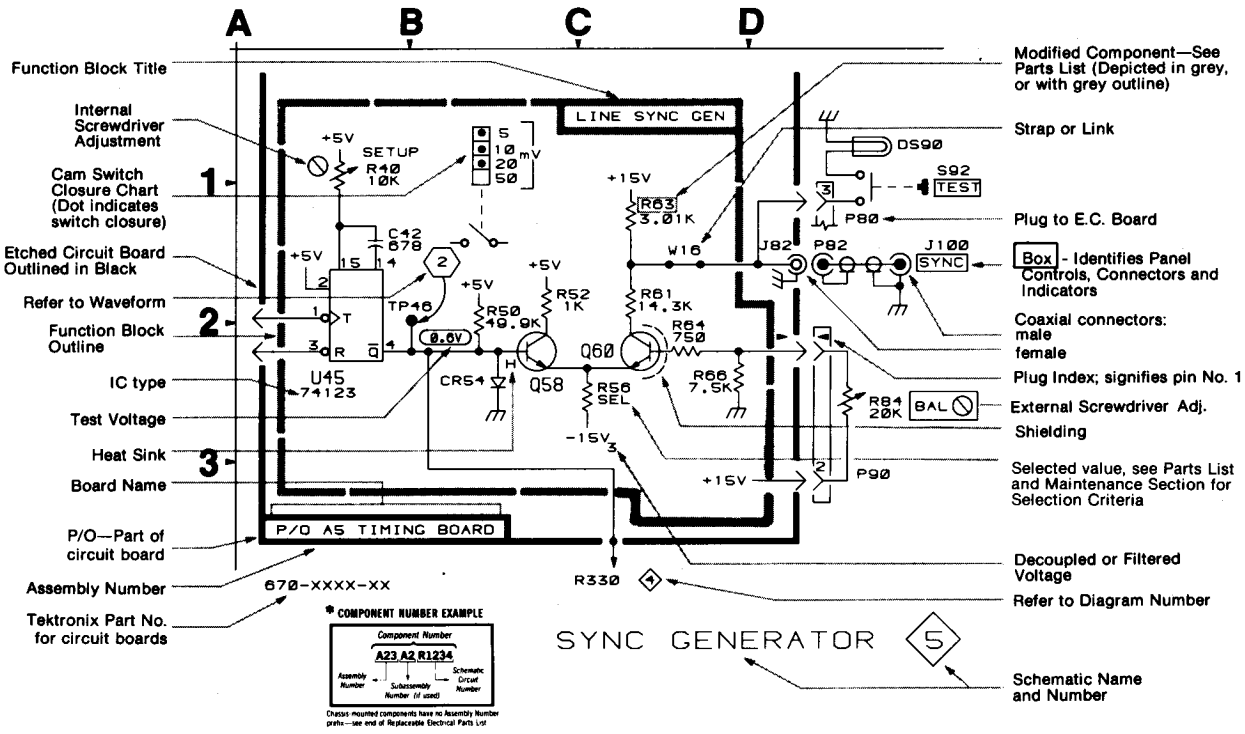
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

The information and special symbols below may appear in this manual.

Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number *(see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.



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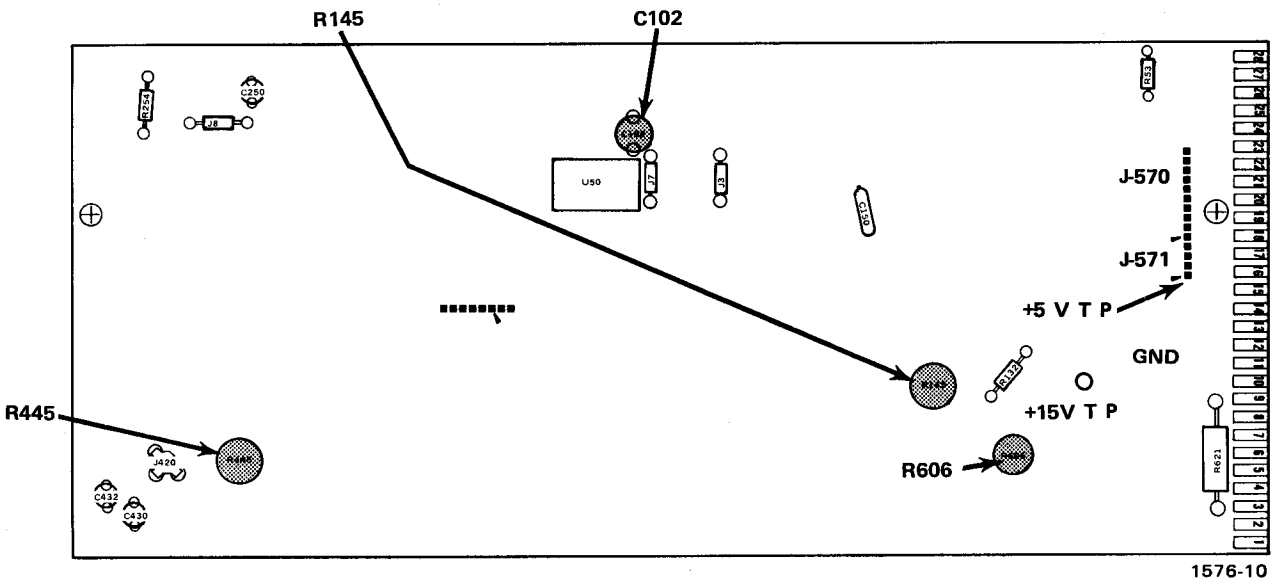


Fig. 8-1. Back of A1 main board.

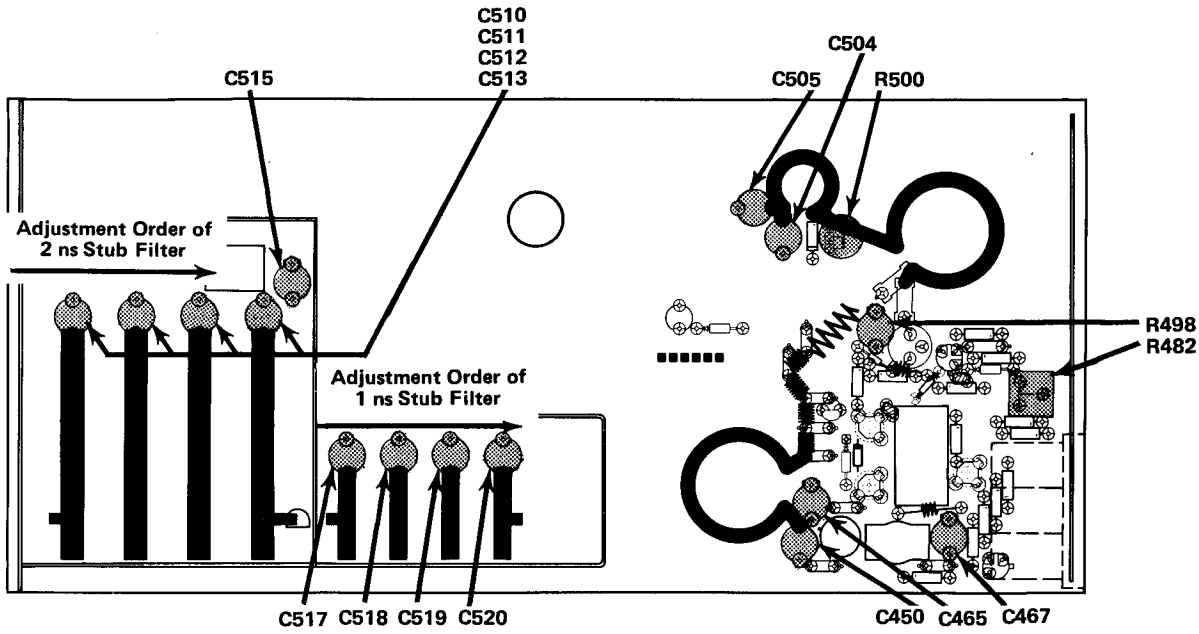


Fig. 8-2. A2 multiplier circuit board.

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TG 501

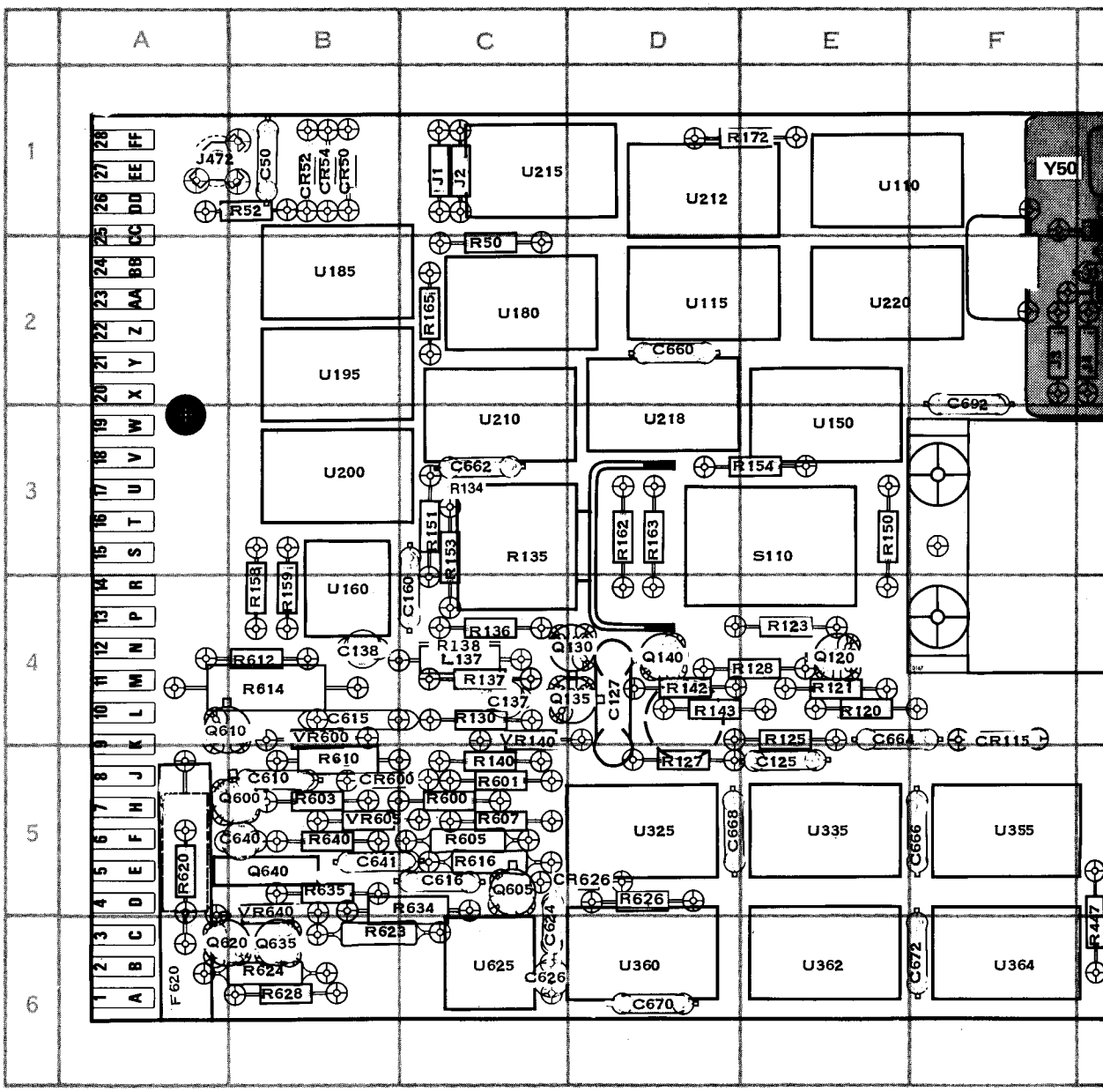


Fig. 8-3. A1—Main b

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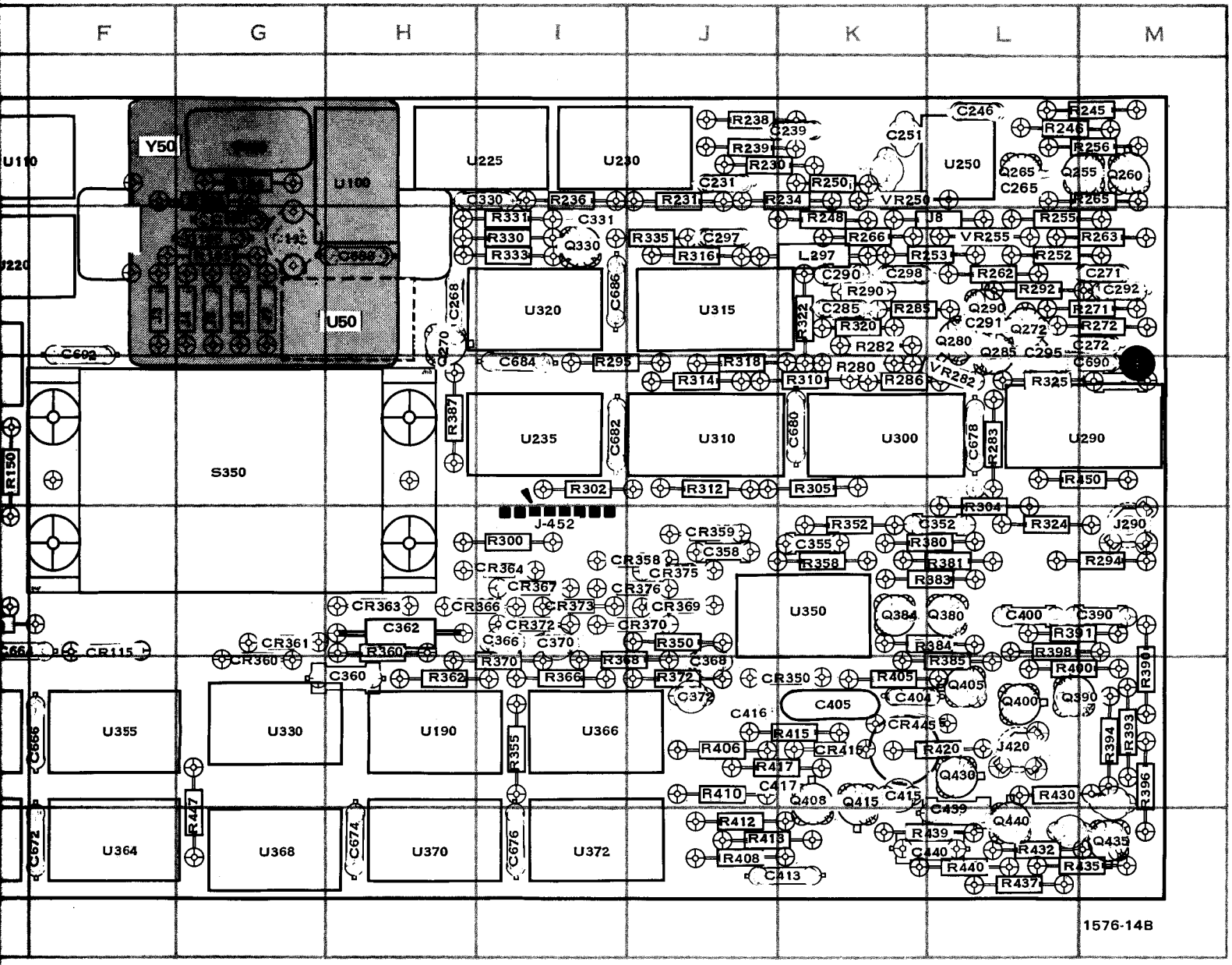


Fig. 8-3. A1—Main board component location grid.

For Option 1—Components in shaded area are replaced by Y50 and U50. U50 is installed on the back side of board.

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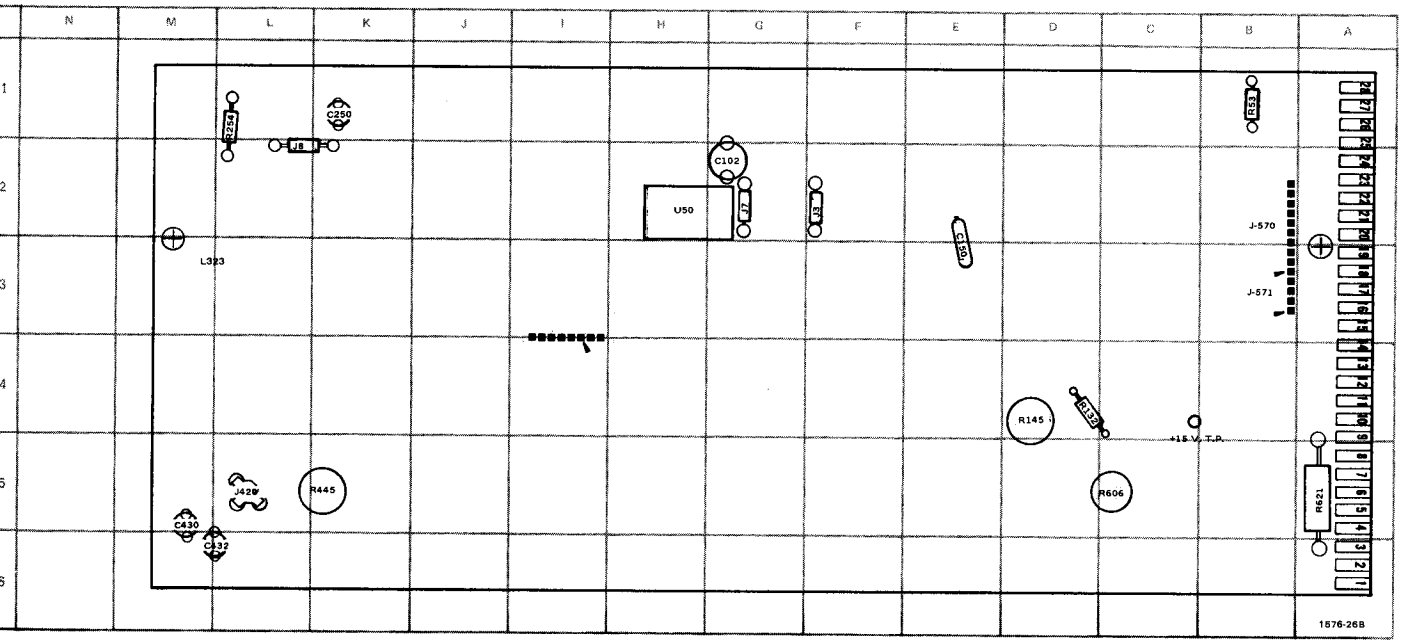


Fig. 8-4. Component location grid for back of A1—Main board.

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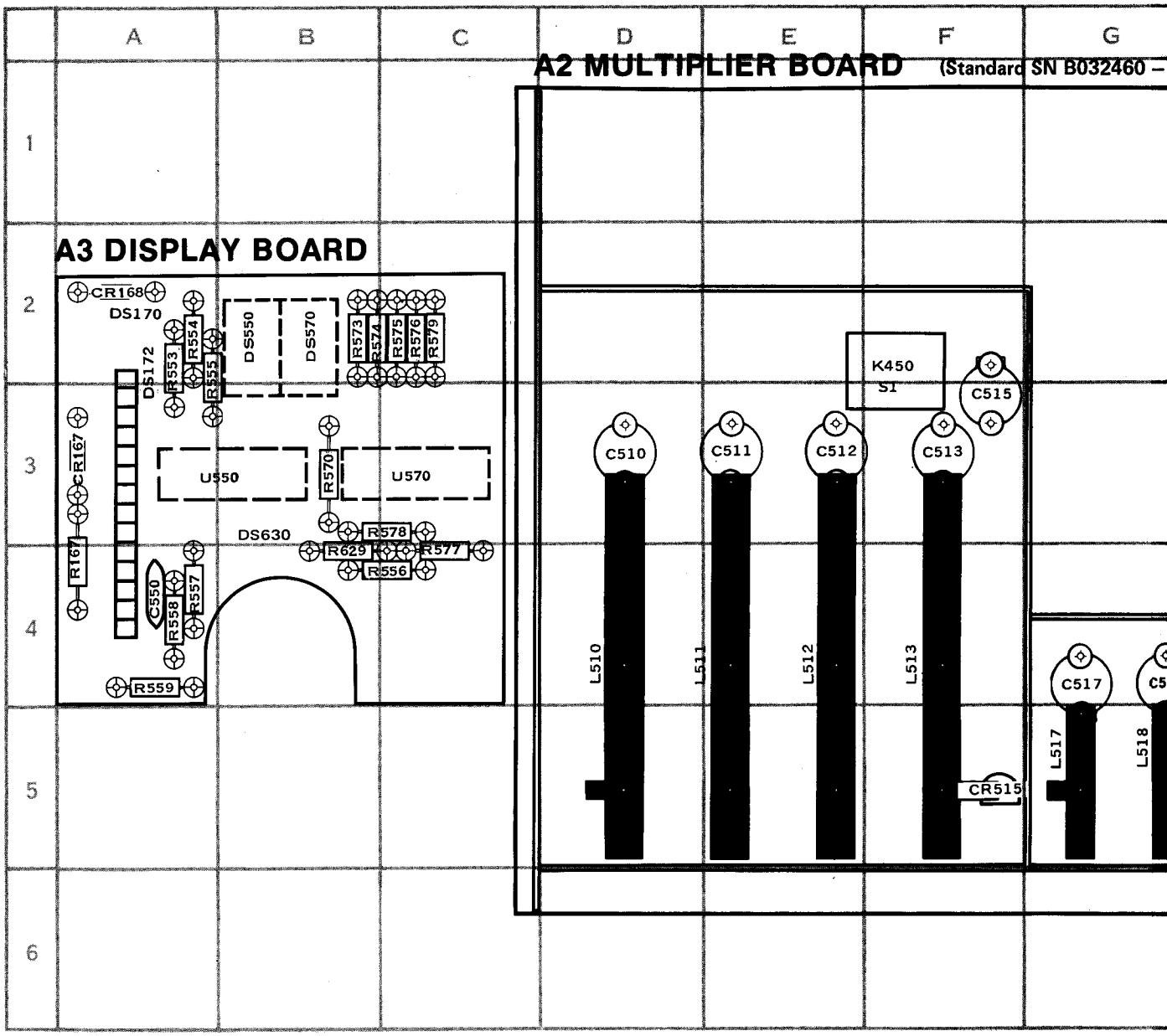
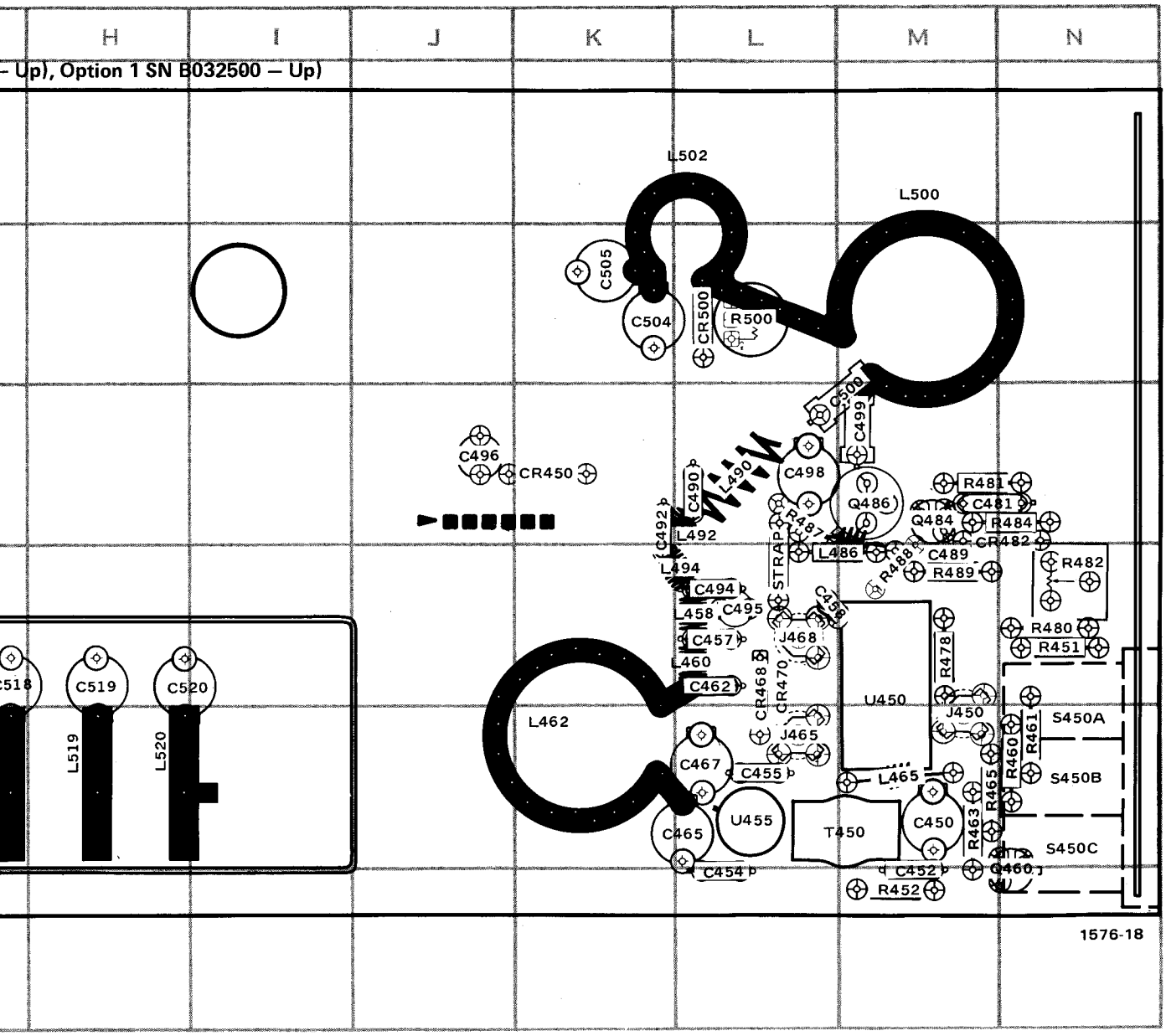


Fig. 8-5. A3—Display board and A2—Multiplier

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er board component location grid.

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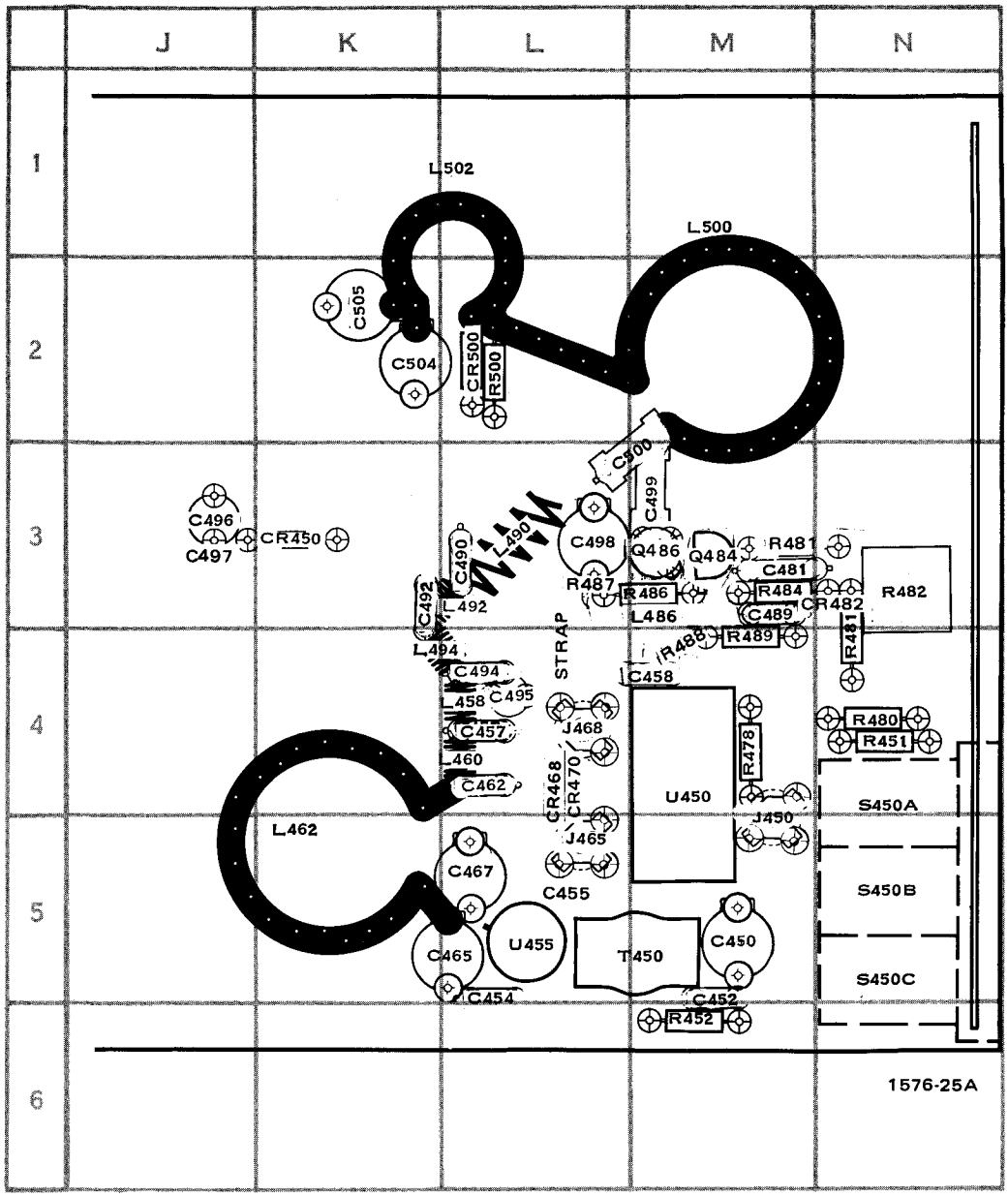


Fig. 8-6. Partial A2—Multiplier board component location grid.

(Standard SN B010100 – B032459, Option 1 SN B010100 – B032499)

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P/O A1 ASSY — **Readout Logic & Phase Lock Loop** 1

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C50	B1	B1	R50	B2	C1	R283	H7	L3
C100**	A3	G2	R52	B1	B1	R285	J8	K2
C102 †	A3	G2	R53†*	B1	B1	R286	J8	K3
C105**	B3	G2	R100**	B2	G1	R290	K8	K2
C125	C4	E5	R105**	B3	G2	R292	K7	L2
C127	C5	D4	R108**	B3	G1	R294	K8	M4
C137	B6	C4	R120	A4	E4	R295		I3
C138	B6	B4	R121	A5	E4			
C150†*	D2	E3	R123	B5	E4	S110	C4	E3
C160	F2	C4	R125	C4	E4			
C231	F6	J1	R127	C5	D5	U50†**	B2	H2
C239	F8	K1	R128	B5	E4	U100A**	B3	H1
C246	F7	L1	R130	A5	C4	U100B**	B2	H1
C250†	G7	K1	R132*†	B5	D4	U100C**	C3	H1
C251	G7	K1	R134*	B5	C3	U100D**	B3	H1
C265*	H6	L1	R135	B5	C3	U110A	D6	E1
C268	J6	H2	R136	B5	C4	U110B	D6	E1
C290	K7	K2	R137	B6	C4	U110C	J4	E1
C271	K6	M2	R138††*	B6	C4	U110D	C3	E1
C272	K5	M2	R140	A7	C5	U115A	E2	D2
C285	J8	K2	R142	C7	D4	U115B	H2	D2
C291*	K7	L2	R143	C7	D4	U115C	H4	D2
C292	K8	M2	R145†	C8	D4	U115D	C3	D2
C295*	K7	L2	R150	F3	E3	U150A	E3	E3
C297	G8	J2	R151	F2	C3	U160	F1	B4
C298	H8	K2	R153	E2	C3	U180A	C1	C2
C688**		H2	R154	E1	E3	U180B	J4	C2
CR50	B1	B1	R158	F1	B4	U180C	J5	C2
CR52	B1	B1	R159	F1	B4	U180D	H4	C2
CR54	B1	B1	R162	G1	D3	U185	J5	B2
CR115	C3	F4	R163	G1	D3	U190B	K4	H5
J1	C1	C1	R165	H1	C2	U195	K4	B2
J2	C1	C1	R172	K3	E1	U200	K5	B3
J3†*	B2	F2	R230	E6	J1	U210	G4	C3
J4**	C2	G2	R231	E6	J1	U212	F4	D1
J5**	C1	G2	R234	F6	K1	U215A	F4	C1
J6**	C2	G2	R236	E7	I1	U215B	F5	C1
J7†**	C2	G2	R238	E7	J1	U218	E4	D3
J8†	G6	L2	R239	F7	J1	U220	E4	E2
			R245	F6	M1	U225	D7	I1
L137††*	B6	C4	R246	F7	M1	U230A	E6	J1
L297	G7	K2	R248	F7	K2	U230B	E7	J1
			R250	F7	K1	U235A	E7	I3
Q120	B4	E4	R252	G6	L2	U235B	J3	I3
Q130	B5	D4	R253	G5	L2	U250	F6	L1
Q135	C6	D4	R254†*	H6	L1	U290D	L8	M3
Q140	B7	D4	R255	G6	L2	U350	C3	K4
Q255	G6	M1	R256	G7	M1			
Q260	H6	M1	R262	H6	L2	VR140	A7	C4
Q265	H6	L1	R263	H6	M2	VR250	G6	K1
Q270	J6	H2	R265	H6	M1	VR255	G6	L2
Q272	K6	L2	R266	H7	L2	VR282	H7	L3
Q280	J7	L2	R271	K6	M2			
Q285	K2	L2	R272	K5	M2	Y50**	B2	F1
Q290	K2	L2	R280	J7	K2	Y100 **	B2	G1
			R282	H7	K3			

P/O A3 ASSY — **Reference, Readout Logic, & Phase-Lock Loop** 1

CR167	K1	A3						
CR168	K1	A2						
DS170†	K2	A2						
DS172†	K2	A2						
R167	K1	A4						

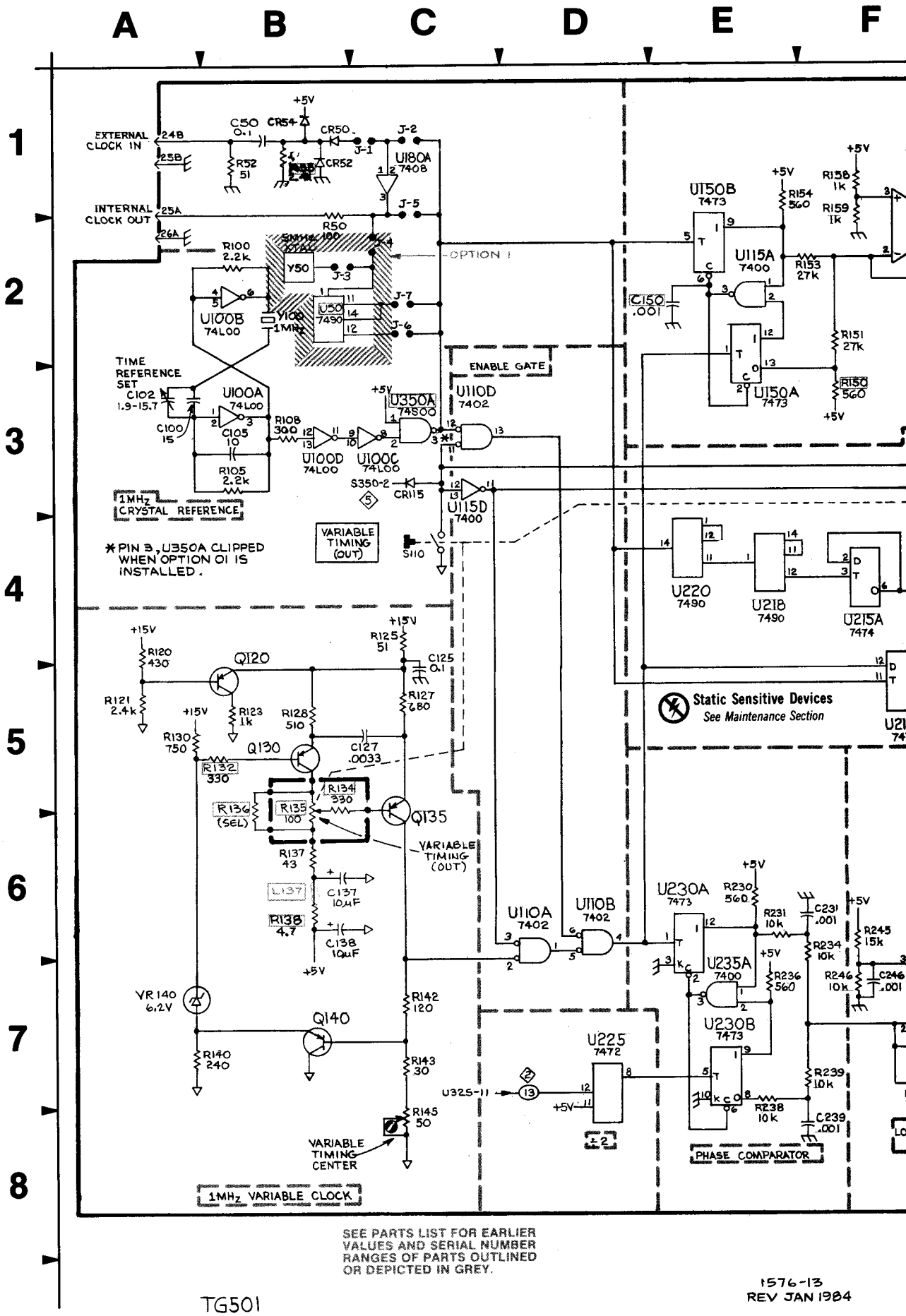
†Located on back of board

††L137 Replaced by R138 at SN B030000

*See Parts List for serial number ranges.

**Option 1 only

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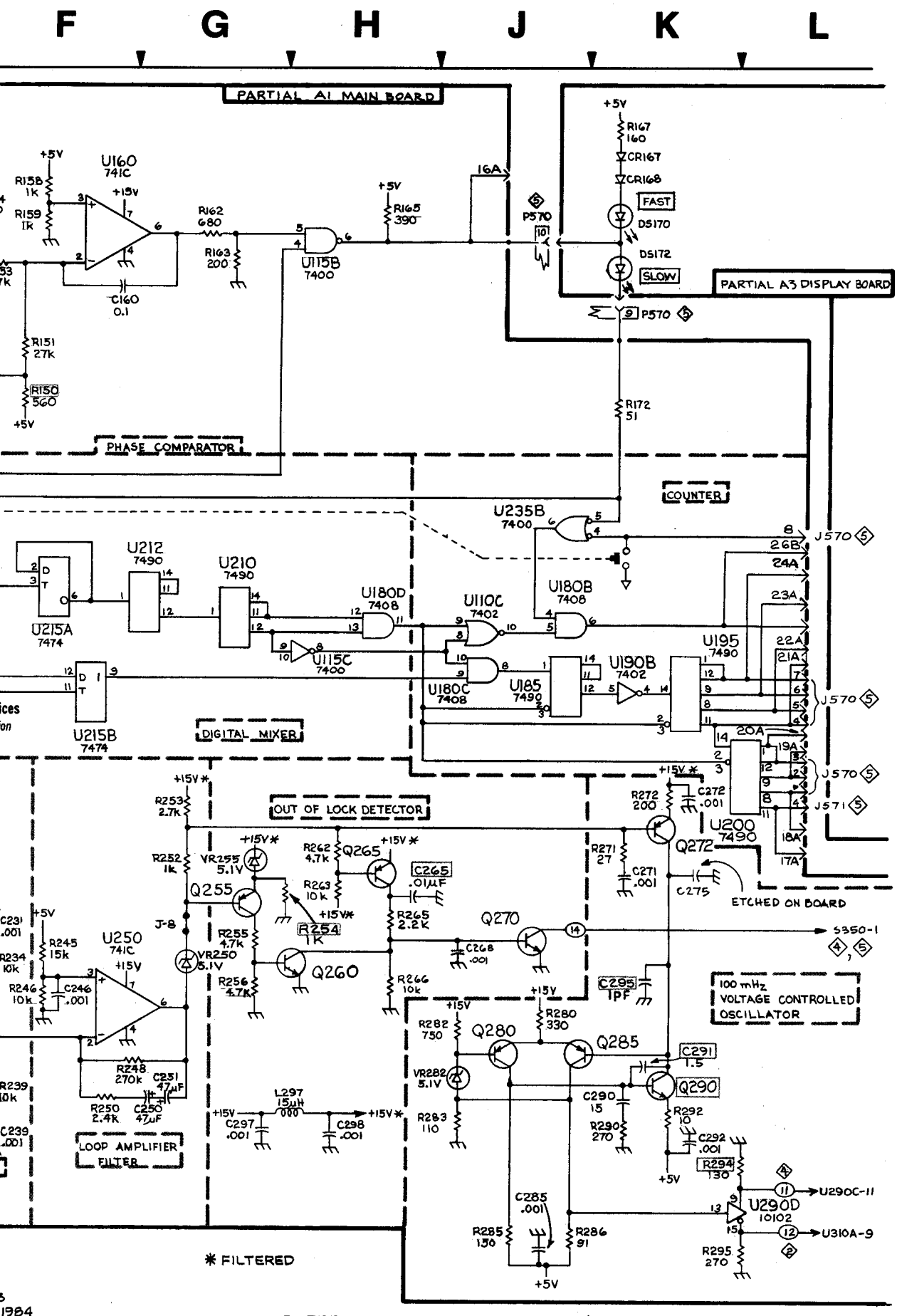


SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

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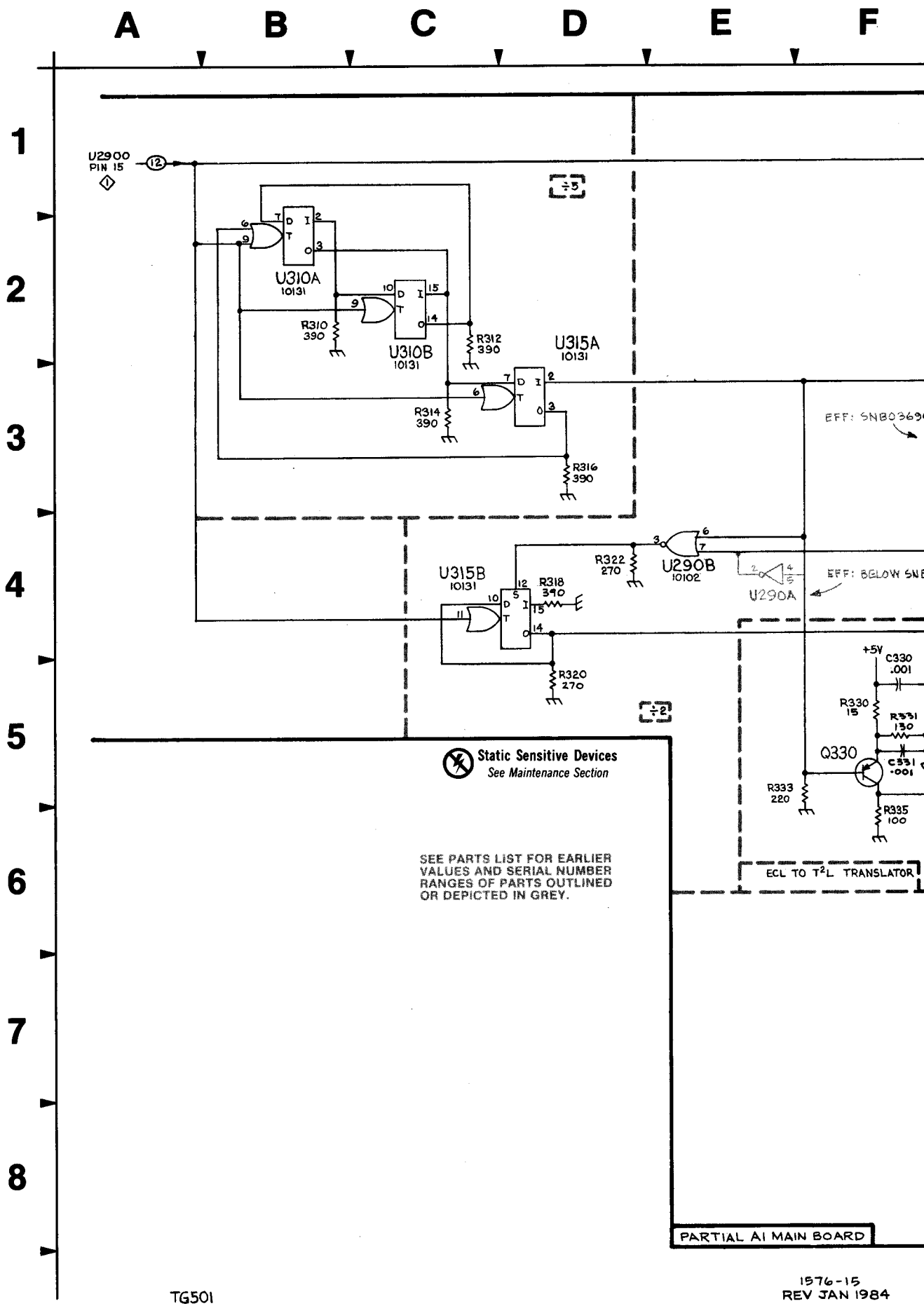
P/O A1 ASSY

High Speed Dividers & 5,2,1 Sequencing Logic ◇2◇

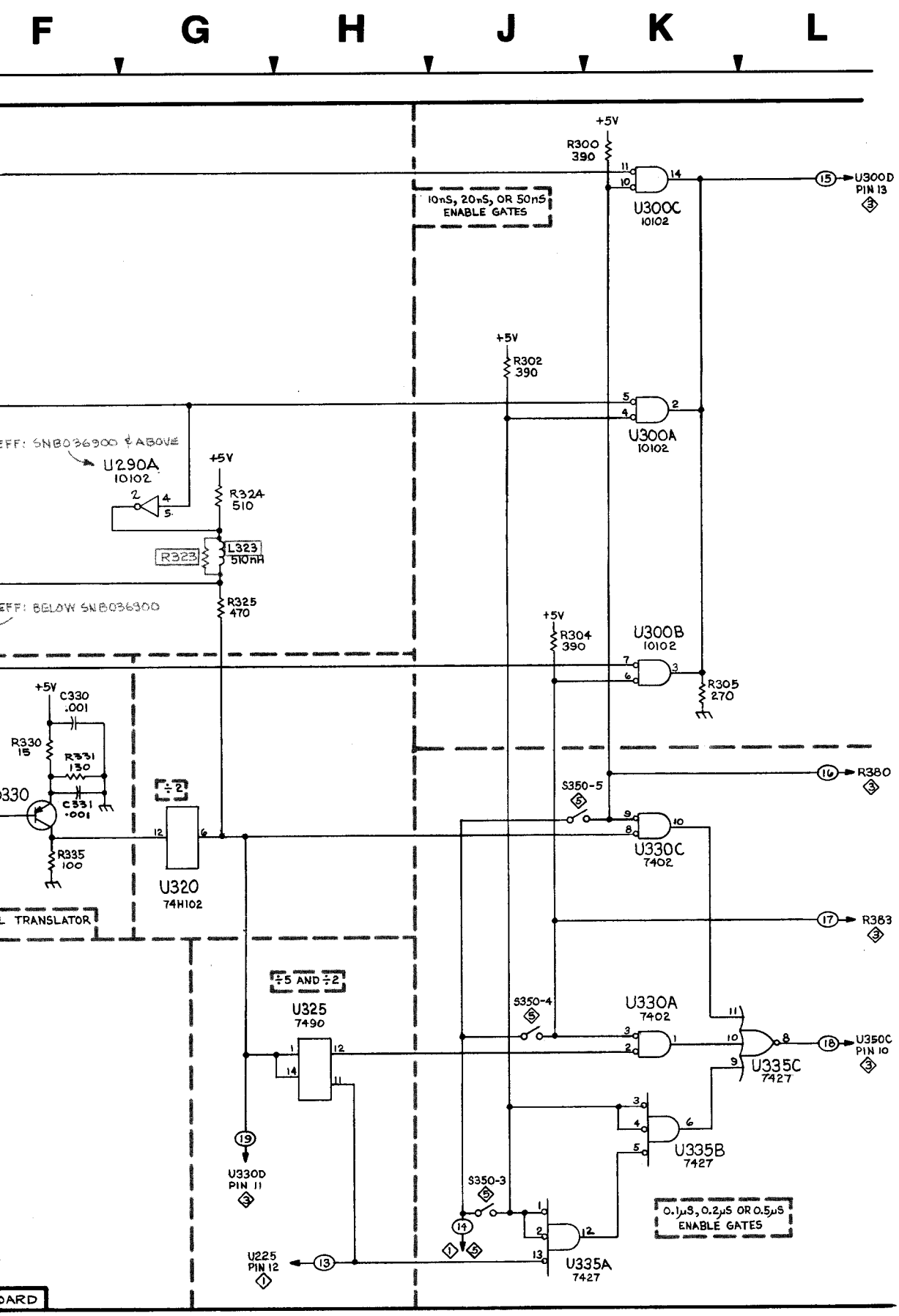
CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C330	F4	I1	S350-3	J8	G3
C331	F5	I2	S350-4	J6	G3
L323*	G4	L3	S350-5	J5	G3
Q330	F5	I2			
R300	J1	I4	U290A	F3	M3
R302	J2	I3	U290B	E4	M3
R304	J4	L3	U300A	K3	K3
R305	K4	K3	U300B	K4	K3
R310	B2	K3	U300C	K1	K3
R312	C2	J3	U310A	B2	J3
R314	C3	J3	U310B	C2	J3
R316	D3	J2	U315A	D2	J2
R318	D4	J3	U315B	C4	J2
R320	D5	K2	U320	G6	I2
R322	D4	K2	U325	H7	D5
R323*	G4	L3	U330A	K6	G5
R324	G4	L4	U330C	K5	G5
R325	G4	L3	U335A	J8	E5
R330	F5	I2	U335B	K7	E5
R331	F5	I2	U335C	L7	E5
R333	E5	I2			
R335	F5	J2			

*See Parts List for serial number ranges.

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HIGH SPEED DIVIDERS & 5, 2, 1 SEQUENCING LOGIC ②

HIGH SPEED DIVIDERS & 5,2,1 SEQUENCING LOGIC ② JEN

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P/O A1 ASSY

Decade Divider & Output Amplifier 3

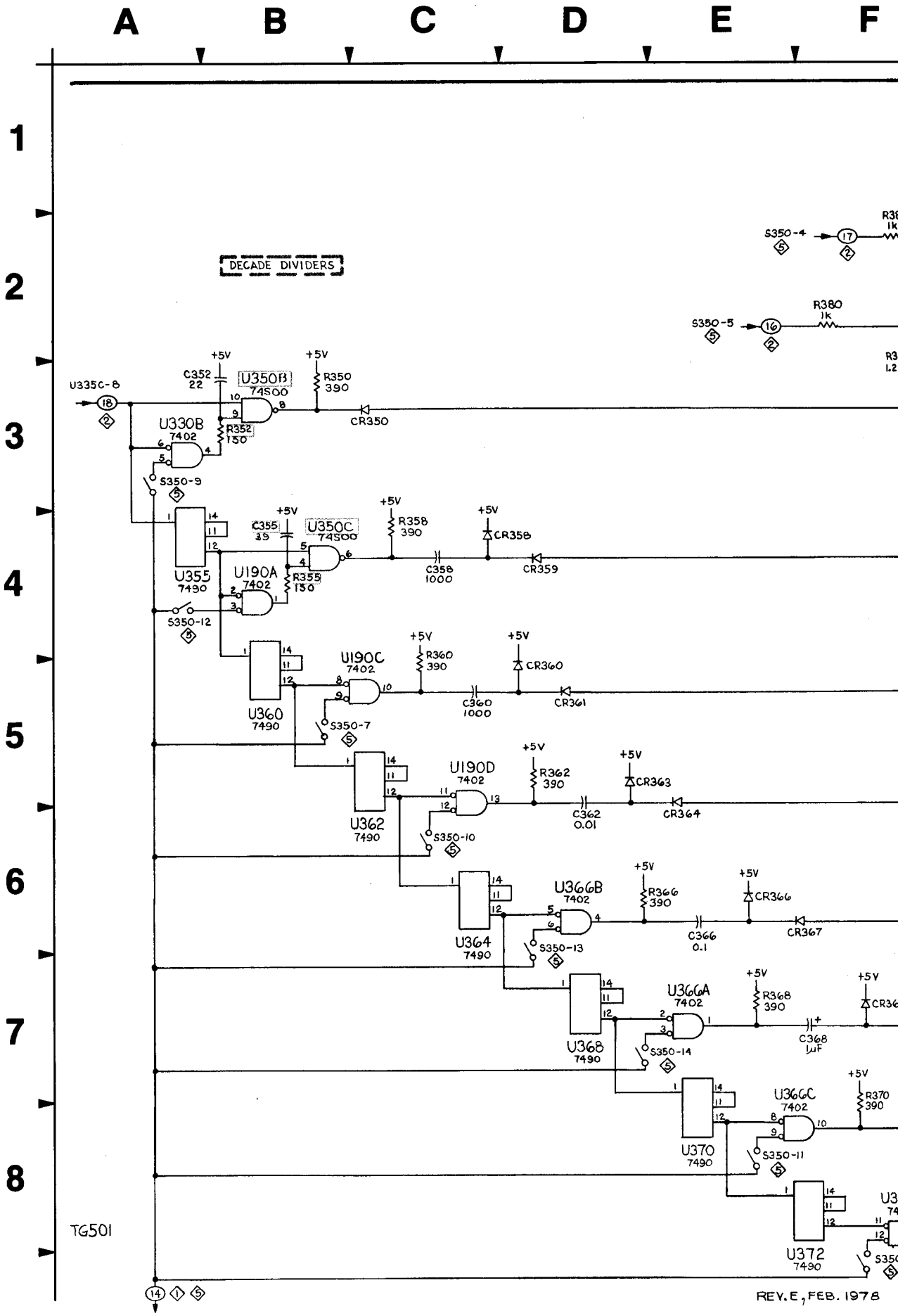
CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C352	A3	L4
C355	B4	K4
C358	C4	J4
C360	C5	H5
C362	D6	H4
C366	E6	I4
C368	F7	J4
C370	F8	I4
C372	G8	J5
C390	J1	M4
C400	J2	L4
C404	G2	K5
C405	H3	K5
C413	J3	K6
C415	K2	K5
C416*	J3	J5
C417*	K3	K5
C430†	K4	M5
C432†	K5	L6
C439	K5	L5
C440	J6	L6
CR350	C3	K5
CR358	C4	J4
CR359	D4	J4
CR360	D5	G4
CR361	D5	G4
CR363	D5	H4
CR364	E6	I4
CR366	E6	I4
CR367	E6	I4
CR369	F7	J4
CR370	F7	J4
CR372	G8	I4
CR373	G8	I4
CR375	G8	J4
CR376	G8	J4
CR415	K3	K5
CR445	J5	K5
Q380	F2	L4
Q384	G2	K4
Q390	K1	M5
Q400	K2	L5
Q405	G3	L5
Q408	J2	K5
Q415	J2	K5
Q430	K5	L5
Q435	K6	M6
Q440	K6	L6
J420†	K3	L5
R350	B3	J4
R352	B3	K4
R355	B4	I5
R358	C4	K4
R360	C4	H4
R362	D5	H5
R366	E6	I5
R368	E7	J4
R370	F7	I4
R372	G8	J5

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
R380	F2	L4
R381	F2	L4
R383	F2	L4
R384	G2	L4
R385	G2	L4
R387	H1	H3
R390	J1	M5
R391	J2	L4
R393	K1	M5
R394	K1	M5
R396	K1	M5
R398	K2	L4
R400	K2	M5
R405	G3	K5
R406	H3	J5
R408	H2	J6
R410	J3	J5
R412	J3	J6
R413	J3	J6
R415	J3	K5
R417	J3	J5
R420	K3	L5
R430	K4	L5
R432	K5	L6
R435	K6	M6
R437	K6	L6
R439	K5	L6
R440	J6	L6
R445†	J6	K5
R447	J5	G5
S350-2	H6	G3
S350-6	H6	G3
S350-7	B5	G3
S350-8	F8	G3
S350-9	A3	G3
S350-10	C6	G3
S350-11	E8	G3
S350-12	A4	G3
S350-13	D6	G3
S350-14	E7	G3
U190A	B4	H5
U190C	C4	H5
U190D	C5	H5
U235C	H6	I3
U235D	H6	I3
U300D	H2	K3
U330B	A3	G5
U330D	J6	G5
U350B	A3	K4
U350C	B4	K4
U355	A4	F5
U360	B5	D6
U362	C6	E6
U364	C6	F6
U366A	E7	I5
U366B	D6	I5
U366C	E7	I5
U366D	F8	I5
U368	D7	G6
U370	E8	H6
U372	E8	I6
J435	L6	CHASSIS

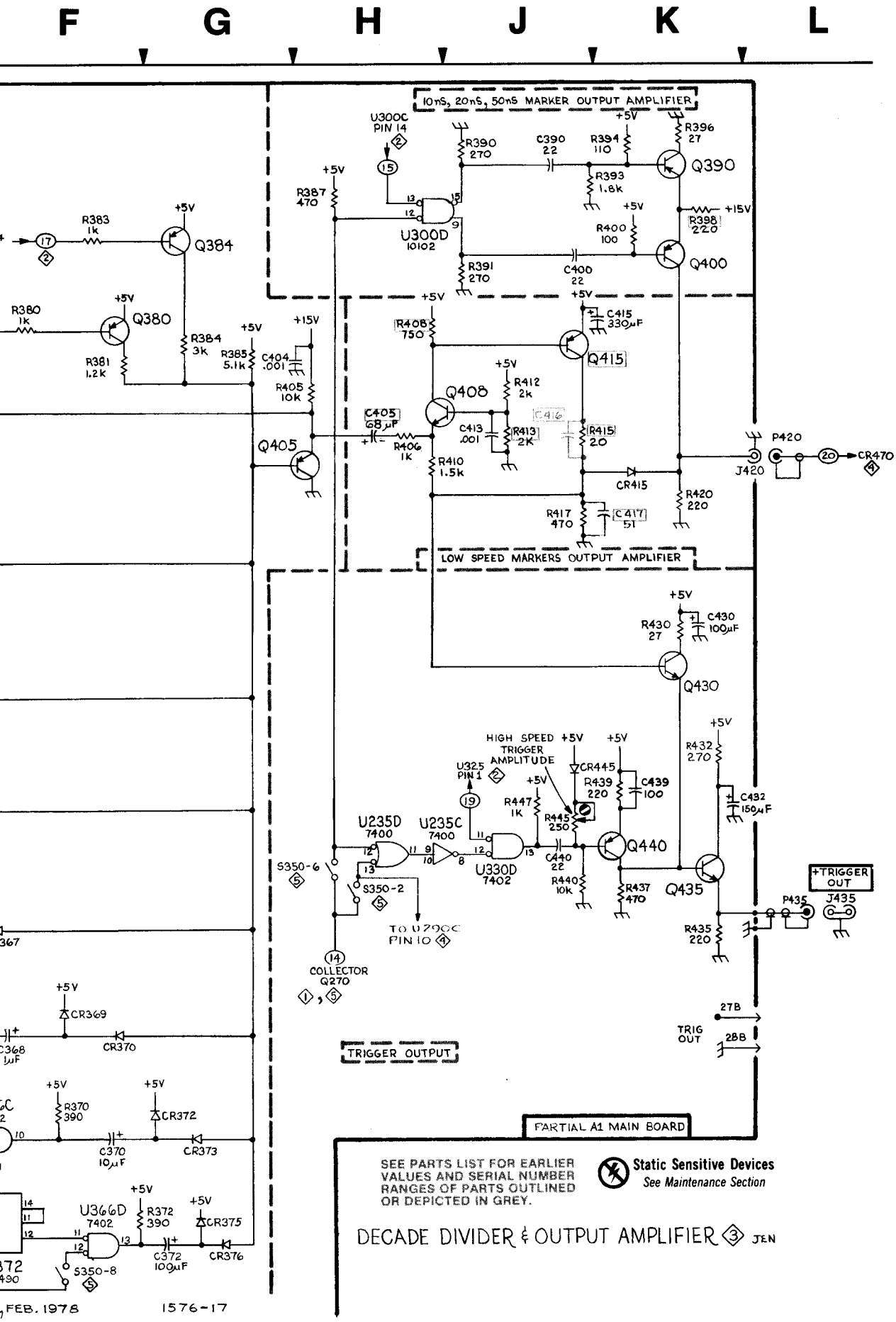
*See Parts List for serial number ranges.

†Located on back of board.

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P/O A2 ASSY — **Multiplier 4**

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C450	C3	M5	L510	H5	D4
C452	C3	M6	L511	H5	E4
C454	D3	L6	L512	H5	E4
C455	E2	L5	L513	H5	F4
C457	D2	L4	L517	K5	G5
C458	C1	L4	L518	K5	G5
C462	E2	L4	L519	K5	H5
C465	F3	L5	L520	K5	H5
C467	F3	L5			
C481	C5	M3	Q460*	G3	N6
C489	D5	M4	Q484	D5	M3
C490	E4	L3	Q486	E6	M3
C492	F4	K3			
C494	K6	L4	R451	B3	N4
C495	K6	L4	R452	D3	M6
C496	K6	J3	R460*	F3	N5
C497*	L7	J3	R461*	G4	N5
C498	E5	L3	R463*	G3	M5
C499	F5	M3	R465*	G3	M5
C500	F5	L3	R478	B5	M4
C504	G5	K2	R480	B5	N4
C505	G5	K2	R481	C5	M3
C510	H4	D3	R481[1]	C5	N4
C511	H4	E3	R482	D5	N4
C512	H4	E3	R484	D5	N3
C513	H4	F3	R486	D6	M3
C515	J4	F3	R487		L3
C517	K4	G4	R488	D5	M4
C518	K4	G4	R489	D5	M4
C519	K4	H4	R500	F5	L2
C520	K4	H4			
CR450	C4	K3	S1[2]		
CR468*	H3	L4	S450A†	A3	N5
CR470	J2	L4	S450B†	A4	N5
CR482	D5	N3	S450C†	A6	N5
CR500	F5	L2			
CR515	J5	F5	T450	D2	M5
J450	B2	M5	U450	C5, C3	M4
J465	J2	L5	U455	E3	L5
J468	J3	L4			
K450	C4	F2			
K450-S1	C4	F3			
L458	E2	L4			
L460	E2	L4			
L462	E2	K5			
L465*	G3	M5			
L486*	D6	L4			
L490	E4	L3			
L492	E4	L3			
L494	E4	L4			
L500	F5	M2			
L502	G5	L1			

P/O A1 ASSY — **Multiplier 4**

J290	A2	M4	S350-1	B7	G3
J472	K3	A1	S350-2	A7	G3
			S350-5	B2	G3
R450	A2	M3			
			U290C	A2	M3
			P290	B2	CHASSIS
			P450	B2	CHASSIS

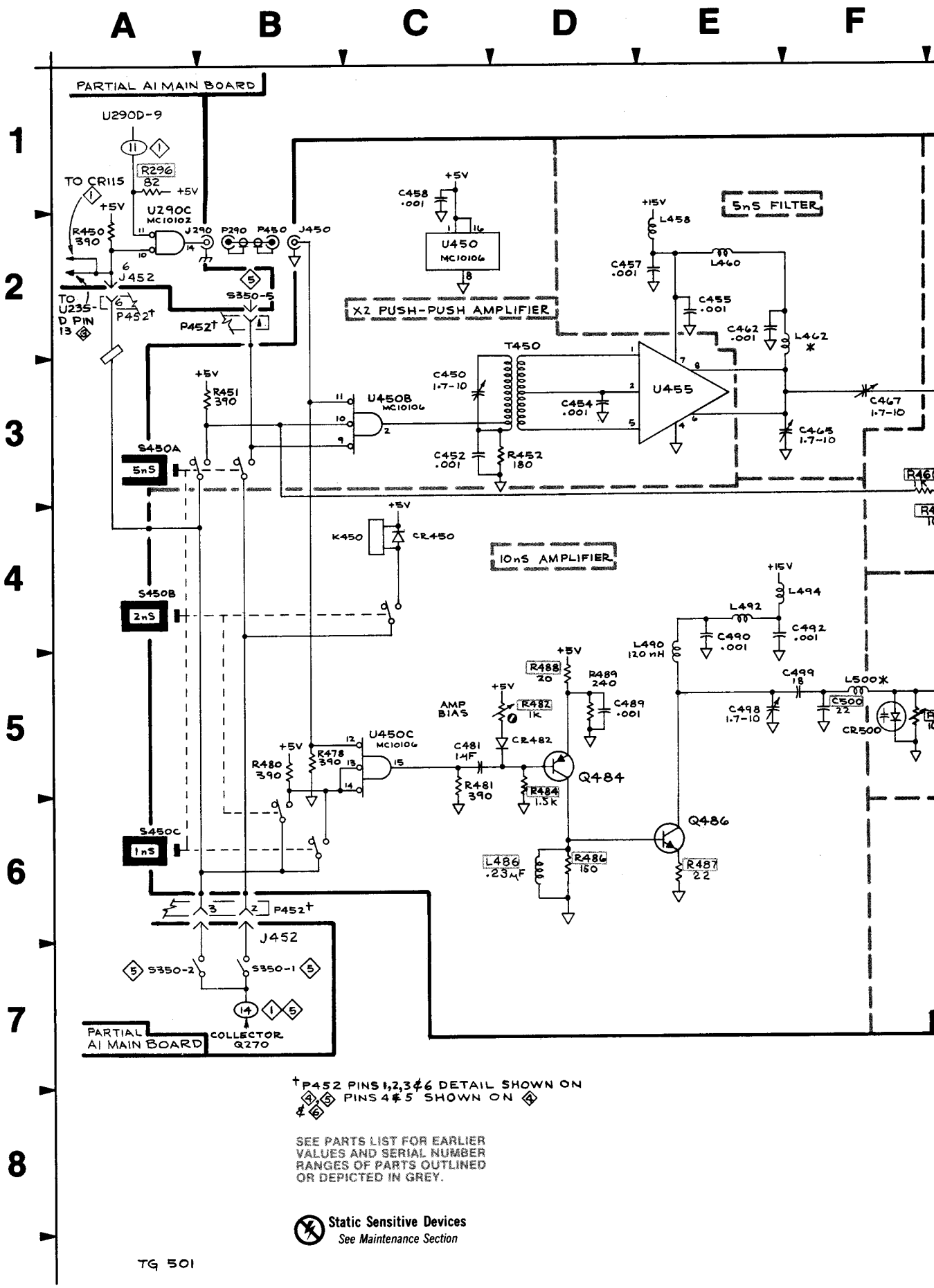
†Located on back of board.

*See Parts List for serial number ranges.

[1] Alternate Location

[2] See K450-S1 for S1[2]

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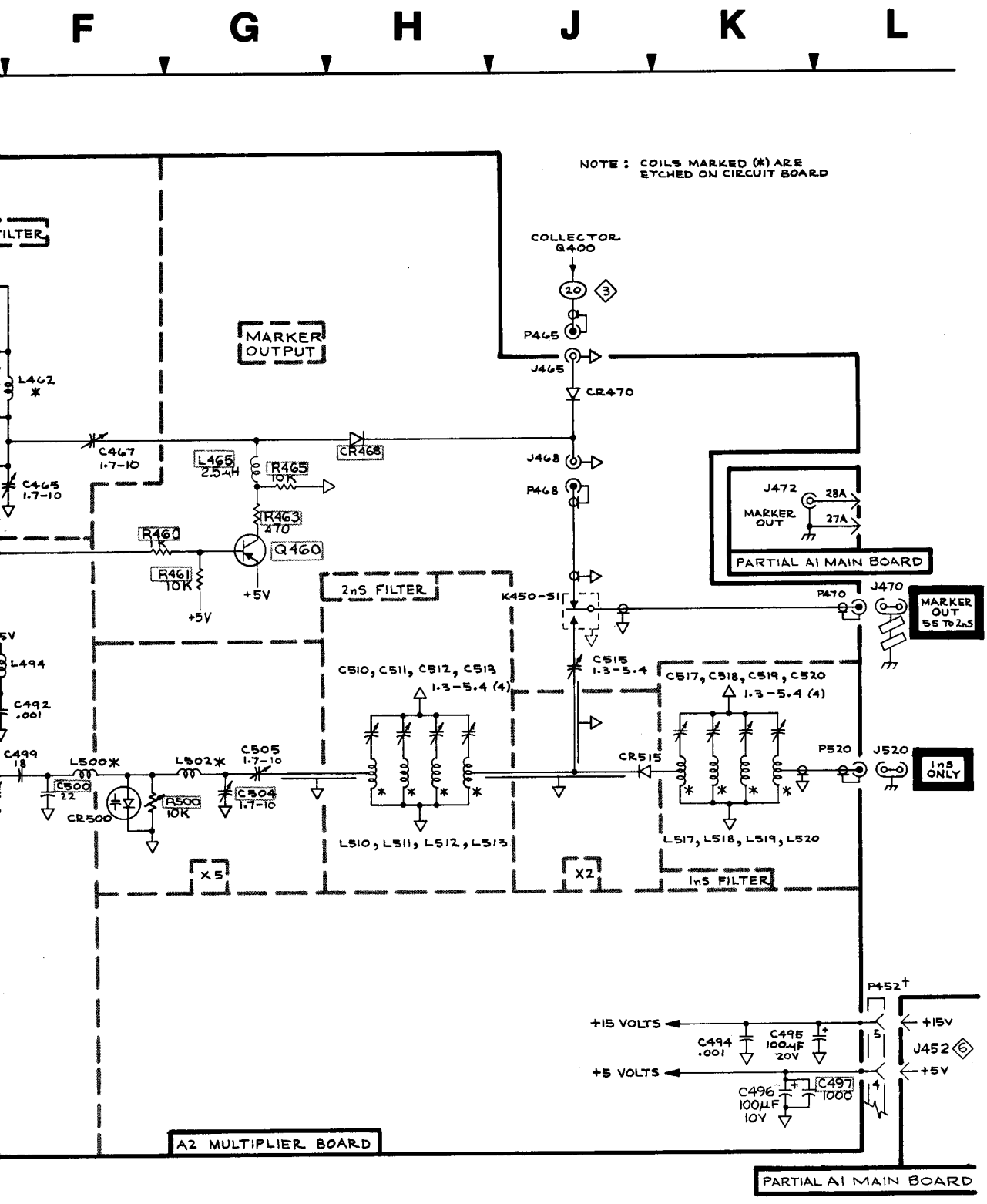
†P452 PINS 1,2,3 & 6 DETAIL SHOWN ON ④
PINS 4 & 5 SHOWN ON ④ & ⑥

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

Static Sensitive Devices
See Maintenance Section

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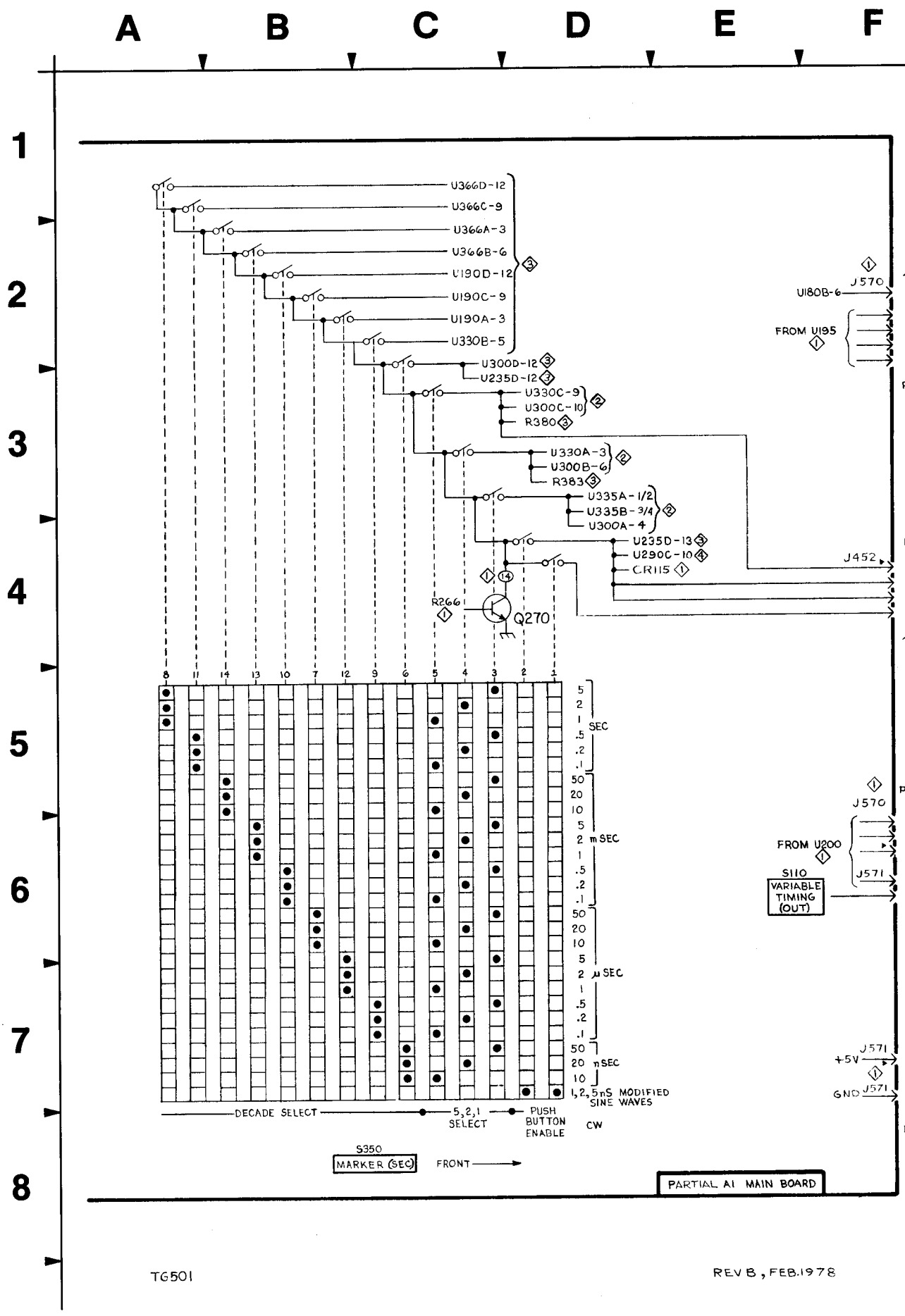
P/O A1 ASSY — **Display & Switch Details** ◇5

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
J452	F4	I4	Q270	C4	H2
J570	F2	B2			
J571	F6	B3	S350	C8	G3

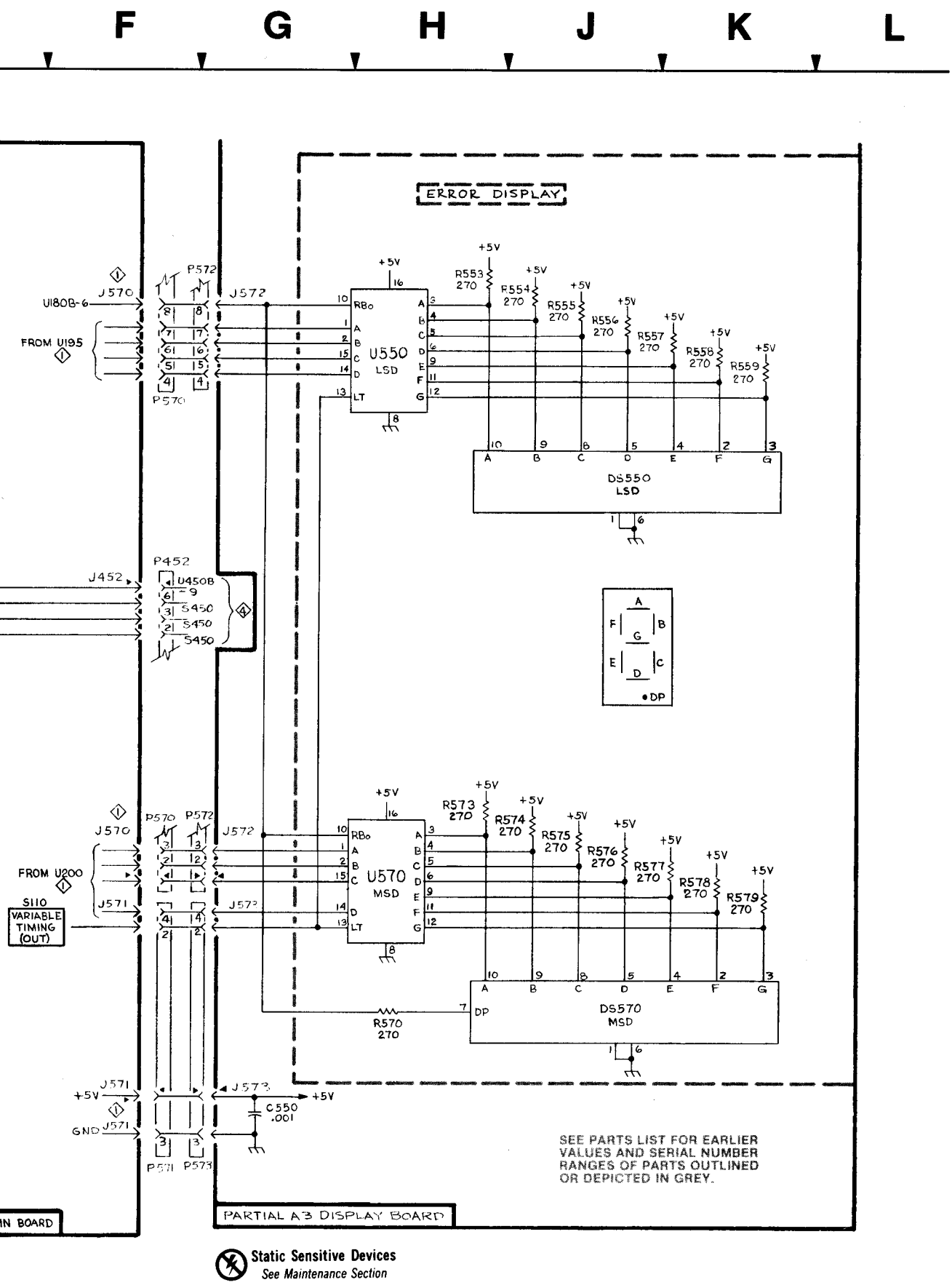
P/O A3 ASSY — **Display & Switch Details** ◇5

DS550†	J3	B2	R557	K2	A4
DS570†	J7	B2	R558	K2	A4
			R559	K2	A4
C550	G7	A4	R570	H7	B3
			R573	H5	B2
J572	G5	A3	R574	J5	B2
J573	G7	A4	R575	J5	C2
			R576	J6	C2
R553	H2	A2	R577	K6	C4
R554	J2	A2	R578	K6	C3
R555	J2	A2	R579	K6	C2
R556	J2	C4			
			U550†	H2	B3
			U570†	H6	C3

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Static Sensitive Devices
See Maintenance Section

DISPLAY AND SWITCH DETAILS 5 0873 JEN

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P/O A3 ASSY — **Power Supply 6**

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
DS630	F8	B3	R629	F8	B4

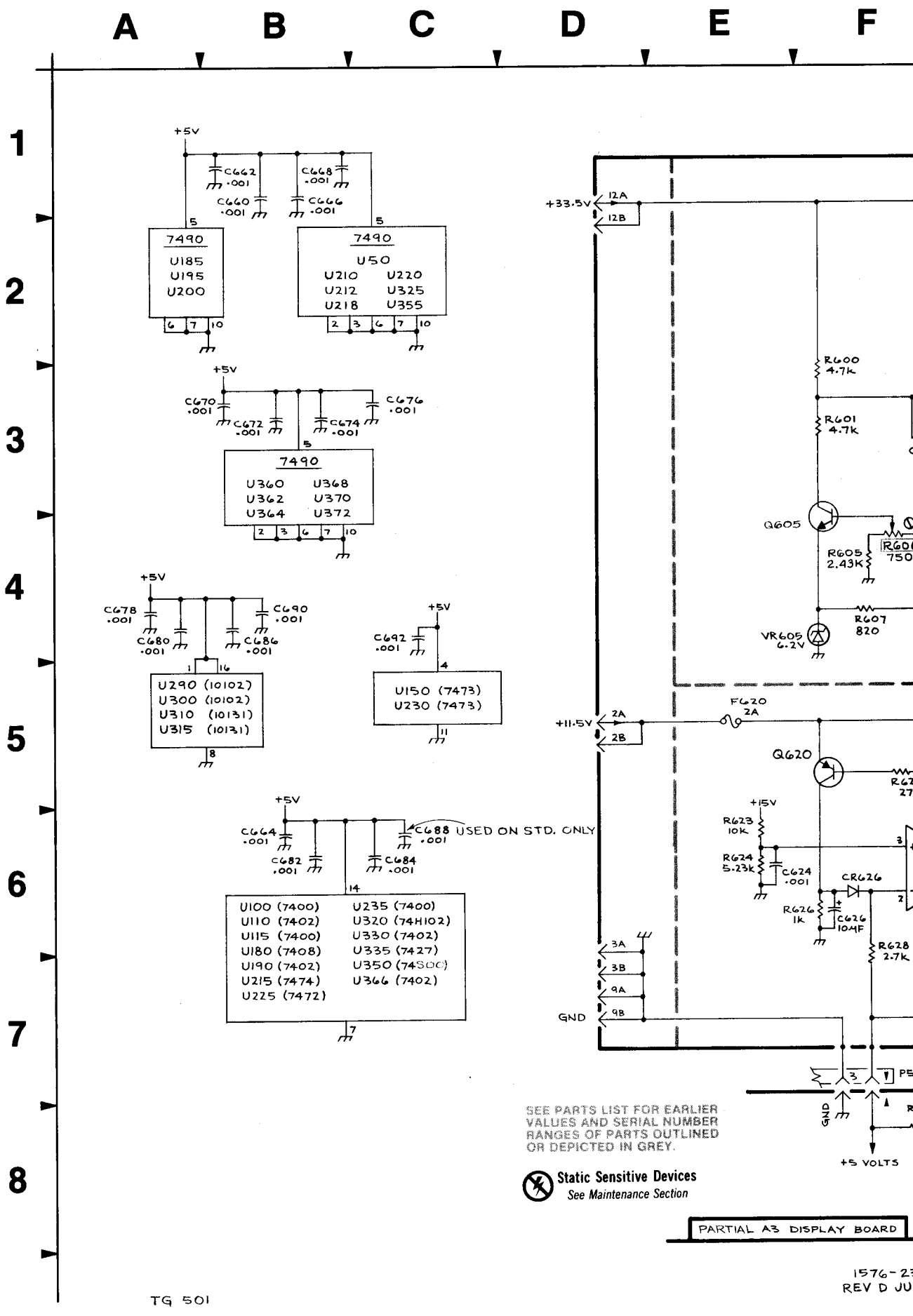
P/O A1 ASSY — **Power Supply 6**

C610	H3	B5	R603	G3	B5
C615	J4	B4	R605	F4	C5
C616	H4	C5	R606†*	F4	C5
C624	E6	C6	R607	F4	C5
C626	F6	C6	R610	H3	B5
C640	J7	B5	R612	H2	B4
C641	J7	B5	R614	J2	B4
			R616	H4	C5
CR600	F3	B5	R620	F5	A5
CR626	F6	D5	R621†	G5	A5
			R623	E6	B6
F620	E5	A6	R624	E6	B6
			R626	F6	D5
Q600	G3	B5	R628	F7	B6
Q605	F4	C5	R634	H6	C5
Q610	H3	B4	R635	H6	B5
Q620	F5	B6	R640	J8	B5
Q635	H6	B6			
			U625	G6	C6
R600	F3	C5			
R601	F3	C5	VR600	G2	B4
			VR605	F4	B5
			VR640	J7	B5

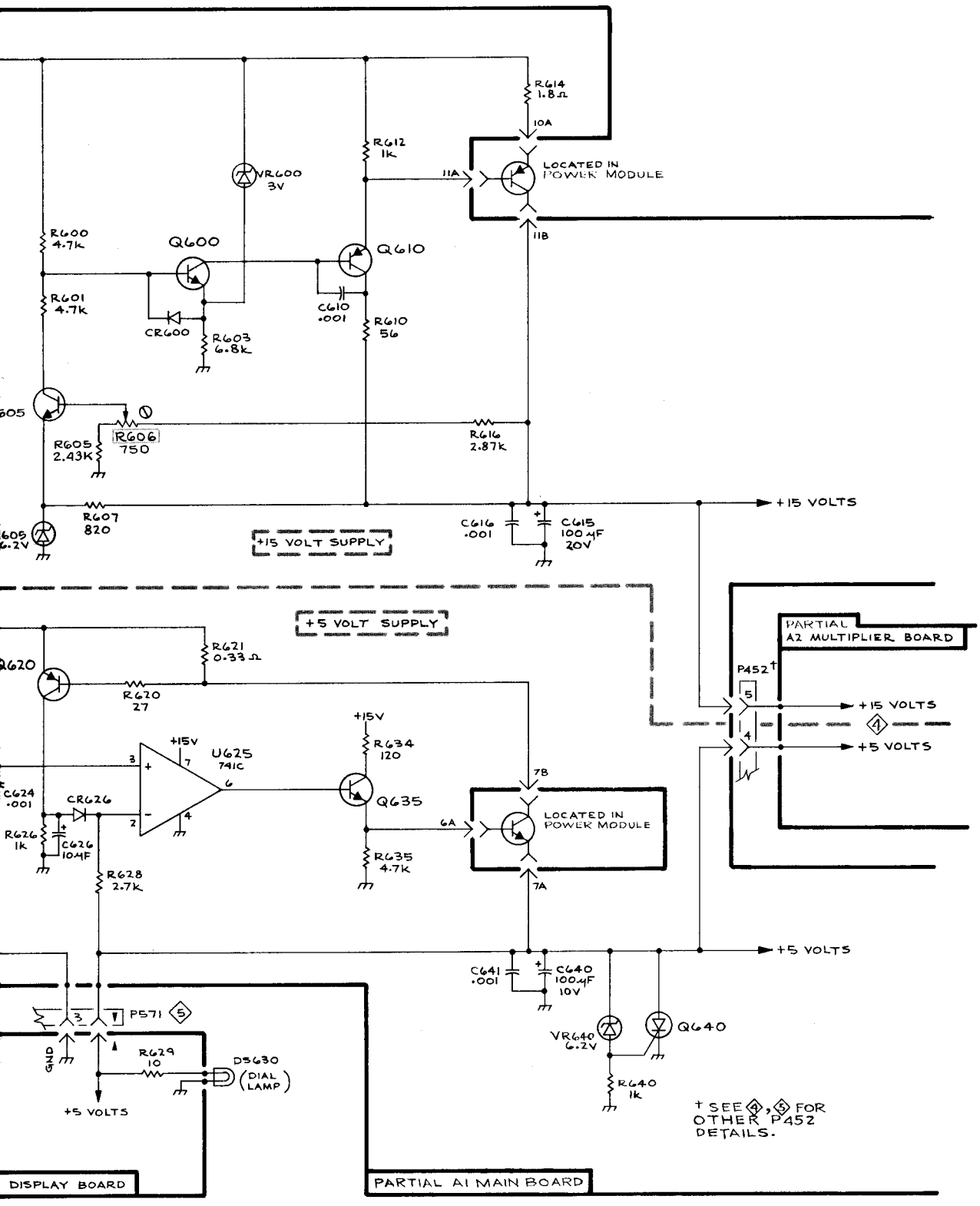
†Located on back of board.

*See Parts List for serial number ranges.

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Power Supply 6 DEH

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REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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, instrument type or number, 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, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 *Name & Description*

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

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CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OREGON 97005
000EX	O'HARA METAL PRODUCT COMPANY	542 BRANNAN STREET	SAN FRANCISCO, CA 94107
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
45722	USM CORP., PARKER-KALON FASTENER DIV.		CAMPBELLSVILLE, KY 42718
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
71159	BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC.	P O BOX 2244, 40 BRISTOL ST.	WATERBURY, CT 06720
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
93907	CAMCAR SCREW AND MFG. CO.	600 18TH AVE.	ROCKFORD, IL 61101
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	337-1399-00	B010100	B010209	2		SHLD,ELECTRICAL:SIDE	80009	337-1399-00
	337-1399-00	B010210		1		SHLD,ELECTRICAL:SIDE	80009	337-1399-00
	337-1399-02	XB010210		1		SHLD,ELECTRICAL:SIDE WITH INSULATOR	80009	337-1399-02
-2	366-1166-00			1		KNOB:RED,0.127 ID X 0.392 OD	80009	366-1166-00
	213-0153-00			1		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-3	366-1509-00	B010100	B036340	1		KNOB:GRAY	80009	366-1509-00
	366-1509-01	B036341		1		KNOB:GRAY	80009	366-1509-01
	213-0153-00			2		. SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT	000CY	OBD
-4	358-0029-00			1		BSHG,MACH.THD:HEX,0.375-32 X 0.438"LONG	80009	358-0029-00
						(ATTACHING PARTS)		
-5	210-0590-00			1		NUT,PLAIN,HEX.:0.375 X 0.438 INCH,STL	73743	2X28269-402
-6	210-0012-00			1		WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
						- - - * - - -		
-7	366-1489-33			1		PUSH BUTTON:--5NS	80009	366-1489-33
-8	366-1489-34			1		PUSH BUTTON:--2NS	80009	366-1489-34
-9	366-1489-35			1		PUSH BUTTON:--1NS	80009	366-1489-35
-10	426-0681-00			3		FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
	214-1840-00	B010100	B033140X	1		PIN,KNOB SECRG:0.094 OD X 0.120 INCH LONG	80009	214-1840-00
	----- -----			-		STANDARD ONLY)		
	214-1840-00	B010100	B033259X	1		PIN,KNOB SECRG:0.094 OD X 0.120 INCH LONG	80009	214-1840-00
	----- -----			-		(OPTION 01 ONLY)		
-11	366-1422-01	B010100	B033149	1		KNOB:LATCH	80009	366-1422-01
	----- -----			-		STANDARD ONLY)		
	366-1690-00	B033150		1		KNOB:SIL GY,0.53 X0.23 X 1.059	80009	366-1690-00
	----- -----			-		STANDARD ONLY)		
	366-1422-01	B010100	B033259	1		KNOB:LATCH	80009	366-1422-01
	----- -----			-		(OPTION 01 ONLY)		
	366-1690-00	B033260		1		KNOB:SIL GY,0.53 X0.23 X 1.059	80009	366-1690-00
	----- -----			-		(OPTION 01 ONLY)		
-12	131-1315-00	B010100	B035209	3		CONN,RCPT,ELEC:BNC,FEMALE	80009	131-1315-00
	131-1315-01	B035210		3		CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR 306-1
-13	333-1778-00			1		PANEL,FRONT:	80009	333-1778-00
						(ATTACHING PARTS)		
-14	213-0055-00	B010100	B031769	2		SCR,TPG,THD FOR:2-32 X 0.188 INCH,PNH STL	93907	OBD
	211-0034-00	B031770		2		SCREW,MACHINE:2-56 X 0.50 INCH,PNH	83385	OBD
						- - - * - - -		
-15	378-0742-00			1		LENS,LIGHT:CLEAR	80009	378-0742-00
-16	214-1513-01	B010100	B033149	1		LCH,PLUG-IN RET:	80009	214-1513-01
	----- -----			-		STANDARD ONLY)		
	105-0719-00	B033150		1		LATCH,RETAINING:PLUG-IN	80009	105-0719-00
	----- -----			-		STANDARD ONLY)		
	214-1513-01	B010100	B033259	1		LCH,PLUG-IN RET:	80009	214-1513-01
	----- -----			-		(OPTION 01 ONLY)		
	105-0719-00	B033260		1		LATCH,RETAINING:PLUG-IN	80009	105-0719-00
	----- -----			-		(OPTION 01 ONLY)		
						(ATTACHING PARTS)		
-17	213-0254-00			1		SCREW,TPG,TF:2-32 X 0.250,100 DEG,FLH	45722	OBD
						- - - * - - -		
-18	105-0718-00	XB033150	B034819	1		BAR,LATCH RLSE:	80009	105-0718-00
	----- -----			-		STANDARD ONLY)		
	105-0718-01	B034820		1		BAR,LATCH RLSE:	80009	105-0718-01
	----- -----			-		STANDARD ONLY)		
	105-0718-00	XB033260		1		BAR,LATCH RLSE:	80009	105-0718-00
	----- -----			-		(OPTION 01 ONLY)		
-19	386-2673-00	B010100	B035695	1		SUBPANEL,FRONT:	80009	386-2673-00
	----- -----			-		(STANDARD ONLY)		
	386-2673-01	B035696		1		SUBPANEL,FRONT:	80009	386-2673-01
	----- -----			-		(STANDARD ONLY)		
	386-2673-00	B010100	B035919	1		SUBPANEL,FRONT:	80009	386-2673-00
	----- -----			-		(OPTION 01 ONLY)		
	386-2673-01	B035920		1		SUBPANEL,FRONT:	80009	386-2673-01
	----- -----			-		(OPTION 01 ONLY)		
						(ATTACHING PARTS)		
-20	213-0229-00	B010100	B035089	4		SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL	93907	OBD
	213-0123-00	B035090		4		SCREW,TPG,TF:6-32 X 0.375,SPCL TYPE,FLH	93907	OBD
						- - - * - - -		

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-21	----- -----			1		CKT BOARD ASSY:DISPLAY(SEE A3 REPL)		
						(ATTACHING PARTS)		
-22	213-0138-00	B010100	B031769	4		SCR,TPG,TF:4-24 X 0.188 INCH,PNH STL	83385	OBD
	213-0138-00	B031770		2		SCR,TPG,TF:4-24 X 0.188 INCH,PNH STL	83385	OBD
	210-0405-00	XB031770		2		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	12157-50
						- - - * - - -		
-23	131-0608-00			14		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-24	136-0252-04			40		. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-25	337-1873-00			1		SHIELD,ELEC:FRONT SUBPANEL	80009	337-1873-00
-26	337-1915-00			1		SHIELD,ELEC:COVER	80009	337-1915-00
-27	----- -----			1		CKT BOARD ASSY:MULTIPLIER(SEE A2 REPL)		
						(ATTACHING PARTS)		
-28	211-0014-00			2		SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
-29	211-0116-00	B010100	B037049	4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	----- -----			-		(STANDARD ONLY)		
	211-0292-00	B037050		4		SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
	----- -----			-		(STANDARD ONLY)		
	211-0116-00	B010100	B037169	4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	----- -----			-		(OPTION 01 ONLY)		
	211-0292-00	B037170		4		SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
	----- -----			-		(OPTION 01 ONLY)		
						- - - * - - -		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-30	136-0252-04			39		. SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-31	----- -----			3		. CONNECTOR BODY,:(SEE J450,J465 & J468 REPL)		
-32	----- -----			1		. SWITCH,PUSH:(SEE S450A-C REPL)		
-33	361-0383-00	B010100	B032459	4		. SPACER,PB SW:CHARCOAL,0.33 INCH LONG	80009	361-0383-00
	361-0382-00	B032460	B037409X	4		. SPACER,PB SW:BROWN,0.275 INCH LONG	80009	361-0382-00
	361-0542-00	XB032460	B037409	4		. SPACER,SWITCH:PLASTIC	71590	J-64281
	361-0383-00	B037410		4		. SPACER,PB SW:CHARCOAL,0.33 INCH LONG	80009	361-0383-00
-34	337-1436-00			1		. SHLD,ELECTRICAL:REED SWITCH	80009	334-1436-00
-35	337-1894-00			2		. SHIELD,ELEC:3.90 X 0.60"H,STRAIGHT	80009	337-1894-00
-36	337-1892-00			1		. SHIELD,ELEC:2.48 X 1.26 X 0.60"U SHAPE	80009	337-1892-00
-37	337-1891-00			1		. SHIELD,ELEC:2.96 X 2.53 X 0.60"U SHAPE	80009	337-1891-00
-38	337-1895-00	B010100	B032459X	2		. SHIELD,ELEC:EMI,LEFT	80009	337-1895-00
-39	337-1893-00	B010100	B032459	1		. SHIELD,ELEC:2.48 X 1.26 X 0.24"U SHAPE	80009	337-1893-00
	337-2311-00	B032460		1		. SHIELD,ELEC:1 NANO SEC COMB FILTER	80009	337-2311-00
-40	337-1890-00	B010100	B032459	1		. SHIELD,ELEC:2.50 X 2.96 X 0.24"U SHAPE	80009	337-1890-00
	337-2312-00	B032460		1		. SHIELD,ELEC:2 NANO SEC COMB FILTER	80009	337-2312-00
-41	337-1875-00	B010100	B032459	1		SHIELD,ELEC:AUXILIARY CKTBD	80009	337-1875-00
	337-1875-01	B032460	B035695	1		SHIELD,ELEC:AUXILLARY CKTBD	80009	337-1875-01
	----- -----			-		(STANDARD ONLY)		
	337-1875-03	B035696		1		SHIELD,ELEC:AUXILIARY CKT BD	80009	337-1875-03
	----- -----			-		(STANDARD ONLY)		
	337-1875-01	XB032460	B035919	1		SHIELD,ELEC:AUXILLARY CKTBD	80009	337-1875-01
	----- -----			-		(OPTION 01 ONLY)		
	337-1875-03	B035920		1		SHIELD,ELEC:AUXILIARY CKT BD	80009	337-1875-03
	----- -----			-		(OPTION 01 ONLY)		
						(ATTACHING PARTS)		
-42	211-0008-00			2		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						- - - * - - -		
	672-0068-00			1		CKT BOARD ASSY:--SWITCH,TIMING	80009	672-0068-00
	----- -----			-		(OPTION 01 ONLY)		
	672-0068-01			1		CKT BOARD ASSY:--SWITCH,TIMING	80009	672-0068-01
						(ATTACHING PARTS)		
-43	211-0008-00			2		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
-44	129-0123-00			2		SPACER,POST:0.688 L X 0.25,W/4-40 THD	80009	129-0123-00
-45	213-0146-00			2		SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
						- - - * - - -		
-46	384-1219-00			1		. EXTENSION SHAFT:8.20 INCH LONG	80009	384-1219-00
-47	214-1190-00			1		. CPLG,SHAFT,RGD:0.125 OD TO 0.125 OD,AL	80009	214-1190-00
	213-0075-00			1		. . SETSCREW:4-40 X 0.094,STL BK OXD,HEX SKT	000BK	OBD
	213-0239-00			1		. . SETSCREW:3-48 X 0.062 INCH,HEX SOC STL	71159	OBD
-48	214-1136-00			1		. ACTUATOR,SL SW:DUAL DPST	80009	214-1136-00

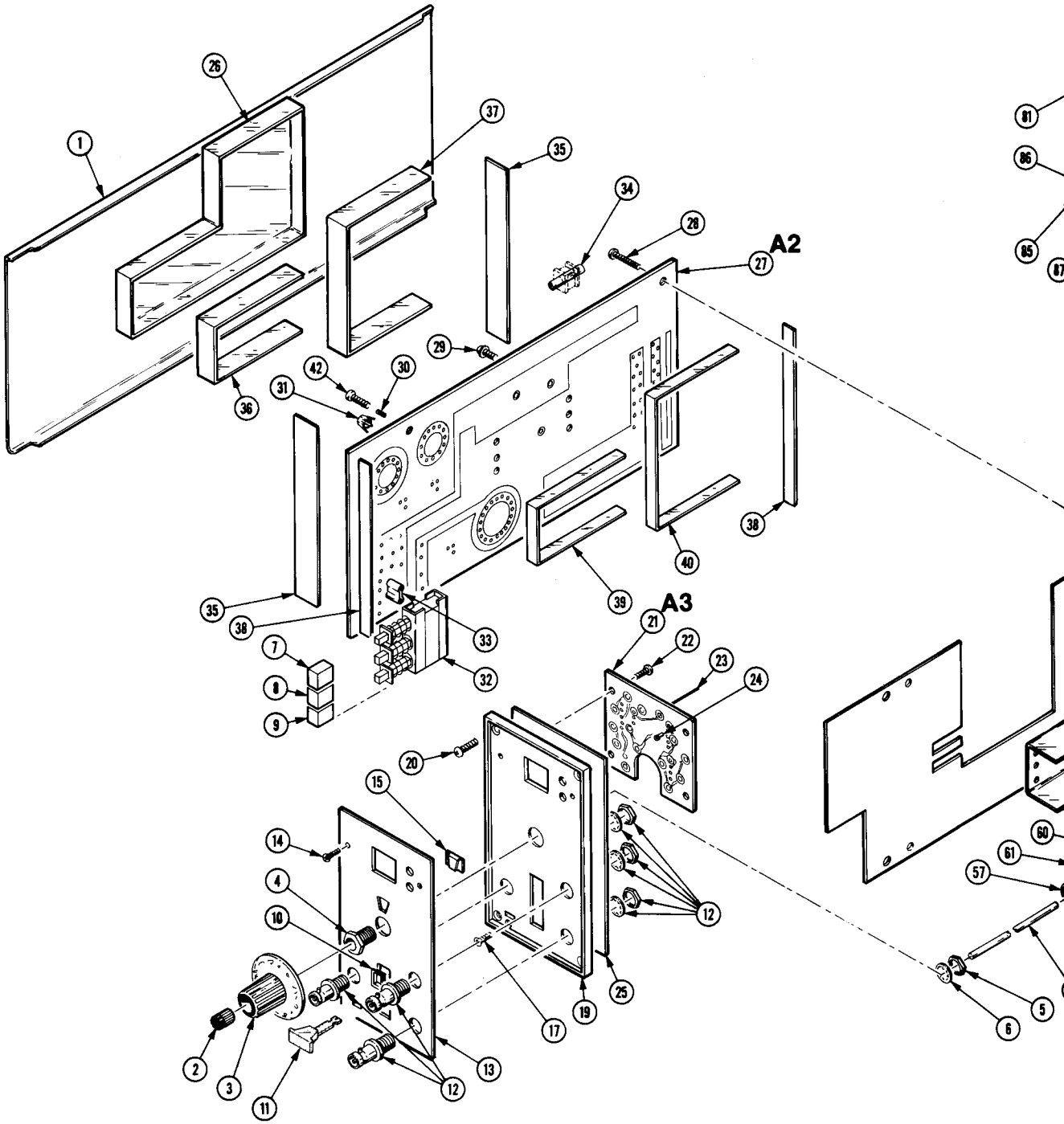
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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-49	----- -----			1		. RESISTOR,VAR:(SEE R135 REPL)		
						(ATTACHING PARTS)		
-50	210-0583-00			1		. NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-51	210-0046-00			1		. WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
-52	210-0940-00			1		. WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-53	210-0583-00			1		. NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-54	407-1393-00			1		. BRACKET,ANGLE:BRASS	80009	407-1393-00
						- - - * - - -		
	263-1008-00			1		. SW CAM ACTR AS:	80009	263-1008-00
						(ATTACHING PARTS)		
-55	211-0116-00	B010100	B037049	4		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	----- -----			-		. (STANDARD ONLY)		
	211-0292-00	B037050		4		. SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
	----- -----			-		. (STANDARD ONLY)		
	211-0116-00	B010100	B037169	4		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	----- -----			-		. (OPTION 01 ONLY)		
	211-0292-00	B037170		4		. SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
	----- -----			-		. (OPTION 01 ONLY)		
						- - - * - - -		
-56	200-1571-00			1		. . COVER,CAM SW:14 ELEMENTS	80009	200-1571-00
-57	354-0391-00			1		. . RING,RETAINING:0.395"FREE ID X 0.025" STL	97464	3100-43-CD
-58	214-1139-03			1		. . SPRING,FLAT:RED COLORED	80009	214-1139-03
-59	214-1139-00			1		. . SPRING,FLAT:0.885 X 0.156CU BE GLD CLR	80009	214-1139-00
-60	214-1127-00			2		. . ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-61	210-0406-00			6		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-62	131-0963-00			2		. . CONTACT,ELEC:GROUNDING	000EX	OBD
-63	401-0082-01			1		. . BEARING,CAM SW:FRONT	80009	401-0082-01
-64	105-0424-00			1		. . ACTUATOR,CAM SW:TIMING	80009	105-0424-00
-65	401-0146-00			1		. . BEARING,CAM SW:REAR	80009	401-0146-00
-66	----- -----			1		. CKT BOARD ASSY:--MAIN(SEE A1 REPL)		
-67	----- -----			3		. . CONNECTOR BODY,:(SEE J290,J420 & J472 REPL)		
-68	136-0514-00			3		. . SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-69	136-0269-00	B010100	B010182	27		. . SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	73803	CS9002-14
	----- -----			-		. . (STANDARD ONLY)		
	136-0269-02	B010183		27		. . SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-		. . (STANDARD ONLY)		
	136-0269-00	B010100	B010182	27		. . SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	73803	CS9002-14
	----- -----			-		. . (OPTION 01 ONLY)		
	136-0269-02	B010183		27		. . SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
	----- -----			-		. . (OPTION 01 ONLY)		
	136-0234-00	XB035696		2		. . SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
-70	136-0252-04			109		. . SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-71	131-0608-00	B010100	B029999	20		. . TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0608-00	B030000		6		. . TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0589-00	XB030000		14		. . TERMINAL,PIN:0.46 L X 0.025 SQ	22526	47350
	131-0566-00	XB010336		2		. . BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
	136-0234-00	XB035696		2		. . SOCKET,PIN TERM:0.088 OD X 0.247 INCH L	00779	380598-1
-72	131-0604-00			16		. . CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-73	344-0154-00			2		. . CLIP,ELECTRICAL:FUSE,CKT BD MT	80009	344-0154-00
-74	131-0566-00			1		. . BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-75	351-0180-00			1		. . SLIDE,GUIDE:SWITCH ACTUATOR	80009	351-0180-00
	214-1808-00	XB010183	B010336X	1		CONTACT,ELEC:GROUNDING	80009	214-1808-00
	210-1002-00	XB010336		2		WASHER,FLAT:0.125 ID X 0.25 INCH OD,BRS	12327	OBD
-76	386-3657-00	XB033190	B035264	2		SUPPORT,PLUG-IN:	80009	386-3657-00
	----- -----			-		(STANDARD ONLY)		
	386-3657-01	B035625		2		SUPPORT,PLUG IN:	93907	OBD
	----- -----			-		(STANDARD ONLY)		
	386-3657-00	XB033260		2		SUPPORT,PLUG-IN:	80009	386-3657-00
	----- -----			-		(OPTION 01 ONLY)		
-77	210-1270-00	XB033190		2		WASHER,FLAT:0.141 ID X 0.04 THK,AL	80009	210-1270-00
	----- -----			-		(STANDARD ONLY)		
	210-1270-00	XB033260		2		WASHER,FLAT:0.141 ID X 0.04 THK,AL	80009	210-1270-00
	----- -----			-		(OPTION 01 ONLY)		
-78	426-0724-04			1		FR SECT,PLUG-IN:BOTTOM	80009	426-0724-04
-79	214-1061-00			1		SPRING,GROUND:FLAT	80009	214-1061-00
-80	426-0725-05			1		FR SECT,PLUG-IN:TOP	80009	426-0725-05

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-	198-2190-00			2		WIRE SET,ELEC:	80009	198-2190-00
-81	131-0707-00			34		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	47439
-82	175-0827-00			FT		. CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
-83	175-0829-00			FT		. WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
-84	175-0833-00			FT		. WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1026-7
-85	210-0774-00			8		. EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00
-86	210-0775-00			8		. EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
-87	352-0162-01			2		. CONN BODY,PL,EL:4 WIRE BROWN	80009	352-0162-01
-88	352-0164-02			1		. CONN BODY,PL,EL:6 WIRE RED	80009	352-0164-02
-89	352-0168-00			2		. CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00

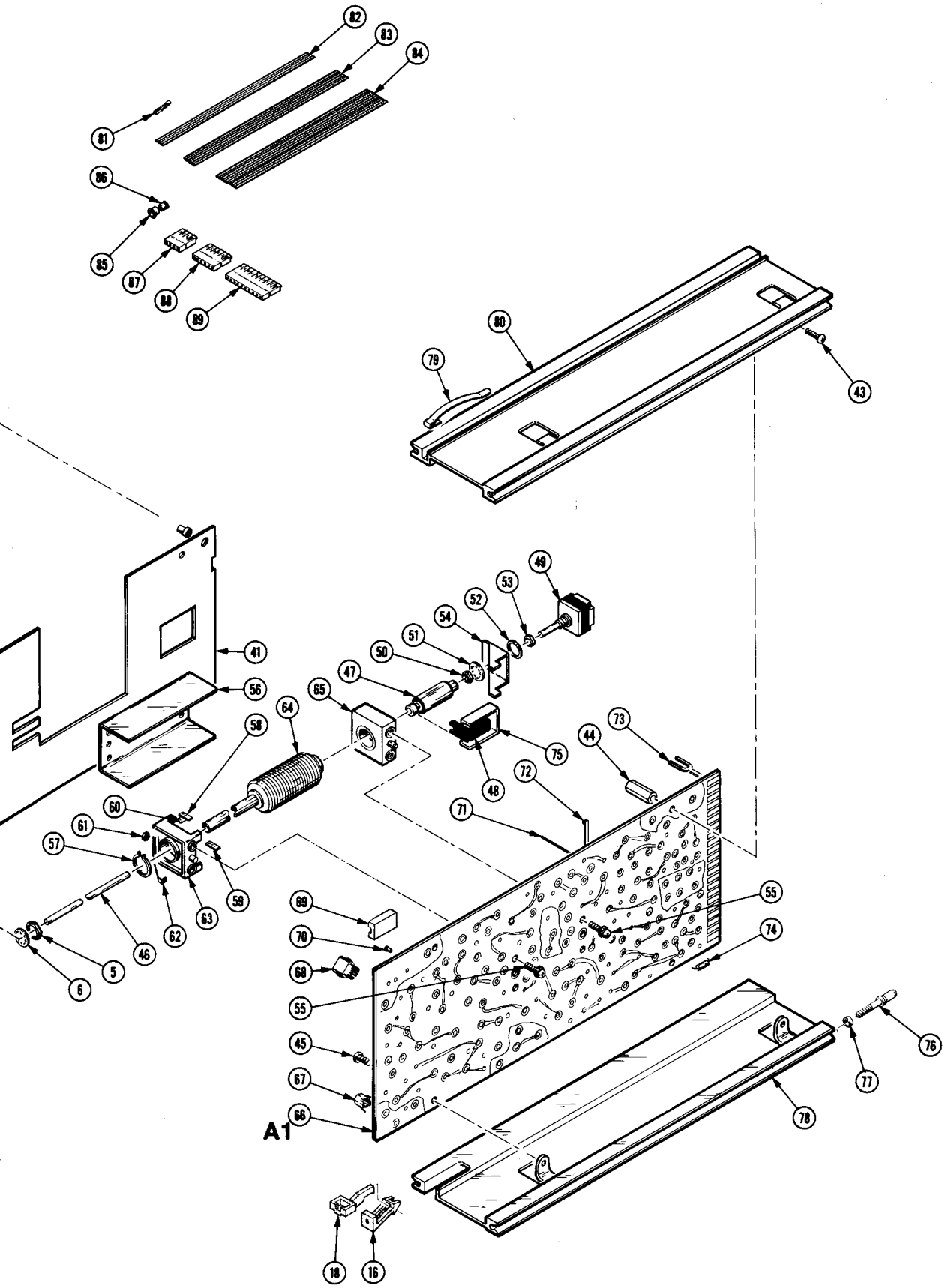
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FIG. 1 EXPLODED



TG 501

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Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						ACCESSORIES		
	070-1576-02			1		MANUAL,TECH:INSTRUCTION	80009	070-1576-02

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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.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

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MANUAL CHANGE INFORMATION

Date: 10-18-83 Change Reference: M45764

Product: TG501 TIME MARK GENERATOR Manual Part No.: 070-1576-02

DESCRIPTION PG75

EFFECTIVE SERIAL NUMBER: B049200, B049320-Option 01

CHANGE TO: (New Mechanical Package)

Figure numbers refer to the mechanical exploded view.

Figure No.	No.	Part Number	Description
1-18	1	105-0865-00	BAR LATCH, RELEASE
1-16	1	105-0866-00	LATCH, RETAINING: PLUG-IN
	2	105-0932-00	LATCH, PANEL: SIDE
1-20	1	211-0025-00	SCREW, 4-40 x 0.375 L
1-20	3	211-0101-00	SCREW, 4-40 x 0.250 L
1-14	2	211-0244-00	SCREW, 4-40 x 0.312 L
	2	213-0793-00	SCREW, TPG 6-32 x 0.437
	1	214-3143-00	SPRING, LATCH
	2	214-3364-00	FASTENER LATCH: SIDE
1-79	1	214-3406-00	SPRING, GROUND: FLAT
	1	333-3056-00	PANEL, FRONT, ASSEMBLY
1-26	1	337-1915-01	SHIELD, ELEC: COVER
1-1	2	337-3039-00	SHIELD, ELECT: SIDE
1-25	1	337-3085-00	SHLD, ELECT: FRONT SUBPANEL
1-7 1-8 1-9	3	366-1559-00	PUSH BUTTON, SIL GY 0.18 SQ x 0.43
1-11	1	366-1851-01	KNOB, LATCH
	1	378-2030-07	LENS, LED DSPL, RED, PRINTED
	1	386-4866-00	SUPPORT, FRAME, REAR
1-78	1	426-0724-25	FRAME SECTION: BOTTOM
1-80	1	426-0725-24	FRAME SECTION: TOP
A1	1	670-2737-08	CKT. BD. ASSY: MAIN
A3	1	670-2878-01	CKT. BD. ASSY: DISPLAY
A2	1	670-2992-03	CKT. BD. ASSY: MULTIPLIER
A1	1	670-3415-08	CKT. BD. ASSY: MAIN
F620	1	159-0208-00	FUSE, WIRE LEAD, 2A, 125V. 5 SEC
C100	1	281-0620-00	CAP.,FXD, CER DI: 21pF. 5%, 500V, Selected

Move C102 to the front of the board.

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MANUAL CHANGE INFORMATION

Date: 12-21-83 Change Reference: M53047

Product: TG501 TIME MARK GENERATOR Manual Part No.: 070-1576-02

DESCRIPTION PG 75

---- This insert also includes M52989. ----

Effective Serial No. B049200, B049320 (Option 01)

CHANGE TO:

Replace R323 by L323, an inductor.

L323	108-0262-00	COIL,RF,FIXED: 510nH
R294	315-0131-00	RES, FXD,CMPSN: 130 OHM,5%,0.25W
A1	670-2737-10	
Option 01	670-3415-09	
A2	670-2992-04	

ADD:

C497	283-0359-00	CAP,FXD,CER DI: 1000pf,10%,200V

(C497 is added in parallel with C496 on schematic .

R296	315-0820-00	RES,FXD,CMPSN: 82 OHM,5%,0.25W

(R296 is added from pin 11 of U290 to +5V on schematic .

C265	283-0204-00	CAP,FXD,CER DI: 0.01uF,20%,50V

(C265 is added from the collector of Q265 to ground on schematic .

C291	283-0160-00	CAP,FXD,CER DI: 1.5pF,±0.1pF,50V

(C291 is added from the collector to the base of Q290 on schematic .

Add two ferrite beads, 276-0614-00 to J470 next to the Multiplier output.

Add one ferrite bead, 276-0635-00 at P452 on the interconnect cable.

Add two ground straps, 214-0982-00 between the top rail of the instrument and the Multiplier board ground.

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